

Proceedings of the 7th International Conference on Economics and Social Sciences

Exploring Global Perspectives: The Future of Economics and Social Sciences

Edited by: Alina Mihaela DIMA
Vanessa Madalina VARGAS

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June 13-14, 2024

Bucharest University of Economic Studies, Romania





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Contents

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Foreword

Alina Mihaela DIMA, Vanesa Madalina VARGAS 9

Agrifood and Environmental Economics

Comparative Performance Assessment of Foreign Trade Flows in Agri-Food Products between Romania and Italy

Marius CONSTANTIN, Donatella PRIVITERA 11

Consumers' Perception and Behaviour on the Characteristics of Food and Agri-Food Products during the COVID-19 Pandemic

Alexandru-Mihăiță ICHIM, Teodora FULGA, Andrei-Dorian PANDURU 24

Marketing Channels as a Factor of Sustainable Agribusiness

Katica RADOSAVLJEVIĆ, Simona Roxana PĂTARLĂGEANU,
Branko MIHAILOVIĆ, Mirela MITRAŠEVIĆ 39

Ecotourism in Romania: Exploring Potential and Promoting Responsible Tourism

Jonel SUBIC, Simona Roxana PĂTARLĂGEANU,
Marko JELOČNIK, Alina Florentina GHEORGHE 49

Factors Influencing Customers' Green Purchase Intention: The Role of Perceived Environmental Responsibility and Health Consciousness

Dinh Van HOANG, Le Van TUNG, Nguyen Thanh TUNG 59

Accounting and Management Information Systems

Professional Skills of Future Accountants using ERP Systems

Laura-Eugenia-Lavinia BARNA 71

SMEs Representatives' Perceptions of Corporate Governance-Performance Relationship. Evidence from an Emerging Economy

Andreea Madalina BOJAN 79

SDG Reporting in a Romanian Listed Company in Crisis Period Ana-Maria BRATU, Miruna-Iuliana CUNEA.....	89
Sustainability Performance Indicators and Firm Financial Performance in the Healthcare Sector during Crisis Period Miruna-Iuliana CUNEA, Andrei-Constantin TÎRNOVANU	100
Sustainable Business Models in the European Energy Sector NingShan HAO, Voicu D. DRAGOMIR	111
The Effect of Good Corporate Governance Practices in Corporate Risk Management Disclosure: An Overview of European Banking Sector Natalia Maria GREAPCĂ.....	123
Two-Decade Bibliometric Analysis of Collaborative Trends in Gambling Studies: A Structured Literature Review and Analysis of Gambling Research (2004-2023) Daniel-Marius IORDACHE, Florin MIHAI, Ofelia ALECA.....	133
How is the Adoption of E-invoicing System Affecting the Outsourcing of Accounting Services? Adrian ISIP	142
A Case Study on Performance Analysis through Digitalisation and Gender Equality Monica Aureliana PETCU, Raluca-Andreea POPESCU-PREDULESCU, Andreea THEODORESCU.....	156
Revisiting Cloud Enterprise Resource Planning Systems Implementations through the Lens of End Users Sînziana-Maria RÎNDAȘU, Liliana IONESCU-FELEAGĂ, Bogdan-Ștefan IONESCU, Velimir LUKIĆ.....	166
A Bibliometric Analysis regarding ESG Reporting Oana Cristina STOICA	176
The Evolution and Impact of Digital Transformation on Internal Audit and Managerial Control in Public Institutions Lucia-Maria UDRESCU.....	187
Business Administration and Entrepreneurship	
Evaluating the Impact of Demographic Shifts: A Comparative Analysis of Economic and Social Consequences in G7 and BRICS Nations Flavius Cosmin DARIE, Cosmin PROSCANU, Cătălin Gheorghe ZEMELEAGĂ, Enrico PRINZ.....	199
The Trustworthiness of AI Algorithms and the Simulator Bias in Trading Alina Cornelia LUCHIAN, Vasile STRAT	211

Approach of Determining Process Maturity in Information Security Management Systems

Michael Matthias NAUMANN, Fabian PITZ,
Georg Sven LAMPE, Stelian Mircea OLARU 221

Longitudinal Trends in Financial Metrics within Female-Led Software Firms

Julia Anamaria ȘIȘU, Marian NĂSTASE, Andrei Constantin TÎRNOVANU,
Mircea-Mihai OBREJA, Luis Miguel CIRAVEGNA MARTINS DA FONSECA..... 231

The Evolution of Saudi Arabia's Investments in Romania, in Opposition to the Framework of the Coronavirus Pandemic and the War in Ukraine

Beatrice TROCINESCU, Violeta-Mihaela DINCĂ, Kim Oliver TOKARSKI 243

Business and Tourism

Artificial Intelligence and Employee Stability: The Mediating Effect of Job Engagement in Romania's Health Tourism Sector

Marius Lucian BREABAN, Ionut Andrei MILITARU,
Mariuzio LANFRANCHI, Remus Ion HORNOIU 254

Does the Organisational Culture Play a Role in Choosing a Job in Tourism?

Vlad DIACONESCU, Iulia (DĂUȘ) OGOREANU, Alina-Maria VIERIU 265

Destination Brand Equity of Cultural Destination: The Case of Hue City, Vietnam

Khanh Hung DOAN, Dao Phu Loc TRAN, Maruf Mohammad Sirajum MONIR..... 275

European Capitals of Smart Tourism – A New Direction in Tourism Research

Georgica GHEORGHE, Mihaela CLINCU,
Monica Maria COROS, Iuliana TUDOSE-POP 287

Erasmus Experiences' Influences on Students' Entrepreneurship Competences

Raluca Mariana GROSU, Bianca Georgiana BURLACU, Vera AMICARELLI 297

Practice Generated Knowledge – Monitoring of Tourism Educational Process based on Self-Assessment Analysis

Nadezhda KOSTADINOVA 307

Trends in Labour Resources in Romania

Andreea MARIN-PANTELESCU, Irina ALBĂSTROIU NĂSTASE 317

Professors versus Students: An Introductory Bibliometric Review of AI Acceptance in Higher Education's Specialisations of Tertiary Sector

Luciana-Floriana POENARU, Delia POPESCU,
Remus-Ion HORNOIU, Giuseppe LANFRANCHI..... 326

The Evolution of Female Leadership Research: A Bibliometric Review of Publications over the Past 20 Years

Andreea Simona SĂSEANU, Andreea Bianca ENE (CONSTANTIN),
Claudiu Nicolae GHINEA 336

Civic Engagement and Sustainable Education

National Examination in Romania between 2017 and 2023 – A Microdata Analysis Tudorel ANDREI, Andreea MIRICA, Irina-Elena STOICA.....	346
Exploring the Economic Effects of Sustainability in a Knowledge-Based Circular Economy Raluca Florentina CREȚU, Adina-Theodora NECULA, Viorel-Costin BANȚA	357
Transformative Education: Economic and Political Implications of the Conflicting Dynamics within Traditional Schooling Hesam JEBELI-BAKHT-ARA, Octavian-Dragomir JORA.....	370
Generational Perspectives on Sustainable Consumption: Exploring Consumer Behaviour of Millennials and Generation Z Petre-Sorin SAVIN, Georgiana RUSU, Claudia-Maria MIU, David-Florin CIOCODEICĂ, Esraa Ibrahim Fathy Twfik KASEM	380
Student Attitudes towards the Circular Economy: A Comparison between Bulgaria and North Macedonia Ana TODOROVA, Irina KOSTADINOVA, Dusica STEVCEVSKA SRBINOSKA.....	392

Management and Public Administration

Towards a Robust Assessment Framework for the EU Open Data Maturity Index Angelos FOUNTOULAKIS, Anastasia PAPASTILIANOU	402
Digitalisation Risks and their Impact on Business Sustainability Madalina MAZARE, Cezar-Petre SIMION, Catalin-Alexandru VERDES, Alexandra-Andreea MIRONESCU, Samar KAIS	413
Particularities of the Public Procurement Contracts Concluded by Public Hospitals in Romania in the Pandemic Year 2021 Elvira NICA, Alina SAMOILĂ (BRATILOVEANU), Teodora Nicoleta PLEȘA, Oana Matilda SABIE, Tomáš KLIĚŠTIK	423
Institutional Capacity – Provisional Results of Member States during 2014-2020 Programming Period Mihaiela Simona ȘTEFĂNESCU, Mădălina-Ioana MONCEA	435

Labour and Social Welfare

Understanding the Emergence of Populist Parties: A Review of the Interconnected Factors Involving Individual Resilience, Educational Levels, and Party Support – A Case Study of Romania Ionela-Alina ALUPOAEI, Fatih PEKTAS	448
Transformative EU 27 Labour Markets: Assessing Opportunities, Risks and Trends Florin Marius PAVELESCU, Laura Mariana CISMAS, Cornelia DUMITRU	464

What Factors Affect Households' Decision to Be a New “International Migrant Household” in Rural Bangladesh? Evidence from a Unique Panel Data Mahtab UDDIN	474
--	-----

Resilience of Higher Education Students during the COVID-19 Pandemic Ana-Maria ZAMFIR, Anamaria Beatrice ALDEA, Teodora Cătălina DUMITRA	501
--	-----

Integrating Sustainable Development Goals into Real World: Challenges and Opportunities

Sustainable Development through Green Innovations: Economic Strategies of China and the EU Compared Denys ILNYTSKYI, Olga DROBOTIUK, Vladyslav ANDRUSYK	512
---	-----

The Worldwide Progress of SDGs. Depicting the Yearly Hot Topics, using Language Processing Andreea PERNICI, Stelian STANCU	526
--	-----

Social and Environmental Commitment Across the Early and Established Stages of Entrepreneurial Activity Sanja PFEIFER, Nataša ŠARLIJA	537
---	-----

Circular Economy as the Pathway to Sustainable Future: A Case Study on ALTRNTV Shop Daniela STAICU, Ruxandra ARGATU, Andrei BENGA	547
---	-----

An Analysis of Sustainable Urbanism in Europe: Unveiling Trends and Key Contributors Alexandra-Nicoleta CIUCU (DURNOI), Camelia DELCEA, Kosyo STOYCHEV, Cosmin Alexandru TEODORESCU	562
---	-----

Finance & Banking

The Governance Profile of European Countries and Key Banking Indicators – A Causality Analysis Iustina Alina BOITAN, Wafaa SHABBAN	586
--	-----

Quantitative Dimensions of Yield Curve Dynamics in Post-Pandemic Environment – The Case of Romania Alexander GANCHEV, Cătălin DEATCU	600
--	-----

Using Machine Learning to Model Bankruptcy Risk in Listed Companies Vlad TEODORESCU, Cătălina-Ioana TOADER	610
--	-----

Trends in Transition: Fintech Credit Effects on Romanian Bank Stability Bekir ZENGİN	620
--	-----

Statistical Methods and Data Science in Applied Economics

Supervised Learning Algorithms for Non-Life SCR Ratio Forecasting

Marius ACATRINEI, Adriana AnaMaria DAVIDESCU,
Laurentiu Paul BARANGA, Razvan Gabriel HAPAU, George CALIN 631

Exploring the Influence of the COVID-19 Pandemic on the Professional Trajectories of Young Women: Findings from the Eurobarometer “Women in Times of COVID-19”

Anamaria Beatrice ALDEA 648

Measuring the Dynamics of Inequality of Opportunity by Income Sources

Claudia AVOSSA 661

Sentiment Analysis of Research on AI Ethics: A Web-Based Study

Alexandra-Cristina-Daniela CIUVERCA 672

Enhancing Portfolio Structure with Evolutionary Multi-Objective Optimisation

Robert-Ştefan CONSTANTIN, Marina-Diana AGAFIŢEI,
Adriana AnaMaria DAVIDESCU 682

The Development of a Quantitative Measurement Scale to Assess Romanian Knowledge and Attitude Towards Sustainability and Sustainable Clothing

Anastasia COSMA 692

Bayesian Symbolic Regression and Other Similar Methods as a Tool for Forecasting Commodities Prices

Krzysztof DRACHAL 703

Identifying Factors for the Development of Sustainable Urban Transport in the Context of Urban Sprawl – A Comparative Study among EU’s Capitals

Giani-Ionel GRĂDINARU, Alin-Cristian MARICUŢ,
Ana-Maria DINU, Rareş BĂLĂUŢĂ 714

Teaching ITC in European Universities: A Non-Parametric Efficiency Approach

Andreea-Monica MUNTEANU, Anamaria ALDEA 723

International Business and Economics

Leveraging Digital Technologies for Sustainable and Inclusive Development Strategy in Leading Innovative Nations

Larysa ANTONIUK, Yehor DAVYDENKO 732

Evaluating the National Innovation Systems of EU Countries through Innovation Indicators

Larysa ANTONIUK, Larysa LIGONENKO,
Denys ILNYTSKYI, Olha DENISOVA 744

Analysis of Stock Indices during the SVB Bank Run in March 2023 based on Sentiment Analysis

Andreea-Mădălina BOZAGIU, Zorina ALLIATA 759

**IMF Tariff Conditionality, Aid for Trade and Trade:
Evidence from Sub-Saharan Africa**

Seboka Alemu GEMECHU 772

Green Bonds in EU Countries: Towards Sustainable Finance

Andra Nicoleta MECU, Florentina CHIȚU, Gheorghe HURDUZEU,
Georgiana Ionela MARIN, Xin LI..... 801

**Exploring the Dynamics of Junk Bonds and Green Bonds
in Financial Markets**

Andra Nicoleta MECU, Florentina CHIȚU, Gheorghe HURDUZEU 812

**Mega Events and Their Impact on Country Image:
A Comprehensive Bibliometric Analysis**

Luminița NICOLESCU, Alexandra BARBU 822

Economics and Business Communication

The Evolution of Business Communication in the Digital Age

Maxim CETULEAN, Marta STOIAN..... 836

Digital Assets: Emerging Opportunities and Challenges

Elena Roxana DEAK..... 849

**The Impact of Fiscal Transfer from the EU Budget
on Economic Growth in CEE Countries**

Irene-Ioana DRĂGHICI, Carlos Ramírez VALDEBENITO..... 858

Digitalisation's Vital Role in Sustainable Circular Economy

Edi-Cristian DUMITRA, Radu Alexandru BUDU,
Liana Ioana PARASCHIV, Mariarosaria LOMBARDI 867

Building Digital Skills through Digitalisation of Education

Sorin NASTASIA, Nicolae MOROIANU,
Alexandra CONSTANTIN, Cristian STANA 877

**From Roads to Riches: Infrastructure Development
as a Method of Driving Growth in Romania National Economy**

Rareș NIȚU, Robert URICARU, Maria NEGREPONTI-DELIVANIS 890

**Analysing Consumer Behaviour:
The Pathway to Sustainable Food Consumption**

Cezara-Georgiana RADU 905

**Increase of Production Capacities and Investments in Enterprises Depending
on the Perspective of Regional Development**

Marinela TENEQEXHI, Klaudeta MEROLLARI, Eleni VANGJELI, Anila MANÇKA.... 912

Innovation Spillovers, Economic Growth, and the Role of Absorptive Ability

Muhammad USMAN, Lal Khan ALMAS, Shoab HASSAN 923

**Influence of Organisational Climate and Employee Desires
on Managerial Drive**

Abbiha WAQAR, Andreea Claudia ŞERBAN, Muhammad Nauman JAMAL 951

**The Influence of Corporate Social Responsibility on Organisational Commitment
among Employees in Pakistan**

Abbiha WAQAR, Andreea Claudia ŞERBAN, Çetin BEKTAŞ 962

Innovative Marketing

**Emerging Trends and Impacts: A Bibliographic Analysis of Generative AI
in Marketing**

Octavia ALBU, Iulia CIUREA, Ruxandra DUȚĂ, Francesco BELLINI 972

**Social Media and Online Shopping: Exploring Interactions and Implications
in the Digital Environment**

Ştefan-Ionuț ANGHEL, Florin Alexandru STAN 985

**A Data-Driven Approach: Assessing the Relevance of AI Algorithms
in Tailoring Personalised Content for Social Media Users**

Ingrid Georgeta APOSTOL, Mihai PRELIPCEAN,
Elena BOSTANICA, Maria-Cristiana MUNTHIU 994

Hedonic and Utilitarian Motivations of Social AR Filters Usage

Elena BOSTĂNICĂ, Ingrid-Georgeta APOSTOL, Mihai PRELIPCEAN,
Elena GOGA, Mihai Cristian ORZAN 1004

Understanding Consumer Behaviour in the Digital Era: A Literature Review

Diana E. DRĂGHICI, Mihaela CONSTANTINESCU 1014

Green Deal Era: Exploring Environmental Attitudes and Ecological Behaviour

Cătălina Elena FRĂȚILĂ, Georgiana GRIGORE, Mihai Ioan ROȘCA 1025

**The Application and Efficiency of Neuromarketing Tools in Marketing Research:
A Comprehensive Review and Future Research Agenda**

Elena GOGA, Mihai Cristian ORZAN, Camelia GOGA,
Claudia Cristina (BIZON) STAN, Danut TRIFU 1040

**Navigating Online Success: Assessing the Impact of Google and Meta Ads
on a Family-Owned Pharmacy Chain in Romania**

Alina-Andrea MIRON, Florin-Tudor IONESCU, Anca Ioana BLAGA, Oana MOGOȘ.... 1050

**A Study of Consumer Trust in Online Reviews and Social Media Comments
in the Age of Artificial Intelligence**

Ionut TANASE, Lucia Nicoleta BARBU 1062

Empathy in Marketing: A Customer-Oriented Approach based on Authenticity

Ana TODOROVA, Svilena RUSKOVA 1076

The 7th International Conference on Economics and Social Sciences
Exploring Global Perspectives:
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Foreword

Alina Mihaela DIMA^{1*}, Vanesa Madalina VARGAS²

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The International Conference on Economics and Social Sciences (ICESS) represents the largest and the most prestigious research event organised by the Bucharest University of Economic Studies, proving the collaborative efforts and academic excellence of each faculty within the university, based on international collaboration with academic and business partners.

By fostering communication and collaboration among relevant stakeholders, the main goal of the event is to identify intelligent tools and instruments that stimulate economic development, social equity, and sustainable growth. The conference showcases the interconnected economic and social dimensions and emphasises the importance of interdisciplinary approaches in driving impactful and sustainable change.

The opening ceremony took place on 13th June, having some special invited guests in the plenary session, such as Cristian Badarinza, professor at Singapore National University, alumnus ASE, with the keynote speech *Real estate sustainability: Taking stock or going with the flow?*, Suman Mishra, professor at Southern Illinois University Edwardsville, United States of America with the keynote speech *Media Industries and AI: The Changing Landscape of Business and Communication* and also Sorin Nastasia, professor at Southern Illinois University Edwardsville, SUA with the keynote speech *Environmental, Social, and Governance (ESG) Practices for 21st Century Businesses*. Every year, the conference benefits from prestigious invited professors who can inspire academics and students in their professional career.

The conference has grown every year both in quantitative and in qualitative terms. Thus, Friday, June 14, 2024, researchers and academics from all over the world presented over 270 papers within the 12 parallel sessions, the topics being related to: sustainability within the 17 SDGs, experimental economics, challenges and opportunities connected with artificial intelligence, taxation impact on business,

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digitalisation and economic competitiveness, technological development and digital performance, entrepreneurship challenges in the digital era, blockchain and financial innovation, the economic impact of energy crises, and other topics with practical implications.

Also, the conference hosted for the first time in 2024 the workshops: *SDG: Integrating Sustainable Development Goals into Real World: Challenges and Opportunities*, *Workshop for Young Researchers* and *Experimental economics, application for innovation economy*, which reunited the specialists from the academic area jointly with the economic and social environment to debate the real challenges faced by private and public institutions within the dynamic and uncertain international framework.

The conference has offered networking opportunities for national and international specialists from different partner institutions and academics, researchers and PhD students from universities of various countries such as USA, Germany, France, Greece, Spain, Italy, Japan, Poland, Portugal, UK, Slovakia, Bulgaria, etc. and a great part of the scientific papers are the result of the joint collaboration between national and international professors or representatives of the socioeconomic environment.

The conference used the platform ScholarOne (Clarivate) for the submissions and review process and has relevant partners such as the international network of universities HERMES, EM Strasbourg Business School, the Economic Forecasting Institute of the Romanian Academy, the National Institute of Scientific Research in the field of Labour and Social Protection, Enformation, and United Media Services.

Given the large variety of participants, ICESS could be considered an international forum for debate, a research platform, a very important tool for the dissemination of research and more importantly, a very useful and learning experience for PhD students who can use this opportunity to improve their research in progress.

The publication opportunities of the conference are considered major assets and we expect them to expand in the future. The proceedings volumes along with some journals indexed in Web of Science offer to the participants wide opportunities for publication to get validation for the research outcomes, but also to meet the criteria for promotion or evaluation.

The sustainable partnership with university business partners is definitely another competitive advantage. Based on a selection made by the members of the international scientific committee, two best papers receive an award supported by our business partners in order to stimulate competition and performance in terms of scientific research, but also international collaboration based on co-authorship.

„The collaboration between academia and the socio-business environment is a very important dimension of the university research and we aim to create a sustainable partnership to produce effects in the long run. The outcomes of the academic research should strongly contribute to the *identification of the relevant and practical solutions for the business environment.*”

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Comparative Performance Assessment of Foreign Trade Flows in Agri-Food Products between Romania and Italy

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Abstract

Agri-food supply chains are increasingly vulnerable to the pressures and disruptions stemming from geopolitical instability, pandemics, population growth, and various societal, economic, and environmental challenges. At this critical moment, the study of foreign trade flows in agri-food products is of high importance to the European Union, considering that the results of such evaluations could assist in the development of strategies to optimise trade flows in alignment with emerging market opportunities. Both endowed with abundant factor resources, Romania and Italy have the opportunity to leverage their advantages in this turbulent global environment. By assuming leadership roles within the European Union, they can strengthen the competitiveness of their agri-food sectors. Given this context, the objective of this research was to propose strategic directions to improve the level of food security and economic performance of the Romanian and Italian agri-food sectors, according to the findings derived from a comparative assessment of foreign trade flows. Therefore, this article addressed a literature gap by proposing an assessment framework focused on mapping trade patterns that can mutually maximise economic benefits. Descriptive statistical analyses and a correlation matrix were performed based on the data extracted from the International Trade Centre's database, covering the period from 2013 to 2022. This research revealed a fundamental contrast: Due to limited processing capabilities, Romania is dependent on exporting low-priced, unprocessed agricultural materials, mainly cereals and oil seeds; while Italy excels in exporting processed agri-food products with high added value, namely beverages, spirits, vinegar and preparations of cereals. Both countries should intensify collaboration by leveraging their respective strengths to counterbalance their weaknesses, thereby leading to the mutual advancement of their agri-food sectors.

Keywords: foreign trade performance; trade balance; economic competitiveness; food security; agri-food sector.

JEL Classification: Q17, F10.

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1. Introduction

The performance assessment of international trade flows has received increased attention in the scholarly research, with a particular focus on the agri-food sector, an area of significant interest. Pandemics, geopolitical instability, population growth, and a mix of other societal, economic and environmental challenges have aggravated the vulnerabilities of global food supply chains, which have become more exposed than ever to the adverse effects of such disruptive events. As a result, the need to minimize the damage to global food supply chains arose. It calls for further investigation of the effects of these challenges on the patterns of foreign trade in agri-food products, which could reveal some opportunities to improve the degree of resilience of food supply chains globally, with echo in the European Union (EU).

Although the EU has an integrated approach to the agricultural sector through the Common Agricultural Policy (CAP), it still finds itself at a critical juncture, given the current crises that have to be successfully handled (Beluhova-Uzunova et al., 2024). The necessity to assess and improve the performance of foreign agri-food trade flows is top priority in the context of increased resource scarcity and constant food price increases worldwide (Deng et al., 2024; Istudor et al., 2022). To add more, the negative effects of resource scarcity on global food supply chains have considerable consequences for the ability to meet the growing food demand at the macro level (Deaconu et al., 2023). Moreover, the continuous increase in food prices exerts high pressure, especially on lower-income populations, therefore amplifying food insecurity and social unrest (Djeufack et al., 2024; Rudolfson, 2020).

Therefore, in such a complex global climate, improving the performance of agri-food trade flows is a strategic policy objective that can contribute to reducing the troubling effects caused by the difficulties facing EU food supply chains are facing. Designing a strategic assessment framework and an action plan to improve trade results could serve as a real solution to stabilise agri-food prices, increase food security levels, and ensure optimal nutrition for all (Johnson et al., 2023).

Despite the fact that these turbulent times pose actual threats for EU's successful implementation of the CAP 2023-2027, Romania and Italy could leverage the global challenges as market opportunities. These countries possess an abundance of factor endowments, favourable climates for agriculture, and strategic positions within the EU; therefore, they are privileged to be able to deliver more competitive and resilient food supply chains in the EU, as well as to set new benchmarks for agricultural results. The distinctive combination of natural and strategic advantages endows both Romania and Italy with the capacity to assume the role of the leaders in the further development of the EU's agri-food sector (Ciutacu et al., 2015), despite the challenges posed by the global context (Grunert et al., 2023; Santeramo & Kang, 2022), which also embodies great market opportunities (Pătărlăgeanu et al., 2022).

The collaborative efforts of Romania and Italy have the potential to enhance the competitiveness of the EU agri-food sector by increasing foreign trade flow performances. Nevertheless, the means to attain this goal are distinct, involving sophisticated approaches from both sides, in accordance with the agricultural profile of each country (Matthews, 2008; Mikuš et al., 2019). Although pursuing different,

yet interlinked objectives, the collective impact of Romania and Italy could efficiently build upon the competitiveness of the EU agri-food sector (Bossuyt et al., 2020; Henke et al., 2018).

2. Problem Statement

Food availability and access have always been a critical concern globally (Istudor et al., 2014; Rosegrant & Cline, 2003), yet the urgency to improve food security levels is reaching new scholarly interest peaks, in the context of the food shortages caused by the COVID-19 pandemic (Zhu et al., 2022), geopolitical instability (Sohag et al., 2022), as well as food price increases caused by inflation (Adjemian et al., 2023; Balogh & Sárvári, 2024). By evaluating the performance of foreign trade flows in agri-food products, policymakers can efficiently identify both inefficiencies and market opportunities within the global agri-food supply chain. Insights gathered from such assessments can guide strategies to promote the diversification of food sources and strategic investment in agricultural practices that can generate higher levels of added value. As a result, food security would increase, along with the economic resilience of the agri-food sector (Ignat et al., 2020; Yang et al., 2022).

Considering the positions of Romania and Italy in this context, the evaluation of foreign trade flows in agri-food products is necessary with the aim of identifying market opportunities. By securing equitable consumer prices for agri-food products and reducing dependency on unpredictable international markets, these countries could improve their position in the EU's agri-food sector by implementing a strategic trade management system, which would efficiently handle market fluctuations.

In this field of research, comparative analyses between Romania and Italy exist in the literature. For example, Lădaru et al. (2022) studied the link between the imports, exports, their level of concentration, and the agri-food trade balance results, based on the Combined Nomenclature. According to the Gini coefficients computed by the authors, the research results showed that Italy's trade flow performance is superior to Romania', which has a lower level of competitiveness. Thus, to complement the findings Lădaru et al. (2022), the novelty factor of this paper resides in the proposed research framework that puts the spotlight on the mapping the patterns that ensure increased economic performance in foreign trade flows in agri-food products.

3. Aims of the Research

Taking into account the context into account, the purpose of this research was to comparatively assess the performance of Romania and Italy's foreign trade flows in agri-food products. Furthermore, the insights derived from this comparative analysis were intended to guide strategies to optimise trade dynamics in these countries, according to the identified vulnerabilities and opportunities. Moreover, by analysing trade flow performances, research findings aimed at providing solutions to increase food security and the economic resilience of Romania and Italy's agri-food sectors,

by resorting to a more strategic approach in trade management and by providing efficient tools for the sectoral adaptation to global market fluctuations.

4. Research Methods

Based on the research aim, the assessment of the trade flow performance based on statistical data available online, uses International Trade Centre's platform (<https://www.trademap.org/>). Data collection was carried out in March 2024, using the first 24 classes of Combined Nomenclature, and only a small set of agri-food products. Romania and Italy both observe similar data architecture in the context of trade statistics, the above circumstance rendered conduction of statistical comparisons possible. The research covered the latest data offered by the database, for the period 2013-2022. First, in terms of the exports of agri-food products, a relative situation was provided between Romania and Italy, and national-level export shares were taken into account; moreover, trade balance performances were displayed. Subsequently, the next appraisal step involved detailed analysis of the most performant agri-food classes at the level of countries, from the perspective of the national level export shares. For these two groups, further observations have been gathered beneath the indicators: mean, standard deviation, coefficient of variation, average annual growth rate (AAGR), rates of all types and categories with several bases (the 2013 base year and the national average based on the 2013-2022 period). Finally, a correlation matrix was built for the results of exports and trade balance, but only in the case of agri-food classes that participate with major export shares at national levels. Its aim consisted in making it easier to single out key foreign trade patterns regarding Romania and Italy, which should underlie policy recommendations. In addition, agri-food classes with significant impact on economic performance have been identified by the matrix. This helps point out strategic investments, hence improving the general competitiveness of the sector.

5. Results

Analyzing the data in Table 1, referring to Romania and Italy's agri-food exports, the share of national exports, and balance of trade for the period 2013-2022, offers information full of value about the trend dynamics of the two economies and results of their trade flows, helping to identify weaknesses and possible advantages. This is, therefore, an indication of good performance in the cereals sector, where the national export share is 34.63%, putting Romania in an obvious advantageous position in this respect. This is also complemented by showing a noticeable trade surplus of 1.974 billion euros in cereals, which in itself is again demonstrative of well-managed agricultural resources contributing economically. That said, it is not an advantageous and/or competitive sale of raw material over the long term. The results of which highlight the need for Romania to develop the agri-food processing capacities quickly by strategic investment in effective infrastructure, allowing for the production and export of agri-food products with higher value-added. Compared to other agri-food categories, the strong export share and favorable balance of the trade

results in cereals indicating that Romania plays a crucial role as a large net exporter in third-country markets. But once measures are taken in time, based on proper financing strategies, the economic risks aroused from the large export of raw agricultural materials would be assuaged.

Table 1. Overview on the exports, export share at national level, and trade balance results in agri-food products in the case of Romania and Italy (average 2013-2022)

Class	Exports			Export share nationally			Trade balance results		
	Unit of measurement: Billion EUR			Unit of measurement: Percentage			Unit of measurement: Billion EUR		
	Romania	Italy	RO/IT	Romania	Italy	RO/IT	Romania	Italy	RO-IT
01	0.394	0.050	7.871	5.64%	0.12%	46.975	0.216	-1.491	17.065
02	0.247	2.161	0.114	3.59%	5.04%	0.712	-0.549	-2.433	18.840
03	0.022	0.425	0.051	0.30%	0.99%	0.308	-0.173	-4.006	38.331
04	0.194	3.420	0.057	2.76%	7.75%	0.356	-0.336	-0.511	1.753
05	0.033	0.154	0.213	0.48%	0.35%	1.370	-0.029	-0.089	0.597
06	0.003	0.886	0.004	0.05%	2.02%	0.024	-0.136	0.319	-4.543
07	0.102	1.564	0.066	1.47%	3.64%	0.404	-0.302	-0.094	-2.076
08	0.079	3.535	0.022	1.14%	8.29%	0.138	-0.514	0.342	-8.556
09	0.026	1.565	0.017	0.36%	3.57%	0.102	-0.224	-0.170	-0.538
10	2.497	0.755	3.307	34.63%	1.75%	19.757	1.974	-2.531	45.056
11	0.026	0.378	0.070	0.34%	0.85%	0.394	-0.091	0.061	-1.524
12	1.176	0.565	2.080	16.37%	1.29%	12.651	0.732	-0.940	16.720
13	0.001	0.282	0.004	0.02%	0.63%	0.024	-0.026	0.068	-0.945
14	0.002	0.005	0.304	0.02%	0.01%	1.911	0.000	-0.023	0.229
15	0.274	2.257	0.121	3.71%	5.18%	0.716	0.051	-1.768	18.197
16	0.165	1.138	0.145	2.30%	2.60%	0.884	-0.051	-0.396	3.454
17	0.059	0.379	0.156	0.89%	0.88%	1.012	-0.241	-0.682	4.412
18	0.088	1.788	0.049	1.21%	4.09%	0.295	-0.201	0.637	-8.382
19	0.190	5.225	0.036	2.61%	11.90%	0.219	-0.293	3.736	-40.283
20	0.068	3.535	0.019	0.93%	8.16%	0.113	-0.255	2.281	-25.358
21	0.180	2.469	0.073	2.49%	5.55%	0.449	-0.310	1.288	-15.978
22	0.158	9.050	0.017	2.17%	20.81%	0.104	-0.280	7.161	-74.417
23	0.233	0.980	0.238	3.27%	2.22%	1.474	-0.280	-1.155	8.754
24	0.953	1.093	0.872	13.25%	2.28%	5.821	0.612	-0.915	15.269

Source: authors' own calculations, based on International Trade Center data (2024).

Class legend: 1 – Live animals; 2 – Meat and edible meat offal; 3 – Fish and crustaceans, molluscs and other aquatic invertebrates; 4 – Dairy produce; birds' eggs; natural honey; edible products of animal origin; 5 – Products of animal origin, not elsewhere specified or included; 6 – Live trees and other plants; bulbs, roots and the like; cut flowers and ornamental foliage; 7 – Edible vegetables and certain roots and tubers; 8 – Edible fruit and nuts; peel of citrus fruit or melons; 9 – Coffee, tea, maté and spices; 10 – Cereals; 11 – Products of the milling industry; malt; starches; inulin; wheat gluten; 12 – Oil seeds and oleaginous fruits;

miscellaneous grains, seeds and fruit; 13 – Lac; gums, resins and other vegetable saps and extracts; 14 – Vegetable plaiting materials; vegetable products not elsewhere specified or included; 15 – Animal or vegetable fats and oils and their cleavage products; prepared edible fats; 16 – Preparations of meat, of fish or of crustaceans, molluscs or other aquatic invertebrates; 17 – Sugars and sugar confectionery; 18 – Cocoa and cocoa preparations; 19 – Preparations of cereals, flour, starch or milk; pastrycooks' products; 20 – Preparations of vegetables, fruit, nuts or other parts of plants; 21 – Miscellaneous edible preparations; 22 – Beverages, spirits and vinegar; 23 – Residues and waste from the food industries; prepared animal fodder; 24 – Tobacco and manufactured tobacco substitutes.

Italy's strategic advantage in the global agri-food value chain is shown by its capacity to convert and export processed agri-food products. In contrast to this trend, Romania has a dependence on importing finished goods within the same category, as indicated by a deficit of 0.292 billion EUR in the processing of grains. This disparity underscores a crucial aspect that requires improvement in Romania's agri-food industry, indicating the necessity for investment in processing capacities to enhance the value-added procedures and decrease reliance on imported processed agri-food products.

Nevertheless, Romania excels in primary agricultural output, namely in cereals and oil seeds, which make up a significant portion of its national exports (averaging 16.37%). Additionally, there is potential for future growth by enhancing its processing industries and moving up the global value chain. However, Italy excels in the strategic processing and exporting of high-value agri-food products, even if it must import raw ingredients. Both nations should encourage cooperation, particularly in sectors where one country's shortage corresponds to the other's excess, facilitating improved bilateral trade connections and sectoral progress. Italy might capitalize on Romania's plentiful and economical agricultural production as a source of raw materials for its food processing sector. This would result in a decrease in expenses related to importing these commodities from distant markets. On the contrary, Romania could benefit from Italy's advanced food processing techniques and technologies, improving its own value-addition mechanisms, and potentially increasing its competitiveness level in this sector. To add more, the development and implementation of educational, technological, and technical exchange programs between the Romanian and Italian agri-food sector stakeholders could lead to innovation and improved efficiency in both countries.

The descriptive statistics in Table 2 spotlight Romania's best performance and strategic position in the primary production of cereals and oil seeds, areas where Italy shows less efficiency. Romania's ratios, up to 2.524 in the case of oil seeds exports, generally indicate strong growth in the national export portfolio with raw agricultural products, suggesting both the necessity and opportunity to leverage this growth towards greater value addition. However, Italy's results, especially the deficits with cereals and oil seeds, reflect a different market orientation, focused on higher value processed products rather than primary production. For cereals, the average annual growth rate of Italy's deficit is 11.48%, similar to the growth reached in the case of oil seeds and oleaginous fruits (11.54%). Impressive coefficients of variation

(32.47% and 39.26%) were reached on the basis of alarming increase ratios (the year 2013 as baseline), which indicate a more than twofold increase in Italy's trade balance deficit with cereals (2.524), oil seeds, and oleaginous fruits (2.272). The descriptive statistics from Table 3 on Italy's agri-food classes with the greatest export shares at national level add robustness to the current research findings.

Table 2. Descriptive statistics of Romania's agri-food classes with the greatest export shares at national level

Product	Indicator	Country	Average (2013-2022)	Standard deviation	Coefficient of variation	Average annual growth rate	Ratios	
							Baseline: the national average	Baseline: the year 2013
Cereals	Exports (billion EUR)	RO	2.497	0.832	33.34%	11.24%	1.755	2.196
		IT	0.755	0.154	20.39%	8.32%	1.503	1.865
	National export share (percentage)	RO	34.63%	2.52%	7.27%	0.16%	1.049	0.965
		IT	1.75%	0.25%	14.25%	-0.03%	0.981	0.941
	Trade balance results (billion EUR)	RO	1.974	0.688	34.88%	13.20%	1.730	2.047
		IT	-2.531	0.821	32.47%	11.48%	1.897	2.246
Oil seeds; oleaginous fruits	Exports (billion EUR)	RO	1.175	0.376	32.01%	12.89%	1.736	2.524
		IT	0.565	0.130	23.15%	8.18%	1.541	1.939
	National export share (percentage)	RO	16.37%	2.05%	12.52%	2.01%	1.033	1.110
		IT	1.29%	0.05%	3.58%	-0.05%	1.020	0.979
	Trade balance results (billion EUR)	RO	0.732	0.179	24.57%	10.84%	1.278	1.704
		IT	-0.939	0.369	39.26%	11.54%	1.880	2.272

Source: authors' own calculations, based on International Trade Center data (2024).

Italy's strategic focus on higher-value processed agri-food products is confirmed by the country's high exports in preparations of cereals, which averaged 5.225 billion EUR during 2013-2022, while Romania reached 0.190 billion EUR, on average, thus almost 30 times less than Italy. While cereals hold the greatest share of Romania's exports (34.63%), the preparations of cereals hold the second greatest share of Italy's exports (11.90%). This contrast reflects the difference in the processing capabilities of each country, as well as other infrastructure deficiencies in the agri-food sector.

With an average yearly export of 9.049 billion EUR during the period 2013-2022, the class of beverages, spirits, and vinegar holds the greatest export share in Italy's total exports (20.81%). These products are of strategic importance to Italy's export portfolio and demonstrate the country's ability to capitalize on competitive advantage through the exports of higher value-added products in international markets. The processes of producing and exporting beverages, especially wine and spirits, involve high-value addition through cultivation, fermentation, and ageing efforts.

The research findings showed that Romania predominantly exports cereals and oil seeds, crucial commodities for the global food supply, but with lower prices associated on the international market due to their basic, unprocessed nature. Thus, Romania's dependence on low added-value exports limit its potential for economic growth and market resilience, particularly in the face of volatile agri-food prices. In comparison, Italy has established a distinct market segment – beverages, wine, and preparations of cereals, therefore products that embody higher added-value. This market dynamic allows Italy to practice higher prices for its exports, thus ensuring a more competitive position for itself. Thus, similar to the findings of Boboc (2021), the results argue for the need to strategically invest in entrepreneurial projects capable of improving the technical-economic performance of the Romanian agricultural sector.

Table 3. Descriptive statistics of Italy's agri-food classes with the greatest export shares at national level

Product	Indicator	Country	Average (2013-2022)	Standard deviation	Coefficient of variation	Average annual growth rate	Ratios	
							Baseline: the national average	Baseline: the year 2013
Beverages, spirits, vinegar	Exports (billion EUR)	IT	9.049	1.825	20.17%	7.14%	1.432	1.834
		RO	0.157	0.058	37.29%	12.80%	1.949	2.646
	National export share (percentage)	IT	20.81%	0.56%	2.71%	-0.82%	0.944	0.926
		RO	2.17%	0.19%	8.75%	2.28%	1.173	1.163
	Trade balance results (billion EUR)	IT	7.161	1.368	19.11%	6.66%	1.377	1.775
		RO	-0.280	0.154	55.15%	19.68%	2.091	4.711
Preparations of cereals	Exports (billion EUR)	IT	5.225	1.362	26.08%	9.29%	1.607	2.166
		RO	0.190	0.072	37.83%	14.23%	1.778	3.253
	National export share (percentage)	IT	11.90%	0.45%	3.79%	1.06%	1.069	1.093
		RO	2.61%	0.40%	15.36%	4.33%	1.076	1.430
	Trade balance results (billion EUR)	IT	3.735	1.127	30.18%	10.50%	1.677	2.384
		RO	-0.292	0.098	33.80%	12.57%	1.623	2.849

Source: authors' own calculations, based on International Trade Center data (2024).

Expanding on these research finding through the development of Table 4, which is a correlation matrix for the exports and trade balance results; this step of research emerged strategically. This matrix was dedicated to the agri-food classes that hold the largest export share at national level. The aim of this matrix was to identify key foreign trade patterns for both Romania and Italy that would support decision-makers in policy formulation, by providing valuable insight regarding the agri-food classes that have a significant impact on economic performance, thereby calling for targeted strategic investments to improve the agri-food sector's competitiveness.

Each correlation coefficient in the matrix is statistically significant, with *p*-values below the 0.05 threshold, indicating strong reliability in the observed relationships. In the matrix, TB is the acronym for the trade balance result, E is the acronym for exports, 10 indicates the class of cereals, and 19 indicates the class of the preparations of cereals.

The negative correlation of -0.889 between Italy's trade balance in cereals and in preparations of cereals indicates a strategic trade-off in resource allocation, described by the fact that Italy is prioritizing its resource management and policy support towards the processing of raw agricultural materials. This ensures higher profit margins through empowering the process of value addition. Furthermore, the strong positive correlation of 0.998 between Italy's exports and trade balance in cereal preparations for Italy stand proof for the country's efficient value chain management by securing the generated added value from the processed foods.

Table 4. Correlation matrix between the exports and trade balance results in the case of the agri-food classes with the greatest export shares at national level

	TB _{IT_19}	TB _{IT_10}	TB _{RO_19}	TB _{RO_10}	E _{RO_10}	E _{RO_19}	E _{IT_19}	E _{IT_10}
TB _{IT_19}	1.000							
TB _{IT_10}	-0.889	1.000						
TB _{RO_19}	-0.952	0.760	1.000					
TB _{RO_10}	0.835	-0.847	-0.786	1.000				
E _{RO_10}	0.909	-0.897	-0.847	0.979	1.000			
E _{RO_19}	0.980	-0.835	-0.989	0.846	0.901	1.000		
E _{IT_19}	0.998	-0.909	-0.952	0.852	0.922	0.981	1.000	
E _{IT_10}	0.807	-0.869	-0.684	0.722	0.818	0.742	0.826	1.000

Source: authors' own calculations, based on International Trade Center data (2024).

The strong correlation of 0.979 between Romania's cereal exports and its trade balance surplus highlights significant deficiencies in agricultural infrastructure, particularly in processing capabilities. Conversely, the inverse relationship with Italy's trade balance in cereal preparations indicates Romania's potential vulnerability to competitive pressures in the trade with high added-value agri-food products. Hence, for this country, the diversification and development in the processed food segment could alleviate market pressures and foster the sustainable growth of the sector.

The contrasting strengths and weaknesses of Romania and Italy identified through the descriptive statistics analysis and confirmed by the correlation matrix results suggest opportunities for both countries, as well as complementarity. Joint ventures in agri-food product processing, knowledge transfer, partnerships, and

cooperative research could help Romania improve its processing capabilities, while offering Italy access to high-quality, competitively priced agricultural raw materials.

6. Conclusions

In light of the current socioeconomic context, marked by rising food insecurity and volatile prices of agri-food products due to pandemics, geopolitical instabilities, and a growing population, this research aimed to evaluate the performance of foreign trade flows in agri-food products in the case of Romania and Italy, countries with rich agricultural endowments and strategic positions within the EU. The selection of these countries was based on their potential to become EU leaders in enhancing food security levels, ensuring the availability of high-quality agri-food products globally, and contributing to price stabilization and reduction. Since both countries are recognised for their abundance of agricultural resources and favourable climates, which, coupled with their strategic geographical and economic positions, grant them the basic tools to increase the competitiveness of EU's agri-food sector.

This research enriches the literature by providing a deeper understanding of the economic dynamics and strategic orientations concerning the Romanian and Italian agri-food sectors. With a research framework that incorporated elements such as descriptive statistics and the correlation matrix, the findings offered empirical evidence to support the discovery of socioeconomic vulnerabilities and market opportunities at the level of the agri-food sector in the case of both countries.

The results showed that Romania's agri-food trade performance is characterised by a significant economic dependence on exporting raw agricultural materials with associated lower prices, due to their unprocessed nature, a strategic gap caused by many factors, including Romania's poor agri-food processing capabilities. In contrast, Italy manifested a strategic orientation towards exporting high-value agri-food products such as beverages, wine, and preparations of cereals. Hence, these research findings demonstrate both the necessity and opportunity for Romania to diversify its agri-food exports by focusing on the higher-value processed foods—this could help in the mitigation of the global agri-food market's competitive pressures. Italy's expertise in processing and value addition could serve as a model for Romania, facilitating the bridging of gap through the knowledge and technology transfer, and best practices.

Collaborative efforts could also facilitate regulatory alignment and advocacy within the EU, streamlined mutually beneficial trade policies. Together, Romania and Italy could take advantage of their combined influence to advocate for regulations that favour the modernisation of agricultural infrastructure in Romania, with Italy serving as a role model due to its extensive experience with EU funding mechanisms. In addition, Italy could help Romania in implementing large-scale agricultural projects, helping to design and execute initiatives aimed at developing Romania's agricultural infrastructure. Such a partnership could foster improved efficiency, innovation, and sustainability within Romania's agricultural sector, while simultaneously reinforcing Italy's position as a leader in agricultural innovation and cooperation within the EU.

Although this research offers significant empirical insights, it is still subject to the primary limitation inherited from focussing on the analysis of only two agri-food classes per country, based on the performance of each class from the perspective of export share at national level. Consequently, future research could expand the scope of this article by including a more diverse range of agri-food products in the analysis and even go beyond by considering additional variables, including agri-food prices, inflation rate, trade tariffs, and market concentration.

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**Consumers' Perception and Behaviour
on the Characteristics of Food and Agri-Food Products
during the COVID-19 Pandemic**

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Abstract

Regardless of its size and intensity, a crisis will always affect people in their capacity as consumers in some way or another. But what happens, and how does it affect a crisis that appears and manifests once every 100 years, such as the COVID-19 pandemic? Although a definitive answer to this question may elude us, it is evident that the COVID-19 pandemic has plunged consumers into a realm of significant uncertainty, requiring them to prioritise their health. This heightened health consciousness has directly influenced their purchasing decisions and consumption patterns, leading to heightened scrutiny of food and agri-food product characteristics, particularly in the early stages of the pandemic. This research effort aims to understand how consumers perceive and report specific characteristics of food and agri-food products during the initial phase of the COVID-19 pandemic, a crisis that has significantly affected consumer behaviour. By applying and using the statistical method, correspondence analysis will be possible. Identifying and observing which features became more important to consumers during that period and how they relate to them will be possible. The results of this analysis will provide a detailed picture of how the pandemic has influenced the food and agri-food market, thus contributing to a deeper understanding of how significant crises affect consumer behaviour and, by implication, the food industry.

Keywords: consumer, perception, behaviour, COVID-19, food.

JEL Classification: Q13.

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1. Introduction

There is a category of unpredictable and uncontrollable events that have varying durations of time, produce fear and insecurity, and generate material and human damage, officially called “crisis situations” (United Nations International Strategy for Disaster Reduction (UNISDR), 2009).

When a crisis occurs and manifests itself, it changes people's lives and behaviour. At the same time, a crisis can also unite them and focus their attention, knowledge, and resources to solve it and minimise damage (Fanelli and Di Florio, 2016; Pauchant and Mitroff, 1992).

Most of the time, a crisis breaks out surprisingly, either because of chance or because certain risks/hazards specific to any activity get out of control and degenerate (Brecher and Wilkenfeld, 2000; Shaluf et al., 2003).

Crises are many and varied. Their multitude and diversity are provided by the plurality of risks that can cause a crisis, risks present and existing in almost all activities undertaken by man or found in natural phenomena (Howitt and Leonard, 2009; Richardson, 1994).

Depending on the risk that generates a crisis, they can be classified into different categories, such as crises arising from the manifestation of natural phenomena, health crises, military crises, economic crises, or social crises. This categorisation of crises is essential because correctly classifying a crisis into the category that matches its specifics and characteristics means limiting the effects and reducing the time of manifestation, which helps better understand how people behave in those moments (Schenker-Wicki et al., 2010).

Health crises, with their potential to spread rapidly and uncontrollably, are among the most severe and significant crises that can occur and manifest.

A health crisis is a situation where a disease rapidly and uncontrollably spreads, posing a significant threat to a large number of people and causing substantial societal and economic damage (Barry, 2005; McCracken and Phillips, 2012).

Usually, the impact and repercussions of a health crisis are felt by the whole society, and because of this, other new crises can appear at the same time or in a short interval (Bavel et al., 2020; Ezell et al., 2021; Ho et al., 2020; Tavailani et al., 2021). In addition, they are also responsible for changes in people's behaviour from the perspective of citizens or consumers of products (food or non-food) or services (Vázquez-Martínez et al., 2021).

This article analyses how and whether a health crisis of the intensity of a pandemic can change consumers' perceptions and reports on nine general or particular characteristics of food and agri-food products.

More specifically, this research considers how and if the beginning of the COVID-19 pandemic (the period between the outbreak of the COVID-19 pandemic, March 2020, and the end of the lockdown, June 2020) changed the perception and reporting of consumers of food and agri-food products in Brăila County, Romania, on nine characteristics (brand; price; sustainable product characteristic; quality; quantity; shelf life; availability in store and at merchants; fast delivery and different

physical and chemical properties of the product with health effects) of food and agri-food products.

Carrying out this analysis is essential because the results obtained contribute to a better understanding of consumer behaviour manifested in health crises by referring to food and agri-food products from the consumption perspective. The article and the analysis found in its composition propose the research and study of a part of an event that has already ended (2020-2023) to understand it so that in the future, the producers, respectively, the traders of food and agri-food products, will be able to anticipate and react much better at changes in consumer behaviour when an event similar to the one analysed occurs. The importance of studying this topic is significant because the COVID-19 pandemic has generated significant changes in consumer behaviour regarding the consumption of food and agri-food products (Pătărlăgeanu et al., 2021).

In this way, the obtained results can help to form a picture of the perception and how consumers relate to the consumer behaviour of food and agri-food products from the perspective of the decisions they make regarding consumption habits (Pătărlăgeanu et al., 2020).

The need to study, understand, and know these aspects is generated by the increasingly circulated hypothesis of the outbreak of a new health crisis. Even the European Food Safety Authority (EFSA) and the World Health Organisation claim another health crisis will appear soon (EFSA Panel on Animal Health and Animal Welfare (AHAW) et al., 2024; World Health Organisation (WHO), 2024).

The structure consists of six parts: the introduction; the second part is a review of specialised literature on the researched problem; the third part is the purpose of the research; the fourth part is the methodology used in the analysis; the fifth part is the research results, and the sixth part is the conclusions that can be drawn from the completion of this work.

2. Problem Statement

Over time, epidemics and pandemics were crises that, once manifested, changed society and people's behaviour (Barry, 2005; Berche, 2022; Cinti, 2005; Heymann and Rodier, 2004; Quarantelli and Dynes, 1977).

The two types of health crises are particular because they spread quickly, have a broad intensity, have very low predictability, and affect many people (Ho et al., 2023). For example, if there were an epidemic or a pandemic from the Middle Ages until the 20th century, people's lives would suffer because the vast majority of activities carried out then were directly or indirectly influenced by the manifestation of the disease and the crisis (Brecher and Wilkenfeld, 2000; Preston, 2019; Reinhart and Rogoff, 2009). In the 21st century, the circumstances are similar to those of the Middle Ages to the 20th century, and the experience provided by the emergence of the COVID-19 pandemic (2020-2023) has demonstrated and confirmed this to us (Phillips, 2020).

The COVID-19 pandemic is one of the most complex, intense, and important health crises in human history. This crisis has been a challenge and a concern for humanity because it has generated significant social and economic effects in both essential areas (food or medical) and less critical areas (Pătărlăgeanu et al., 2021). Its impact on society cannot be compared to that of any health crisis that has appeared and manifested in the last 100 years, and its effects have partially or totally changed people's way of life and behaviour (Sarkis et al., 2020). From a medical point of view, COVID-19 is less lethal than diseases such as SARS-CoV, MERS-CoV, tuberculosis, Ebola, or bird flu, diseases that, in turn, have generated epidemics or pandemics (Rabaan et al., 2020). However, the fact that initially not much information was known about the virus that produces it and that a worldwide lockdown was imposed caused a change in people's behaviour as consumers (Griffin et al., 2023; Mahase, 2020; Organizația Mondială a Sănătății (OMS) | World Health Organization (WHO), 2020a, 2022; Sun et al., 2020).

The lockdown is a security measure adopted as an emergency by the government of a state in an attempt to prevent and protect its citizens from potential or specific existing dangers (Gilbert et al., 2020). This measure limits some rights and freedoms by changing people's behaviour (Béné, 2020). The lockdown imposed in 2020 was an extraordinary measure because never in the 21st century has such a decision been adopted by all countries worldwide and for a long time (Grunert et al., 2021; Mégarbane et al., 2021).

At the same time, this measure produced one of the most exciting and vital changes in people's behaviour in the 21st century. More precisely, the lockdown imposed due to the emergence and manifestation of the COVID-19 pandemic has changed people's behaviour manifested as consumers of food and agri-food products (Pantano et al., 2020). Then, people of all ages related differently to these products in terms of the features they were looking for (Ellison et al., 2021; He and Harris, 2020; Wang et al., 2020).

The reasons for their behaviour were various.

On the one hand, it was the specificity of crises, a specificity that triggered unpredictable, irrational, ambiguous, and impulsive behaviour (Brug et al., 2009; Woodside, 2012). In this way, the fear of a possible sudden infection with COVID-19 and the limitation of travel time outside the home or the operating hours of the shops were some factors that contributed to the change in behaviour (Jribi et al., 2020).

On the other hand, the lack of money for food purchases, the increase in prices and the abundance of wrong information about the evolution of the pandemic contributed to the change in consumer behaviour (Abd-Alrazaq et al., 2020; Farooq et al., 2020).

It should also be mentioned that the change in consumer behaviour and the different reporting on food and agri-food products was also generated by the advice and information appearing in the media about the benefits of consuming healthy food and agri-food products and the benefits of having a balanced diet (Jayawardena and Misra, 2020). Moreover, the idea that food can be the “shield” of people in the fight

against viruses has also contributed to this hypothesis (Gibson et al., 2012; Naik et al., 2010). This advice and information about the benefits of a healthy diet has been supported and demonstrated by the low number of cases of disease recorded in the “blue zones” around the globe (Stefanadis et al., 2022). There, people, through a healthy diet and lifestyle, managed to protect, prevent, and fight against COVID-19 much better than those in regular areas (Janssen et al., 2021; Jayawardena and Misra, 2020).

At the same time, even the World Health Organisation drew up a food guide suggesting that a healthy diet consists of daily consumption of 5 fruits and vegetables in 4 distinct portions (World Health Organization (WHO), 2020b).

3. Research Questions / Aims of the Research

This article analyses how and if a health crisis of the intensity of a pandemic can change consumer perception and reporting of a series of general or particular characteristics specific to food and agri-food products. Specifically, this research considered how and if the COVID-19 pandemic, between March and June 2020, changed the perception and reporting of consumers in Brăila County, Romania, on nine characteristics, see Table 1.

The question that started this analysis was: How important were the following characteristics of food and agri-food products during the March-June 2020 period of the COVID-19 pandemic?

Then, to obtain an answer, two hypotheses were issued:

Null hypothesis (H₀): there are no significant differences, and there is no different reporting concerning the preference for one or more characteristics that the consumers of food and agri-food products in Brăila County, Romania, had in mind when the COVID-19 pandemic appeared (March-June 2020).

Alternative hypothesis (H₁): there are significant differences, and there is a different reporting of preference for one or more characteristics that consumers of food and agri-food products in Brăila county, Romania, had in mind at the time that the COVID-19 pandemic appeared (March-June 2020).

4. Research Methods

The method called correspondence analysis was used to analyse the data in the framework of this article, providing an answer to the question from which it started or confirming one of the hypotheses.

Correspondence analysis is a multivariate statistical technique that calculates the coordinates found in the rows and columns of a contingency table, the relationships between the nominal variable categories, and creates a two-dimensional graph (biplot) for the correspondence tables (Greenacre, 2015; IBM, 2024). Two-dimensional graphs or biplots provide an image of coordinates calculated on two axes, visually representing the relationships between categories (Greenacre, 2015; IBM, 2024). To perform this analysis, you must use statistical software such as SPSS, SAS, or R. Also, these softwares offer dedicated functions and

automatically perform calculations or generate graphs. These statistical programmes are necessary because correspondence analysis uses many formulas and mathematical calculations (Chi-square decomposition or Eigenvalues and vectors) (Greenacre, 2015; IBM, 2024).

This analysis is a quantitative research and the software used was SPSS. The data used for this research was collected via an anonymous online survey in 2022 through Google Forms. The people who participated in this survey were people from Brăila county in Romania, over 18 years old, and the sample consisted of 408 people/eligible respondents out of a total of 422 (18 respondents were not eligible). The survey was conducted between April and June 2022. All information received from respondents was treated strictly confidential by the ethical norms that govern high-quality research worldwide.

Even if the survey is a research method that does not provide an overview/general picture, it gives a picture for a certain period of time. This particularity of the survey perfectly suited the purpose of this article and its analysis. More precisely, the fact that the study was carried out during the period when the COVID-19 pandemic was still unfolding and the fact that the specificity of this research method captures the reaction for a specific moment and in a particular context all these characteristics help to understand the specifics of a crisis.

Regarding the question and the answer options used for this research, they can be seen in Table 1.

Table 1. Research data

Characteristics of food and agri-food products followed by consumers in Brăila county, Romania, at the time of the outbreak of the COVID-19 crisis and during the lockdown period (March-June 2020)	Scale of importance				
	Very important	Important	Less important	Very little important	Insignificant
Brand	102	171	93	28	10
Price	129	187	44	13	31
Sustainable product	114	186	78	17	9
Quality	289	104	6	3	2
Quantity	125	181	79	14	5
Shelf life	277	99	19	6	3
Disponibility	155	163	63	15	8
Fast delivery	96	154	96	28	30
Beneficial properties for health	214	127	45	10	8

Source: author's own research and processing.

5. Findings

After the analysis, different results were obtained, as seen in Table 2, Table 3, Table 4, Figure 1, Figure 2, Figure 3, and Figure 4.

In Table 2, the analysis has four dimensions, but only the first two are significant.

In this sense, dimension 1 obtained the result of .370 for “singular value,” .137 for “inertia”, and “the proportion of inertia” recorded the value of .845. Dimension 2 also for the same indicators obtained .130, .017, and .104. The values of the two cumulative dimensions have a percentage of 94.9% of the cumulative total of the proportion of inertia. The values of the other two dimensions do not add a significant percentage to the proportion of inertia, their cumulative percentage being 5.1%, see Table 2.

Given these obtained results, the graphical representation of the analysis will be a two-way representation.

Table 2. Summary analysis

Dimension	Singular Value	Inertia	Chi Square	Sig.	Proportion of Inertia		Confidence Singular Value	
					Accounted for	Cumulative	Standard Deviation	Correlation 2
1	.370	.137			.845	.845	.015	.040
2	.130	.017			.104	.949	.020	
3	.088	.008			.048	.996		
4	.024	.001			.004	1.000		
Total		.163	590.869	<.001a	1.000	1.000		

a. 32 degrees of freedom

Source: author's own research and processing.

Table 3 and Figure 1 of the analysis constitute an overview of the distribution of points in a row, i.e., they show how each attribute contributes to the variable “Characteristics of food and agri-food products followed by consumers in the county Brăila, Romania, at the time of the outbreak of the COVID-19 crisis and during the lockdown period (March-June 2020)” (Greenacre, 2015).

In the first dimension, see Table 3 and Figure 1, the characteristics “Quality” and “Shelf life” obtained the values of .339 and .257 and were the characteristics (points) that contributed the most to the dimension (Contribution of point to inertia of dimension), see Table 3 and Figure 1.

In the second dimension, see Table 3 and Figure 1, the characteristics “Price” and “Quantity” obtained the values of .555 and .139 and were the characteristics (points) that contributed the most to the dimension (Contribution of point to the inertia of dimension), see Table 3 and Figure 1.

Regarding the contribution of the dimension to the inertia of the point (Contribution of Dimension to the inertia of point), see Table 3 and Figure 1; in the first dimension, the characteristics (attributes) “quality” and “shelf life” contributed the most,” .999 and .990. The rest of the characteristics (attributes) contributed

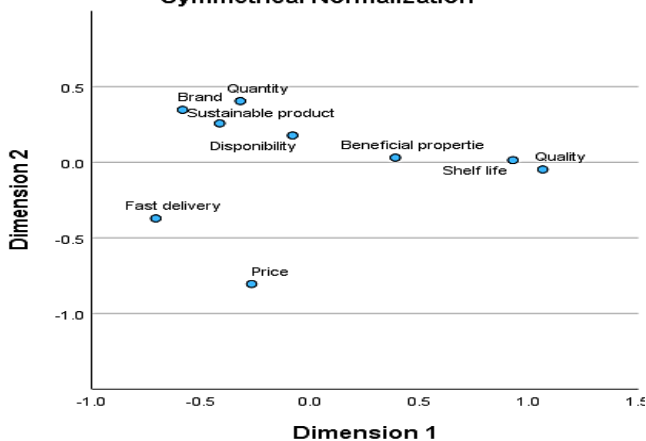
unequally. And, in the second dimension, the characteristics (attributes) “price” and “availability” contributed the most, .664 and .514, see Table 3 and Figure 1.

Table 3. Row Points of analysis

Characteristics of food and agri-food products	Score in Dimension		Inertia	Contribution				
	1	2		of Point to Inertia of Dimension		of Dimension to Inertia of Point		
				1	2	1	2	Total
	Brand	-.585		.346	.017	.103	.102	.850
Price	-.269	-.806	.014	.022	.555	.210	.664	.874
Sustainable product	-.415	.256	.009	.052	.056	.809	.108	.917
Quality	1.063	-.048	.047	.339	.002	.999	.001	.999
Quantity	-.320	.404	.008	.031	.139	.563	.314	.878
Shelf life	.926	.013	.036	.257	.000	.990	.000	.990
Disponibility	-.081	.177	.001	.002	.027	.312	.514	.826
Fast delivery	-.707	-.372	.026	.150	.118	.792	.077	.869
Beneficial properties for health	.388	.030	.006	.045	.001	.965	.002	.967
Active Total			.163	1.000	1.000			

Source: author's own research and processing.

**Figure 1. Row points of analysis
Symmetrical Normalization**



Source: author's own research and processing.

Table 4 and Figure 2 of the analysis provide a comprehensive presentation of how each attribute contributes to the characteristics (attributes) of the variable “Characteristics of food and agri-food products followed by consumers in Brăila county, Romania, at the time of the outbreak of the COVID-19 crisis and during the lockdown period (March-June 2020)”. These findings, based on the distribution of points in the column (Greenacre, 2015), are crucial for understanding the consumer behaviour during the COVID-19 crisis.

In the first dimension, the “Very important” attribute contributes the highest, .533, to the inertia of point to dimension (Contribution of point to the inertia of dimension). This precise data underscores the reliability of our analysis; see Table 4 and Figure 2.

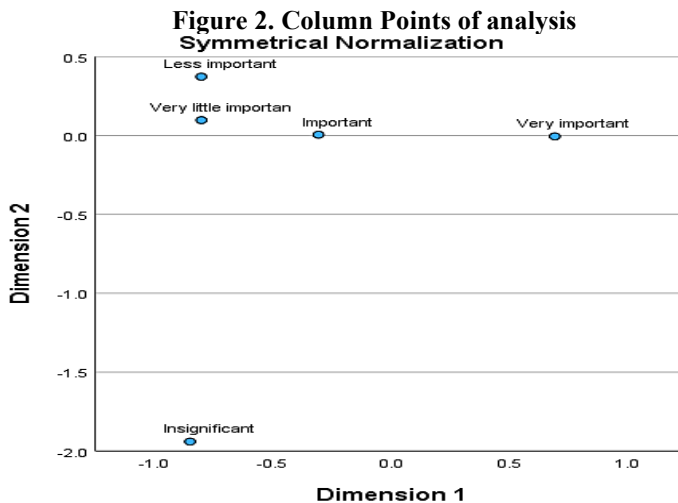
In the second dimension, the “Insignificant” attribute contributes the highest, .844, to the inertia of point to dimension (Contribution of point to inertia of dimension), see Table 4 and Figure 2.

Regarding the contribution of the dimension to the inertia of the point (Contribution of Dimension to the inertia of point), see Table 4 and Figure 2; in the first dimension, the “very important” attribute contributed the most, .955. In the second dimension, the “insignificant” attribute contributed the most, .985, see Table 4 and Figure 2.

Table 4. Column Points of analysis

Scale of importance	Score in Dimension		Inertia	Contribution				
	1	2		of Point to Inertia of Dimension		of Dimension to Inertia of Point		
				1	2	1	2	Total
Very important	.692	-.006	.074	.533	.000	.995	.000	.995
Important	-.307	.005	.017	.096	.000	.773	.000	.773
Less important	-.802	.373	.038	.250	.153	.892	.068	.960
More less important	-.802	.097	.011	.064	.003	.796	.004	.800
Insignificant	-.850	-1.940	.022	.057	.844	.348	.637	.985
Active Total			.163	1.000	1.000			

Source: author's own research and processing.



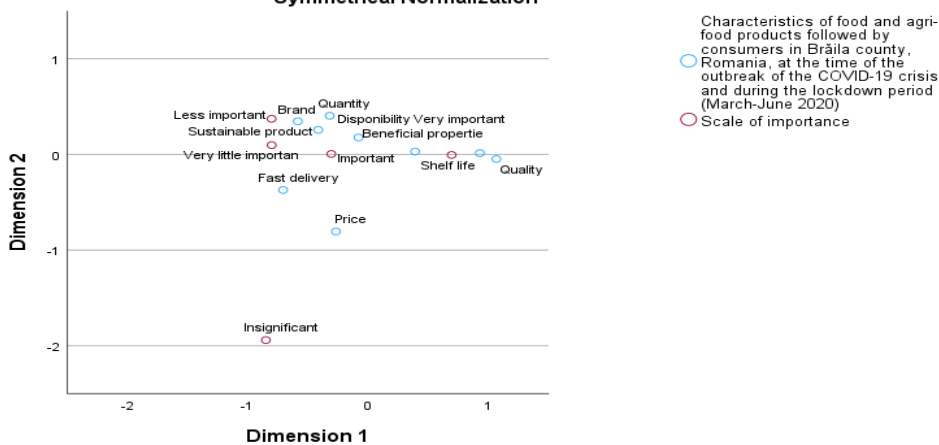
Source: author's own research and processing.

About how the variable features and attributes are dispersed, we should check Figures 3 and 4.

Therefore, following the interpretation of the graph and the results obtained, it can be stated that there is a very strong association between the characteristics “quality,” “properties beneficial for health” and “shelf life” with the “very important” attribute; and the characteristics “brand”, „sustainable product”, and “quantity” are associated with the “less important” attribute; see Figure 3 and Figure 4.

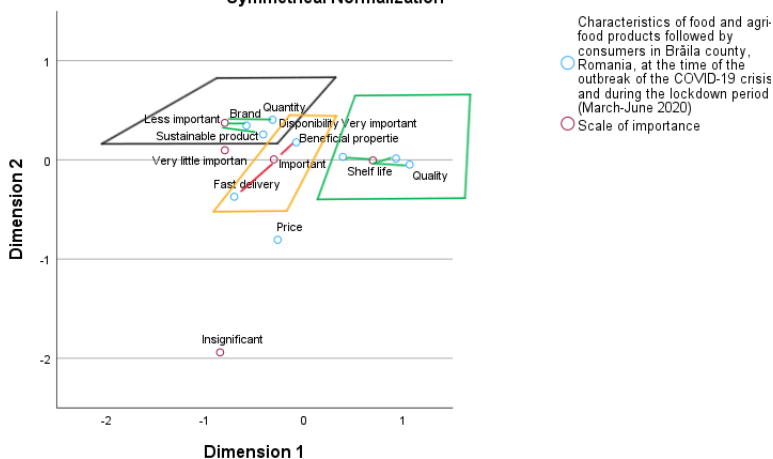
The characteristics “availability”, “price”, and “fast delivery” are pretty tricky to associate with any attribute because their positioning does not allow an interpretation that is 100% correct. But if we abstract from this fact, the characteristics “availability” and “fast delivery” can be associated with the attribute “important”, see Figure 3 and Figure 4.

Figure 3. Row and Column Points of analysis
Symmetrical Normalization



Source: author's own research and processing.

Figure 4. Row and Column Points of analysis 2
Symmetrical Normalization



Source: author's own research and processing

6. Conclusions

Our analysis, which focused on the impact of the COVID-19 pandemic (March-June 2020) on consumer perception and reporting in Brăila County, Romania, revealed some intriguing insights. These findings, detailed in Tables 2, 3, 4 and Figures 1, 2, 3 and 4, respectively, shed light on how a health crisis and subsequent lockdown period can significantly influence consumer reporting behaviour and the importance they assign to various characteristics of food and agri-food products.

Among the characteristics presented in the analysis, the most important relationships are between the characteristics “quality”, “properties beneficial for health,” and “shelf life” with the attribute “very important” and the characteristics “brand,” “sustainable product” and “quantity” are associated with the “less important” attribute. Therefore, the results obtained confirm the alternative hypothesis, which claims that there are significant differences and different reports compared to the preference for one or more characteristics that consumers of food and agri-food products in Brăila County, Romania, followed at the time when COVID-19 appeared (March-June 2020).

For producers and traders of food and agri-food products, the implications of our findings are clear. When a health crisis occurs, prioritising the characteristics of 'quality', 'properties beneficial to health', and 'shelf life' can help meet the criteria and expectations of consumers, ensuring continued demand for your products.

Regarding the limitations of this analysis, it should be remembered that no analysis is 100% perfect.

The present analysis used in this article may be limited by the handling of the data used, which may generate inaccurate estimates and difficulties in interpretation; the misinterpretation of the results, especially by people unfamiliar with this technique; and the impossibility of concluding cause and effect. For these reasons, it is essential not to make assumptions about the direction or nature of the relationships between the variables but only to observe the existing associations between the variables and the associations related to the sensitivity of the data distribution.

Future research that can start from this article and the analysis carried out should consider the extension to spatial data, the qualitative interpretation of the results, or research that compares different scaling methods.

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"During the preparation of this work the author(s) used Grammarly: Free AI Writing Assistance in order to check to correct the grammatical errors. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication."

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Marketing Channels as a Factor of Sustainable Agribusiness

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Abstract

Due to the growing importance of marketing channels in market economies and the dominance of trade, particularly retail, as well as the fact that current economic flows in the Republic of Serbia, in the process of transitioning from an administrative to a market system of economy, highlight channels of traffic and distribution as a central problem and area of business rather than product, price, and promotion, the subject of this paper is precisely marketing channels, i.e., trade in the Republic of Serbia. The contemporary business environment requires a different approach to business. Between domestic and foreign markets, there is a very pronounced competition. The demands and needs of consumers are more complex, and their expectations have increased. Rapid adaptation is necessary due to constant changes in the environment. On the one hand, it is essential to monitor changes and adapt, while on the other hand, it is essential to show initiative. All these mentions indicate the absence of a single formula that guarantees success, therefore flexibility, proactivity, and willingness to accept changes appear as key success factors.

Keywords: marketing channels, agribusiness, trade, vegetables.

JEL Classification: M31, Q01, Q10, Q13.

1. Introduction

Globalisation has created a business environment that is beneficial for the internationalisation of operations in the food and beverage industry. International markets are accessible to more and more businesses thanks to advances in communication methods and the facilitation of the transport of goods, knowledge, and capital. Due to the development in international business and technology,

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borders seem to disappear and this results in the world being seen as a single market. Connectivity and interdependence among international markets are at a high level. This is evidenced by the fact that consumers from various parts of the world have access to products that are not characteristic of their region (the supply has become quite equalised across different markets).

However, the propagation of negative effects is also present, caused by the high degree of interconnection between markets. An enterprise must be prepared to react to the occurrence of negative effects in order to mitigate the potential consequences on its operations. A good example of unexpected situations for which there was no preparation and which had a big impact on the changes in the market are the events in 2020, caused by the Covid-19 pandemic. Companies faced numerous difficulties and problems. Some managed to cope and make the best out of the situation, some still feel the consequences to this day, while some ceased operations.

The purpose of this study is to examine the method of choosing an appropriate strategy for the development of marketing channels for agricultural products. The expansion in the process of creating a competitive advantage requires an analysis of various factors that can affect operations. As the modern business environment is uncertain and exposed to rapid changes, the objective of the study is also to emphasise the importance of monitoring these changes and reacting quickly to them, so that the enterprise is able to maintain its competitive advantage, an even more difficult task.

2. Problem Statement

The food and beverage industry is crucial because it satisfies the basic needs of a human being. The food industry is a dynamic global network of enterprises that provide the biggest ratio of the world's food. Because it represents around 15-30% of the total negative effects on the environment, it is very important for us to better understand this sector. There has been an increasing focus on certain topics such as food origin, quality, sustainability of food production, and nutritional value. The importance of the origin and quality of products has become more relevant since the COVID-19 pandemic. The main effects of the pandemic are related to the physical access to food. Both the purchase and supply of food have been limited because of the restrictions, having a negative effect on the supply and demand for food. (Kakaeia et al., 2020, pp. 4-5; Koster 2021, p. 6; Memon et al., 2021, p. 1071).

Given the increasing emphasis on building and managing buyer-supplier relationships as a foundation for sustainable competitive advantage, opportunities arise where strategic procurement contributes to improving business performance and positioning manufacturing enterprises better in the global market.

These opportunities include the ability of enterprises to: (a) develop close business relationships with a limited number of suppliers; (b) promote open communication among supply chain partners; and (c) develop a long-term strategic orientation to achieve common benefits. Together, these activities foster sustainable competitive advantage by enabling the company to build interorganisational relationships. Additionally, the rapid response of suppliers is a crucial component of

competitive advantage through which strategic procurement has a significant impact on company performance (González-Benito, 2010).

The development of strategic relationships with suppliers and the exchange of information, ideas, and suggestions on the quality of goods and services are becoming increasingly significant (Ellram and Krause, 2014; Castaldi et al., 2011; Weigel and Ruecker, 2017).

The effects of strategic procurement not only have a positive impact on company performance, as confirmed in our and many other empirical studies, but also become a crucial factor for survival, sustainable development, and creating a competitive position in the strategic positioning of manufacturing enterprises in the global market (Shen, Lapede, 2005).

The cumulative effect of generational shifts and changes in consumer behaviour in pandemic conditions is reflected in the dominant shift of digital commerce in B2B companies. B2B companies that rely on digital channels are achieving higher overall sales. For example, a food distributor reported a 40% revenue growth compared to the previous year for its online customers, compared to approximately 9% growth for its customers overall (Deloitte, 2021: 14). Therefore, the e-commerce increases sales and fosters new customer relationships. The same source indicates that global sales through e-commerce increased in 2020 by 11,8%, although the total sales B2B decreased by 2,6% because of the negative impacts of the pandemic.

It is very important to consider numerous environmental factors in order to build a successful strategy of the marketing channels in all sectors, especially agriculture. Marketing channels in agriculture are strongly related to environmental information.

Finding an equilibrium between achieving economies of scale and aligning with local customer tastes is essential. Adaptation strategies are most common in food and beverage, apparel, and retail businesses. For example, Nestle offers its famous KitKat chocolate bar to consumers in Japan in combination with various local flavours (such as wasabi, azuki beans, and green tea). Coca-Cola and Pepsi use different levels of sweetness in their products to respond to the local taste (Lund et al., 2019, pp. 95-96).

3. Research Questions / Aims of the Research

The focus of the study will be on the process of globalisation and marketing channels of agricultural products in contemporary developments. It will examine their impact on creating a modern way of doing business that has led to changes in the food market.

The subject of research will be specific internal and external factors that contribute to the choice of strategies for the local and international expansion of food marketing channels. The application of the international expansion strategy will be explored through a specific example. The marketing channel in the vegetable sector, using potatoes as an example, will be analysed. Challenges, problems, and solutions encountered by potato marketing channel entities in placing products on the local and international market will be addressed.

In theoretical terms, the analysis of marketing channels in agribusiness can be viewed from two perspectives. The first approach focusses on analysing the specifics of food marketing channels at the local level, while the second approach leans toward the internationalization of food distribution issues from producers to consumers as end users and involves analysis at the global level. Considering the agrobiological, production organizational, and market-specific characteristics of agricultural production, and the need for its economic renewal and restructuring towards the development of agribusiness - market-orientated exports, the expected perspectives of development and changes are:

- Liberation from social constraints and the emergence of economically responsible agriculture;
- Contribution to food security (self-sufficiency, operational and strategic reserves);
- Sustainable development - optimal use of agricultural resources (land, water, air, biological diversity), and environmental protection,
- Market stability, with a tendency to decrease the share of food costs in the family budget structure;
- Export orientation, with the ambition to achieve a surplus in foreign trade,
- Integral rural, regional development - economic-social recovery and sustainability of rural areas, which will include the formation of alternative earning opportunities.

Variables by which the agribusiness system, efficiency, effectiveness, or sustainability of the entire sector will be measured and evaluated include:

- Adaptation to market changes;
- Creation and adoption of technological innovation;
- Access to capital;
- Ability to gain and retain market share;
- Climate change.

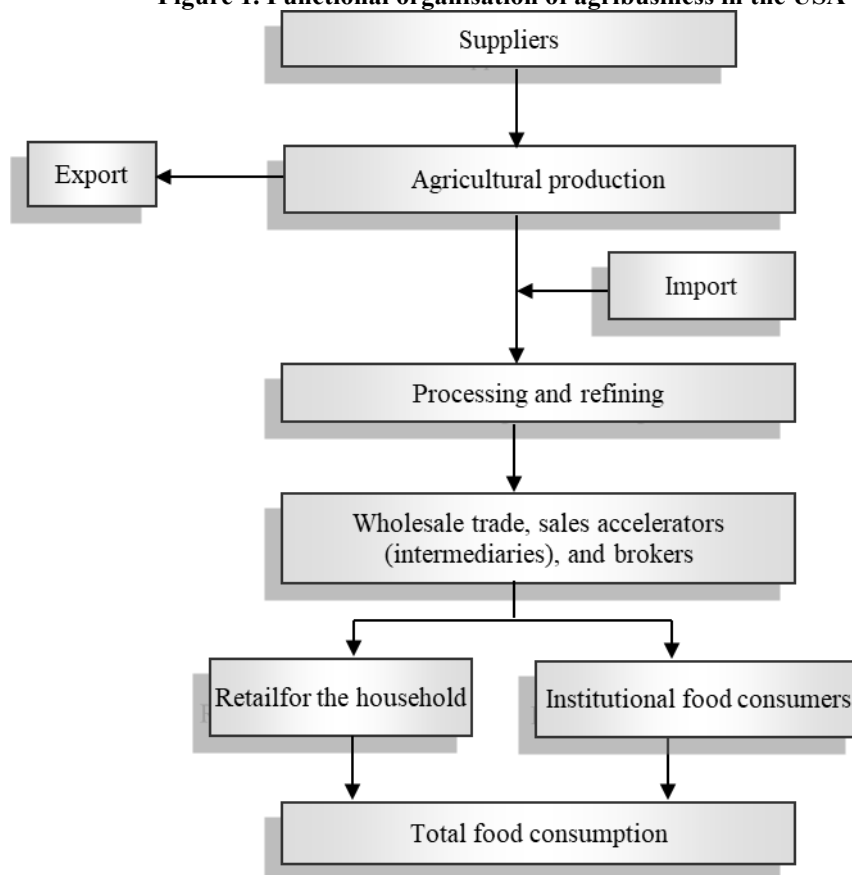
The response of companies in the food and beverage industry to global crises is accelerating process digitisation. The digitalisation of processes has emerged as a response to the crisis, and companies in various sectors have resorted to digital communication and business systems.

The trend in modern agriculture is less focused on farms and their dominance in production of basic foodstuffs and raw materials for the accompanying industry. To understand the complexity of marketing channels for this sector, we must explain the concept of agribusiness.

Trade in marketing channels for agricultural products involves economic entities from the agricultural sector, as well as those from the processing industry and trade. Hence, in the United States, modern agriculture is seen as a homogeneous economic activity consisting of: family farms, large corporations, credit institutions, input suppliers, processing companies, transportation firms, wholesale, retail, and restaurant chains. Davis coined the term "agribusiness" to denote vertical integration and harmonious functioning in food production. We conclude that there is a large

number of participants in marketing channels, which can be graphically represented in the following figure 1.

Figure 1. Functional organisation of agribusiness in the USA



Source: Vujatović-Zakić Zorka, Tomić R. (1998). Agricultural Economics, Faculty of Management, Zaječar and Megatrend Business School, Belgrade.

Under the influence of exceptionally variable economic circumstances throughout the twentieth century, marketing channels have undergone significant changes.

In addition to the permanent implementation of various innovations and thereby achieving significant progress in their quality, in recent decades, their evolution has primarily been directed towards shifting power from producers to intermediaries, namely towards strengthening the role and position of one of the primary participants in the channel: retail, within which over time, retail has become the dominant and decisive factor in the functioning of marketing channels.

4. Research Methods

The research in the paper is based on existing domestic and foreign, professional, and scientific literature, as well as available statistical data from the food industry, in order to approach the given topic as accurately as possible.

Using the method of comparison, analysis, and synthesis, with a wider range of literature from the marketing channels of agricultural value products, including theoretical and empirical studies, knowledge of food production and marketing methods in the EU with the help of new technology in production through the application of the principles of sustainable marketing channels in the last ten years, we came up with key solutions and recommendations for food marketing channels in Serbia, applying the principles of sustainable development.

5. Findings

All the crises from the last decade accentuate the idea that businesses must be flexible, by implementing appropriate strategies. Thanks to the large amount of information available today, businesses have access to large databases of precollected secondary data, ensuring faster and easier navigation when entering new and unfamiliar markets.

In the food industry, it is necessary to create a new personal database that is combined with the existing ones to create a quality product that gives a sense of trust to parents, the target customers. When choosing an appropriate strategy for the company to apply to foreign markets, it is very important to have a detailed analysis of the company's current position, its strengths and weaknesses, and the analysis of the external environment.

The main purpose of marketing channels is to deliver agricultural and food products from the primary producer to the consumer in the shortest possible time, with minimal costs, and preserving the product's properties intended for consumers. The research task is also to present how the specific characteristics of agricultural and food products and their purpose influence the choice of marketing channels, as well as to highlight the effects of organising marketing channels for agricultural products on the competitiveness of Serbia's agro-sector in the global market.

Specifically, the aim of the paper would be to design the structure of marketing channels for selected types of products typical for small, family, and large agribusiness farms, both domestically and internationally. Although direct marketing channels, which exclude intermediaries between production and consumption, are present in modern business, channels that imply the use of intermediaries, primarily retailers, are much more common. This is because intermediaries, thanks to their specialisation in performing marketing functions, are much more efficient than producers and consumers.

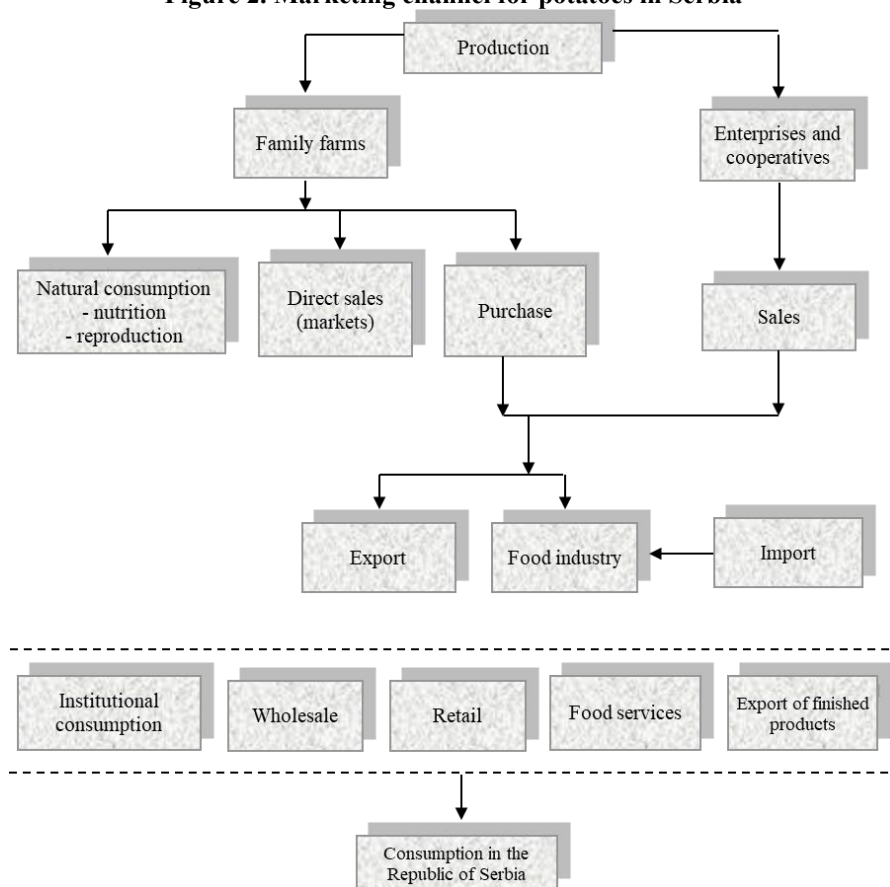
Regarding trade in Serbia, its position, role, and development in the overall system of reproduction have changed depending on changes in socioeconomic determinants and specific economic systemic solutions and their modifications.

It is important to mention legal and other measures, activities and actions that have been taken from the trading practices of developed Western countries but

created and implemented with the consideration of experiences from Eastern European countries, where transitional processes (currently characteristic of our trade) have long been realised, in order to avoid and prevent problems that those countries faced and to utilise their positive experiences and solutions. If we compare the functional organisation of agribusiness in the USA (Figure 1.) with the potato marketing channel in Serbia (Figure 2.), we notice the lack of connection and organization of family farms (Figure 2.), in the process of placing agricultural products. Organised marketing of agricultural products from family farms to wholesalers is a weak link in the marketing channel of agricultural products in Serbia.

A barrier to the marketing of potatoes is related to an outdated product range: the use of traditional seeds that do not meet the requirements of modern consumers. In addition to the above, another barrier concerns the processing and packaging of products, which are unsuitable for market needs – the lack of washed potatoes, products in packages of various sizes – packages of 100g for snacks or family packages, products "to go" or "ready to use". (Figure 2.)

Figure 2. Marketing channel for potatoes in Serbia



Source: author's processing.

Producer: After socialism, the production estates were fragmented into smaller production units. Marketing organisations, such as cooperatives, and marketing infrastructure are no longer available to producers, and alternative solutions have not been found.

One proposal to improve the functioning of cold storage facilities, to remain competitive in the market, is to invest in new processing technologies. Negative experiences from the past have caused distrust among producers. However, the new production organisation would not be a traditional cooperative but would engage in other marketing activities (quality control, promotion, and market research). The cooperative would represent a capital society.

Industry: In order to achieve integrated quality improvement, the concept of total quality management is increasingly being applied in all enterprises. The essence of this process is that the entire organisation and all employees, as well as suppliers and consumers, should be involved in the quality improvement process. Raw material processors will initiate vertical marketing integration to protect against uncertain further raspberry and cherry product placements. The industry will offer producers guarantees for production contracts and future prices. The basic documents regulating quality, by law, are standards. Standards are regulations that determine certain characteristics of a product or define terms, dimensions, graphical, and letter symbols.

Wholesale Trade: The future of wholesale trade also involves its entry into the sphere of production. To avoid competition between production organisations and wholesalers in the market and reduce marketing costs for production organizations and risk, the suggestion is that wholesalers to join cooperatives as shareholders. The cooperative would have the opportunity to collaborate with a larger number of wholesalers to promote competition.

Industries can organise the sale of their finished products in several ways.

- Industrial placement under their own brand for domestic wholesale
- Industrial placement under the brand of domestic wholesale
- Industrial placement under their own brand for foreign wholesale in the domestic market
- Industrial placement under the brand of foreign wholesale for the domestic market

Retail: The properties based on which it can be assessed that a product meets the need for which it is intended represent objective characteristics, such as technical, physical, chemical, mechanical, functional, aesthetic, etc.

Consumer: determines the fate of the entire marketing channel. The aim of the entire channel is to satisfy consumer needs through a quality, safe, attractive product, and an acceptable price.

6. Conclusions

It can be said that good organisation of agricultural product traffic requires meeting the demands related to understanding and respecting certain specificities resulting from the nature of agricultural production. The specificity lies in the fact

that the production results depend not only on agronomic measures and technology, but also on climate and soil. On the other hand, the demand for agricultural products is generally continuous over time. Therefore, a legitimate question arises: How to organizationally overcome these discontinuities and align the supply and demand of agricultural products? The problem becomes even more complex when considering the constant growth of consumer centres that need to ensure not only adequate supply, but also the stability and continuity of that supply, at an increasingly higher level of dietary standards. From a transportation point of view, it is also essential to consider that agricultural products are generally larger, many of them are susceptible to damage and rot, which makes them very risky for the traffic phase. The influence of incomes, prices, and other variables expressed by coefficients of elasticity are an inevitable factor in determining the future development of agricultural and food products.

Farmers and small and medium enterprises in developing countries have been severely affected by the pandemic due to a lack of advanced technology and infrastructure. Moreover, food businesses that import raw materials were the severely affected. As local producers and small food supply chains are less restricted by containment laws, an effective crisis mitigation strategy is improving and providing technological solutions for them. In India, the dairy subsector has led digitization and automation during the pandemic. One of the leading organisations in India, 'Chitale Group', has implemented a traceability system that tracks milk from purchase to sale, along the entire value chain. This allows spoilage to be easily detected and eliminated (Memon et al., 2021, pp. 1085-1087).

The general goal of the food and agriculture sector, as well as the fruits and vegetables subsector, in the future should be value addition and diversification of placement, which would result in enhanced competitiveness. Policies aimed at achieving this should take into account the key characteristics of the domestic supply: fragmented structure and predominantly domestic and regional ownership of companies, as well as demand characteristics for products: the export market can only be a true engine of growth, unlike the quantitatively saturated and weak domestic market in terms of purchasing power.

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**Ecotourism in Romania: Exploring Potential
and Promoting Responsible Tourism**

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Abstract

In Romania, ecotourism has become an important tool for nature conservation and the sustainable development of local communities. It promotes not only environmental protection, but also cultural values and local traditions. The Ecotourism Certification System was developed in collaboration with authorities and organisations in the field and is an important tool to achieve environmental protection objectives. The Romanian Ecotourism Association through the statistical data provided show a significant increase a economic impact of ecotourism in Romania, highlighting his potential. The present study investigates consumer perceptions and behaviours regarding ecotourism in Romania, in the situation where environmental protection is gaining proportions day by day, and sustainable development is an increasingly important topic. This article aims to show the importance of promoting ecotourism in Romania and how necessary a tourism offers to protect first and to satisfy tourists' preferences for responsible and sustainable vacations.

Keywords: ecotourism, sustainability, consumer perceptions and behaviour, Romania.

JEL Classification: Q010, Q200.

1. Introduction

After the end of World War II, society's perception has headed more and more toward understanding the finitude of our planet's resources. In addition, ecotourism has become a symbol of this awareness. Due to advances in transportation and information technology, several areas of the plant that were previously isolated have led to a rapid increase in natural area tourism. We are facing climate change,

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with global temperatures rising, and now we are forced to bear the consequences of our own behavioural mistakes towards the planet that hosts us. The contributions of the tourism sector to these climate changes through air travel or personal vehicle use, deforestation, construction, water consumption, etc., essentially represent a self-destructive manifestation since they affect the very foundations on which tourism relies (Cornish, 2004; Constantinescu, 2012; Holden et al., 2022).

It has to be underlined that preserving the sustainable development in some business activity requires a permanent broadening of offered services and products contrary to growing human needs and desires, setting up the tourism within the mentioned mechanism (Jeločnik et al., 2020).

Therefore, the need for change in tourism has become evident, aiming to attract more attention from governments and partners in the private and public sectors, based on principles of sustainable development. The principles presented include: a) The environment has an intrinsic value and must be recognised, this principle is very important for tourism and must be kept forever; b) Tourism must be considered an activity that does not harm the environment, and local communities can benefit; c) A relation between environment and tourism where the support tourism activities in the long term, the condition being that tourism does not affect the environment; d) It is necessary to respect the ecological, social, economic and cultural characteristics of the geographical area related to tourist activities; e) It is desired to maintain a balance between the needs of tourists, destinations and host communities (Maziliu, 2004).

At the beginning, sustainable tourism was intended to be a business opportunity driven by concern for the environment. Although these two concerns may seem incompatible at first glance, a sustainable tourism business can thrive in the long run if managed responsibly, adhering to both market standards and sustainable development principles (Guja, 2023; Milojković et al., 2023).

2. Literature Review

According to Zaharia and Cofas (2012), sustainable tourism involves the ability of tourist destinations to remain competitive in the face of all challenges, attract visitors, retain them over time, maintain a distinct cultural identity and uphold a constant balance with the surrounding environment. So, it considers prudent mutual linking of tourism, ecology and economic interests (Puška et al., 2022). Ecotourism is a specific form of sustainable tourism that emphasises the exploration and conservation of nature and the surrounding environment (Chandel and Mishra, 2016). The primary motivation of ecotourists is to experience and learn about biodiversity and unique ecosystems, thereby contributing to their conservation. Also, ecotourism involves many aspects, such as visits in protected areas, interaction with the local communities, and supporting environmental conservation efforts. It is more nature-focused and has specific objectives regarding conservation and environmental education (Wearing and Neil, 2009).

Ecotourism differs from other forms of tourism by involving more direct and intimate interactions with the natural and cultural environment. It is primarily a development initiative in the form of an active partnership between tourists, tour operators, travel

agencies, local communities, protected area administrators, environmental organisations, and experts in the field (Vdovicenco and Aşevschi, 2015). Nowadays, when more and more countries are facing the issues of socio-economic development of rural space and rural communities (Ivolga and Shakhramanian, 2019), preserving the traditional Romanian village and utilising its resources, including exploring its non-agricultural potential, are development directions that should be tailored to local needs (Dinu et al., 2020).

In 1986, Mexican architect Héctor Ceballos-Lascuráin, Director General of Standards and General Technology at SEDUE and founding member of the Mexican organisation PRONATURA, formulated one of the earliest definitions of ecotourism (Lama, 2021). According to him, ecotourism is a form of tourism that is environmentally responsible. In his conception, ecotourism involves visiting national parks and protected areas with the primary objective of admiring and studying the surrounding environment, including landscapes and wild plant and animal species (Bekele et al., 2017). Ceballos-Lascuráin emphasises the importance of cultural aspects that promote nature conservation and reduce negative impacts on the environment in this sphere. In addition, he shows the social and economic benefits for the local communities related to ecotourism.

In 1991, the International Ecotourism Society (TIES) created a definition of ecotourism, described as a form of responsible travel in natural environments, the purpose being to preserve the environment and support the well-being of local communities (Barna et al., 2011).

The World Tourism Organisation chose to use the term "ecotourism" to describe "all types of tourism in which the primary motivation of the tourist is the observation and appreciation of nature, contributing to its conservation and generating minimal impacts on the surrounding environment and cultural traditions" (Carvache Franco et al., 2021).

Experts in ecotourism from the Department of Tourism and Geography at the Faculty of Business and Tourism of the Bucharest University of Economic Studies, members of the Academic Centre for Tourism-Service Research (CACTUS), propose a comprehensive definition of ecotourism, considering it as a form of tourism conducted in natural environments with the primary goal of knowing and appreciating nature and local culture (Nistoreanu et al., 2003). This definition emphasises that ecotourism brings benefits to the population and requires measures for nature conservation. Synthesising the mentioned definitions, ecotourism can be understood as a responsible form of tourism that involves conserving and protecting nature with human support, and also having an educational role in promoting respect for the environment and local communities. It is a way to act carefully to minimise negative impacts on nature, culture, and local traditions during eco-tourism activities.

Romania marked a historic moment in 2012, becoming the first country in Europe to implement a system for recognizing ecotourism destinations according to criteria developed by the Global Sustainable Tourism Council (GSTC) and European Ecotourism Standards (EETLS), (Dragan et al., 2014; Mazilu et al., 2017).

The purpose of the Ecotourism Certification System is to guarantee environmental conservation and promote sustainable development of local communities through tourism (Dragomir et al., 2018).

The Romanian Ecotourism Association (AER) brings together, through an innovative approach, both the public and private sectors in a partnership dedicated to nature conservation and tourism promotion. This partnership involves tourist associations, nongovernmental organizations active in sustainable development and nature conservation, as well as tourism service providers (Barna et al., 2011).

The association's mission is to promote the concept and development of ecotourism, with the aim of supporting nature conservation, the sustainable development of local communities in regions with natural values, and improving the quality of ecotourism-related services. Additionally, the association seeks to promote nature as a fundamental element of Romania's tourism image (Tudorache et al., 2016).

Another argument in favour of expanding this type of tourism is presented by the statistical data provided by the Romanian Ecotourism Association (AER). According to this information, the economic impact generated by ecotourism programmes organised by AER member tour operators in our country has shown a significant increase, rising from approximately 1.6 million euros in 2008 to 3 million euros in 2014 and more than 5 million euros in 2017 (Ilie, 2019). This upward trend is driven by the growing number of AER members who conduct ecotourism programmes, as well as the increasing number of tourists who participate in these programmes. Particularly remarkable is the fact that the local impact significantly exceeds the average of traditional tourism. In the case of AER member operators, more than 50% of the expenses incurred by tourists remain in the communities where the tourist programmes take place, especially in rural areas (Ilie, 2019).

3. Research Methodology and the Research Objectives

This study aims to analyse consumers' perception of the ecotourism market.

To achieve the research goal, an empirical approach was chosen, the research method being a survey, the instrument used being a questionnaire. The questionnaire comprises 10 closed questions, including 4 demographic questions, with multiple-choice answers.

The survey questions were created in order to determine the level of awareness that the population has about ecotourism, the experiences tourists have had with ecotourism, financial preferences for one night's accommodation, reasons for choosing ecotourism, and the average number of nights preferable for an ecotourism accommodation.

320 people responded to the questionnaire and it was distributed between March 12 and April 10 online via Google Forms.

The objectives of this study are determined by the importance of understanding the reasons behind choosing eco-tourism accommodation, the amounts of money allocated, the average number of nights stayed, etc.

4. Results and Discussions

Regarding demographic data, the proportion of women to men is nearly equal (49% men and 51% women), (Table 1).

Table 1. Respondents' gender distribution

Variable	Absolute (persons)	Relative (per cent)
Male	158	49%
Female	162	51%

Source: Self-conceptualisation based on the questionnaire.

Regarding the level of net income, the distribution is as follows: more than 57% of respondents earn between 4001 and 5000 lei per month, 20% of them earn between 5001 and 6000 lei per month, 13% earn over 6001 lei per month, 4% earn less than 3000 lei per month, while 6% of them earn between 3001 and 4000 lei per month (Table 2.).

Table 2. Respondents' income

Variable	Absolute (persons)	Relative (percent)
< 3000 lei (under 600 euros)	13	4%
3001 - 4000 lei (600 - 800 euros)	19	6%
4001 - 5000 (800 - 1000 euros)	182	57%
5001 - 6000 (1000 - 1200 euros)	64	20%
> 6001 lei (over 1200 euros)	42	13%

Source: Self-conceptualisation based on the questionnaire.

Table 3. Age of respondents

Age		
Variable	Absolute (persons)	Relative (per cent)
18 - 24 years	70	22%
25 - 35 years	76	24%
36 - 45 years	141	44%
46 - 65 years	17	5%
Over 65 years	16	5%

Source: Self-conceptualisation based on the questionnaire.

According to age of respondents, the most of them are between 36 and 45 years old, specifically 44%, while 22% are between 18 and 24 years old, 24% between 25 and 35 years old, 5% between 46 and 65 years old, and 5% are over 65 years old (Table 3.).

Around 67% of the respondents have completed university studies, 23% have completed postgraduate studies, while 10% of them have completed high school (Table 4).

Table 4. Highest education completed

completed studies		
Variable	Absolute (persons)	Relative (percent)
High School	32	10%
University	214	67%
Postgraduate	74	23%

Source: Self-conceptualisation based on the questionnaire.

Table 5 shows that 60% of respondents have heard about ecotourism, this fact indicating a high level of awareness of this concept. This number also suggests that ecotourism has become a familiar topic for more people. Thus, this number also shows a growing interest in environmental protection and concern for the negative impact that some trips have.

Table 5. Ecotourism awareness

Have you heard of ecotourism before?		
Variable	Absolute (persons)	Relative (percent)
Yes	192	60%
No	128	40%

Source: Self-conceptualisation based on the questionnaire.

Knowing that the purpose of ecotourism is to promote responsible and sustainable travel, it is good thing that a significant part of the sample is familiar with this concept. Therefore, it can be concluded that there is potential to increase sustainable travel and adopting sustainable tourism behaviour.

Table 6. Accommodation in an ecotourism guesthouse

Have you stayed in an ecotourism guesthouse up to now?		
Variable	Absolute (persons)	Relative (percent)
Yes	67	21%
No	253	79%

Source: Self-conceptualisation based on the questionnaire.

Table 7 provides valuable information regarding the amount of money respondents would be willing to allocate for one night's accommodation in an ecotourism guesthouse, in the context of the definition of ecotourism and travel trends previously expressed.

It can be observed that the largest share, 45% of respondents, would be willing to allocate between 200 and 300 lei per night for accommodation in an ecotourism guesthouse. This figure reflects a concern for a balance between affordable pricing and the benefits of an ecotourism experience, suggesting that many travellers are willing to invest in an accommodation option that promotes environmental conservation but within the limits of a reasonable budget for them.

Table 7. Allocated amount

Ecotourism is a form of tourism that primarily aims to conserve the environment and emphasizes educating tourists about environmental protection. Therefore, what amount of money would you be willing to allocate for such accommodation per night?		
Variable	Absolute (persons)	Relative (percent)
Under 200 lei per person per night (Under 40 euros)	48	15%
Between 200 and 300 lei per person per night (40 - 60 euros)	144	45%
Between 300 and 400 lei per person per night (60 - 80 euros)	96	30%
Between 400 and 500 lei per person per night (80 - 100 euros)	16	5%
Over 500 lei per person per night (Over 100 euros)	16	5%

Source: Self-conceptualisation based on the questionnaire.

Table 8 provides insights into respondents' preferences regarding the duration of their stay in an ecotourism accommodation. Taking into account the previous data and the context of ecotourism, we can interpret these figures in a broader perspective of traveller behaviour and attitudes. The most common preference is for 2 or 3 night stay, reflected by 40% of respondents. This choice may indicate a desire to spend enough time at a destination to enjoy the ecotourism experience and explore the surrounding environment and activities, without committing to an extended stay.

Table 8. Number of nights respondents would allocate to an ecotourism guesthouse

For how many nights would you be willing to stay in an ecotourism accommodation?		
Variable	Absolute (persons)	Relative (percent)
1 night	96	30%
Between 2 - 3 nights	128	40%
Between 3 - 4 nights	64	20%
Between 4 - 5 nights	16	5%
Between 5 - 6 nights	16	5%
Over 6 nights	0	0%

Source: Self-conceptualisation based on the questionnaire.

Table 9 provides an overview of the main motivations of respondents to practice ecotourism for the first time or again. These reasons reflect the varied concerns and interests of travellers regarding their ecotourism experiences. The most common motivation, identified by 40% of the respondents, is relaxation. This indicates that many travellers see ecotourism as an opportunity to relieve stress and enjoy the tranquillity and beauty of nature.

Table 9. Reasons

If you were to try ecotourism for the first time (or again), what would be the reasons you would do so?		
Variable	Absolute (persons)	Relative (percent)
Hiking in nature	48	15%
Traditions and customs	48	15%
Nature education/awareness	19	6%
Relaxation	128	40%
Observing nature in protected areas	70	22%
Minimising the negative impact on nature caused by mass tourism	7	2%

Source: Self-conceptualisation based on the questionnaire.

Observing nature in protected areas is the next main motivation, mentioned by 22% of respondents. This shows that many travellers are interested in exploring and enjoying the biodiversity and natural landscapes of protected areas, suggesting an appreciation for the beauty and importance of conserving these ecosystems. For 6% of the respondents, education and awareness are the main motivations to practice ecotourism. This shows that there is a growing interest in understanding the environment within ecotourism experiences, indicating that in efforts to preserve the environment, education plays a primary role.

5. Conclusions

In conclusion, to achieve a balance between the environment and society, a change in the behaviour is used to is necessary. Ecotourism helps change the usual tourism experiences into environmentally friendly ones. This study analyses consumer perception of sustainable tourism and highlights important aspects related to tourists' experiences, awareness, and preferences regarding sustainable travel. Regarding the current level of knowledge of ecotourism, 60% of respondents, and regarding people who have stayed in sustainable accommodation, this number is even lower. Most travellers prefer trips with only 2-3 nights of accommodation, indicating a trend toward short and affordable getaways. But there is also a smaller segment that prefers longer stays. Most of the respondents are willing to spend between 200 and 300 lei / night in ecotourism accommodation. At the same time, there is less interest in premium accommodation, but also in the most affordable ones. Regarding the motivations for practicing ecotourism, the most common reasons are relaxation and observation of nature in protected areas.

There is also a relatively small interest in environmental education and appreciation of local traditions.

These findings underscore the diversity of interests and needs among travellers in ecotourism. Promoting varied and customised ecotourism experiences can contribute to greater awareness and participation in responsible and sustainable travel practices.

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**Factors Influencing Customers' Green Purchase Intention:
The Role of Perceived Environmental Responsibility
and Health Consciousness**

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Abstract

The demand for green products is rooted in consumer health and environmental issues and provides an incentive for organisations to produce such products using sustainable methods. Customer responsibilities toward the environment, however, have been very sparingly studied in developing countries like Vietnam. This study extends the theory of planned behaviour (TPB) through the addition of factors of perceived environmental responsibility and health consciousness to the model of theory of planned behaviour. The current study focusses on the mediating effects of attitude and perceived behavioural control within the TPB framework. We collected data using convenient sampling, which yielded 308 original survey responses from Vietnam, and analysed them using PLS-SEM. The results show that: (a) the attitude towards green products positively affects the purchase intention; (b) perceived environmental responsibility and health consciousness positively influence the green attitude and the purchase intention; and (c) perceived behavioural control does not affect the green purchase intention. These insights can help marketers create creative plans to appeal to green product customers.

Keywords: customer's attitude; health consciousness; perceived environmental responsibility; perceived behaviour control; green purchase intention.

JEL Classification: M31; Q56.

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1. Introduction

Population growth, the industrialisation process, and the release of toxic substances into the environment have been the main culprits behind significant environmental problems in the past. These serious threats to our planet have prompted a strong call for action to save the environment through moral behaviour and sustainable consumption (Tanner & Wölfling, 2003). Health-conscious consumers have been increasingly demanding safe and ecologically protective eco-friendly products (Laviri et al., 2021). This rising concern of people toward green products provides a very good opportunity for policymakers and the businesspeople to not only to explore the complexity of consumer decisions and "green marketing" methods, but also to go deeper in knowing the actual behaviour of consumers (Miniero et al., 2014).

Studies in environmental psychology have been trying to determine or predict factors that affect green purchasing behaviour (Chaudhary & Bisai, 2018; Duong et al., 2022; Lavuri et al., 2023; Nguyen et al., 2024). Most of these studies, however, were conducted in developed countries, which underlines the serious deficiency of empirical research in developing countries such as Vietnam (Vu et al., 2022; Nguyen et al., 2024). The deteriorating environmental conditions in these rapidly industrialised countries, which lead to numerous health problems, have spurred the emergence of green consumerism. In these emerging economies, the adoption and usage of green products are heavily influenced by social, cultural, and economic factors. Therefore, studying customer intention and behaviour towards green goods in such contexts is of paramount significance (Chaudhary & Bisai, 2018).

Finding out of purchasing intention of green products among Vietnamese consumers is the target of this study, by using the Theory of Planned Behavior (TPB) (Ajzen, 1991). Previous studies indicated the ability of the three core TPB factors in explaining desire to consume green. However, not all behaviours and contexts allow for high levels of prediction with just these three core factors; therefore, researchers have suggested including some more elements in the TPB model itself to enhance the predictiveness of the sustainable consumption behaviour process (Rise et al., 2010; Yadav & Pathak, 2017; Varah et al., 2021).

Considering the context of green consumption, we propose adding two new factors to an extended TPB model: health awareness (HC) and perceived environmental responsibility (PER). To measure this, we applied two factors: attitude towards green products (ATG) and perceived behavioural control (PBC), which are components of TPB.

This study contributes to the existing literature on the theme of green consumption. Its primary objective is to supplement the TPB with additional antecedent factors, most notably PER and HC, as important factors driving the intention to purchase green. Second, it seeks to shed light on the complex dynamics underpinning the interaction between outcome and predictor factors by examining the social-psychological mechanisms that create motivation to promote purchasing

behaviour. The insights gained from this study would enable green marketers to exploit the full potential of this market and capitalise on the 'green buying capability' of Vietnamese consumers by designing more focused initiatives. Methodology, theoretical background, literature review, results, comments on the results, limits, implications, and objectives for the next investigations constitute the framework of the study.

2. Theoretical Framework and Hypotheses Development

2.1 Theory of Planned Behaviour (TPB)

TPB is a model that explains how specific actions are cognitively enacted with the objective of explaining a wide variety of actions (Ajzen, 1991). An important element in this theory is behavioural intent, which identifies the major reasons underlying people's choices to perform certain activities (Duong et al., 202). In cognitive psychology, behavioural intentions are defined as a cognitive state that "arises right before an action is performed." (Altmann & Trafton, 2002). Many previous studies have shown that the three cognitive elements of TPB, such as attitudes, subjective norms, and perceived behavioural control, serve as strong predictors for continued consumption patterns and therefore behaviour (Yadav & Pathak, 2017; Varah et al., 2021; Vu et al., 2022).

2.2 Perceived Environmental Responsibility (PER)

Consumers with a high degree of environmental responsibility do not just meet their fundamental needs with purchases, but also try to compensate for the negative social and environmental effects resulting from their consumption pattern (Michel et al., 2023). Perceived environmental responsibility (PER) is called the willingness of people to protect the environment by reducing negative impacts on society, being conscious of purchasing decisions (Johri & Sahasakmontri, 1988). Previous research indicates that environmental performances can be considerably improved if ethical behaviour exists among stakeholders (Shahrin et al., 2020; Duong et al., 2022). Prakash and Pathak (2017) show that the necessity of the role of raising awareness among consumers and the responsibility arising from their actions is necessary, due to the fact that their shifted purchasing behaviour can positively influence the environmental situation (Hamzah & Tanwir, 2021; Duong et al., 2022). In this respect, the factors of the TPB connected an individual's PER to their intentions to buy. We base this theory on the ideal social theory, where an informed and sensitive person will behave in a responsible manner as they try to practice the ideals of society.

H1: PER positive effect on ATG.

H2: PER positive effect on PBC.

H3: PER positive effect on PI.

2.3 Health Consciousness (HC)

Health consciousness refers to the means by which consumers recognise changes in their health condition and the degree of importance they give to their health needs (Hsu et al., 2016). People who regard their health usually engage in activities that mitigate their well-being in whole. Previous studies have found that purchasers of green products are usually are health conscious, and that the most determinant factor in their choice is safety in health and foodstuffs (Tarkiainen & Sundqvist, 2005; Hsu et al., 2016; Yadav & Pathak, 2016). Through various studies of green consumption, a positive relationship has been illustrated that human health awareness triggers the day-to-day intake of various green commodities. Earlier research has revealed that the health consciousness of an individual has a positive impact on ATG (Tarkiainen & Sundqvist, 2005), PBC (Gam et al., 2020), and on PI (Hsu et al., 2016):

H4: Positive effect of HC on ATG.

H5: Positive effects of HC on PBC.

H6: Positive effects of HC on PI.

2.4 Attitude toward Green Products (ATG)

The attitude of a person is a judgment of good or not good results of conduct and the willingness to do the activity or not (Varah et al., 2021), in a number of different situations, ATG and PI have a positive relationship. For example, Duong et al. (2022) focused on a wide range of green products and established the positive relationship between ATG and the intention of purchasing such green products. Yadav and Pathak (2017) found that positive ATG is related to increased green purchasing intentions.

H7: Positive effects of ATG on PI.

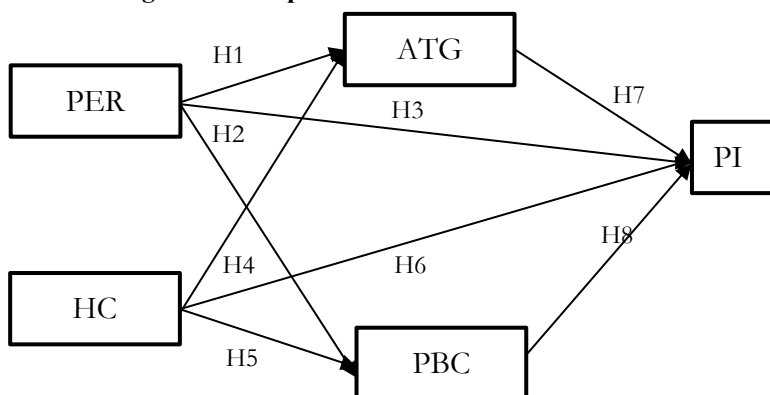
2.5 Perceived Behaviour Control (PBC)

PBC is the extent to which an individual believes that they are able to perform a certain behaviour (Ajen, 1991). TPB assigns significant weightage to PBC in explaining intentions and behaviours, especially if the behaviour under consideration is not fully under the personal control of the individual. Previous studies have found that PBC is highly correlated with intentions and behaviours toward green products (Yadav and Pathak, 2017; Vu et al., 2022).

H8: PBC positive effects on PI.

Based on the proposed hypothesis and the extension of the TPB, the following research model (Figure 1).

Figure 1. PBC positive effects on PI



Note: PER: Perceived environmental responsibility; HC: Health consciousness; ATG: Attitude toward green products; PBC: Perceived behaviour control; PI: Purchase intention.

Source: authors model.

3. Research Methodology

3.1 Research Design and Measurement

We designed the quantitative questionnaire survey to ensure the hypothesized relationships of this study inquiry (Figure 1). The first component of the questionnaire was a brief invitation letter that informed the study participants of the objectives and assured them that data protection and confidentiality up to the ethical standards. Then it reiterated the fact that responses must be thoughtful, and the participants can leave the survey at any time or avoid any question they were not comfortable answering. The next part of the questionnaire identified interest factors such as PER, HC, ATG, PBC, and PI.

The following part of the questionnaire collected sociodemographic information. Adapted for the purpose of this study, include four items on PER by Hamzah and Tanwir (2021); three items on health awareness by Tarkiainen and Sundqvist (2005); three on attitude toward green products by Varah et al. (2021); three on perceived behavioural control by Lavuri et al. (2023); and four on purchase intention by Yadav and Pathak (2017). The responses to all these elements were based on a 5-point Likert scale from 1 = totally disagree to 5 = totally agree.

3.2 Sample, Data Collection, and Protocol

Ho Chi Minh City was chosen as the most appropriate location for collecting data, since pro-environmental consumer behaviour would occur more in large cities (Duong et al., 2022). In addition to being the largest city in Vietnam, it is also a city with an increasing proportion of consumers who have a better knowledge about climate change, nature and the ecological environment, as well as the availability and consumption of green products, therefore increasing the chances of getting useful responses in relation to this study (Vu et al., 2022). We targeted

customers in Ho Chi Minh City using a convenience sample. Data were collected online from June to August 2023, mainly through Facebook and Zalo, two social media preferred by Vietnamese consumers to be used due to the vast coverage and speed of the systems. We had 308 valid surveys after eliminating 65 that did not meet the living space criteria. We considered the sample size to be sufficient since it was more than ten times the number of elements and met the set criteria (Shmueli et al., 2019).

According to Shmueli et al. (2019), PLS-SEM has emerged as a powerful approach for prediction-orientated modelling. PLS-SEM evaluates both the measurement and structural models. While the measurement model evaluates the relationships between latent variables and their manifest indicators, the structural model tests the hypothesised relationships among variables in order to test the study hypothesis. We analyse PLS-SEM using SmartPLS 3 software.

4. Results and Discussion

4.1 Descriptive Statistics

376 questionnaires were issued. After a rigorous screening, the author obtained 308 valid questionnaires, representing a response rate of 81.9%. The effective questionnaires distributed that 41.9% were males and 58.1% were females. As far as education is concerned, 8.4% graduated from high school, followed by 12.7% with postgraduate degrees, 23.1% college graduates and 55.8% university graduates. For occupations, 5.8% identified themselves as managers, while 9.4% were workers, 13.6% did sales or household work, 15.6% were in other occupations, and the largest group at 56% worked as office staff. Income levels were structured as follows: 11.7% above 30 mil VND, 21.8% between 20 and 30 million VND, 28.9% between 10 and 20 million VND, while the bulk, at 37.7%, earned less than 10 million VND.

4.2 Measurement Model

The empirical model consists of two major parts: the measurement model and the structural model. Table 1 shows the results of the measurement model, which deal with the reliability and validity of the constructs. Consequently, all the constructs have composite reliability values of 0.70 and above. AVE assesses the reflexive constructs. Henseler and Schuberth (2020) suggested a threshold value of 0.50 for every construct. Thus, all the above-mentioned requirements are met for both the reflexive variables of the model. Furthermore, Hair et al. (2019) found that Cronbach's alpha for each construct was higher than 0.70, so their reliability and internal consistency were guaranteed. The size of each individual reflexive is considered to be high if it has a correlation of more than 0.70 with the measured variable. The reliability of indicators with outer loading > 0.70 (Hair et al., 2019). The VIF to address the issue of lateral collinearity. Table 1 shows that each of the VIF values we obtained lies within the range of [2.271; 2,859], all less than 3.3.

Table 1. Outer loadings, convergent validity and composite reliability

Items / Variables	Outer loadings	AVE	CR	CA
Perceived environmental responsibility		0.760	0.927	0.895
PER1 “I consider the environmental issue when making a purchase”	0.864			
PER2 “I have changed my principal products for ecological reasons”	0.880			
PER3 “I am emotionally involved in environmental protection issues”	0.878			
PER4 “I would rather be willing to reduce my unsustainable consumption to help protect the environment”	0.866			
Health consciousness		0.811	0.928	0.884
HC1 “I carefully choose green products to ensure the good health”	0.913			
HC2 “I think I am a consumer with health conscious”	0.863			
HC3 “I often think about issues related to health”	0.924			
Attitude toward green products		0.781	0.935	0.907
ATG1 “Purchasing a green product is a good idea”	0.896			
ATG2 “Green product is good for the environment”	0.869			
ATG3 “I possess desirable attitude with regard to green products”	0.890			
ATG4 “I feel good about myself when I use green products”	0.880			
Perceived behaviour control		0.811	0.928	0.883
PBC1 “I am hoping to buy sustainable goods”	0.905			
PBC2 “I help the environment by buying eco-friendly goods”	0.894			
PBC3 “I have the time, the money, and the desire to purchase eco-friendly products”	0.903			
Green purchase intention		0.814	0.929	0.886
PI1 “I will purchase green products for personal use”	0.910			
PI2 “I am willing to purchase green products for personal use”	0.886			
PI3 “I will make an effort to purchase green products”	0.911			

Source: results from Smart PLS.

Indeed, the widely used heterotrait-monotrait ratio approach (Henseler et al., 2015) proved to confirm the discriminant validity. The constructs are distinctly different from each other because the HTMT assessment of every pair was below the recommended threshold of 0.85 (Henseler & Schubert, 2020). The HTMT ratios for all constructs were below 0.85; the result is shown in Table 2, thus indicating discriminant validity.

Table 2. Heterotrait-monotrait (HTMT)

	ATG	HC	PBC	PER
HC	0.513			
PBC	0.410	0.272		
PER	0.426	0.440	0.325	
PI	0.551	0.515	0.322	0.470

Source: results from Smart PLS.

4.3 Structural Model

Using a bootstrapping technique with 5000 resamples as recommended by Hair et al. (2019), the structural model of exogenous variables was sufficiently explaining their endogenous counterparts, since the R2 values for ATG 26.9%, PBC 9.7%, and PI 34.5% all exceeded the permitted level. Exogenous variables represented their endogenous counterparts well. According to Cohen (2013), for R2 values, the external variables predict their endogenous counterparts. Hair et al. (2019) suggested that for Q2 values greater than zero, the external variables predict their endogenous counterparts. The coefficient, t, p and effect sizes (f^2) from the route analysis are shown in Table 3 (Hair et al., 2019). The findings disproved one hypothesis and confirmed seven.

Table 3. Summary of hypotheses testing

Hypotheses	Paths	Effect size	Path coefficients	T-statistics	p-values	Results
H1	PER>ATG	0.068	0.242	4.198	0.000	Supported
H2	PER>PBC	0.051	0.232	3.703	0.000	Supported
H3	PER->PI	0.046	0.281	4.596	0.000	Supported
H4	HC->ATG	0.166	0.378	6.761	0.000	Supported
H5	HC->PBC	0.021	0.149	2.373	0.018	Supported
H6	HC->PI	0.062	0.353	5.991	0.000	Supported
H7	ATG->PI	0.086	0.286	4.663	0.000	Supported
H8	PBC->PI	0.006	0.067	1.310	0.190	Not Supported

Source: results from Smart PLS.

The hypotheses, from the results in Table 3, have a significance threshold of 95%. With the results from H1: ($\beta=0.242$, $p < 0.05$); H2: ($\beta=0.232$, $p < 0.05$); and H3: ($\beta=0.281$, $p < 0.05$), it is very evident that the suggested PER significantly affects ATT, PBC, and PI. The result of this study is supported by other previous

studies in which the customer's attitude toward the environment is responsible and easily expressed by opting for green products during any shopping activity. The results of H4 ($\beta=0.378$, $p < 0.05$), H5 ($\beta=0.149$, $p < 0.005$), aH6 ($\beta=0.353$, $p < 0.05$) and H7 ($\beta=0.086$, $p < 0.05$) support the positive effects of HC on ATG, PBC and GPI. Thus, it adds to the literature that shows that highly health-conscious consumers often choose green products because they perceived these products as being safer and attach greater importance to health-related issues while consuming those products. The study further confirms that ATG will have a positive effect on PI, similar to Varah et al. (2021), indicating that ATG will more often trigger green purchase decisions. The result did not find any direct relationship between PBC and PI, contradicting Arvola et al. (2008) in H8 ($\beta = 0.067$, $p > 0.05$).

4.4 Discussion

Previous studies showed that attitudes and perceived behavioural control affect green purchase intention; however, in this study the results show the perception of ease or difficulty in implementing green behaviour. It is also known as perceived behavioural control does not affect PI, this study is supported by previous studies by Arvola et al. (2008) and Chaudhary & Bisai (2018) because in the context of green consumption in Vietnam, a developing country, availability or price barriers can affect the intention to purchase green products (Barbarossa & Pastore, 2015).

The results showed that PER and HC indirectly affected the PI through ATG and PBC. Meanwhile, this study investigates the indirect effects to show that PER and HC influence customers' green intention behaviour through impacts on ATG and PBC, respectively. This shows that the impact mechanism of these factors shows the value of TBP in recognising the green purchasing behavior of Vietnamese customers. According to Vu et al. (2022), Vietnam, the concept of ethical consumerism has only recently emerged, highlighting the importance of easy access to green products to create the urge for consumers to buy green products. This suggests that while there is a perception of how easy or difficult it is for an individual to make environmentally friendly purchases, such ease or difficulty may only occur if green products are available or perhaps priced higher than available alternatives (Barbarossa & Pastore, 2015), it will be a precursor to weakening positive attitudes toward green products.

5. Conclusions

Theoretically, the contribution of this study can be considered very significant for the theme of green consumption. First, this research confirms the extension of the TPB in the prediction of green consumption behaviour. Both PER and HC, as two antecedents, together with two psychological mediators from the TPB, have positive influences on the decision-making of consumers about environmentally friendly behaviours. The findings show that both PER and HC significantly influence the tendency to purchase green products. Their attitude toward green products and their perceived behaviour control the behaviour and mediate this influence. However, PBC has no influence on PI. Current research also provides insights

into pro-environmental behaviour and its determinants within the context of developing countries, particularly Vietnam.

Provides, from a practical point of view, some valuable information for marketers on factors that can be improved to predict PI. Accordingly, segmentation using PER and HC will guide marketing efforts toward those who are most likely to have a higher intention to purchase from green. Marketers can focus on changing consumer attitudes toward green products by emphasizing their functionality and increasing the perceived ease of accessing green products to increase PBC (Chaudhary and Bisai, 2018). The policy implications are that policymakers have to influence the attitude of the entire society regarding the benefits of green goods in reducing hazardous substances by introducing various campaigns and marketing. Such efforts can help raise human consciousness to achieve extensive green consumerism. These initiatives can be taken up by the organisation as part of their corporate social responsibility policies in order to gain a better reputation externally and gain more sales revenue capture (Duong et al., 2022).

Several limitations of the study can be improved in future research. Convenience sampling among Vietnamese consumers reduces the generalisability of the findings; future research should be conducted with targeted samples of millennials and Gen Z of the general population. In addition, we drew our data from Ho Chi Minh City, which is a part of the southern region of Vietnam. Future studies should increase the sample size and scale to more regions in Vietnam or other developing economies to enhance the representation of the results. Although demographic factors are statistically under control, their influence on suggested connections can be somewhat strong. Future studies might integrate certain elements into this model, including social conventions, perceived green value, and perceived impact of the market.

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**Professional Skills of Future Accountants
using ERP Systems**

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Abstract

Digitisation in recent years has led to massive changes in the way certain activities are carried out in various fields. This paper aims to analyse the field of finance and accounting, capturing how the activities of accounting professionals are changing as a result of the evolving phenomenon of digitisation. At the same time, it was also studied how the implementation of ERP (Enterprise Resource Planning) systems provides functions that allow more efficient and accurate processing of data, and reports needed by managers can be generated more easily. The research method used in this paper was based on a quantitative analysis, specifically a bibliometric analysis, with the aim of illustrating the main skills that accounting professionals should develop in the future as a result of the digitisation phenomenon in recent times. The research aims to follow the importance of developing technical skills, critical thinking skills, and adaptability to navigate the complexities of ERP systems effectively. As a result of the evolution of digitisation and the increasing implementation of ERP systems in finance and accounting companies, the results of the study indicated that accounting professionals should possess a range of skills including proficiency in data analysis, system implementation, and financial reporting within ERP systems. The paper adds value to the literature, providing accountancy professionals with a range of useful insights into how the profession will change as a result of digital transformation.

Keywords: ERP systems, accountants, professional skills, digitisation.

JEL Classification: M40, M41.

1. Introduction

The rapid evolution of digitisation has shown that the integration of ERP systems within an organisation is a necessity in modern financial management. Most organisations want efficiency, accuracy and real-time data information, and the role of the accountant is changing as they need to acquire new professional skills. This

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article aims to present the main skills that future accountants should develop, as well as the digital skills they should possess in order to effectively use ERP systems in their daily practices.

ERP systems have reformed the manner of processing, analysing, and reporting through the simplification of business processes, the alleviation of decision-making competences, and the supply of the entire picture of an organisation's financial elements.

Future accountants need to own several software skills in order to properly deal with the intricacies of ERP systems in an effective way, besides the technical capabilities that they need to develop. Moreover, the comprehension of complex financial data is based on communication skills, while the identification and the resolution of issues that can appear in relationship with ERP systems heavily relies on critical reasoning.

The goal of the article is to delve into the main professional skills and the utilisation of ERP systems in accounting, to define the most suitable components that should be owned by accounting professionals due to activity digitisation, as well as to prove how technical knowledge and interpersonal capabilities can be integrated by them.

2. Problem Statement and Literature Review

The rapid development of information technology has also been observed by Amirul et al. (2017) having a massive impact on the accounting profession. The business environment is constantly changing as a result of globalisation and the evolution of technology. Thus, it should be observed whether future accounting professionals have the necessary skills to cope with the new changes.

Various studies by Chen et al. (2011) and Damasiotis et al. (2015) have shown the need for accountants' knowledge of ERP system functionality, data structure, and reporting capabilities. In addition to technical skills, other authors, such as Schwade and Schubert (2016), identified the need to develop soft skills while using ERP systems.

Omane-Antwi (2017) mentioned that critical thinking, communication, and problem-solving opportunities play a role in improving data processing and management decision-making.

Communication is essential to translate financial data into meaningful action for shareholders, and critical analysis helps accountants analyse and interpret information processed with ERP systems. ERP systems are among the most effective tools for managing small and medium-sized enterprises (Kovalev et al., 2023). Adaptability and the desire to know what is new gives a broad view on the concept of digitisation. Future accounting professionals need to demonstrate flexibility and a proactive approach to acquire new features and functionality.

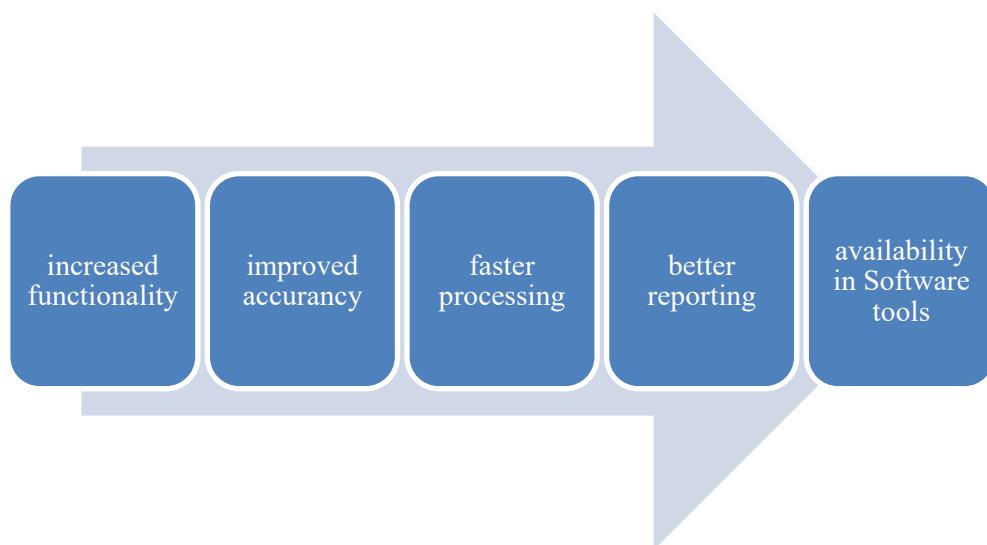
A combination of technical competencies, software skills, and adaptability so that accountants excel in using ERP systems to empower organisational success in the digital age (Ozdogan, 2017).

The reason why many organisations decide to implement ERP systems comes down to the possibility of integrating information into a single database, being accessible and controlled from any department of the organisation. Major operations are combined into a single department-specific module (El Sayed, 2006; Chen et al., 2011).

ERP systems include modules specific to accounting and finance, human resources, production, sales, and distribution (Grabski et al., 2011; Gunasekara & Wijesinghe, 2020). The implementation of ERP systems can result in a range of benefits, including increased efficiency, cost savings, and improved decision-making (Darie, 2023; Zain et al., 2023).

Damasiotis et al. (2015) identified several advantages of using these systems, such as those found in Figure 1.

Figure 1. Advantages of using ERP systems



Source: Damasiotis et al. (2015).

The article thus aims to analyse what are the main skills that future accountants should possess in the process of digitising organisations.

3. Research Questions / Aims of the Research

The research questions of the article are presented below:

RQ₁: *What skills should future accounting professionals possess?*

RQ₂: *What other skills should future accounting professionals develop in the digital age?*

Table 1. The 7 clusters of the bibliometric analysis

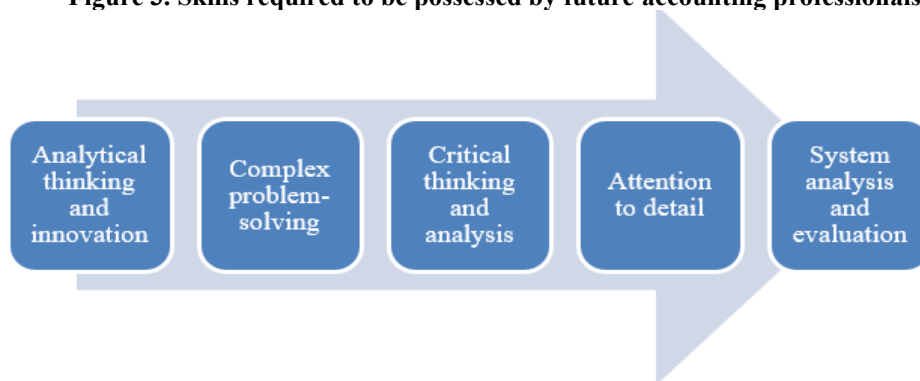
Number of cluster	Keywords
Cluster 1	Acceptability, Accounts, Adults, Association, Anxiety, Behaviour, Burnout, Cognitive function, Community, Depression, Efficacy, Emotion regulation, Experiences, Health, Involvement, Mental health, Participation, Quality of life, Reliability, Risk, Recovery, Social competence, Social skills, Social support, Strategies, Stress, Virtual reality, Well-being
Cluster 2	Account, Accuracy, Activation, Adaptation, Addictions, Anticipation, Attention, Brain activation, Brain potential, Capacity, Cognitive control, Connectivity, Decision-making, Deep learning, Development, Developmental language, Emotion, Emotion recognition, ERP components, ERP processing, Expertise, Face perception, Face recognition, Facial expression, Feedback, Judgement, Networks, Skills acquisition, Social cognition, Specialisation, System, Tasks, Visual attention
Cluster 3	Acceptance, Analytics, Artificial Intelligence, Benefits, Big Data analytics, Business intelligence, Cloud ERP, Capabilities, Complexity, Critical success factors, Data Analytics, Corporate governance, Data Analytics, Competitive advantage, Complexity, Decision-making, Digital transformation, Digitalisation, ERP systems, ERP implementation, ERP postimplementation, Financial performance, Firm performance, Industry 4.0, Information systems, Innovation, Integration, Lifecycle, Management accounting, Management control, Optimisation, Project, Quality, Satisfaction, Transformation
Cluster 4	Academic performance, Accountants, Accounting education, Active learning, Attitudes, Autonomy, Challenge, Collaboration, Communication skills, Competence, Computational thinking, Critical thinking, Digital skills, Education, Educational technology, Emotional intelligence, Employability skills, Engagement, Ethics, Experiential learning, Higher education, Motivation, Professional development, Professional skills, Self-determination, Soft skills, Thinking, University students
Cluster 5	Abilities, Academic achievement, Attentional control, Awareness, Comprehension, Executive function, Gender differences, Language development, Language impairment, Language proficiency, Language skills, Literacy skills, Mathematical skills, Process, Spatial skills, Vocabulary development, Vocabulary knowledge
Cluster 6	Accountability, Advantage, Automation, Cognitive skills, Economic growth, Employment, Flexibility, Growth, Inequality, Investment, Job satisfaction, Labour-market, Non-cognitive skills, Persistence, Personality, Productivity, Technological-change
Cluster 7	Balance, Climate change, Error, Forecasting, Improvement, Intensity, Resolution, Predictability, Variability

Source: author's contribution.

Most keywords refer to the critical thinking, analytical and digital skills, cognitive and noncognitive skills, and communication skills that accounting professionals should develop.

For the first research question “*What skills should future accounting professionals possess?*”, the author has identified in literature review the following skills that future accounting professionals should possess, which are presented in Figure 3.

Figure 3. Skills required to be possessed by future accounting professionals



Source: Goncalves et al. (2022).

These skills identified in the article of Goncalves et al. (2022) were confirmed by the bibliometric analysis performed by the author. Skills such as critical thinking, attention to details, communication and the language used, flexibility, the complexity of problems that can be solved with the help of ERP systems, as well as the influence of ERP systems on the decision-making process were identified in the bibliometric analysis carried out by the author.

For the second research question “*What other skills should future accounting professionals develop in the digital age?*”, the author has identified in literature review the following skills they should develop presented in Table 2.

Table 2. Skills that accounting professionals should develop

Technical Skills / Hard Skills		Social Skills	
Understanding the capabilities of the software	Basics of coding	Strong communication	Emotional intelligence ethical
Analysis skills	Fintech software knowledge	Conflict solving	Adaptability, tolerant of uncertainty
Data visualisation	Data security, forensic tools	Leadership skills	Sales knowledge
Knowledge of International Standard	Data warehouse management	Risk management	Innovative/Creative
Knowledge of industry-specific regulations	Enterprise resource planning (ERP) experience	Strategic decision making	Customer service orientation

Source: Goncalves et al. (2022).

6. Conclusions

The implementation of ERP systems within organisations has revolutionised accounting activities, leading accountants to develop a complex set of professional skills in order to adapt to the digital age. In line with literature review, the future of the accounting profession in the digital era is shaped by various factors, such as software skills, technical skills, and adaptability. Technical skills hold the mission of assuring the meaningfulness of comprehending software functionality, data structures, and financial reporting competences. Software skills involve critical thinking, communication, and problem-solving abilities, and permit the analysis and interpretation of information processed with ERP systems in an easier manner by accountants. Adaptability refers to the need for accounting professionals to be open towards change and to have a forward-looking attitude in acquiring novel features and functionalities of ERP systems.

The study carried out in the article demonstrated that future accounting professionals must focus a lot on increasing digital, communication, and language, social skills, developing attention to details, and improving performance.

Thus, ERP systems are intended to help accountants to ensure the improvement of professional quality, the efficiency of the activity, as well as the growth and success of the organisation.

Limitations: The limitation of the article was the small number of research questions that could be formulated based on the theme of the article.

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**SMEs Representatives' Perceptions of Corporate
Governance-Performance Relationship. Evidence
from an Emerging Economy**

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Abstract

Considering the new European and international sustainability frameworks and standards, along with the legal requirements and social expectations of the national government, SMEs are under pressure to adopt enhanced corporate governance policies and practices, facilitating the shift to a sustainable economy. Hence, the main purpose of this study is to identify and debate the SME's representatives' perceptions regarding the corporate governance – performance relationship, examining the relevance of adopting and applying specific management responsibilities for the present and future entrepreneurial pursuits. Approached as quantitative research, a questionnaire is addressed to management, operational personnel, and private investors. A total of 130 questionnaires are analysed to test the research hypotheses, through descriptive and frequency statistics, correlation matrix, and linear regression analysis. The main findings indicate that SMEs' representatives do not disregard the necessity of forming a Supervisory Board, considering the requirement related to Board members' independence as being extremely important. Furthermore, a clear separation of duties between Board and executive management, together with a significant percentage of Board members' competence, knowledge, and experience, and Board gender diversity are recognised as opportunities to strengthen the businesses' performance. The findings imply that improvement of corporate governance policies and practices offers new knowledge to SMEs in an emerging country. Consequently, this study may represent a valuable resource in developing strategies and policies for sustainable economy and business environment, for government and investors, equally.

Keywords: corporate governance, performance, SMEs, emerging economy, management responsibilities.

JEL Classification: G34, M41.

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1. Introduction

According to Jiang et al. (2023), the expansion of the global socio-economic system is directly and positively impacted by small and medium-sized enterprises (SMEs). Regarding the implementation of sustainable business practices, SMEs usually face a variety of challenges. Among these challenges may be counted a lack of capital, deficiency of technical expertise, and limited access to global markets and entrepreneurial information. Having regard to those considerations, this study's objective consists in examine how SMEs representatives perceive the connection between corporate governance and performance.

In the light of government's legal requirements and social expectations, corporate governance mechanisms stand out as a key element for a clearer understanding of SMEs long-term development horizons (Nasrallah & El Khoury, 2021). In this research, the attention is drawn to how corporate governance practices influence the performance of SMEs. Based on the findings, there several recommendations are formulated for SMEs' representatives, to focus on developing strategies and policies for the integration in a sustainable business environment. Thus, corporate governance mechanisms may lead to Romanian SMEs notoriety and their activity development in a resilient background.

This paper performs research based on a quantitative analysis, using questionnaire as the main research method, in the sample being included Romanian SMEs' representatives who achieve their business goals in a dynamic economic environment. All respondents have extensive professional expertise, carrying out activities in financial business fields, such as Accounting, Audit, Tax advisory, Payroll. According to the results, Romanian SMEs may promote corporate governance practices as well as corporate social responsibility, contributing to a more resilient and sustainable socioeconomic development.

This study is structured as follows: Section 2 covers the problem statement, standing out through a review of scientifically recognised publications regarding the studied topic, while Section 3 is an extended presentation of the research aim, including hypothesis development. Section 4 presents the research methodology and Section 5 summarises the results. Section 6 is intended for conclusions.

2. Literature Review

In the last few years, globalisation has brought about paradigmatic shifts that have had a significant impact on the nature of competition faced by businesses, as well as their performance. These shifts include international conflicts, a worsening of the world health crisis, and a greater emphasis on digitalisation. A high level of competition in the business environment represents a threat for companies, especially for small and medium-sized enterprises (SMEs), due to their limited resources from a managerial and financial viewpoint. Hence, it is crucial for SMEs to strategically develop their competencies to manage entrepreneurial changes and focus on new horizons for sustainable business opportunities (Adomako et al., 2022; Nasrallah & El Khoury, 2021; Sarango-Lalangui et al., 2023).

In the entrepreneurial background, corporate governance is understood as a challenge, especially in the light of agency theory, because of the connections established between owners and managers, which give rise to the agency problems. However, it is highlighted that SMEs should be concerned about corporate governance mechanisms, even if it is considered that these enterprises do not face agency problems, because they do not rely on the resources at the macroeconomic level (Wen et al., 2023; Adrian & Wright, 2018).

In Romania, regulations addressed to SMEs are stipulated in Law no. 346 (Romanian Parliament, 2004), while corporate governance policies and practices are covered in the Corporate Governance Code issued by the Bucharest Stock Exchange, applied for companies that are listed on the capital market (Bucharest Stock Exchange, 2015). Consequently, this study is approached to fill the gap in the corporate governance and SMEs literature, given the circumstances of the necessity for corporate governance regulations designed in accordance with SMEs' specifics.

According to Wen et al. (2023), there is a real push for corporate governance codes to be fully implemented, particularly for SMEs. This is primarily due to the fact that effective corporate governance may boost the SMEs' sector by introducing tighter internal controls, improved operational procedures, and more opportunities for international expansion. Similar persuasions are suggested by Issa and Abbaszadeh (2023). The authors highlight that corporate governance has a key role in protecting shareholders as well as maximising their long-term value creation.

This research is performed in line with prior literature (Di Bella & Al-Fayoumi, 2015; Jiang et al., 2023; Nasrallah & El Khoury, 2021; Xiao & Shailer, 2022) that approach the topic of corporate governance and corporate social responsibility in the light of sustainable development, using questionnaires to collect the data and quantitative methods for analysis.

Permatasari and Gunawan (2023) draw attention to sustainability policies for SMEs, underlying the significance of establishing laws and regulations that promote corporate social responsibility in SMEs to achieve sustainable development goals. Nasrallah and El Khoury (2021) examine corporate governance as a predictor of SMEs' financial performance. The authors analyse developing countries and show that an improvement in corporate governance practices determines an increase in financial performance.

Furthermore, a considerable interest in scientific literature is for the banking industry. For example, Issa and Abbaszadeh (2023) find that corporate governance positively influences the banks' agility and their reaction to the dynamic business environment. El Sayad and Diab (2022) present that banks may focus on employees' experience and CSR training programmes, while Di Bella and Al-Fayoumi (2015) emphasise that stakeholders have a positive attitude regarding corporate social responsibility.

The originality of this analysis is ensured by focusing on Romania, an emerging economy where there is a lack of corporate governance regulations stipulated for SMEs. Thus, this research may consist of a basis for comparison both with other emerging and developed countries.

3. Research Hypothesis

This study aims to examine the influence exerted by management responsibilities on SMEs' performance, debated in the light of Romanian SMEs representatives' perceptions. Management responsibilities are understood as an integrated part of corporate governance mechanisms. Hence, this study seeks to provide insights related to how the corporate governance-performance relationship is perceived by SMEs' business environment in an emerging economy, considering the managerial duties. The research perspectives may be a complementary element in the previous literature, a body of knowledge in the relationship between corporate governance and performance reflected based on entrepreneurial representatives' perceptions.

The scientific literature (Nasrallah & El Khoury, 2021; Sarango-Lalangui et al., 2023) covers key characteristics of SMEs in the background of sustainable development and corporate governance implications, with insights regarding socioeconomic patterns. Prior studies highlight the need for research to consider the perspectives of SMEs' representatives to improve strategic agility and performance (Adomako et al., 2022), emphasising the mechanisms such as Board of directors, disclosure and transparency (Wen et al., 2023) as performance determinants. Consequently, the research hypothesis is developed as follows: *RH1. SMEs representatives' perceptions of the relationship between corporate governance and performance are positively and significantly influenced by management responsibilities.*

The results contribute to the scientific literature by providing sustainable entrepreneurial development with relevant information about SMEs representatives' perceptions of how corporate governance practices influence the organisational aspects in this specific cluster of companies.

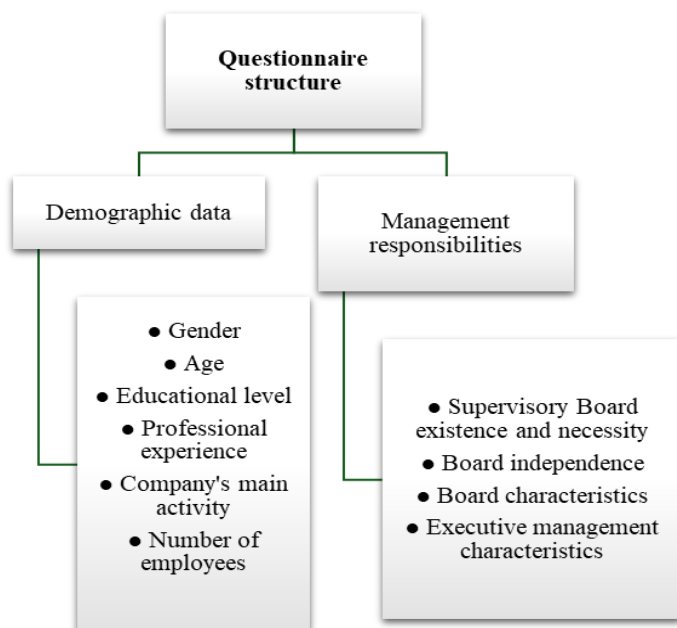
4. Research Methods

4.1 Data Collection

The primary data for this study are gathered based on a questionnaire and the validity of the research hypothesis is established through a quantitative approach. The questionnaire is a suitable and reliable method, which allows to investigate behavioural patterns from many respondents who have similar interests and viewpoints regarding a business activity (Caraiani et al., 2023; Issa & Abbaszadeh, 2023; Wen et al., 2023).

Figure 1 presents the questionnaire summary, involving several defining elements for questionnaire design, participants' characteristics, together with the main sections covering questions addressed. In order to draw a valid overview of the findings, *the first section* includes profile information from respondents, while a synopsis of management responsibilities' information is provided in *the second section*.

Figure 1. Questionnaire structure as a basis for the conceptual model



Source: authors' own research adapted from Caraiani et al. (2023) and Xiao and Shailer (2022).

The data were collected in the time frame between February and March 2024. The questionnaire has been designed in a digital form and then sent to respondents by e-mail. The sample consists of management, operational personnel, and private investors, with an extensive experience in business management, Accounting, Audit, or Tax advisory services, most of them being part of professional organisations, such as The Chamber of Tax Consultants from Romania and The Body of Expert and Licenced Accountants of Romania.

4.2 Research Variables and Regression Analysis

Table 1 summarises the variables included in the statistical analysis, complemented with a description and measurement of each variable. The dependent variable is SMEs' performance (SMES_PERF), constructed based on the impact exerted by financial and corporate governance specifics in SMEs' performance, such as the transparency in financial statements and information disclosure, executive management skills and experience, independent Board members, the policies related to forecasts, dividend, corporate governance and corporate social responsibility, risk management, internal control, audit committee. The respondents rated characteristics on a 5 Likert scale (1 = not at all important; 5 = extremely important), and then the average value for the variable measurement is computed.

Table 1. Variables used for testing the research hypothesis

Variables	Description	Measurement
<i>Dependent</i>		
SMES_PERF	SMESs' performance rated based on corporate governance and financial performance characteristics	Average value based on 5 Likert scale
<i>Independents</i>		
BOARD_EXISTENCE	Supervisory Board existence in SMEs	2 - Yes 1 - No 0 – I do not know
BOARD_NECESSITY	Board necessity in SMEs	5 Likert scale
BOARD_INDEPENDENCE	Board independence in SMEs	5 Likert scale
BOARD_CHARACTERISTICS	Board characteristics rated on 5 Likert scale	Average value based on 5 Likert scale
EXEC_CHARACTERISTICS	Executive management characteristics rated on 5 Likert scale	Average value based on 5 Likert scale

Source: authors' own research adapted from Caraiani et al. (2023).

The independent variables in Table 1 cover an in-depth view of management responsibilities, representing corporate governance mechanisms, measured both by 5 Likert scale average values, and through a dummy variable. For example, in the independent variables' list are included the existence (BOARD_EXISTENCE) and necessity (BOARD_NECESSITY) of the Board. Furthermore, perceptions related to Board independence (BOARD_INDEPENDENCE) in Romanian SMEs are considered. Likewise, there are rated several Board characteristics (BOARD_CHARACTERISTICS), such as clear separation of duties between the Board and executive management, gender diversity, independence of nonexecutive Board members, Board members' competence, knowledge, and experience. Moreover, there are highlighted the executive management characteristics (EXEC_CHARACTERISTICS), including effective decisions, knowledge, and experience, setting up business plans and policies, executive management motivation based on performance indicators, and decision-making transparency. The selection of variables is in line with prior studies conducted by Issa and Abbaszadeh (2023), Wen et al. (2023), Xiao and Shailer (2022), and Nasrallah and El Khoury (2021).

Regression analysis is performed to determine the corporate governance-performance relationship in the SMEs representatives' accepted meaning. Hence, the following linear regression equation is used to test the research hypothesis:

$$SMES_PERF_i = \alpha_0 + \alpha_1 * BOARD_EXISTENCE_i + \alpha_2 * BOARD_NECESSITY_i + \alpha_3 * BOARD_INDEPENDENCE_i + \alpha_4 * BOARD_CHARACTERISTICS_i + \alpha_5 * EXEC_CHARACTERISTICS_i + \epsilon_i, \quad (1)$$

where SMES_PERF_i represents the SMEs' performance, measured by financial and corporate governance characteristics, α₀ is the constant, α₁ to α₅ are coefficients associated with management responsibilities, while ε_i is the error term.

5. Findings

5.1 Descriptive Statistics

Respondents appear to be generally well distributed by demographical data. The summary of results shows that more than 60% of the respondents are women. Furthermore, the dominating age rank is between 40 and 49 years old, respondents having more than 20 years of professional experience. Likewise, more than 80% of the companies carry out activities in services field, providing Accounting, Auditing, or Tax advisory services and have less than 9 employees, being included in the microenterprises category, according to the Law no. 346 (Romanian Parliament, 2004). Table 2 presents descriptive statistics.

Table 2. Descriptive statistics

Variables	Mean	Std. Dev.	Min.	Max.	Med.	Skewness	Kurtosis
SMES PERF	3.81	0.90	1.00	5.00	3.86	-0.64	0.24
BOARD EXISTENCE	0.82	0.98	0.00	2.00	0.00	0.36	-1.89
BOARD NECESSITY	3.07	1.38	1.00	5.00	3.00	-0.09	-1.18
BOARD INDEPENDENCE	3.79	1.21	1.00	5.00	4.00	-0.83	-0.15
BOARD CHARACTERISTICS	3.79	1.01	1.00	5.00	4.00	-1.15	1.26
EXEC CHARACTERISTICS	4.38	0.62	1.00	5.00	4.44	-1.94	6.53

Source: authors' own research.

The overall top characteristics rated by respondents pertain, first, to executive management (mean 4.38), where knowledge and experience, effective decisions in managing activities, transparency in decision making, assistance provided to staff members in carrying out their duties, designing corporate governance guidelines, and ensuring their successful implementation within the company could be mentioned. Second, respondents draw attention to Board independence (mean 3.79) and the snapshot of Board characteristics, including gender diversity (mean 3.79). Likewise, respondents recognise Board necessity in Romanian SMEs.

Similarly to Wen et al. (2023), to evaluate univariate analysis, Skewness and Kurtosis indices are used. The indices' results were both within the advised ranges between -3.00 and 3.00 (for Skewness) and between -8.00 and 8.00 (for Kurtosis), respectively.

5.2 Reliability and Correlation Analysis

In line with Issa and Abbaszadeh (2023) and Wen et al. (2023), Cronbach's Alpha is used to measure the reliability of the constructs. The results of the tests performed, as shown in Table 3, emphasise that Alpha values are satisfactorily over the minimal cutoff of 0.70, indicating the internal consistency of scales employed to measure the constructs. Given the Cronbach's Alpha estimate of 0.748 to 0.951, it is considered that the questionnaire in this research has a suitable internal structure.

Table 3. The reliability and validity of research findings

Cronbach's Alpha	Cronbach's Alpha Based on Standardised Items	N of items
0.794	0.800	6

Source: authors' own research.

The correlation between the variables is measured using the Pearson coefficient. The bivariate correlation analysis is shown in Table 4. In accordance with Wen et al. (2023), the findings demonstrate that multicollinearity is minimised because the links between independent variables do not exceed the 0.8 threshold.

Table 4. Bivariate correlation analysis

	1	2	3	4	5	6
SMES PERF	1	0.326***	0.582***	0.550***	0.668***	0.465***
BOARD EXISTENCE	0.326***	1	0.568**	0.126	0.173**	0.115
BOARD NECESSITY	0.582***	0.568***	1	0.400***	0.462***	0.280***
BOARD INDEPENDENCE	0.550***	0.126	0.400***	1	0.623***	0.249***
BOARD CHARACTERISTICS	0.668***	0.173**	0.462***	0.623***	1	0.418***
EXEC CHARACTERISTICS	0.645***	0.115	0.280***	0.249***	0.418***	1

Note: *** p<0.01, ** p<0.05.

Source: authors' own research.

5.3 Regression Analysis

Regression estimation is performed to test the research hypothesis, the results being summarised in Table 5. Linear regression analysis highlights that there is a positive and significant association between corporate governance variables reflecting management responsibilities, excepting for Board existence. For instance, the coefficient for BOARD_NECESSITY is 0.252, with a p-value of 0.002, indicating a positive and significant impact of Board necessity on the Romanian SMEs' performance. Similarly, the coefficient for BOARD_INDEPENDENCE suggests a positive association between independent members in the Board and performance.

Similarly to Pongelli et al. (2023), potential multicollinearity is checked by calculating Variance Inflation Factors (VIFs), whose values are between 1.227 and 1.983. All VIFs are below the generally advised cutoff of 5, indicating that multicollinearity is not a significant issue in this research.

Table 5. Linear regression analysis

Independent variables	Dependent variable: SMES PERF	VIF
BOARD EXISTENCE	0.078 (0.268)	1.508
BOARD NECESSITY	0.252*** (0.002)	1.927
BOARD INDEPENDENCE	0.173** (0.022)	1.692
BOARD CHARACTERISTICS	0.348*** (0.000)	1.983
EXEC CHARACTERISTICS	0.197*** (0.002)	1.227
Observations	130	
R-Squared	0.592	
F-stat (Sig.)	35.969***	
Durbin-Watson	1.891	

Note: *** p<0.01, ** p<0.05

Source: authors' own research.

Moreover, BOARD_CHARACTERISTICS are positively related to SMEs' performance, at the 1% level of significance. These results suggest that SMEs' may be focused on a clear separation of duties between the Board and the executive management, the Board gender diversity, knowledge, and independence of nonexecutive Board members, together with Board experience, to achieve performance. These findings are in line with Pongelli et al. (2023) and Wen et al. (2023). Likewise, Romanian SMEs' representatives may be aware of executive management key characteristics (EXEC_CHARACTERISTICS). The positive, but not statistically significant influence exerted by BOARD_EXISTENCE may be attributed to the fact that 58.5% of the SMEs in the sample have no established Boards in their internal structures.

6. Conclusions

This paper examines the impact of corporate governance mechanisms on the SMEs' performance in an emerging country. The primary data are gathered based on questionnaires addressed to the representatives of SMEs. Using descriptive analysis and econometric estimation, it is documented that corporate governance practices have a positive relationship with performance in Romanian business environment.

The study has several implications for management, policymakers, and researchers. First, the findings summary implies that the performance achievement of Romanian SMEs is supported by considering the development of comprehensive corporate governance guidelines specially addressed to these companies. SMEs should focus on establishing a Board of directors including independent members, gender diversity, and Board professional experience. The support of prior literature (Nasrallah & El Khoury, 2021; Wen et al., 2023) is given to these considerations.

Second, respondents' perceptions suggest that corporate governance specifics such as transparency in decision-making processes, setting up business policies, together with effective decisions, play a key role in SMEs from an emerging economy. Thus, the debated findings conduct to research hypothesis validation.

The limitations of this study may be related to having a small sample of respondents and a short frame time. Likewise, this research includes a small number of questions. Therefore, research perspectives may be extended with a larger sample size and a broader range of questions to guide future approaches on different corporate governance specifics, such as audit, internal control, and connection with stakeholders.

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**SDG Reporting in a Romanian Listed Company
in Crisis Period**

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Abstract

A big challenge for companies is identifying the best sustainable practices and implementing them in their corporate strategy, ensuring their alignment with the UN Sustainable Development Goals. The purpose of this study is to identify companies' sustainable performance from the perspective of SDG reporting. This research aims to analyse the reported information about the SDGs adopted and implemented by a company listed on the Bucharest Stock Exchange. This article employs the case study as a research methodology to analyse the sustainability reports containing SDGs information presented by OMV Petrom Group Romania in the multiple crisis period (2020-2022). Along with the obligation to present information on sustainability, the sustainability reports submitted by OMV Petrom Group contain relevant information about the SDGs met by the group, but also about the company's impact on environmental, social and governance factors during the crisis. OMV Petrom Group Romania is among the few companies in Romania that have reported information on sustainability since 2011. The originality of the study is reflected in the completion of the specialised literature with relevant information on the sustainability practices carried out and adopted by a well-known company in Romania.

Keywords: SDG, sustainability, ESG, crisis, Romania.

JEL Classification: M41, Q56, H12.

1. Introduction

Organisations undergo difficulties when balancing resource consumption and economic progress, this process determining the integration of green business practices with the intention to alleviate the economic, social, and environmental standing. Increased pollution and resource exhaustion pressure stakeholders to adopt

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sustainable practices, improve operational efficiency, and strengthen competitive advantage (Mousa & Othman, 2019).

Due to recent multiple crises (health-war-climate changes), authorities and specialised organisations came to the aid of companies, with regulations and standards to be achieved, such as the UN Sustainable Development Goals 2030 Agenda. Meeting these criteria represented a challenge for the corporate world but were considered to bring economic benefits and advantages (Pucker, 2021; Voss, 2019).

This study fills a research gap by analysing the sustainability pillars (environmental, social, and governance), focusing on the social pillar, which is most affected during crisis periods. Cachon-Rodriguez et al. (2022) discovered that social initiatives in organisations lead to increased employee engagement, ultimately reducing the negative impact of crises.

This research analyses a company's sustainable performance through the perspective of SDG reporting in a multiple crisis period. A research question is established to perform a case study analysis on the information provided by a Romanian listed company. Therefore, the overall scope is to find *which SDG criteria were fulfilled during the crisis period by a Romanian company listed on the Bucharest Stock Exchange?*

The study is structured as follows: the first part of the research presents the theoretical framework and the research question; the second part emphasises the methodology used for analysing the sustainable performance of the Romanian listed company, while the last part of the research focuses on presenting the results of the sustainability reports disclosed by OMV Petrom Group during the crisis period.

2. Theoretical Framework and Research Question

The equilibrium between resource use and economic development represents a challenge for companies to adopt sustainable green practices within their daily activities (Mousa & Othman, 2019). In addition to achieving these objectives, there are other problems such as health crises (such as SARS-CoV-2), conflicts between states (such as the war between Russia and Ukraine, but also the conflicts in the Middle East), as well as the most visible climate changes, which companies face to ensure their continuity (Margherita & Heikkila, 2021; Sahebjamnia et al., 2018). Climate change might be the most dangerous crisis that affects all communities and ecosystems around the world. For example, in Romania, climate change is one cause of economic damages and number of deaths, but also floods, droughts, and excessive temperatures (Benedek et al., 2021).

Authorities and specialised organisations support companies by promoting sustainable practices to avoid crises and improve economic performance and profitability, ensuring that regulations and standards are met. Sustainable practices enhance a company's economic performance and profitability, as they align with sustainable development goals. However, identifying best practices and incorporating them into a company's strategy remains a challenge, as noted by Amrutha and Geetha (2019), Pucker (2021), and Voss (2019).

The theoretical framework of this paper is supported by the *Stakeholder Theory* (ST), which is a theory of business ethics and organisational management, where organisations aim to generate sustainable benefits for various stakeholders. ST encourages organisations to recognise and manage stakeholder needs, promoting a sustainability framework that goes beyond a sole focus on shareholders, thus enabling organisations to be strategic and maximise their long-term success (Mahajan et al., 2023).

The Sustainable Development Goals (SDGs) were embraced in 2015 by the member states of the UN through the 2030 Agenda. The agenda contains information pertaining to 17 SDGs and 168 connected targets. In line with the Department of Economic and Social Affairs' Sustainable Development Report, the number of mentioned goals is of 17. Each of the 17 goals promotes the a world where there is: no poverty, zero hunger, good health and wellbeing, quality education, gender equality, clean water and sanitation, affordable and clean energy, decent work and economic growth, industry, innovation and infrastructure, reduced inequalities, sustainable communities and cities, responsible production and consumption, climate action, life below water, life on land, peace, justice and strong institutions, partnership for the goals (United Nations, 2023). SDGs are divided into 3 categories that deal with topics that are aimed at improving the economic, social, and environmental aspects. However, companies tend to present sustainability information with a specific interest in the environmental, social, and governance aspects (Saetra, 2021).

Environmental issues are now at the centre of attention for organisations, as well as social issues involving communities and governments, with increasing corporate governance responsibility for environmental impact, focusing on sustainable resource use and responsible waste management. Awareness of these issues has led organisations to adopt environmental and sustainable management practices that could be implemented with the help of human resource management and corporate governance (Khan & Muktar, 2023). The essential role of human resources for organisations has been following an augmenting trend, as a result of the persistent concern for sustainability and corporate social responsibility. Their impact is a high one in matters linked to the financial, legal, and clean production domains, mostly in the environmental impact circumstances. Human resources constitute the knowledge basis of an organisation, thus the loss of meaningful human capital is detrimental to the organisational performance. Given these facts, the performance of investments in their further growth is a vital activity (Amrutha & Geetha, 2019).

Corporate governance is essential for sustainability, integrating leadership systems, controls, shareholder relationships, and executive connections within a company, and encompassing information concerning leadership, controls, and executive relationships (Constantinescu et al., 2021). A diverse board of directors can provide comprehensive perspectives and influence, enabling a company to perform effectively by appointing the best managers (Huang et al., 2023). Companies require the skills and innovative measures and policies taken by managers to approach sustainability goals. According to Albu and Mateescu (2014), corporate governance refers to the managers appointed by the company's

shareholders to run their business on their behalf and delegate decision making to it. This is usually referred to agency theory commonly adopted by the companies. The best management decisions of a company are highly correlated with management and influence the company's operational performance (Huang et al., 2023).

In the light of the recent numerous crises and new sustainable development goals to be achieved by companies, this study intends to analyse and understand *which SDGs criteria were fulfilled during the crisis period by a Romanian company listed on the Bucharest Stock Exchange?*

3. Research Methodology

To investigate the research question, case analysis is used, through published sustainability reports, which is a detailed method of researching a single example. This approach contributes to obtaining relevant knowledge through in-depth observation and understanding of specific situations. However, criticisms of case analyses highlight the inability to develop theories based on a single study (Widdowson, 2011). Case analysis involves an empirical investigation that examines a particular issue using multiple sources. Such studies are valuable when there is a need to clarify a problem or situation by analysing available information. Sustainability reports are essential for Romanian companies but lack specific legislation. European directives may affect some companies, depending on size and impact. Companies voluntarily producing such reports reflect their commitment to social responsibility and stakeholder expectations. The quality and content of these reports influence investors' decisions and build brand reputation (Hronova & Spacek, 2021).

The aim of this study is to develop a deeper understanding of the factors that encourage compliance with sustainable practices. To do this, we examined the website of a Romanian company listed on the Bucharest Stock Exchange that has issued sustainability reports and included information related to the Sustainable Development Goals (SDGs). All data used in this study were manually collected from OMV Petrom's sustainability reports for the period 2020-2022. OMV Petrom is a company with three interconnected divisions that ensure financial stability through its integrated business model, allowing it to moderate oil and gas price fluctuations.

In order to obtain a better understanding of the information presented in the group's sustainability reports, the study considers SDGs divided into three different pillars than those exposed in the 2030 Agenda. Some research (Kostoska & Kocarev, 2019) focuses on the three dimensions of sustainability, economic, environmental, and social; the article following Saetra (2021) focuses in particular on assessing and presenting sustainable development goals on the three aspects of ESG (environmental, social, and governance). Evaluating companies' sustainability and social responsibility is crucial, and one method for this evaluation is the use of ESG criteria (Petrica et al., 2024). Figure 1 provides a graphical representation of how the SDGs are divided into ESGs.

**Figure 1. The 17 SDGs grouped into three pillars:
environmental, social, governance**



Source: Sactra, 2021, p. 4.

4. Findings & Discussion

OMV Petrom is the main operator in the energy sector in the South-East Europe region, with extensive involvement in the entire network of energy activities. It is involved in the exploration and extraction of hydrocarbons, continuing through the refining process to the fuel distribution stage. In addition, the company engages in power generation and in the marketing of natural gas and electricity (OMV Petrom, 2022b). In 2020 the topic of sustainable global development goals starts to be discussed in more detail in the Sustainability Report (OMV Petrom, 2020). OMV Petrom is among the few Romanian companies that manages to develop and implement a coherent and well-articulated social responsibility strategy, having a positive impact on the sustainable development of the Romanian society (Dura & Dobre Baron, 2015).

Firstly, the goals associated with the Environmental Pillar information are presented in chapter of the Sustainability Report on Health, Safety, Security, and Environment (HSSE) and it covers themes such as biodiversity protection, waste management, water performance, and water risk assessment. During 2020 the group reviewed the risks associated with environmental harassment and implemented risk reduction measures through which SDG9, SDG12, and SDG13 have been accomplished. In the Carbon Efficiency-Climate Change and Energy Transition-Customer, and in the Product Responsibility chapter, OMV Petrom Group accomplished SDG 3 (through the 3.7. and 3.9 targets), SDG12 (through the 12.2. and 12.4. targets) and SDG13 (through the 13.1 target). The group aims to reduce carbon intensity by 27% by 2025, achieving a 26% reduction in 2020, focusing on climate change mitigation.

Secondly, the 11 targets associated with the social pillar are also found in the chapters of the Sustainability Report on HSSE mentioning that the targets supported in 2020 are SDG3 supported by target 3.4, 3.6, 3.8 and 3.9, SDG6 through targets 6.3, 6.4, SDG8 through target 8.8 and SDG12 through targets 12.4 and 12.5 specifying that the main priority in all activities is HSSE (OMV Petrom, 2020). Another chapter that includes sustainable objectives belonging to the social pillar is Circular Economy and Innovation, including SDG3 being supported by target 3.9,

SDG9 by target 9.4 and SDG12 by target 12.5. The chapter on Employees contains five SDGs, SDG3 detailed through target 3.2, SDG4 through targets 4.4 and 4.5, SDG5 through targets 5.1 and 5.5, SDG8 through targets 8.5, 8.6 and 8.8 and SDG10 through targets 10.2 and 10.3. The chapter on Business Principles and Social Responsibility is subdivided into three sub-chapters such as Community Relations and Human Rights, Business Ethics and Supply Chain where SDG1 targets supported by target 1 are included. SDG3 through the targets 3.7 and 3.8, SDG4 through the target 4.7, SDG5 through the targets 5.2 and 5.4, SDG8 through the targets 8.5, 8.6, 8.7 and 8.8, SDG10 through the target 10.3, SDG16 through the targets 16.1, 16.3 and 16.5.















In detail, the social pillar of the Sustainability Report (OMV Petrom, 2020) focuses on age, nationality, and gender diversity, training programmes, employee information and communication, performance management, compensation management, workplace flexibility, family-related rights: time off and financial support. Thus, the SDGs supported this year translate into sustainability targets for 2025, these being “increasing the percentage of women in leadership positions to 30% by 2025, growing the next generation of talent through recent graduates, measuring, and increasing the level of engagement of our employees” (OMV Petrom, 2020, p. 101).

Third, the governance pillar is developed as well through the Business Principles and Social Responsibility chapter of the 2020 Sustainability Report. The main goals to be achieved by the group until 2025 are aimed at maintaining the social licence to operate through Community Development, strategies, plans, and targets, as well as budgets based on social impact needs and risk assessment. In 2020, the group was involved in projects that supported the medical system during the pandemic period. SDG3 and SDG4 in the supply chain chapter information about supplier audits covering sustainability topics are estimated to be performed until 2025, and until 2020 only 12 audits were performed. The OMV Petrom Group performs annual audits to understand the safety, the quality, and the efficiency of its processes. They also established tools which evaluate the impact of SARS-CoV-2 impact on its suppliers. Based on the score obtained by each supplier, the group has established mitigation measures to ensure that no interruptions will affect the business continuity. Therefore, SDG12, SDG16, and SDG17 have been met during this period.

The 2020 goals are focused on the social pillar, meaning that once with the SARS-CoV-2 pandemic, OMV implemented measures to protect the group’s society by implementing practices such as communication and workplace flexibility. Those practices are in line with the findings of the study of Bratu and Cunea (2023) on the sustainable practices to prevent crisis periods in Romanian companies.

The Sustainability Report for 2021 and 2022 presents the same information on sustainable targets as in 2020 but it comes with major improvements in the details of the targets compared to the previous year. Thus, they also present the proposed targets and are grouped by ESG (Environmental, Social, Governance). Figure 2 shows the sustainable global development objectives of OMV Petrom.

Figure 2. OMV Petrom Group Sustainability Report 2022

Sustainability Framework	Material topics categories	SDGs	ESG Topic
Transition to low carbon business	Climate change and Energy transition	    	Environment
	Health, Safety and Security	   	Social
Run Responsible operations	Environment	  	Environment
	Business Principles & Economic Impacts	  	Governance
Foster People & Communities	Supply chain	   	Social
	Employees	  	Social
	Community Relations	  	Social
Leverage Innovation & Digitalization	Human Rights	  	Environment
	Circular economy and Innovation	  	Social

Source: OMV Petrom, 2022a, p. 16.

The group approach to Environmental Protection contributes to the following UN Sustainable Development Goals: SDG3 (through target 3.9), SDG12 (through target 12.4), and SDG15 (through target 15.5). In 2022, the same goals as in 2021 are achieved through the SDGs of the environmental pillar. However, an interesting fact is represented by the conflict between Russia and Ukraine, which is exposed as an issue for the company's energy supply. In this regard, the group's main goal was to identify sustainable projects from the energy sector that are aimed at achieving the decarbonisation goal (OMV Petrom, 2022a). The plans of implementing sustainable energy projects were observed before the conflict by Radu et al. (2021). They observed through the group's several SDGs disclosed in the Refinitiv Eikon database that its carbon efficiency plan considered optimisation processes and efficient energy measures from 2021. It was also noticeable that during 2021 and 2022, the SARS-CoV-2 pandemic was mentioned less once it was over, but climate change issues and conflicts between states are still affecting business continuity.

Regarding the social pillar, according to the Sustainability Reports (OMV Petrom, 2021, 2022a), the chapters addressing these SDGs are HSSE through SDG3 supported by targets 3.3 and 3.9 related to reducing the spread of contagious diseases, SDG8 including target 8.8 referring to the implementation of systems that guarantee the respect of rights and the promotion of a safe working environment for all team members, and SDG12 through target 12.4 referring to the sustainable management of natural resources. The OMV Petrom Sustainability Report highlights the company's commitment to achieving SDG1 through targets 1.4 on equal rights and SDG16 through strict zero tolerance policies for corruption. It also emphasises its commitment to SDG8 through targets 8.7 and 8.8, aiming to eliminate forced labour, end modern slavery, and promote safe working environments (OMV Petrom, 2021, p. 71). The Employees chapter mentions several SDGs accomplished: SDG3 through target 3.3 which refers to the fight against communicable diseases, SDG4

through targets 4.3, 4.4 and 4.5 through gender equality, SDG5 through target 5.1 which is related to the elimination of discrimination against women, SDG8 through targets 8.2 and 8.5 which refer to diversity, updating technologies, and stimulating innovation, ensuring a fair and equal working environment for all team members, and SDG10 through target 10.3 which refers to the elimination of all forms of discrimination (OMV Petrom, 2021). Five targets are specified in the Community Relations chapter. Thus, SDG1 is supported by target 1.4 through sets of protocols and internal rules for stakeholder engagement and measures applied, SDG3 through target 3.3 on caring for health in local communities, SDG4 through target 4.7 on actions related to education, environment, and vulnerable people, and SDG8 through targets 8.5 and 8.6 on actions related to communities and youth programmes. The Human Rights chapter contains 2 targets mentioning SDG4 on target 4.7 which relates to human rights and SDG8 through target 8.7 on ensuring full achievement of the UN sustainable development goal of eliminating all forms of child labour or forced labour (OMV Petrom, 2021).

According to Bancu and Dascalu (2024), companies report around 56% of the overall SDG scores in the European companies during 2019-2021 period. Political stability, absence of violence, terrorism, and regulatory quality of control of corruption significantly influence European companies in SDG reporting. However, during the multiple health-war-climate crisis, the companies tend to focus on the society's well-being. A summary of the SDGs met by the group during this period is presented in Table 2. The company has tried to comply with as many objectives as possible in order to be in line with the sustainability targets, and according to the information extracted from the sustainability reports analysed, OMV Petrom attaches particular importance to the social pillar objectives, being one of the companies with the most detailed information on this aspect in Romania. This result is in line with the findings of Radu et al. (2021) that observed that OMV Petrom Group has a significant contribution to the social pillar in the workforce and community dimensions.

Table 2. OMV Petrom's reported SDGs for the ESG pillars for the period 2020-2022

Company	OMV Petrom								
ESG Pillars	Environmental pillar			Social pillar			Governance pillar		
Years	2020	2021	2022	2020	2021	2022	2020	2021	2022
SDGs	SDG9 SDG12 SDG13	SDG3 SDG12 SDG15	SDG3 SDG12 SDG15	SDG3	SDG1	SDG1	SDG3 SDG4 SDG12 SDG16 SDG17	SDG1 SDG8 SDG16 SDG17	SDG1 SDG8 SDG16 SDG17
				SDG4	SDG3	SDG3			
				SDG5	SDG4	SDG4			
				SDG8	SDG5	SDG5			
				SDG9	SDG8	SDG8			
				SDG10	SDG10	SDG10			
				SDG12	SDG12	SDG12			
SDG16	SDG16	SDG16							

Source: authors' own research.

In the 2021 and 2022 Sustainability Reports, the governance pillar contains the same information on the Corporate Sustainability Governance chapter. Under the governance pillar, the Business Principles and Economic Impacts Chapter and Supply Chain Chapter are the focus of the group. SDG8 (through goals 8.7 and 8.8), SDG16 (through goal 16.5) and SDG17 (through goal 17.16) were accomplished and aimed at implementing sustainable business practices.

5. Conclusion

This study analysed the SDGs implemented and reported by OMV Petrom Group during multiple periods of health crisis, war, and climate change. The findings revealed that the most known oil and gas company listed in Romania made efforts to align its sustainability performance with the UN Sustainable Development Goals during the crisis periods. The Group's contributions in achieving the SDGs are seen in the environmental, social, and governance pillars. According to Firoiu et al. (2019), Romania falls behind other European nations in social services, social exclusion, and poverty prevention, even with the establishment or revision of legal norms in these sectors.

The environmental pillar goals met (SDG3, SDG9, SDG12, SDG13, SDG15) comprised information on how the group managed biodiversity protection, waste management, water performance, and water risk assessment. During the multiple health-war crisis, the focus on meeting the social pillar objectives was considerably increased. That was evident through the SDGs accomplished during the crisis period such as SDG3, SDG4, SDG5, SDG8, SDG9, SDG10, SDG12, and SDG16. The group achieved the UN SDGs, focusing on healthy lives, quality education, gender equality, decent work, reducing inequalities, and promoting peaceful societies. The governance pillar of the group contained valuable information about business boards and the supply chain. The tool developed by the sustainability department to evaluate the risks associated with business suppliers during crisis periods was an innovation in sustainable business practices. Therefore, SDGs 1, 2, 3, 8, 12 and 17 were mentioned as being accomplished during this period by the group.

The research is relevant to the Romanian listed companies and to other stakeholders interested in how sustainable practices and measures can be implemented through business activities. OMV Petrom Group is one of first Romanian companies to prepare a sustainability report since 2011. This study considered recent health-war-climate change crises. Therefore, this study is limited to the information presented according to the environmental, economic, and social pillars in the Sustainable Development Report, and to the study's focus only on the analysis disclosed by the group on SDGs. A deeper understanding of the performance reported about environmental, social and governance, as well as on the data presented by the group could be considered as a future study.

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Sustainability Performance Indicators and Firm Financial Performance in the Healthcare Sector during Crisis Period

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Abstract

Starting with the pandemic period, the healthcare sector was expected to consider measures aligned to the evolving needs of patients and communities. Healthcare providers were keen to adopt environmental and social strategies to overcome crises, but those were postponed due to multiple health-war-climate crises. The aim of this research is to observe whether sustainability performance is reported during crisis periods and its implication for sustainable performance and profitability of healthcare companies. To investigate the sustainability indicators reported by the healthcare sector and their implications during the crisis period towards companies' performance, a sample of 199 listed European companies was used to perform a quantitative analysis based on descriptive statistics of the mean, standard deviation, minimum, and maximum reported values. The data sample was collected from the Refinitiv Eikon database for the period 2020-2022. The sustainability performance indicators used in the analysis are ESG scores, ESG Controversies, Environmental Pillar Score, Social Pillar Score, Governance Pillar Score, CSR Sustainability Committee Score, Board Size and Board Gender Diversity Score, while for analysing the firm financial performance indicators, the study uses ROA, ROE, Assets Turnover, and Number of Employees. The results of the study reveal that European companies in the healthcare system took measures and reported sustainability along with firm financial performance during the crisis period. Descriptive statistics revealed that healthcare sector companies reported sustainability information in ESG reporting and ESG controversies without being involved in any controversies. The social pillar was the focus of the sector, as it was the most affected during this period. ROA and ROE recorded negative values, while Assets Turnover showed that healthcare sector companies effectively used their assets to generate sales during crisis periods. The novelty of the study is reflected in the analysis of sustainability and financial performance indicators reported by European listed companies in crisis periods.

Keywords: sustainability performance indicators, firm financial performance indicators, healthcare sector, crisis period.

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1. Introduction

During multiple crises, the healthcare industry faced challenges such as increased workload, hygiene measures, war, and climate changes. To overcome these challenges, special strategies were implemented, considering patients and community needs, as well as environmental and societal concerns. Countries with developed healthcare systems are prepared to combat pandemic crises. Sustainable practices in the healthcare sector, such as ESG reporting and Corporate Sustainability Reporting (CSR), are beneficial, but a burden for decision makers. Without any kind of engagement with its surroundings, no business can function in a vacuum or as a closed system. The business sector becomes more complicated and labour-intensive as corporations strive to outperform their rivals; this has an impact on society and the environment. Over the past 10 years, the conversation around sustainability and corporate social responsibility (CSR) has expanded rapidly.

This study is relevant for the further development of strategies and practices by the healthcare sector during crisis periods based on the information reported. This study aims to observe whether sustainability performance is reported during crisis periods and its implication towards healthcare companies' sustainable performance and profitability. In detail, the authors investigate the connection between sustainability performance reporting and the financial success of healthcare sector companies, as well as on and CSR adoption. In order to achieve the research purpose, a descriptive analysis of the statistics of sustainability performance indicators used by the healthcare sector listed companies' and the firm financial performance indicators during crisis period is used in the study. The data was collected from Refinitiv Eikon Database for the 2020-2022 crisis period.

The author's contribution to the study resides in: (1) the analysis of sustainability performance indicators and firm financial performance indicators reported by the healthcare sector during crisis periods, compared to other studies analysing a pre-crisis period, and (2) filling the literature gap on studies about sustainability reporting in relation to firm financial performance of the healthcare sector during a crisis period.

The study is organised as follows: the first part of the research presents the problem statement and the aim of the research; the second exposes the methodology used for analysing the sustainability indicators reported by the healthcare sector and its implication during the crisis period towards companies' firm financial performance, while the last part of the research focuses on presenting the findings and discussion on the results of the descriptive statistics, as well as the conclusion of the study.

2. Problem Statement

The importance of reporting sustainability performance has grown for both developed and emerging economies due to growing concerns about the environment

and the maintenance of ecosystems to ensure sustainability. The 1987 Brundtland Report on closing the development gap between human and environmental issues led to the rise in popularity of the idea of sustainable development, or sustainability (Bebbington & Unerman, 2018). Sustainability performance reporting is often confused with other concepts, such as triple bottom line reporting and corporate social responsibility (CSR) reporting, that refer to the disclosure of information about economic, environmental, and social impacts. Businesses that want to provide their stakeholders with more information and value on how their operations and activities affect society and the environment voluntarily release sustainability performance reports (Garg, 2015). According to Dyllick and Hockerts (2002), addressing the needs of current and potential stakeholders without sacrificing a company's capacity to meet those of future generations is the definition of sustainability from the viewpoint of the business. Since it encompasses the environmental, social, and economic (ESG) pillars of the triple bottom line, the concept of sustainability is quite inclusive (Hart & Milstein, 2003). The literature on sustainability performance reporting only partially addresses the issues of why some businesses use sustainability management strategies while others do not, as well as the situations in which adopting sustainable practices might give businesses a competitive edge (Rivera-Camino, 2007).

Sustainable practices in the healthcare sector through ESG reporting and CSR led to the idea that these are beneficial and a burden at the same time, especially for decision makers (Deselaers et al., 2023). The CSR performance studies' analysing sustainability performance in relation to firm financial performance (Kuzey et al., 2021), or in ESG in relation to financial performance and firm value (Alareeni & Hamdan, 2020; Almeyda & Darmanasyah, 2019; Constantinescu et al., 2021) acknowledged both positive and negative influences on companies. In the healthcare sector, CSR performance did not generate firm value and profitability before the crisis period (Kuzey et al., 2021). Therefore, it is interesting to observe whether the recent health crisis (SARS-CoV-2) has changed the value and profitability of the healthcare sector.

Growth in total assets, profitability, and efficiency (Return on Assets – ROA, and Return on Equity – ROE) are metrics that can be used to assess a company's performance. A company's ability to use its assets effectively and efficiently to produce resources is subjectively measured by its financial performance. ROA and ROE are the subsets of profitability performance that make up an organisation's financial performance. The growth dimension of performance is made up of market share growth, asset growth, net revenue growth, net income growth, and increased number of employees (Santos & Brito, 2012).

The extent to which a company discloses information can be influenced by its size and profitability. As stated by Uwuigbe et al. (2018), larger companies, for instance, are more inclined to reveal more information to lower agency costs, enhance their reputation, gain the public's support, and find investors. According to Turban and Greening (1997), who also offered practical support for the claim, companies that perform well in terms of sustainability are more likely to draw in the

best candidates for employment. Therefore, these companies would attract more competent candidates, perhaps increasing their competitive advantage over rivals.

During the multiple crisis period (climate change, SARS-CoV-2, and conflicts between states), the healthcare sector (services and providers) was affected by functional challenges such as increased workload and hygiene measures for society (Deselaers et al., 2023), the war affecting business continuity and lifestyle of citizens, and climate change, which is one of the hazardous problems today (Barchielli et al., 2022; Benedek et al., 2021). To overcome these crises, the healthcare sector should have considered special strategies aligned with the needs of patients and communities, as well as environmental and societal concerns. The study of Zaremba et al. (2021) observed that countries with developed healthcare systems are prepared to combat pandemic crises.

3. Aim of the Research

This paper analyses whether sustainability performance indicators and firm financial performance are reported in the healthcare sector during crisis periods. Based on the literature review and through specific indicators, this study aims to observe how sustainability performance reported during the crisis periods affected the firm financial performance of the healthcare sector.

4. Research Methods

From a methodological perspective, the analysis of sustainability performance indicators and firm financial performance in the healthcare sector during crisis periods is based on quantitative research performed through descriptive statistics of the mean, standard deviation, minimum, and maximum values reported. Descriptive statistics are instruments that aid in organising and summarising the real data regarding observations and scores. They also measure uncertainty and how it impacts planned observations and experiments (Dong, 2023). The scope of this research is to observe the sustainability performance indicators reported during the crisis period and their implication towards healthcare companies' sustainable performance and profitability. In this section, the sample data and the variables included in the analysis are presented.

4.1 Study Sample

The database size for the analysis of sustainability performance indicators and firm financial performance in the healthcare sector initially totalled 199 listed European companies. Considering that the analysis was focused on sustainability indicators reported during multiple crisis periods, only companies that presented sustainability information in the period 2020-2022, based on the reported ESG Score, were considered. Therefore, 21 companies were removed from the database and only 178 companies reported information on sustainability based on ESG Scores. It was remarkable that companies in Northern and Western Europe were more interested in reporting sustainability and financial performance, while Central and Eastern Europe

(CEE) companies were just starting to implement sustainability measures due to new directives (Arraiano & Hațegan, 2019). The details can be found in Table 1.

Table 1. Final Sample Data

	Overall
Number of listed companies	199
Initial observations for the period 2020-2022	597
Less: observations dropped due to insufficient data to ESG Score	(21)
Final observations for the period 2020-2022	576
Number of Final Observations by Region	
Central and Eastern Europe	5
Northern Europe	102
Southern Europe	13
Western Europe	79

Source: Refinitiv Eikon (2024).

For this quantitative study, the Refinitiv Eikon database (Thomson Reuters) was used as a secondary data source. This database source was previously used in other studies that analysed sustainability reporting in relation to financial performance indicators (Bancu et al., 2023; Bătae et al., 2020; Constantinescu et al., 2021; Kuzey et al., 2021). The analysis was carried out for the period 2020-2022 for the analysis of the healthcare sector performance during multiple crisis periods. The study of Kuzey et al. (2021) analysed the performance of the healthcare sector during the period 2011 and 2018, considering the CSR performance, leaving the impression that sustainability reporting improved the efficiency of companies in that period, but in terms of profitability, a weak performance was observed, since sustainability performance cannot generate profit. However, this study aims to observe a different period in which pandemic, conflicts between countries, and climate change impacted company performance, especially the healthcare sector. Nevertheless, these were considered the latest challenges of all time in the world (Barchielli et al., 2022).

4.2 Variables

The construction of the descriptive analysis was based on 13 indicators, out of which seven are independent variables, three dependent variables, and three control variables. Nine of them represent sustainability performance indicators (ESG Score, ESG Combined Score, Environmental Pillar Score, Social Pillar Score, ESG Controversies, CSR Sustainability Committee Score, Board Size, and Board Gender Diversity Score) and four of them firm financial performance indicators (Return on Assets - ROA, Return on Equity - ROE, Assets Turnover, and Number of Employees). The reason this study employs these indicators is that they are commonly used in sustainability performance articles (Kuzey et al., 2021). The details of the description sources used and the references to the variables are presented in Table 2.

Table 2. Definitions of variables, sources, and references

Indicators	Definition	Source	Reference
Sustainability Performance Indicators			
ESG Score (independent variable)	It considers CSR performance and ESG scores separately.	Refinitiv Eikon	(Kuzey et al., 2021)
ESG Combined Score (independent variable)	It considers CSR performance, ESG score ranging between 0 and 100.		(Kuzey et al., 2021)
Environmental Pillar Score (independent variable)	It contains information on resource use, emissions reduction, and innovation.		(Bătae et al., 2020; Constantinescu et al., 2021; Kuzey et al., 2021)
Social Pillar Score (independent variable)	It contains information on the workforce, human rights, the community, and product responsibility.		(Bătae et al., 2020; Constantinescu et al., 2021; Kuzey et al., 2021)
Governance Pillar Score (independent variable)	It contains information about Management, Shareholders, and CSR Strategy.		(Bătae et al., 2020; Constantinescu et al., 2021; Kuzey et al., 2021)
ESG Controversies Score (independent variable)	It measures a company's exposure to controversies related to the environmental, social, and governance pillars, reflected in the global media. Its score ranges from 0 (worst) to 100 (the best).		(Bătae et al., 2020)
CSR Sustainability Committee Score (independent variable)	Analyses if a company has a CSR committee established by the board level or senior management to make sustainability decisions. If a committee exists, the score is 1, otherwise 0.		(Bancu et al., 2023; Kuzey et al., 2021)
Board Size (control variable)	Total number of directors on board.		(Kuzey et al., 2021)
Board Gender Diversity Score (control variable)	The percentage of women directors on board.		(Kuzey et al., 2021)
Firm Financial Performance Indicators			
ROA (dependent variable)	Net Income After Taxes/Total Assets	Refinitiv Eikon	(Kuzey et al., 2021; Alareeni & Hamdan, 2020)
ROE (dependent variable)	Net Income After Taxes/Total Equity		(Kuzey et al., 2021; Alareeni & Hamdan, 2020)
Assets Turnover (dependent variable)	Total Assets/Revenue		(Alareeni & Hamdan, 2020)
Number of Employees (control variable)	Total number of employees		(Kuzey et al., 2021)

Source: the authors' own research.

5. Findings and Discussion

5.1 Findings

The summary of statistics for each variable is presented in Table 3. In terms of sustainability reporting indicators, the results show that the healthcare sector has the highest mean value reported on the ESG Controversies Score (95), followed by the Social Pillar Score (51.56), Governance Pillar Score (51.50), and Board Diversity Score (51.28). According to Bătae et al. (2020), higher scores of ESG mean a high involvement of companies in public controversies. In the healthcare sector, the mean results show the best score close to 100, not confirming the involvement in too many controversies.

Table 3. Descriptive Statistics overall

Variables	N*	Mean	Standard Deviation	Min	Max
ESG Score	576	47.96	23.05	5.152	95.58
ESG Combined Score	576	46.61	21.68	5.152	95.10
Environmental Pillar Score	575	34.70	29.53	0.000	94.40
Social Pillar Score	575	51.56	28.39	0.616	97.75
Governance Pillar Score	576	51.50	22.12	0.657	97.78
ESG Controversies Score	575	95.00	16.73	0.735	100.00
CSR Sustainability Committee Score	576	31.40	34.32	0	83.58
Board Size	576	8.04	3.13	1.000	21.00
Board Gender Diversity Score	576	51.28	28.25	0.962	99.75
ROA	576	(0.10)	0.37	(3.255)	0.45
ROE	576	(0.16)	2.36	(41.855)	27.45
Assets Turnover	576	0.48	0.39	(0.094)	2.54
Number of Employees	558	11642	31790.49	6	316078

Note: * N represents the total number of valid observations.

Source: the authors' own research results.

During the multiple crisis period, such as the SARS-CoV-2 pandemic, companies were usually focused on the social pillar part which were the most affected during these times (Barchielli et al., 2022). This is also confirmed by the mean results of the mean of the Social Pillar Score (51.56), which is the highest of the ESG separated scores. On average, the companies in the sample have a mean of 47.96 percent of ESG Score and 46.61 percent of ESG Combined Score, meaning a high performance, as well as a high standard deviation. Compared to the study of Kuzey et al. (2021), where the mean was more than 50%, this study is lower and could indicate that healthcare companies did not continue to focus on reporting sustainability information with high interest. An interesting result is observed in the CSR Sustainability Committee Score. Healthcare listed companies, as well as other companies, used to obtain the maximum score of 1 (Bancu et al., 2023; Kuzey et al., 2021). Now the maximum score obtained is 83.58 indicating a high presence of a sustainability committee in charge of sustainability actions during the crisis period.

The control variables Board Diversity and Board Gender Diversity presented that the maximum number of people in charge of sustainability reporting was 21 and 51.28% of the board members were women. The sustainability performance indicators, as well as its control variables, presented a high standard deviation. According to the results of the study by Hutagaol-Martowidjojo et al. (2023), the sustainability performance of the healthcare sector differs from countries and situations, and the crisis periods, companies could suffer losses.

In terms of firm financial performance indicators, the results show that the healthcare sector has registered low mean scores for ROE and ROA during the multiple crisis period, but a high mean of Assets Turnover. The sampled companies show a negative mean ROE value of -0.16 percent and a negative mean value of ROA of -0.10 percent. The minimum value of ROE is -41.855 and the maximum value is 27.45, which could be translated as a difference between healthcare companies (Mititean, 2022). Usually, companies that report high sustainability performance have higher ROA and ROE according to the findings of Alareeni and Hamdan (2020), and higher sustainability performance scores mean higher financial performance of companies. In this case, descriptive statistics observed positive ESG Scores reported by healthcare companies, but negative results of profitability indicators. The positive mean of the Assets Turnover of 0.48 percent showed that healthcare companies effectively used their assets to generate sales during crisis periods, but not as effectively as in the period analysed by Kuzey et al. (2021).

It could be concluded that European companies in the healthcare sector took measures to achieve sustainable performance during the crisis period. However, to understand if there is a correlation between sustainability performance and firm financial performance reported by healthcare companies (as in Kuzey et al., 2021) during the crisis period, a deeper analysis could be performed through a further correlation analysis between the indicators as in the study of Alareeni and Hamdan (2020).

5.2 Discussion

If the healthcare sector had not taken sustainability performance measures, the business would have been at financial risk. An argument for a relationship between social responsibility and financial risk measures like earnings variance and stock return variance can also be made, even though theory and research have mainly focused on the relationship between sustainability performance reporting, reporting, reporting and measures of financial performance (Ullmann, 1985). To begin with, a company's financial risk may increase in response to low social responsibility. Due to their perception of the firm's low management calibre, investors may view less socially conscious companies as riskier investments (Alexander & Buchholz, 1978). Due to a lack of social responsibility, investors and other stakeholders can also expect a rise in company expenses. For instance, a company's very survival may be threatened by fines imposed by the government or lawsuits like the ones that have been filed against asbestos, chemical, and pharmaceutical companies lately.

Businesses that can create a pleasant and satisfied work environment for their employees have been shown both theoretically and empirically to perform better than those that cannot. According to Habaragoda (2018), a significant proportion of managers think that having contented staff members is essential to achieve exceptional work output. Businesses now understand more than ever how crucial it is to maintain positive working relationships with employees to boost productivity. Workers' views, including their contentment with job security, perks, compensation, and the job itself, are impacted by common internal CSR activities such as employee training, health and safety, welfare facilities, rewarding, and work-life balance. Performance within the company will be influenced by the good sentiments that employees have about it.

6. Conclusions

The analysis of sustainability performance indicators and firm financial performance in the healthcare sector during the multiple crisis period was carried out based on descriptive statistics. Companies in the healthcare sector have reported sustainability performance through ESG scores, ESG Controversies, Environmental Pillar Score, Social Pillar Score, Governance Pillar Score, CSR Sustainability Committee Score, Board Size and Board Gender Diversity Score, as well as firm financial performance through ROA, ROE, and Assets Turnover indicators.

The results of the descriptive statistics of sustainability performance indicators presented that during the multiple crisis period companies reported information in ESG Controversies and ESG scores without being involved in many controversies. The focus of healthcare companies during this period was on the social pillar that was the most affected. In case of the presence of a sustainability committee, an increased one was registered, while the results of the board in charge with sustainability reporting presented a maximum number of 21 members, out of which 51.28% were women.

The results of the firm's financial performance indicators presented negative mean values of ROA and ROE, which could be translated as differences between companies from a financial performance perspective. Healthcare companies managed their assets to produce sales during the crisis period, but less successfully than in other periods, as indicated by the mean of the Assets Turnover.

European companies in the healthcare sector took measures to achieve sustainable performance during the multiple crisis period (climate changes, SARS-CoV-2, and conflicts between states) and reported useful information on firm financial performance. However, the study was limited to a descriptive statistical analysis of the performance indicators chosen. For further research, a deeper understanding through an econometric analysis based on a correlation analysis on the effect of sustainability performance indicators on the firm's financial performance could be performed.

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**Sustainable Business Models
in the European Energy Sector**

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Abstract

The present article investigates the sustainable business models (SBMs) of the two largest renewable energy producers (Iberdrola and Ørsted) in the European Union (EU) and a Romanian renewable energy company (Hidroelectrică). The study area focuses on wind or hydroelectric energy. The goal of the study is to conduct a comparison of the strategies, trends, differences, and best practices held by these organisations. In addition, the research proposes to carry out a comparison between the investment areas of each of the three organisations and the Non-financial Reporting Directive (NFRD) and the EU Taxonomy. The research involves multiple case studies and comparative analysis. The research findings enhance the comprehension of the conjunct tendencies existing in the industry that is placed under study, together with the regulatory framework. The sustainable business model (SBM) concept is frequently kept in the theoretical realm, the article standing as the basis through which its real characteristics are placed under investigation and are indicated. Overall, the information provided in the article will supplement understanding of the present landscape of the industry in the context of current environmental initiatives.

Keywords: sustainability, green energy, sustainable business model, EU Taxonomy.

JEL Classification: M14, M40.

1. Introduction

From the financial year 2024, every company in the European Union (EU) that is classified as a public interest entity (according to size criteria and listing on the stock exchange) needs to issue a sustainability report as part of their annual mandatory reporting. Thus, now it is a critical time for every large firm that meets the Corporate Social Responsibility Directive (CSRD) criteria to prepare and adapt

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its sustainability reporting structure based on the CSRD. The aim of issuing such a report will not only match the trend of environmental and social responsibility but also the EU perspective on sustainable economic activities. As a result of climate change difficulties and the increasing costs of energy, EU renewable energy firms are transitioning their approach to cleaner and greener business. Thus, the article will analyse the EU Taxonomy and its impact on the renewable energy sector in Europe (Hummel & Bauernhofer, 2024; Hummel & Jobst, 2024; Paccès, 2021).

Green technology is at the heart of sustainable business models in the energy sector. Through information-intensive services (Gitelman & Kozhevnikov, 2023), the principles of sustainable business models (SBMs) help businesses not only reduce their environmental footprints but also make profits and contribute to local taxes (Guo et al., 2024). The levels of complexity of regulatory statutes and the pressure to secure the leading position in the market can be seen as major factors encouraging firms to introduce sustainable business practices (Malinauskaite & Jouhara, 2023; Gitelman & Kozhevnikov, 2023). Renewable energy also fits the concept of a circular economy, considering that some inputs serve as outputs. In the context of sustainable energy development, this thinking is gaining ground (Dragomir & Dumitru, 2024).

The EU Taxonomy (Regulation (EU) 2020/852) is a tool that provides a classification framework to help identify which activities contribute to environmental sustainability, as well as to assist the company in having sustainable activities (Velte, 2024; Ringel & Mjekic, 2023; Abraham-Dukuma, 2021). This article will explain the investment strategies of these companies and their growing role in the adoption of the EU taxonomy to achieve the environmental objectives of the EU. One of the main reasons for focusing on taxonomy-aligned activities is to provide a better understanding of corporate strategies (Ciasullo et al., 2019) and the extent to which they could inspire the transition to cleaner energy sources in Europe (Dragomir & Dumitru, 2024).

This article describes the SBMs of major renewable energy companies operating in the European Union by analysing the data and integrating these models into the EU Taxonomy (Malinauskaite & Jouhara, 2023; Gitelman & Kozhevnikov, 2023). Being on the path of sustainable development is the top priority for nearly every country in the modern world (Guo et al., 2024; Moshood et al., 2022; Comin et al., 2020; Malinauskaite & Jouhara, 2023; Gitelman & Kozhevnikov, 2023). Consequently, the transition to renewable energy becomes a significant challenge and, at the same time, a solution. However, it is not easy to choose a strategic path due to the share of costs involved and the current underdeveloped areas that use fossil fuel energy (Gani et al., 2023; Mukoro et al., 2022; Ehrtmann et al., 2021).

In the context of the current article, attention will be paid to the sustainable business models of two of the largest European players in renewable energy and a medium-sized Romanian company in the sector of hydro energy generation. It is essential to compare strategies and draw parallels and differences to understand the most efficient approaches in the industry. At the same time, since the regulatory situation around SBMs is still unclear due to the modifications taking place, it is

crucial to analyse how sustainable, from the perspective of existing approaches, are the cases analysed (Dragomir et al., 2022; Ciasullo et al., 2019).

The remainder of the paper is divided into five sections. The literature review summarises the existing literature that is relevant to SBMs in the energy sector, as well as the EU taxonomy papers. The methodology describes the data that were gathered and the analysis and comparative approach. The findings of the paper include the empirical results of the study concerning the SBMs of selected European renewable energy companies (Iberdrola, Hidroelectrica, and Ørsted) and whether they comply with the EU Taxonomy. The discussion and conclusion summarise the main findings of the article, highlight the contributions, and provide recommendations for future research.

2. Literature Review

The development of SBMs in the energy field represents a new perspective from traditional fossil-based forms of energy. Given the very serious dangers associated with climate change and other types of pollution, it can be argued that the transition to renewable energy is vital (Gitelman & Kozhevnikov, 2023). Such business models are not only environmentally responsible due to the use of green energy, but also more efficient, which can allow companies to achieve success in the long run (Gitelman & Kozhevnikov, 2023). As far as energy companies are concerned, such models include the use of green technologies within energy production, as well as digital technologies for a personalised knowledge-intensive service (Herrera, 2023).

Another characteristic of SBM is the attention to the organisational learning process. In other words, this approach recognises that business reality is constantly changing and the company must learn about it to remain sustainable and competitive (Bocken et al., 2019). As a result, companies can become more capable to respond to emerging environmental, social, and economic challenges through a focus on the learning process and adapting their strategies. SBMs in the EU energy sector are innovative, environmentally friendly, stakeholder-engaged, and accountable. The details of the company's strategies and activities differ, but the goal of integrating sustainability into business practices is a common language. Therefore, the adoption and refinement of SBMs will be crucial for long-term profitability and sustainability as organisations deal with the energy transition (Mont et al., 2019).

There are many challenges that companies in the energy sector face when trying to implement sustainable business models or shift to sustainable energy technologies (Bocken et al., 2019). Regarding economic considerations, the benefits of sustainable business models appear clear, such as higher profits and sustained competitive advantages over nonsustainable companies (Gani et al., 2023; Mukoro et al., 2022; Ehrtmann et al., 2021). However, upfront investments are quite substantial, making this approach unaffordable for many companies, except the largest. This is a considerable challenge; for example, while renewable energy sources do not produce CO₂ emissions, the issue of land use and its effects on wildlife and ecosystems remain. Similarly, keeping closed-loop systems is an idea at the heart of the so-called circular economy concept (Gitelman & Kozhevnikov,

2023). The technological aspects related to the implementation of sustainable business models for energy companies add to the overall challenges. Increasing the utilisation of new ways to produce and consume energy requires the capacity for continued innovation.

The EU Taxonomy Regulation is very important for companies to follow, especially for the energy sector, because it can guide business activities in a more structured way to be in accordance with environmental targets. It focuses primarily on climate change mitigation and adaptation by requiring companies to account for specific proven or quantifiable measures as well as to disclose environmental results. Among other things, considering and recognising the importance of this initiative, the obligation to report seems to be the strongest. This trend is particularly important for the energy sector (Ringel & Mjekic, 2023). By analysing different provisions of the regulation, it describes a relationship between a proven measure and a related activity, ensuring their credibility and relevance.

Another benefit of the EU Taxonomy Regulation is that it is a supranational solution way to drive investment and ensure that businesses with environmentally sustainable criteria become the norm (Abraham-Dukuma, 2021). In the energy sector, for example, such a provision may motivate companies to switch to more renewable resources and stop using fossil fuels in favour of wind or solar energy. However, high costs of implementation not only require initial capital to launch new projects but also involve the need to finance them in case they take longer than initially anticipated. Overall, there is a clear link between the EU Taxonomy Regulation and the energy sector regarding the description of such business models.

3. Research Method

The purpose of this study is to elaborate on the exploration concerning the adoption of SBMs by companies in the European energy sector. Accordingly, the study will use the comparative analysis method. The key attributes of different companies refer to existing patterns, similarities, and differences. Furthermore, by using the method, researchers will be able to make more precise interpretations regarding the way investigated factors work in relation to the adoption and implementation of SBMs (Sunderland et al., 2016).

The main data source for the article is represented by the 2022 sustainability reports issued by the selected companies. All documents have been accessed online on the companies' webpages, as of April 20, 2024. Moreover, the use of the 2022 reports has been chosen based on the principle of accessibility and importance of the most recent information. Not all companies have published their 2023 reports until the completion of this study.

The sample selection has been determined by the sizes of the companies and their importance in the regions of the European Union. Key companies are chosen to represent the main players within the European Union in the renewable energy sector. The selection of these companies was performed based on their size and impact on the regions of deployment.

- Iberdrola: Standing as one of the greatest renewable energy production companies in the world, Iberdrola is headquartered in Spain and holds most of its power plants there. United Kingdom and Germany, Turkey, Qatar, and the Americas, USA, Brazil, Mexico, and Colombia, host other energy facilities of this organisation.
- Ørsted: The company, originating in Denmark, is mainly committed to wind and solar energy, and is one of the greatest offshore wind developers at European level. Ørsted was part of a case study regarding a flourishing shift toward a green energy economy (Abraham-Dukuma, 2021).
- Hidroelectrica: As the greatest hydroelectric power producing company in Romania, it can supply certain information concerning SBMs, that are characteristic to a particular country of the EU. Hidroelectrica reached a market capitalisation of 9.45 billion euros at the time of its IPO in 2023 on the Bucharest Stock Exchange.

The comparative analysis approach involves systematically analysing investment plans, growth dynamics, and the compliance of the two companies with the specific EU taxonomy criteria. According to EU Regulation 2021/2139, eligible activities should contribute unequivocally to the mitigation or adaptation of climate change. However, some industrial activities can still be considered sustainable even if their contributions are not entirely clear and proven scientifically.

The methodology can be described in several steps: (a) identification of key metrics in sustainability reports of the companies that were considered relevant in the study. Data are associated with their financial arrangements concerning renewable energy sources, initiatives to reduce the carbon footprint, and alignment with the specific EU taxonomy requirements. (b) Data extraction from sustainability reports for the financial year 2022 that are focused on particular initiatives, financial commitment, and certain outcomes were extracted to review the SBMs of companies. (c) Comparative evaluation of SBMs regarding their investment plans and growth dynamics in relationship with the taxonomy criteria set by the European Union.

The research is based on a case analysis approach, instead of employing the standard case study approach delineated by Yin. It allows one to study the subject in detail and explore the most relevant SBMs to identify industry best practices. A comparative method was also implemented to examine the accuracy of Non-Financial Reporting Directive compliance by the market actors selected for the study. The researcher conducted an analysis of non-financial disclosures as they were exposed in the sustainability reports to understand to which extent the companies met the NFRD requirements.

4. Findings

4.1 Iberdrola, a Giant in Renewable Energy in the EU

Iberdrola, the largest wind power producer and the world's second largest electricity generator or distributor in terms of market capitalisation, stands out in the

field of new energy. The company has 62 GW of installed capacity, more than 41.75 GW being green generation. The circular economy model is one of Iberdrola's main sustainable strategies. This approach reduces emissions, uses renewable resources in production and resource efficiency, and actively promotes all elements of the value chain. Over the decade 2015-2024, the company has made significant investments in energy generation and grid investment projects: decarbonisation of electricity production, development, and integration of smart grids, and electric demand. Iberdrola's SBM aligns with the objectives of the European Union's Circular Economy Action Plan. Iberdrola, by taking a holistic approach from suppliers to customers throughout the value chain, can satisfy the rapidly increasing demand for clean energy and reduce the environmental footprint.

In addition to adhering to the principles of circular economy, Iberdrola is also committed to further innovation as a driver of sustainability. By 2025, a total of € 2 billion will be directed for inventive effort and research, while for the 2030 figure, this goes up to € 4 billion. By focusing on a few key areas such as decarbonisation, smart grids, and demand electrification, Iberdrola drives the transition of energy systems toward sustainability. As a successful and well-established player in the European energy sector, Iberdrola has created its own set of guiding principles and maximum values (Sinthupundaja et al., 2020). The company specified that they wanted to have a selective investment strategy.

4.2 Ørsted Pioneering Offshore Wind Energy

The Danish renewable energy business is famous for its offshore wind energy initiatives and overall focus on sustainability – Ørsted invests in green and sustainable financing to facilitate its green transformation and expansion. Ørsted is known as the leader in offshore wind power and a trailblazer in renewable energy in the EU, with a determination to keep to end-orientated standards and regulatory requirements. Ørsted's sustainable strategy concentrates on large-scale cost-competitive offshore wind energy solutions. The sustainability objectives reflect its target of 40% reduction in freshwater withdrawal intensity by 2025 and the net positive biodiversity of all new renewable projects commissioned from 2030. Moreover, Ørsted has pledged to adhere to the EU taxonomy for all future projects.

In addition to these measures designed to conserve the environment, Ørsted plans to eliminate coal and reduce emissions in all its operations. Ørsted is actively working on its strategy for green financial innovation. Ørsted declares the sustainable goal to create real value for society while earning long-term returns on behalf of its shareholders (Ciasullo et al., 2019). It invests in research and development and is motivated to create new technologies and business solutions not just to tackle the issues arising from climate change, but also to accelerate the global shift away from hydrocarbon fuels, with more than 250 such projects dedicated to decarbonisation. Ørsted's 1st publication of taxonomy-aligned activities was in 2013 with 73% of turnover, 99% of CAPEX, and 80% in relation to OpEx. At the same time, 27% of sales, 1% of CAPEX, and 20% of OpEx are not compatible with EU taxonomy.

4.3 Hidroelectrica Sustaining Green Energy at the National Level

Hidroelectrica implements a different type of SBM in its strategic plan and its business model relies on hydro energy (SDGs 7 and 13). This is relevant as companies generating hydropower contribute to the national clean energy goals and climate change mitigation. Corporate governance, climate protection, green energy transition, nature conservation and ecology, corporate culture, occupational safety and health, staff benefits, creating customer value, and communicating with local communities are goals that represent its sustainable development approach. In some respects, Iberdrola and Ørsted will be far ahead of the Romanian company, but even the fact that the latter has made the SDGs part of its operational model makes Hidroelectrica one of the important actors in the race to decarbonise the energy industry.

When comparing the sustainable strategies of Iberdrola, Ørsted, and Hidroelectrica, there are several key differences which are relevant for the study of SBMs. Iberdrola is the leading organisation in its industry at the European Union level. When conducting an assessment of the organisation's strategies, it can be clearly noticed that the organisation enacted different strategies intended to foster sustainable development. Pillars such as the introduction of circular economy principles, innovation, and ambitious targets regarding the majority of its programs constitute points that the organisation proved to manage in an appropriate way. Ørsted operates in the clean energy sector and it is a role model for value chain inclusion. Hidroelectrica is a traditional supplier of hydroelectric power that is based on hydroelectric dams from the Communist era in the main rivers and the Danube in Romania. Thus, these three firms should continue their development in all directions with respect to sustainability, innovation, and programs.

4.4 Analysis of the Alignment between the Investment Plans of the Three Major European Energy Companies with the EU Taxonomy

The EU Taxonomy was designed to make companies sustainability reports which activities contribute to the achievement of EU's environmental goals (Rotondo et al., 2019). In the context of our sample, Iberdrola analysed its activities to understand whether they qualify for the EU Taxonomy. According to Annex I and II of Delegated Regulation 2020/852, the company has a list of qualified activities. The most relevant are hydrogen production, photovoltaic solar, and onshore wind power, electricity transmission and distribution, energy storage, electricity produced from heat from the environment, and energy efficiency measures. Iberdrola analysed whether these activities comply with the Taxonomy by examining to what extent they satisfy considerable contribution, do not significantly harm other environmental objectives, and meet social safeguard requirements.

Table 1. The taxonomy-aligned activities and indicators of Iberdrola

Economic activities	Proportion of turnover (%)	Proportion of CapEx (%)	Proportion of OpEx (%)
Eligible activities according to the taxonomy			
A1. Environmentally sustainable activities (that comply with the taxonomy)	36.5	86.5	52.2
A2. Eligible but not environmentally sustainable activities according to the taxonomy	19.8	3.2	40.9
Total (A1 + A2)	56.3	89.7	93.2-
Non-eligible activities according to the taxonomy			
B. Non-eligible activities according to the taxonomy	43.7	10.3	6.8
Total (A+B)	100	100	100

Source: summary based on the company’s annual report.

For our analysis on EU Taxonomy indicators for Ørsted, it is important to mention that the company did not provide a split of the eligible activities according to the Taxonomy. Previously, I argued that the company still demonstrates its commitment to sustainability, but Ørsted is aware that it must, at least partially, engage in taxonomy-aligned activities if it wants to move toward the environmental needs and requirements. More specifically, the company gets benefits from KPI linked products and, hence, is interested in achieving the declared targets. Consequently, the financial rewards are closely related to sustainability performance. Ørsted reported that a significant part of the turnover, CAPEX, as well as OpEx were in line with the Taxonomy. However, the sustainability report of 2022 shows that a substantial portion of its sales, CAPEX, and OpEx were not compatible with the Taxonomy. It is expected to be corrected in the upcoming report, but Ørsted is interested in future improvements and aligning more activities with the Taxonomy. Despite being nontaxonomy compliant, the company is interested in improving its long-term sustainable performance.

Table 2. The taxonomy-aligned activities and indicators of Ørsted

Economic activities - Ørsted	Proportion of turnover (%)	Proportion of CapEx (%)	Proportion of OpEx (%)
Eligible activities according to the taxonomy			
A1. Environmentally sustainable activities (that comply with the taxonomy)	not specified	not specified	not specified
A2. Eligible but not environmentally sustainable activities according to the	not specified	not specified	not specified

Economic activities - Ørsted	Proportion of turnover (%)	Proportion of CapEx (%)	Proportion of OpEx (%)
taxonomy			
Total (A1 + A2)	73	99	80
Non-eligible activities according to the taxonomy			
B. Non-eligible activities according to the taxonomy	27	1	20
Total (A+B)	100	100	100

Source: summary based on the company’s annual report.

Hidroelectrica examined the impacts of its operations and activities on climate change. It held workshops with internal management and workers relevant to the company’s business model to gather requirements for Taxonomy reporting and to assess the proportion of the qualifying economic activity in the company’s revenue, CapEx, and OpEx. Hidroelectrica identified that wind and hydro power generation met the EU environmental objectives. The company mentioned that more assessment was required to comply with Taxonomy technical specifications and to demonstrate the Taxonomy’s relevance to its business model.

Table 3. The taxonomy-aligned activities and indicators of Hidroelectrica

Economic activities	Proportion of turnover (%)	Proportion of CapEx (%)	Proportion of OpEx (%)
Eligible activities according to the taxonomy			
A1. Environmentally sustainable activities (that comply with the taxonomy)	0	0	0
A2. Eligible but not environmentally sustainable activities according to the taxonomy	0	0	0
Total (A1 + A2)	0	0	0
Non-eligible activities according to the taxonomy			
B. Non-eligible activities according to the taxonomy	100	100	100
Total (A+B)	100	100	100

Source: summary based on the company’s annual report.

5. Conclusions

Comparing the investment plans and taxonomy alignment of Iberdrola, Ørsted, and Hidroelectrica reveals performance statistics and avenues for improvement. Iberdrola owns a widespread transmission network, and many of its investments in renewable energy make it one of the top sustainable energy corporations. The company maintains this competitive position by investing in activities and initiatives that assist in the fight against climate change and environmental degradation, as well

as in energy efficiency gains. Ørsted is a leader in green financing of projects, highly detailed reporting and maintains the commitment to ESG performance. By aligning financial activities with sustainability objectives and reporting on Taxonomy-aligned ventures, it also helps stakeholders recognise its sustainability projects and the movement to global renewable energy (Rotondo et al., 2019). Hidroelectrica has limited capacity for other power sources in the business portfolio and is unable to comply with the taxonomy-based development of similar power plants. The investment in hydropower plants was significant and the company's ecological and sustainability goals have been met, but renewable energy sources must be further pursued and the company must comply with EU requirements.

The employment of elements such as sustainability, innovation, and regulatory conformity in the case of the three organisations is a strategy that will assist in addressing climate change (Ciasullo et al., 2019). Iberdrola, Ørsted, and Hidroelectrica can utilise their inherent strengths to cope with or compensate for certain areas of inaction. The energy industry in Europe requires the collaboration of stakeholders, government, and regulators (Sinthupundaja et al., 2020). Such responsible and shared processes will allow the low carbon economy to be realised and sustainable development goals to be achieved. The approaches used by Iberdrola, Ørsted, and Hidroelectrica all contributed a good improvement for the future of the European energy system towards sustainability. Despite the manifestation of various advantages and drawbacks by these entities, they prove ongoing concern toward renewable energy and environmental responsibility. Steps that need to be conducted to achieve progress in the long run and an efficient mitigation of climate change are represented by augmented capital investments in green technologies and a steady alignment with legislation, for instance the EU Taxonomy (Sletten et al., 2023).

Iberdrola, Ørsted, and Hidroelectrica find themselves on the road to sustainability, and there is still room for growth. In what regards Iberdrola, it needs to nurture the generation of innovative sustainable solutions that extend past renewable energy so that market-related risks are addressed. Ørsted can enhance development by including supplementary social value propositions. Concerning Hidroelectrica, the entity has to operate a risk management system to better manage risks pertaining to its reliance on a sole power source. Advantages such as innovation and the adherence to the circular economy model stand among the circumstances that the organisation will rejoice. As a result, in the current landscape of the energy market, each of these companies may benefit from further enhancing their resilience and sustainability.

6. Limitations and Future Research Areas

The major limitation of our study relates to the nature of the sustainability reports utilised. We used the reports for 2022, which follow the Non-Financial Reporting Directive (NFRD). As a result, the findings may be less relevant due to less demanding requirements. Specifically, the sustainability reports provided may not reflect the requirements of the Corporate Sustainability Reporting Directive (CSRD).

Therefore, it is suggested that future research take a closer look at these issues, utilising the recent requirements. On the one hand, it is possible to mention that further analysis of corporate sustainability issues may be performed on the basis of the most recent EU requirements. At the same time, it is suggested that examining the transition from NFRD requirements to the new CSRD framework may provide a valuable foundation for research. Analysis of the perceptions of stakeholders, exploration of their experience during the transition to a green economy, and reflections of companies on the changes may be a valuable direction for research. However, research on the sustainability topic can be conducted with a focus on the growing credibility, comparison, and transparency of the reports.

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During the preparation of this work the authors used *Writefull* to improve readability and language of the work. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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**The Effect of Good Corporate Governance Practices
in Corporate Risk Management Disclosure:
An Overview of European Banking Sector**

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Abstract

Evidence from contemporary research results proves that good corporate governance practices are a fundamental indicator in determining a company's performance. Corporate risk management disclosure assures stability in a business strategy design and decision-making process. The aim of this study is to obtain significant empirical evidence on the impact of good corporate governance (independence and existence of the committees) and company's performance (return on assets and leverage) and characteristics (company size) towards corporate risk management disclosure. The paper investigates data from the European banking sector evidence. As data source for this study, the information is extracted by Thompson Reuters database and by content analysis of banks published integrated reports during the years of observation. The research questions are addressed by employing regression analysis as a model of research, conducted in IBM SPSS Statistics. The partial results show a possible association between the complexity of risk disclosure, good corporate governance practices and company's performance. Prior studies results demonstrate significant effects of financial performance indicators on corporate risk management disclosure. Also, the company size seems to be positively and significantly related to risk disclosure. Moreover, the effects of corporate governance from previous research are demonstrated; accordingly, similar results are expected from the current study as well. Thus far, the research which assimilates risk management and corporate governance is still limited and in the development phase. This paper may provide consistent results in the research area and supports future approaches.

Keywords: risk management disclosure, good corporate governance practices, financial performance, econometric analysis.

JEL Classification: M14, M16, M21.

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1. Introduction

In light of the prominent accounting misconduct and worldwide magnitude financial crises that characterised the beginning of the 21st century in the economic environment, there has been a heightened focus among scientific research activity on corporate governance practice. Since the interest of researchers has a continuous growth in the realm of the subject of risk management and the various obstacles encountered by companies in unfavourable scenarios (Hazaea et al., 2022).

Through years, the issue of what do good corporate governance practices imply (Einde et al., 2023) and how this may impact the adoption and continuous improvement of risk management processes was raised often. The risk management policies are intrinsically linked to its governance strategies, as robust corporate measures can mitigate poor decision-making (Ghofar et al., 2022).

With the aim of revealing what might be the effects of good corporate practices towards corporate risk management disclosure, the current paper is structured as follows. In the second section, a comprehensive literature review of contemporary studies in the field is conducted. The aim of the study and the research question addressed are uncovered in the third section. The methodology approach, along with the explanation of the econometric model, are presented in Section 4. The results are discussed in the fifth section of this research, followed by the concluding section, which presents the key findings of the study, along with its limitations and possible avenues for future research directions in the domains of corporate governance and risk management.

2. Overview of the Scientific Literature

The assurance of financial stability and the integrity of a business are supported by transparency, trust, and accountability, which are promoted by the corporate governance practice within the organisational environment (OECD, 2023). Dimes and Molinari (2023) argue that the effectiveness of corporate governance mechanisms has gained significant attention among the scientific research activity, as for the last two decades the concepts presents continuous evolution through the expansion of its theoretical framework (Komath et al., 2023).

The field of risk management has also developed into a significant area of studies within the corporate sector, the agency theory serving as one of the pivotal bonds between the concepts of risk management and corporate governance (Einde et al., 2023). Risk management processes involve implementing organisational strategies within a company that is suitable to address each specific risk that a company may encounter (Endang & Indah, 2020). Jing and Zhongtian (2022) state that the concern of risk management disclosure may have a direct impact on the decision-making process. Since risk management disclosure is still relatively less approached, the role of the board of commissioners could be notable in risk disclosure implementation (Baulkaran & Bhattarai, 2020).

Prior studies on corporate governance and risk disclosure generally support the idea that companies with robust corporate governance practices are more inclined to

transparently share information about their risks (Yu & Ruxin, 2023). Krishnamurti and Velayutham (2018) contended that the act of disclosing information regarding risks could potentially generate new sources of risk for a company, generating a negative reaction among investors. Moreover, while companies need to present the capability to execute risk management effectively, the act of risk disclosure represents a company's desire to inform annual report users about its facing threats (Endang & Indah, 2020).

Ghofar et al. (2022) examined the effects of independent audit committee on corporate risk management, the findings showing that the level of audit committee independence does not present a significant impact toward risk management disclosure. The findings are supported by Utami et al. (2021), who argue that the independent audit committee is not directly involved in the firm's business processes and may lack access to adequate sources of information necessary for a comprehensive understanding of risk management activities. Sun and Xiao (2024) research also addressed the issue of the independency at the board level, in the context of recent global stock market fluctuations. The results of the study support the impact of board independence on the decrease in corporate risk information disclosure.

Einde et al. (2023) conducted research on how company performance indicators can present effects on risk management disclosure, as good financial performance indicators might encourage a higher probability of wider disclosure of risks. The research presents mixed results, as leverage might have an effect on risk management disclosure complexity, whilst profitability and liquidity does not. Similar research findings from Endang and Indah (2022) show that the return on equity might not have a significant impact toward risk management disclosure.

The significance of corporate governance and transparency is widely debated in the literature on risk disclosure; applying it in practical risk scenarios, companies might be exposed to complex challenges (Luo et al., 2024). Altunbas et al. (2023) observe through the study the effects of disclosure upon risk-taking within the European banking sector, risk disclosure being positively associated with a greater market discipline and with the increase in systematic risk.

In line with the agency theory, prior studies suggest that a company's tendency to disclose risks may be associated with the intention of signalling good corporate governance practices (Raimo et al., 2022). Also, the companies are motivated to increase their risk disclosure complexity as a way to indicate a robust risk management practice and to increase the company's value (Khandelwal et al., 2023).

3. Aim of the Research

The objective of the current study is to obtain significant empirical evidence to the impact of independent corporate governance committees and financial performance and corporate characteristics towards risk management disclosure, within the European banking sector. Independence of committees is seen as a proxy to the use of good corporate governance practices among companies, in line with contemporary scientific literature in the field. Thus, the current study

lies under the aim of providing significant results in observing how good corporate governance practices and corporate characteristics may present effects in risk management disclosure.

To date, prior studies that addressed the current matter encourage more research activity considering the effects of corporate governance mechanism towards risk management, by engaging variables such as audit committee independence (Utami et al., 2021), board independence (Sun & Xiao, 2024) and others associated with good corporate governance practices, and also financial performance indicators (Einde et al., 2023; Endang & Indah, 2022). Therefore, the developed research hypothesis is constructed as follows:

RH1: Good corporate governance practices and corporate financial performance positively affect risk management disclosure complexity.

This research may contribute to the existing literature to broaden the knowledge on corporate risk management by observing the effects of good corporate practices towards risk disclosure.

4. Research Methods

4.1 Research Population and Sample

The current study adopts a quantitative method of research, by incorporating a set of data collected from Thompson Reuters database and company financial statements and annual reports, available in the selected sample companies' websites. For the selection data criteria, there were included in the population only those companies which belong to the financial industry, specifically the banking sector, and whose headquarters are limited within the extent of the European territory. This research observes the effect of good corporate governance practices in corporate risk management disclosure, on 73 banks, whose headquarters are inside the European territory, within three-year observation period 2020-2022. A total of 219 observations were obtained as a sample.

4.2 Measurement of Variables

This study employs Risk Management Disclosure as dependent variable, further denoted as (RMD). Ghofar et al. (2022) and Einde et al. (2023) adopt a variable measurement through which disclosure complexity is scored by the level of meeting the risk disclosure criteria mentioned in the Committee of Sponsoring Organizations of the Treadway Commission Framework (COSO Framework). In line with this, the Risk Management Disclosure variable is given score 0 for no risk disclosure available for public information, score 1 if risk disclosure was available and vague, and score 2 if risk disclosure was not only available, but complex as well (Table 1).

The independent variables employed in this study could be divided as follows: corporate governance performance indicators and companies' financial performance indicators and characteristics. The good corporate governance practices are linked with a higher degree of independence at the level of corporate governance committees (Raimo et al., 2022), therefore, the variables selected for this study are

Board Independence (BI), Audit Committee Independence (ACI), Nomination Committee Independence (NCI), and Compensation Committee Independence (CCI). As good financial performance may be a determinant of good corporate governance practices (Ghofar et al., 2022; Einde et al., 2023), Return on Assets (ROA) and Leverage (Lev) were considered as variables in observing its impact on risk management disclosure. Also, as the company size could be directly linked to the level of risk management implementation, Total Assets (TA) was included as independent variable in the current study’s research model.

Table 1. Variables measurement and description

Variable name	Measurement
Risk management disclosure	“0” – no disclosure available “1” – risk disclosure available and vague “2” – risk disclosure available and complex (the company’s reports provide significant and explicit information regarding risks)
Board Independence	Percent of independent members from total
Audit Committee Independence	Percent of independent members in the committee from total
Nomination Committee Independence	Percent of independent members in the committee from total
Compensation Committee Independence	Percent of independent members in the committee from total
Return on Assets	Net Income/Equity
Leverage	Total Debts/Equity
Company size	Ln (Total Assets)

Source: author’s own research.

4.3 Data Analysis Model

The data analysis method adopted in this study is descriptive statistical analysis followed by the hypothesis testing through the regression analysis technique. Results are obtained using IBM SPSS statistical application version 29. The data analysis model engaged in observing the impact of good corporate governance practices towards risk management disclosure is as follows:

$$RMD = \alpha_0 + \beta_1 BI + \beta_2 ACI + \beta_3 NCI + \beta_4 CCI + \beta_5 ROA + \beta_6 Lev + \beta_7 CS + \varepsilon \quad (1)$$

where:

RMD: risk management disclosure;

BI: board independence;

ACI: audit committee independence;

NCI: nomination committee independence;

CCI: compensation committee independence;

ROA: return on assets;

Lev: leverage;

CS: company size;

α_0 : constant;

$\beta_1 \dots \beta_7$: regression coefficient;

ε : error term.

5. Result and Discussion

5.1 Frequency Analysis and Unidimensional Repartition Parameters

The frequency analysis of the risk management disclosure variable could be observed in the frequencies table below (Table 2). The majority of the observations (124) present complex risk disclosures, covering 56.6% of the total population. Moreover, only 15.5% of the observations were missing the risk disclosure.

Table 2. Risk management disclosure frequency analysis

Valid	Frequency	Percent	Valid percent	Cumulative percent
0 "no disclosure"	34	15.5	15.5	15.5
1 "vague disclosure"	61	27.9	27.9	43.4
2 "complex disclosure"	124	56.6	56.6	100.0
Total	219	100.0	100.0	

Source: author's own research.

The results obtained above may also be confirmed via the unidimensional repartition parameters, as it can be seen in Table 3. Considering the quartiles values, the population distribution is presented as in 75% of the cases there is at least a vague risk disclosure met in the annual banks' reports.

Table 3. Unidimensional repartition parameters of risk management variable

Statistical parameter	Values
N	Valid 219
	Missing 0
Median	2.00
Mode	2
Percentiles	25 1.00
	50 2.00
	75 2.00

Source: author's own research.

5.2 Correlation Analysis

The correlations between the variables of the current research are measured using Spearman's coefficient. Table 4 presents the results of the bivariate correlation analysis. The results show that a correlation could be observed between risk management disclosure and the nomination committee independence. Spearman's correlation test indicates that relationships exist between board independence, audit committee independence, compensation committee independence, and company performance indicators. Similar to Ghofar et al. (2022), inconsistencies in correlation analysis could be noted, as the effects of the governance variables towards corporate risk management disclosure are limited.

Table 4. Bivariate correlation analysis

		RMD	ROE	Lev	CS	BI	ACI	CCI	NCI
RMD	Corr.	1	0.054	-0.050	-0.006	0.120	0.033	-0.004	0.157*
	Sig.		0.424	0.461	0.927	0.077	0.627	0.948	0.020
	N	219	219	219	219	219	219	219	219
ROE	Corr.	0.054	1	-0.568**	-0.608**	-0.071	-0.093	-0.210**	-0.105
	Sig.	0.424		0.000	0.000	0.297	0.170	0.002	0.120
	N	219	219	219	219	219	219	219	219
Lev	Corr.	-0.050	-0.568**	1	0.644**	0.091	-0.012	0.209**	0.027
	Sig.	0.461	0.000		0.000	0.181	0.856	0.002	0.688
	N	219	219	219	219	219	219	219	219
CS	Corr.	-0.006	-0.608**	0.644**	1	0.100	0.121	0.233**	0.212**
	Sig.	0.927	0.000	0.000		0.140	0.075	0.001	0.002
	N	219	219	219	219	219	219	219	219
BI	Corr.	0.120	-0.071	0.091	0.100	1	0.604**	0.671**	0.110
	Sig.	0.077	0.297	0.181	0.140		0.000	0.000	0.104
	N	219	219	219	219	219	219	219	219
ACI	Corr.	0.033	-0.093	-0.012	0.121	0.604**	1	0.745**	0.172*
	Sig.	0.627	0.170	0.856	0.075	0.000		0.000	0.011
	N	219	219	219	219	219	219	219	219
CCI	Corr.	-0.004	-0.210**	0.209**	0.233**	0.671**	0.745**	1	0.176**
	Sig.	0.948	0.002	0.002	0.001	0.000	0.000		0.009
	N	219	219	219	219	219	219	219	219
NCI	Corr.	0.157*	-0.105	0.027	0.212**	0.110	0.172*	0.176**	1
	Sig.	0.020	0.120	0.688	0.002	0.104	0.011	0.009	
	N	219	219	219	219	219	219	219	219

Note: *. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Source: author’s own research.

5.3 Regression Analysis

The regression model is performed in order to test the hypothesis of the research on how good corporate governance practices may impact the risk management disclosure. Considering the results presented in Table 5, the engaged regression model considered in this study is statistically significant, as the threshold of 0.05 is not exceeded (Sig. = 0.015).

Based on the hypothesis testing presented in Table 5, the results obtained confirm that corporate governance variables may present significant effects towards the complexity of risk management disclosure.

Table 5. Risk management disclosure frequency analysis

Model	-2 Log Likelihood	Chi - Square	df	Sig.
Intercept Only	423.664			
Final	406.292	17.372	7	0.015

Source: author’s own research.

Starting from the tested hypothesis research *RH1: Good corporate governance practices and corporate financial performance positively affect risk management disclosure complexity*. Table 6 presents the results on how corporate variables and financial performance indicators may impact the disclosure risks within the European banking sector. Hence, board independence, audit committee

independence, nomination committee independence, and compensation committee independence are used as proxy to determine the effects of corporate governance towards risk disclosure.

Table 6. Risk management disclosure frequency analysis

Model	Unstandardised Coefficients		Standardised Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	0.849	0.873		0.973	0.032
BI	0.702	0.313	0.200	2.242	0.026
ACI	0.212	0.313	0.062	0.678	0.499
NCI	0.416	0.164	0.175	2.529	0.012
CCI	-0.543	0.258	-0.206	-2.102	0.037
ROA	9.297	7.033	0.106	1.322	0.188
Lev	0.010	0.012	0.074	0.859	0.391
CS	-0.010	0.036	-0.025	-0.281	0.779

Source: author's own research.

The results presented in the table above, show that board independence might have a positive impact on risk management, by recording t – value 2.242 and by reaching 0.026 statistical probability value, which does not exceed the significance threshold of 0.05. In the same line, Sun and Xiao (2024) argue that the existence of independent board members impacts the corporate risk information disclosure.

Similar to Utami et al. (2021), the independent audit committee, however, does not present a significant impact toward risk management disclosure, the Std. Error recording 0.313, however, not statistically significant above threshold (Sig. 0.499). The results might be supported by the fact that the independent audit committee did not take any direct part in the firm business process and may not have disposed of sufficient information source for risk management activity knowledge (Ghofar et al., 2022).

The independence level within the nomination committee may have significant effects towards risk disclosure (Sig. 0.012), while the compensation committee independence level might negatively impact the complexity of risk reports within European banks (B value -0.543, Sig. 0.037), the result being statistically significant. In the same direction, prior research stated that the independence of the board of commissioners might also impact the risk disclosure (Baulkaran & Bhattarai, 2020), the tendency of a company in disclosing information about risk being a sign of robust corporate governance practices (Raimo et al., 2022).

The financial performance indicators, return on assets and leverage, do not present significant influence toward risk management variable, the significant threshold of statistical Sig. being exceeded. Prior studies in the field mark mixed results while analysing the effects of various performance indicators toward corporate disclosure, good financial performance not necessarily suggesting also prominent inclination in the desire of risk disclosure (Einde et al., 2023; Endang & Indah, 2022). Khandelwal et al. (2023), states that if a company's primary concerns lie within the increasing firm value, then the probability of risk disclosure complexity could be higher in order to mark strong risk management practices and to gain investors' attention.

6. Conclusions

The current study aims to observe the effects and to offer empirical evidence on good corporate governance practices (independence and existence of the committees) and corporate characteristics (financial performance indicators and company size) toward risk management disclosure among the European banking sector, observed between 2020-2022. Based on the results of the current study, there is proof that a significant influence of corporate governance mechanisms towards risk disclosure has been met. Corporate governance practices such as board member independence may present a direct positive impact towards risk management disclosure complexity and quality (Gull et al., 2023). The nomination committee and compensation committee might have a considerable influence upon a company's desire to present corporate risk disclosure implementation (Baulkaran & Bhattarai, 2020). The financial performance indicators used in this research as a proxy in observing the impact of corporate characteristics against risk disclosure seem to not significantly affect the complexity of risk reports. The results show that the bank size does not seem to significantly impact the corporate risk disclosure, as a company profile does not necessarily also suggest a notable inclination in the desire of risk disclosure (Einde et al., 2023), while Abdulla and Elshandidy (2023) support that a bank size may affect the compliance level within an institution, indicating a widened risk disclosure. As good financial performance indicators might encourage a higher probability of wider disclosure of risks, prior studies in the field present mixed results in the effect of a company profile towards risk management disclosure (Einde et al., 2023; Endang & Indah, 2022).

Considering the study's limitations, the sample of the research addresses only the banking sector which's headquarters are within European territory, however it may provide a comprehensive observation on corporate governance mechanisms effects towards risk management. Future research may approach an extended objective with a wider period of observation. A cross-sectional analysis between different industries may be suitable and contribute with consistent results to the existing literature evidence in the field as well.

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Two-Decade Bibliometric Analysis of Collaborative Trends in Gambling Studies: A Structured Literature Review and Analysis of Gambling Research (2004-2023)

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Abstract

This research analyses the field of gambling studies from the perspective of digital technologies over the past two decades (2004-2023). In the study, we use both qualitative and quantitative methods in order to identify the risks associated with gambling and the impact of digital technologies on them. We analysed 929 articles indexed on the Web of Science by Clarivate Analytics which contained the word “gambling” and were published exclusively in English. The analysis focuses on the themes which influence gambling studies, identifying the most popular topics utilised in studies: risk and technology. We have used qualitative analysis to identify and group the analysed subjects from each theme. Two main directions have been identified in the study: technological innovation and data analysis for business decision improvement. The bibliometric analysis and also the identified main themes from gambling studies ranging from 2004 to 2023 represents the originality of the study. The contribution this study brings is given by the main identified trend: gambling studies are steadily growing on a yearly basis.

Keywords: Gambling Research, Digital Technologies, Risk, Structured Literature Review.

JEL codes: L83, G41.

1. Introduction

In recent years, technological progress determined a rapid digitalisation of many fields of activity. Gambling has been impacted nonetheless, which determined us to engage in this study. As a goal of our study, we wanted to materialise the main

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themes which influenced gambling studies which also refer to digital technologies. In order to do this, we have analysed 929 articles indexed in Web of Science by Clarivate Analytics, which have been published from 2004 to 2023. As gambling expanded online, becoming more and more accessible, more and more scientist started to be interested in the impact on the actual players, and the risks they pose to these players (Lawn et al., 2020).

The research questions we seek to answer are as follows:

RQ1. Which gambling related articles have been the most cited?

RQ2. What are the main themes which influenced gambling-related articles?

This being said, our bibliometric analysis sheds light on the direction of gambling studies. The qualitative analysis part provides an overview of the research direction.

2. Research Methodology

In this study, we combined both qualitative and quantitative analyses of the existing literature, also incorporating a standard literature review (SLR). Data was extracted from Web of Science and consists of articles written in English which contained the keyword “gambling” in the abstract.

A total of 929 articles were analysed and grouped in two categories: the ones referring to risks associated with players and the ones referring to digital technologies which facilitated access to online gambling.

To identify articles that refer to risks associated to players, we selected all articles that contain the word “risk” in their abstract.

To identify articles referring to digital technologies, we filtered those papers that contain words like “online”, “internet”, “digital”, “technology”, “web”, “virtual”, “cyber”, “online platform”, “online gamble”, “internet gamble”, “online betting” and “internet betting” in their abstract.

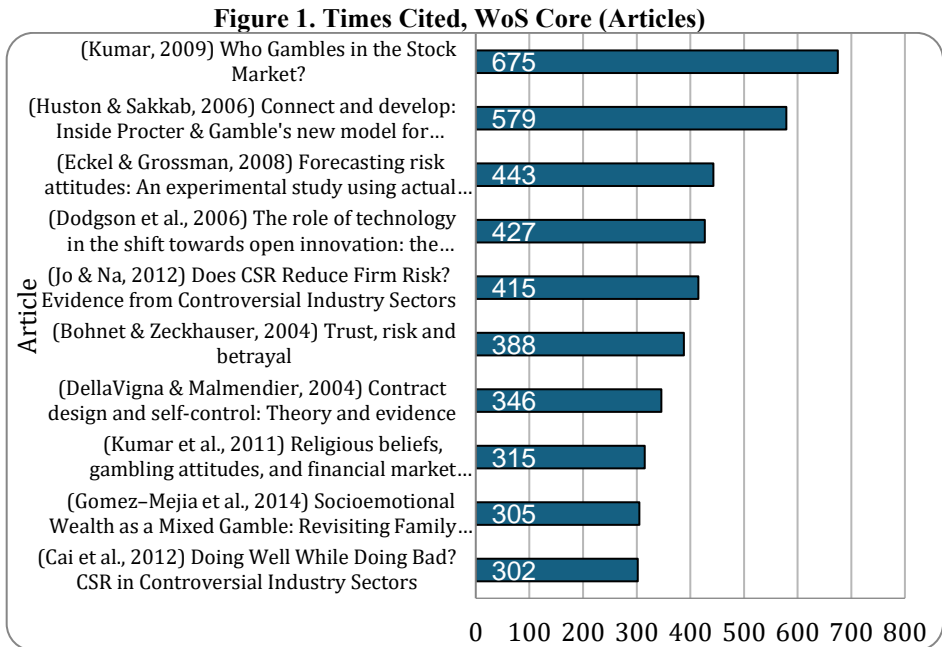
3. Top Cited Articles in Gambling Research

The initial analysis of the data shows that an increasing number of researchers are interested in studying gambling. In recent papers, the topics which were of the most influential were the ones pointing out the negative or harmful aspects of gambling, including it on the list of sinful industries along with industries such as tobacco, alcohol, and even weapons (Grougiou et al., 2016).

Figure 1 presents the top 10 most cited articles in the field of gambling studies. The most cited article in the field of gambling is an article published by Kumar (2009) work titled “Who Gambles in the Stock Market?”. Due to their high citation count, these articles play an important role in influencing future research and developments related to gambling.

The top 10 most cited articles have been collectively cited 4,195 times over the course of the 20 years analysed. This represents 18.1% of the total citations in the entire analysed dataset, despite comprising only 1.1% of the total articles (10 out of 929). In total, all 929 analysed articles have been cited 23,180 times.

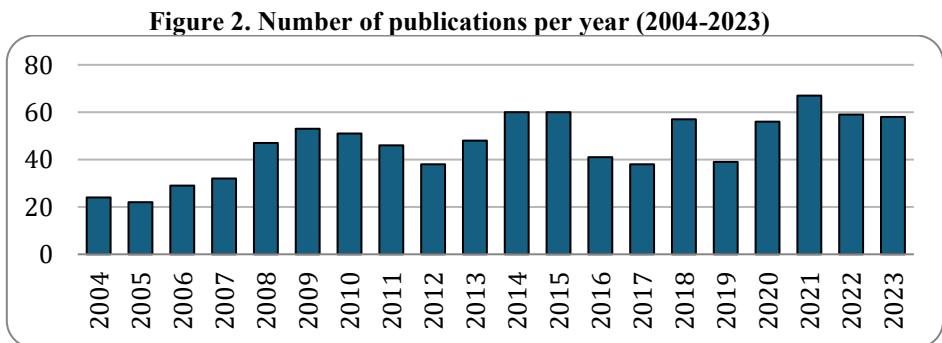
This high number illustrates the bibliographic foundations upon which gambling research has been built over the past 20 years, revealing the important articles that have influenced this field and the primary interests of researchers.



Source: authors' processing using Microsoft Excel application (Microsoft Excel, 2024).

4. Trends in Publication Over Time

The line graph in Figure 2 illustrates the trends in the gambling research publications from 2004 to 2023.



Source: authors' processing using Microsoft Excel application (Microsoft Excel, 2024).

As it can be observed, the number of publications over these years fluctuated noticeably. At the beginning of the analysed period, the number of articles was 24 in

the year 2004 and 22 in 2005. This was also the year with the fewest publications within the interval.

The years with the most publications were 2021 with a record number of 67 publications, 2014 and 2015 with 60 each.

4.1 Main Themes Addressed

The most common themes in these articles are:

- a) The risks associated with gambling, focused on the negative effect that they have on societies and individuals
- b) The internet, digital platforms, and new technologies which created a new landscape for gambling in terms of accessibility and interactions

a. Risks Associated with Gambling

Some articles focus on the effectiveness of implemented regulations for controlling gambling and methods to prevent addiction. A total of 337 articles contain the word “risk”.

Analysing the themes addressed within the top 10 most cited papers that include the term “risk” in their abstracts identified how attitudes toward risk are influenced by gender, education, and social or economic context, as observed in studies by Eckel and Grossman (2008) and Bohnet and Zeckhauser (2004). Gender differences in risk attitudes and stereotypes, as well as the reliability of predictions about risk preferences, are highlighted by Jo & Na (2012). Another identified theme is the interaction between trust and risk in decision making (Bohnet & Zeckhauser, 2004). The comparison between firms in controversial and noncontroversial industries is illustrated by Ross (2004), and modelling uncertainty and its connections to decision theories are analysed in the work of Eckel et al. (2009). The work of Chetty and Szeidl (2007) addresses the impact of consumption commitments on risk preferences. These represent some of the most impactful themes addressed by the top 10 most cited articles, as shown in Table 1.

Table 1. The Top 10 Most Cited Articles in the Gambling Field Referring to “Risk”

No.	Reference	Main Themes	Times Cited, WoS Core
1	Eckel and Grossman (2008)	Measurement of Risk Attitudes through Gamble-Choice Task Gender Differences in Risk Attitudes Exploration of Stereotyping in Risk Preferences Accuracy of Risk Preference Predictions	443

No.	Reference	Main Themes	Times Cited, WoS Core
2	Jo and Na (2012)	CSR Impact on Firm Risk in Controversial Sectors Risk reduction versus window dressing hypotheses Methodological Approach to Address Endogeneity Comparative Analysis Between Controversial and Non-Controversial Firms	415
3	Bohnet and Zeckhauser (2004)	Trust vs. Risk in Decision Making Comparative Analysis of Trust and Risk Games Measurement of Risk Acceptance through MAPs Higher Risk Premium for Trust Decisions	388
4	Ross (2004)	Myth of incentives and risk willingness Conditions Influencing Risk Aversion Through Incentives Analysis of Common Incentive Structures Duality of Fee Schedules and Risk Modification	280
5	Chetty and Szeidl (2007)	Impact of Consumption Commitments on Risk Preferences Resolution of Expected Utility Theory Puzzles Applications to Policy Design and Economic Behaviour Empirical Evidence Supporting the Model	183
6	Booth and Nolen (2012)	Influence of Gender Composition on Risk Preferences Impact of the Educational Environment on Risk-Taking Behaviour Risk Behaviour among Girls in Different Educational Settings Social Learning vs. Inherent Gender Traits in Risk Behaviour	182
7	Eckel et al. (2009)	Temporal Evolution of Risk Preferences Post-Disaster Comparison with the Resident Population Gender Differences in Risk Preferences Emotional states as Predictors of Risk Choices	167
8	Jin and Yu Zhou (2008)	Behavioural Portfolio Selection in Prospect Theory Challenges of Model Formulation Novel Solution Approach for Well-Posed Models Optimal Wealth Positions and Policy Implications	158
9	Aumann and Serrano (2008)	Novel Definition of Gamble Riskiness Axiomatic Characterisation of the Risk Index Properties of the Riskiness Index	147

No.	Reference	Main Themes	Times Cited, WoS Core
10	Grougiou et al. (2016)	CSR Reporting Strategies in Stigmatised Industries Increased CSR Reporting Among Sin Firms Litigation Risk Influencing CSR Reporting Strategic Goals Behind CSR Disclosures	141

Source: authors' processing using Microsoft Excel application (Microsoft Excel, 2024).

b. Internet, Online Platforms, and Technologies

Technology advancements have transformed the landscape of gambling activities. Having access to internet and online platforms, a high number of people have engaged in online gambling activities.

We have trimmed out a database of 929 articles using the keywords “online”, “internet”, “digital”, “technology”, “web”, “virtual”, and “cyber”.

Within these highly cited works addressing digital technologies, we identify the utilisation of other keywords such as technological innovation and open collaboration in innovation, as discussed by Dodgson et al. (2006), and data collection technologies, talent analysis, and their impact on organisational performance described by Davenport et al. (2010). The work of Cotte and Latour (2009) examines the challenges and opportunities of online gambling, highlighting how digital technologies affect user access and experience. Coussement and De Bock (2013) focuses on customer retention through improving on-line experiences to enhance loyalty to platforms. In their work, Brick and Visser (2015) explore technology diffusion and the adoption of innovations in the gambling sector. The need for effective talent acquisition strategies are emphasised in Ready and Conger (2007), which is identified as crucial for innovation and business growth. The motivation to attract players toward online gambling and addressing challenges related to legislation, online security, and social ethics is brought to light by Yanide-Soriano et al. (2012). Jolley et al. (2006) highlight how operators can meet customer expectations by enhancing service offerings.

All are below, as part of Table 2.

Table 2. The top 10 articles most cited in the field of gambling that reference technology

No	Reference	Main Themes	Times Cited, WoS Core
1	Dodgson et al. (2006)	Innovation Technology Open Innovation	427
2	Davenport et al. (2010)	Data-Collection Technology Talent Analytics Business Performance	146

No	Reference	Main Themes	Times Cited, WoS Core
3	Humphreys and Latour (2013)	Media Frames Consumer judgments Online gambling	110
4	Viney et al. (2014)	Discrete Choice Experiments (DCEs) Quality-of-life health states Utility function EQ-5D Health States	98
5	Cotte and Latour (2009)	Online gambling Consumption experience Social welfare implications	98
6	Coussement and De Bock (2013)	Churn Prediction Customer Relationship Management Generalised Additive Models	88
7	Brick and Visser (2015)	Technology diffusion Risk-induced poverty trap Framed index insurance	85
8	Ready and Conger (2007)	Talent management systems Strategic Management Roles High-potential employees	84
9	Yani-de-Soriano et al. (2012)	Online gambling Corporate Social Responsibility (CSR) Health Issue	65
10	Jolley et al. (2006)	Customer satisfaction Online gambling experiment Past behaviour (habit) Actual behaviour (retention)	59

Source: authors' processing using Microsoft Excel application (Microsoft Excel, 2024).

5. Conclusions

The analysis of the most cited articles that reference digital technologies highlights the significant contributions of previous research to studying the impact of digital and innovative technologies on the gambling industry. In our study, we also identified which articles are the most cited and most influential in the field.

Looking at the themes addressed, we can notice that they are diverse, ranging from challenges and opportunities in online gambling, customer retention strategies, innovation adoption, talent acquisition, the influence of digital and social media, to aspects related to problematic gambling.

Combining the analysis of the top 10 most cited articles referencing digital technologies and the top 10 referencing risks, we can conclude that the internet plays a significant role in gambling behaviour and that there is a growing concern over the importance of identifying problematic behavioural interventions related to gambling. Other themes also relate to gambling income and excessive spending, highlighting the necessity of monitoring the social risks associated with gambling.

As a general conclusion, researchers tend to show more interest in gambling studies and the social impact of gambling in general.

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How is the Adoption of E-invoicing System Affecting the Outsourcing of Accounting Services?

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Abstract

Digital technologies have significantly transformed our society by changing the way people communicate, work, and trade. Due to digitalisation, transactions occur faster and they can be easily tracked. Electronic data transfer enables automatic data processing and electronic archiving of documents. Worldwide, there is a growing interest from the tax authorities to monitor and control the business transactions. Considering that in many countries, taxpayers have to exchange e-invoices through the servers administered by the tax authorities. Over the years, the outsourcing of accounting services has become a very widespread practice among small companies for cost reduction reasons. This paper investigates the effects of e-invoicing system adoption on the outsourcing of accounting services. We had in view Technology Organisation Environment (TOE) framework as theory and Romanian business context. We collected data using the content shared online by big four companies on their own websites and accountants on social networks. Following our theoretical framework, the results indicated that environmental context, especially the government regulations, put pressure on organisations to digitalise their business processes or to update the existing technologies in order to accommodate e-invoicing. Our findings revealed that the mandatory adoption of an e-invoicing system creates new opportunities for those companies being larger in size to fully or partially outsource their accounting services. Most accountants believe that an e-invoicing system can remove information delays and it can ensure immediate access to data which is crucial for decision making in case of larger companies. Furthermore, e-invoicing system enables invoice tracking, continuous invoice processing in accounting, and near real-time reporting. Our study has implications for clients and accounting firms, and we emphasised that mandatory adoption of e-invoicing system has a strong impact on accounting outsourcing since it facilitates remote delivery of services and the use of cloud accounting, automatic data collection, and processing due to electronic data transfer.

Keywords: accounting outsourcing, e-invoicing system, cloud accounting, electronic data transfer, automatic data processing.

JEL Classification: M41, M55, O33.

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1. Introduction

The digital revolution has transformed our society and changed the way people communicate, work and trade (Xia et al., 2023). Digital technologies redesigned the business models, accounting, and auditing practices because at this moment transactions can be remotely initiated, occur faster and they can be easily tracked (Knudsen, 2020). Digitalisation made possible the electronic data transfer and exchange of digital documents between the partners, which enabled automatic data processing and electronic archiving of documents (Kokina & Blanchette, 2019).

All over the world, the tax authorities are more and more interested to monitor the business operations and to collect more money from taxes, and digitalisation can contribute to the achievement of these objectives (Uyar et al., 2022). In order to mitigate tax evasion, in many countries tax authorities introduced mandatory e-invoicing system and the implementation of e-invoice is also beneficial for suppliers and clients since it enables the electronic data transfer between the parties (Heinemann & Stiller, 2024).

Outsourcing of accounting services has become very widespread over the years among many small companies seeking to reduce their costs and gain access to specialised expertise (Sharma, 2023). In most cases, smaller companies outsource all range of accounting services out of the need to comply with statutory obligations, whereas larger companies outsource only those activities that require specialised know-how (Rogošić, 2019). The provision of accounting activities involving a mix of internal and external accountants is on the rise today and this manner of organising and operating the accounting function poses lower risks (Islomov, 2022). Digital technologies facilitate outsourcing of accounting services, and the companies became more flexible and less hesitant towards the remote delivery of services considering the telework experienced during the Covid-19 pandemic (Isip, 2023).

After reviewing the existing literature on the e-invoicing system we discovered a lack of information in prior studies regarding the effects of e-invoicing system adoption on the outsourcing of accounting services and because of that research gap we decided to conduct this study considering the Romanian business context. Regarding the business environment, it is important to note that 80% of Romanian companies have fewer than 10 employees.

The aim of this paper is to investigate how the mandatory adoption of e-invoicing system affects the outsourcing of accounting services. We had in view the changes brought by the e-invoice for accounting process and the effects of e-invoice adoption on the outsourcing of accounting services. We engaged a qualitative approach using Technology Organisation and Environment (TOE) framework as theory, the business environment from Romania as research context and we collected data using the content related to e-invoice shared online by big four companies on their own websites and accountants on social networks.

Following our theoretical framework, the results indicated that environmental context, especially the government regulations, put pressure on companies to digitalise their processes or to update the existing technologies in order to accommodate e-invoicing. We found that mandatory adoption of e-invoice creates

new opportunities for larger companies to fully or partially outsource their accounting services. Then the e-invoicing system can remove the information delays and can facilitate immediate access to data. Furthermore, the mandatory adoption of e-invoice will lead to an increase in the remote delivery of services and in the use of cloud accounting. Finally, the e-invoicing system is expected to ensure the tracking of invoices, their continuous processing in accounting and near real-time reporting.

This paper is structured in the following manner: the first part introduces the problem statement containing the literature review and our theoretical framework. In the second section we described the research context, research questions, and research methods. In the third part we emphasised the results of our study and we discussed our findings having also in view the prior research. The final section is dedicated to conclusions, contributions, implications, recommendations, limitations, and directions for future research.

2. Problem Statement

2.1 Literature Review

Developments in the field of information and communication technology contributed to the digital revolution which had a strong impact on the economic and social dimensions of people's lives and brought about changes in the way individuals communicate, work, purchase and make payments (Xia et al., 2023).

Digitalisation reshaped our society, the business models, accounting and auditing practices considering that transactions can be remotely initiated, occur faster, and they can be easily tracked (Knudsen, 2020).

According to Kokina and Blanchette (2019), digitalisation made possible the electronic data transfer and exchange of digital documents between the partners, and for accounting function it came with opportunities such as automatic data processing and electronic archiving of documents.

As the economy becomes more and more digitalised, solutions like e-accounting or cloud accounting gain a strong importance and relevance. According to Teru et al. (2019), e-accounting applications can be used for carrying out record to report tasks for those companies that exchange documents with other organisations in electronic form, and they can ensure high processing speed, accuracy and immediate results.

A study conducted by Asatiani et al. (2019) regarding the impact of cloud technology on accounting outsourcing revealed that those companies that use cloud information systems to perform their daily business operations are more open to outsourcing some or all of the accounting tasks compared to the other organisations.

On the subject of taxation, all over the world the tax authorities are more and more interested to monitor the business operations and collect more money from taxes and digitalisation can contribute to the achievement of these objectives (Uyar et al., 2022).

In his study Alm (2021) mentioned that tax compliance can be improved if the tax authorities engage in tax reforms aiming to simplify the taxation systems, digitalise the taxation systems, and provide appropriate support to taxpayers.

Moreover, the digitalisation of the tax system should improve e-services, reduce the administrative burden, increase the tax compliance, enhance the collection of taxes and the adoption of big data, data analytics and artificial intelligence could help the tax agencies to prevent and detect the tax frauds (Martínez et al., 2022).

Given these advantages of digitalisation, Heinemann and Stiller (2024) observed that in many countries tax authorities adopted e-invoicing system in order to mitigate the tax evasion regarding the sales and purchases then to increase the amount of VAT paid by the companies and, in the end, to simplify the tax audits. Moreover, these researchers mentioned that e-invoice is also beneficial for suppliers and clients since it enables the electronic data transfer between the parties.

Bellon et al. (2022) observed that even though the e-invoicing system is functional for the companies, in some cases the tax authorities do not possess the right tools to analyse all data generated by the use of e-invoicing system and because of that the tax authorities lack a strong strategy for tax risk management.

Besides the e-invoicing system there are countries where the tax authorities also introduced other tax reporting obligations, such as the reporting of road transport of goods to track the movement of goods and SAF-T, which contains accounting records and reports (Merckx & Verbaan, 2019).

With reference to the outsourcing of accounting services, this practice has become very widespread over the years among many small companies that seek to focus on their core competences, streamline their accounting function, gain access to specialized expertise, and reduce their costs (Sharma, 2023).

In most cases, smaller entities outsource both routine and nonroutine accounting tasks primarily out of the need to comply with the statutory requirements, whereas larger companies rely more on their internal staff for routine tasks and outsource only those activities that require specialized know-how, such as reporting and compliance (Rogošić, 2019).

Digital technologies such as cloud computing and online meeting applications facilitate the outsourcing of accounting services and considering the telework experienced during the Covid-19 pandemic, organizations became more flexible and less hesitant towards remote delivery of services (Isip, 2023).

The provision of accounting activities involving a mix of internal and external accountants is on rise today since this manner of organising and operating the accounting function compared to full outsourcing can ensure ongoing and timely information and lower dependence on external providers (Islomov, 2022).

After reviewing the existing literature on e-invoicing system we discovered a lack of information in prior studies regarding the effects of e-invoicing system adoption on the outsourcing of accounting services and because of that research gap we decided to conduct this study considering Romanian business context.

2.2 Theoretical Framework

Technology Organisation Environment (TOE) framework was developed by Tornatzky and Fleischer (1990) and it is used to understand the adoption and the use of new technologies in organisations and to explain how technological, organisational, and environmental factors influence the implementation process.

TOE framework has the focus on the adoption of new technologies at the organisational level instead of individual level. Tornatzky and Fleischer (1990) indicated that the main components of TOE framework and their characteristics are: technology (availability, functionality, complexity, compatibility), organisation (size, structure, resources, readiness), environment (market conditions, macroeconomic context, regulatory requirements, technology infrastructure).

According to Hadwer et al. (2021) TOE framework is suitable to explain the adoption and the use of new technologies, since it provides a comprehensive perspective by having in view both internal and external factors. TOE framework was used in prior research to explain the adoption and the use of e-commerce (Adam et al., 2020), cloud technology (Hadwer et al., 2021), and big data (Sun et al., 2020).

3. Research Questions

The aim of this paper is to investigate the effects related to the mandatory adoption of e-invoicing system on the outsourcing of accounting services having in view the Romanian business environment as a research context.

In Romania at the beginning of the year 2023 according to National Trade Register Office there were active 1.6 million businesses represented by 1.2 million companies and 0.4 million natural persons and in Bucharest and Ilfov counties 22.5% of all active businesses from the country were registered (National Trade Register Office, 2022). Using the Eurostat database, we discovered that 80% of Romanian companies have less than 10 employees, then 19% of them have between 10 and 50 employees, and only 1% of all entities have more than 50 employees (Eurostat database, 2022). These characteristics of the Romanian business environment create opportunities both for companies and accounting firms as regards the outsourcing of accounting services.

An article published by PWC (2023a) emphasised that starting with the year 2015 Romania recorded every year the highest VAT gap (>30%) among all member states of the European Union and that has dramatically affected the state budget. Ernst & Young (2022, 2023) specified that the digitalisation of the tax system and tax administration in Romania is expected to mitigate the tax frauds, increase the collection of taxes, and the adoption of measures such as online cash registers connected to the servers of NAFA (National Agency for Fiscal Administration), SAF-T reporting, e-invoice and e-transport support those objectives.

In Romania the taxpayers have the obligation to use the e-invoicing system for B2G (business to government) transactions and delivery of goods with high tax risk since July 2022 and starting with January 2024 e-invoice has been extended to all B2B (business to business) transactions and from July 2024 the deductibility right

for expenses and VAT will be conditioned by the possession of e-invoices validated by NAFA information system (Deloitte, 2023; KPMG, 2023).

Considering the purpose of this study and the research context we formulated two research questions:

- RQ1. How is the adoption of e-invoicing system leading to changes for accounting process?
- RQ2. How is the adoption of e-invoicing system affecting the outsourcing of accounting services?

4. Research Methods

The aim of this study is to investigate how is the adoption of e-invoicing system affecting the outsourcing of accounting services and given the novelty of this research topic after several discussions with a couple of accounting practitioners having over 15 years of experience, we decided to use online information sources in order to have recent data.

Researchers like Debreceeny (2015) and Teoh (2018) emphasised that social media and social networks represent innovative data sources for accounting research, since they provide large amounts of data, multiple and recent perspectives, and valuable insights. Social media and social networks were used as main data sources in prior accounting research by Bellucci et al. (2019) for investigating the stakeholder engagement in sustainability reporting, Burke et al. (2019) for examining the auditor response to negative information on social media regarding their clients and Xie et al. (2023) for studying how social media is used by accountants to share knowledge and to create online networks of professionals.

Our data collection process involved gathering data using the content shared online by big four companies on their own websites and accountants on a social media group called Accountants on Facebook having more than 50,000 members (practitioners, professors, and students in the areas of accounting and taxation).

First of all, we accessed the websites of big four companies (Deloitte, Ernst & Young, KPMG and PWC) and we discovered seven relevant publications regarding topics related with e-invoice such as e-invoice, e-invoice and e-transport, e-invoice, e-transport, and SAF-T. We read the publications and the main aspects regarded what are the legal obligations of the economic operators, how are expected the organisations to fulfil those obligations, what are the common issues encountered by the companies and the existing software solutions for e-invoice management (Deloitte, 2024; PWC, 2023b).

Secondly, we visited the social media group called Accountants on Facebook and in order to find pertinent data related to e-invoice subject, we applied search filters. We identified 1,698 posts for the period between February 2022 and February 2024 out of which in January 2024 and February 2024 818 posts were generated. We copied the posts in a Word document then we read the posts, created summaries, and put them into categories (themes and topics). The main themes of the posts regarded e-invoicing system, software solutions for digital tax reporting, outsourcing of accounting services, remote accounting services, e-invoice, and e-transport.

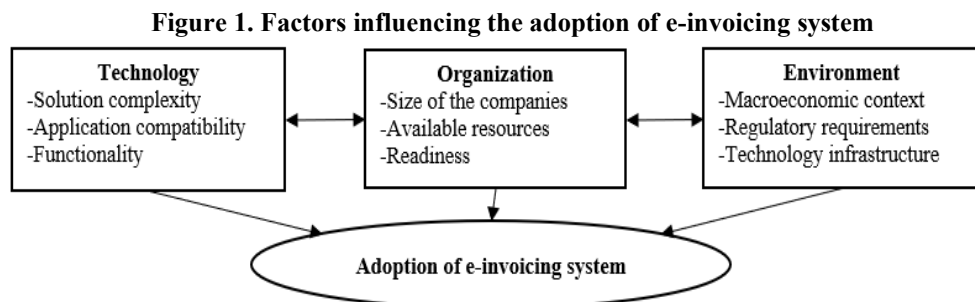
Further, we put all these pieces of information together to capture the picture of perspectives shared by accounting practitioners, and through data analysis our intention was to discover if the adoption of e-invoicing system has any influence or not on the outsourcing of accounting services. Our results are presented in the following section.

5. Findings

We organised the presentation of our findings around Technology Organisation Environment (TOE) framework and we constructed the narratives considering the challenges and opportunities regarding the adoption of e-invoice in Romania and having in view the themes of our research questions represented by the changes made by e-invoice adoption for accounting process then the effects of e-invoice adoption on accounting outsourcing without overlooking the other related topics such as technical solutions to accommodate e-invoice.

5.1 Explaining the Adoption of E-Invoicing System in Romania

Following our Technology Organisation Environment (TOE) framework, the environmental factor macroeconomic conditions in Romania represented by repeated high VAT gap caused by VAT frauds created the need to establish regulations related to the mandatory adoption of e-invoicing system for all companies regardless of their size. This legislative measure determined IT developers to provide the appropriate technology infrastructure. These regulations put a strong pressure on organisations to mobilise resources to digitalise their business processes or to update existing information systems in order to accommodate an e-invoicing system and to be ready to use it. Furthermore, the entities will condition the payment of suppliers on the submission and possession of e-invoices validated by the tax authority. When the companies have to make decisions regarding the adoption of new technologies, they have in view characteristics such as functionality, complexity, and compatibility with existing software products that are already used. For a better understanding we made a visual representation of the factors influencing the adoption of e-invoicing system in Figure 1.



Source: adapted from Tornatzky and Fleischer (1990).

5.2. Challenges, Opportunities and Changes Related to E-Invoice Adoption

Big four companies collaborated with software developers and possess several technical solutions to support their clients on one hand to easily generate and submit sets of e-invoices to the e-invoice platform and, on the other hand, to download, process and archive e-invoices issued by suppliers.

According to the information provided on their websites, big four companies organised many webinars for their clients in order to help them become familiar and gain a comprehensive understanding of the implications related to the mandatory adoption of e-invoice, e-transport and SAF-T. Moreover, big four companies can provide advisory or review services on request for their clients regarding the implementation and operation of e-invoice, e-transport and SAF-T.

Empirical evidence showed us that in Romania the mandatory adoption of e-invoicing system came along with challenges and opportunities both for suppliers, clients, tax authorities, internal and external accountants. For the moment e-invoice platform has only basic functionalities without the possibility to generate reports, then e-invoices are available only for a maximum period of 60 days and this is why accountants recommend to download e-invoices daily or weekly.

Considering the posts made on the social media group called Accountants on Facebook, most accountants believed that e-invoicing system creates opportunities such as automatic data processing, electronic archiving of documents, and outsourcing of accounting. In prior research, Kokina and Blanchette (2019) indicated similar opportunities brought by digitalisation such as exchange of digital documents, automatic data processing and electronic archiving of documents excepting the outsourcing of accounting. We presented in Table 1 the main topics contained in the posts created by accountants on the social media group called Accountants on Facebook.

Table 1. Main topics contained in the posts

Topic and Year	2022	2023	2024	Total by topic
E-invoice and E-transport	9	14	30	53
E-invoicing system	154	279	371	804
Outsourcing of accounting services	51	99	86	236
Remote accounting services	85	69	72	226
Software solutions for digital tax reporting	38	82	259	379
Total by year	337	543	818	1,698

Source: own processed information.

Some posts had in view the case of issuing invoices on behalf of suppliers (self-bills), whereas other posts raised concerns about the possibility of receiving invoices in e-invoice platform by mistake and the rejection process for those invoices.

As regards the software solutions for digital tax reporting we observed a high increase in the number of posts. Accountants agree that those technical solutions

which can easily integrate with the existing accounting information systems being able to submit and download sets of invoices from e-invoice platform and to process data contained in the received invoices are useful. Furthermore, several accountants indicated a couple of software products that could meet those needs based on their experience as users.

Accounting practitioners mentioned that digital tax reporting and the growing number of requests coming from the tax authorities with short deadlines have more and more emphasised that companies need integrated information systems such as ERP systems.

The opinions shared by most accountants is that digital tax reporting is the first and an important step to fight against the tax evasion in Romania, yet maximising the use of data reported by taxpayers is even more important. Most accountants believe that NAFA still uses only a very small amount of data from all the data submitted by taxpayers, and because of that, no significant improvements were observed in respect to the collection of taxes. In their study, Bellon et al. (2022) came to similar findings emphasising that in some countries the tax authorities do not use effectively all the data reported by organisations and that has a negative impact on the tax risk management.

Accounting professionals think that the adoption of e-invoicing system will change the accounting process by making the exchange of invoices between the companies easier and faster, facilitating the ongoing processing of e-invoices in accounting and enabling more the remote delivery of accounting services. Similar views on the possibility of companies to exchange documents easier and faster as main benefits of digitalisation were also conveyed by Knudsen (2020). The thoughts shared by accounting professionals regarding the possibility to deliver remote services due to cloud technology are consistent with the ideas communicated in prior papers by Teru et al. (2019) with the mention that these authors do not anticipate an increase in remote delivery of accounting services because their paper was published before the outbreak of Covid-19.

5.3 Effects of E-Invoice Adoption on Accounting Outsourcing

Taking into account the posts related to the e-invoicing system made on the social media group called Accountants on Facebook, we identified through data analysis several influences exerted by e-invoice adoption on outsourcing of accounting services and remote delivery of services.

Based on their work experience, accounting practitioners estimated that manual data collection and processing from paper documents such as invoices and bank statements used to take before more than 80% of the time allocated for accounting tasks. Nowadays with digital technologies, they think that the time allocated for the processing of invoices and bank statements will decrease at least to half because of the electronic exchange of data.

Moreover, accountants perceived an increasing competition among IT developers who are interested in promoting and selling their software products that are able to accommodate e-invoice and integrate with other information systems. Nevertheless,

accounting practitioners believe that IT developers often overstate the capabilities of their software products, and because of that, it is important to test the technical solutions before the purchase.

Considering the viewpoints shared by accountants, the main effects of e-invoice adoption on the outsourcing of accounting services regard the need for a tight collaboration of accounting firms with their clients, new possibilities of data collection and processing, and the expansion of the client portfolio with companies larger in size.

On the subject of e-invoice adoption, accounting professionals foresee a close collaboration with their clients, the need to use a common technical solution then clients should take the responsibility to approve or reject the e-invoices, and accounting firms should further process only the approved e-invoices. The software application should definitely enable the mass download of invoices from e-invoice platform and the mass approval of invoices by clients if necessary. The following step will be the transfer of approved e-invoices by clients into the accounting information system, and then the processing of e-invoices based on predefined validation and bookkeeping rules.

Since the adoption of e-invoice became mandatory for all businesses and the exchange of invoices between companies is made in electronic form through e-invoice platform, accounting practitioners strongly believe that the use of e-invoicing system creates new opportunities for those companies being larger in size to fully or partially outsource their accounting services. In prior studies Asatiani et al. (2019) indicated that in the past the companies larger in size manifested a lower tendency to outsource their accounting services compared to small companies because larger companies have an increased need of information with high frequency for decision making process, but in the digital age cloud technology can provide real-time collaboration possibilities, remote delivery of services, and by that to encourage larger companies to consider at least to opt for a partial outsourcing of their accounting services. Our result regarding the effects of mandatory e-invoice adoption on the outsourcing of accounting services has not been reported yet in the literature, since in prior research the connection between e-invoice adoption and outsourcing of accounting has not been investigated.

Most accountants agree that the e-invoicing system can remove the information delays since the invoices have to be submitted in the e-invoice platform no later than 5 days after its issuance date. Furthermore, this can facilitate immediate access to data which is crucial for decision making in case of larger companies. For companies, the adoption of e-invoice is expected to ensure the tracking of invoices, their continuous processing in accounting and near real-time reporting.

Few accountants indicated that there are accounting firms using the information system of their large clients to process the approved invoices, bank statements, and other transactions and in some cases the external accountants even make automatic payments from the information system of their clients. For those cases when the accounting firms use the information system of their clients, there are configured

some approval workflows with predefined rules and the clients have to approve the invoices and authorise the payments.

In the end, accounting professionals emphasised that the digital transformation of the business environment and society brought new value to their role and nowadays they can engage to a higher extent in advisory and compliance services as they are more and more free from the burden of repetitive tasks such as manual work related to data collection and processing from the invoices and bank statements.

In addition to that, accountants believe that companies being larger in size became more open to seek external support on a regular basis or to partially outsource some of their accounting tasks incorporating specialised knowledge in order to ensure their compliance with complex accounting and tax issues since those companies assessed that the noncompliance sanctions could be significantly higher than the costs incurred with the services provided by an expert.

6. Conclusions

The aim of this paper was to investigate how is the mandatory adoption of e-invoicing system affecting the outsourcing of accounting services. We had in view the changes brought by the e-invoice for accounting process and the effects of the mandatory adoption of e-invoicing system on the outsourcing of accounting services. We engaged a qualitative approach using Technology Organisation and Environment (TOE) framework as theory, the business environment from Romania as a research context. We collected and processed data related to e-invoice from online sources such as the publications of big four companies and the posts made on a social media group called Accountants on Facebook having more than 50,000 members (practitioners, professors, and students in the areas of accounting and taxation).

Following our Technology Organisation Environment (TOE) framework, the environmental factor macroeconomic conditions in Romania represented by repeated high VAT gap caused by VAT frauds created the need to establish regulations related to the mandatory adoption of e-invoicing system for all companies regardless of their size, even though 80% of Romanian companies have less than 10 employees. These regulations put a strong pressure on organisations to mobilise resources to digitalise their business processes or to update the existing information systems in order to accommodate the e-invoicing system and to be ready to use it. Our results emphasise that the mandatory adoption of e-invoicing comes with new opportunities for those larger companies to fully or partially outsource their accounting services. A large number of accountants think that e-invoice adoption can remove the information delays, since the suppliers have the obligation to submit the invoices no later than 5 days after their issuance date. Accounting practitioners agree that in case of accounting outsourcing the adoption of e-invoice can facilitate immediate access to data which is crucial for decision making in larger companies. Moreover, e-invoice adoption and dedicated software solutions are expected to ensure the tracking of invoices, their continuous processing in accounting and near real-time reporting.

We identified two limitations of our paper. The first limitation is related to our research context represented by the business environment from Romania, however, similar findings are not excluded if future research will be conducted on the same subject in other countries with similar profile like Romania. The second limitation has to do with the fact that we considered only the opinions shared by accounting practitioners because e-invoice for B2B transactions is in its early stage of adoption in Romania and accountants were the most exposed. Moreover, this paper is the first part of a wider research project and our intention is to extend this initial study by applying an online questionnaire so as to reach more participants both accountants and company managers.

Our main contribution was to present how is the adoption of e-invoicing system affecting the outsourcing of accounting services and analysing the link between the mandatory adoption of the e-invoice and the outsourcing of accounting services represents the novelty brought by our paper.

We recommend that managers of larger companies to consider a partial outsourcing for their accounting services, at least for those tasks that are related to compliance, since the benefits could outweigh the costs.

Our study has implications for clients and accounting firms since the implementation of the e-invoicing system is expected to lead to an increase in the remote delivery of services, then in the use of cloud accounting and the exchange of documents, data and information can occur much faster.

Although in this paper we had the main focus on how is the adoption of e-invoicing system affecting the outsourcing of accounting services, yet we discovered other research areas of interest such as the case of document processing by the business process outsourcing (BPO) providers located in other countries and the limitations of e-invoicing system to eliminate all tax frauds and because they are outside the purpose of this study, we propose them as directions for future research.

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**A Case Study on Performance Analysis
through Digitalisation and Gender Equality**

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Abstract

As the digital progress is significantly increasing, businesses must adjust and adopt the latest technologies in order to maintain their position in a competitive environment. Although digitalisation involves an important financial effort from companies, the benefits have proven to exceed the costs, contributing to the improvement of labor productivity and business growth. Nowadays, companies also strive to adjust their policies and business models in order to promote gender equality and comply with the Sustainable Development Goals. This paper aims to demonstrate the positive link between digitalisation, gender equality, and business performance on public companies worldwide. Current research uses the panel data regression method in order to analyse the relationship between total revenue, investment in software development, and board gender diversity. The results showed that businesses that engage in digital progress and promote gender diversity on the board of directors experience an improvement related to activity performance. The findings of this study can be used by employees in management positions in order to better understand the implications of digitalisation and gender equality in business processes and also the advantages of integrating them in the company's long-term goals. Although many studies regarding the impact of these two areas of interest already exist, this paper adds to the literature by providing an overview of the combined effect of both dimensions regardless of the activity field.

Keywords: business performance, digitalisation, gender equality, software investment.

JEL Classification: J16, O33.

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1. Introduction

In recent years, digitalisation has evolved into a critical component for companies in a variety of activity fields, altering workflows, and elevating functionality. Digital tools help the business environment grow faster by automating manual, repetitive work, removing the possibility of human error, thus improving efficiency and reducing costs. In addition, it assists in decision making by processing large amounts of data, offering valuable information for the management, while also creating a better experience for the customers. Even though the process of digitalisation implies significant costs, companies are investing large amounts of money to keep up with the technological progress.

By understanding how digital tools work and using them in a sustainable way, companies can achieve their strategic objectives in the competitive marketplace of today. In consequence, the relationship between digitalisation and business performance has become a topic of interest for business owners, employees, and specialists in the field. Together with digitalisation, the majority of companies around the world became more gender equality oriented, seeking to implement policies and processes which encourage the integration of women. Gender equality represents one of the 17 Sustainable Development Goals established by the United Nations, namely the fifth objective “Achieve gender equality and empower all women and girls”. This goal serves as a tool for the elimination of any form of discrimination between men and women in both public and private life. Gender equality intervenes in the process of harmonising the interests of shareholders with those of stakeholders, women having both executive and nonexecutive roles. The experiences and backgrounds of both men and women lead to ideas and visions which drive creativity, collaboration, and communication inside and outside of the company.

This paper is aimed to investigate if both the investment in digitalisation and gender equality promotion can push a company forward by increasing its overall performance. We endeavour to perform a quantitative analysis by using a multiple linear regression based on relevant indicators for the dimension of digitalisation, gender equality, and performance.

2. Problem Statement

The definition of any business model should be centred on performance as a key objective to achieve. In today’s society, the idea of performance has evolved, meaning not only remarkable results in terms of revenue, cash flow and efficiency of the allocation and use of resources, but also brand awareness, customer satisfaction, and sustainable growth.

Each company strives to achieve such objectives and maintain its long-term relevancy in the market through the most efficient means. Lately, the business environment had been facing a crisis towards the fast advancement of technology, which made it comply with the new tendencies in terms of activity automation and digitalisation.

The concept of digitalisation in relation to businesses can be explained as strategies that fundamentally transform company's operations, elevate customer value delivery for increased profitability, efficiency, and business progress. According to other definitions, digitalisation refers to the adoption of digital technologies in order to reshape the company's business model and release opportunities which facilitate value creation and change business conduct in a positive way (Wang et al., 2023). A more concise, but equally comprehensive definition is saying that digitalisation represents a managerial tool having the ability to improve the development of organisations due to risk mitigation and optimisation ways (Salvi et al., 2022).

A digitised industry involves the implementation of cyber-physical systems, smart factories, cloud-based management systems, and artificial intelligence meant to enhance visibility, productivity, and tracking of business performance (Fallahpour et al., 2021).

Despite being an expensive process to deploy, the overall results seem to exceed the efforts and contribute to a long-term better performance at all business levels. Findings have shown that digitalisation is simultaneously a prefactor for growth, plays an active role in the company's growth process and it is reflected in the outcome of growth. In regards to the first form of digitalisation, this is mirrored in new markets creation and opportunities on the one side and growth capabilities on the other side. As for the role played through the growing process, this is visible in market penetration, product innovation, market development, and diversification. Furthermore, digitalisation in the outcome of growth involves learning about growth and defining future digitalisation goals, adopting a pioneering approach by investing in competence development and continuous learning, management evolution, and creation of reputation capital (Matalamäki et al., 2021). According to other studies, knowledge-intensive industries and services can be reshaped by making fundamental changes and big data analytics. Also, digitalisation contributes to business performance and competitiveness, especially due to enhanced network cybersecurity and strong verification of personal certificates (Ribeiro-Navarrete et al., 2021).

In terms of the involved costs, much of the literature has shown that intense modelling and simulation can improve the cost-benefit assessment of digitalisation. This approach is useful for costs and benefits prediction, such as the resources consumed in delivery, customer wait times, and product quality.

Although digitalisation has proven most of the time to offer satisfactory results and amplify competitiveness in the business environment, the literature also provides analysis towards its potential negative impacts. Some studies relate that digitalisation can be negatively associated with money laundering but that is influenced by the ethical behaviour of companies in a given country. This belief is driven by the fact that systems and technologies are projected and treated by humans, and not paying attention to business ethics may lead to serious consequences such as erroneous decisions and illegal acts (Kheilil et al., 2023).

Furthermore, digitalisation raised serious difficulties in many fields of activity due to its rapidity, that puts organisations and individuals through a serious effort of getting accustomed and change their procedures and routines. Accounting for instance is a domain that evolved in parallel with information technology, however, the process of digitalisation of business processes is considered to be insufficiently covered and systematised (Kovalevska et al., 2022).

Alongside with digitalisation, the business environment seems to be more concerned about another concept which garnered significant attention in recent years, respectively, gender equality. Gender equality intervenes in the process of harnessing the company's human potential through making use of the entire available talent. The promotion of gender equality is beneficial for the creation of new carriers and positions within the company, increases productivity, and it also facilitates the transition to a green and digital economy.

Gender disparities in employment and entrepreneurship are influenced not only by macroeconomic factors such as country's development level, education, culture, and religion, but also by microeconomic factors such as the time allocated for business activities and the size of the organisation.

According to the existing literature, women should initiate and conduct businesses for a more prosperous economy. Adding to that, women entrepreneurship drives gender equality, women empowerment, social inclusion, and economic freedom. In 2022, research had been conducted in order to investigate the contribution of women to the total family income. The study had been focused on the rural areas from Faisal district in Pakistan where the financial opportunities are very small, the dominant profit source being agriculture and the related activities. Their research displayed local women's impressive efforts to support their family and cope with the poor economic conditions (Ge et al., 2022).

The progress towards gender equality had been tracked by the 3 authors: England, Levine, and Mishel who examined the evolution of multiple gender equality indicators during period 1970 - 2018. Their study represented the in-depth exploration of the gender inequality statistics for the United States, through researching the changes which occurred between 1970 and 2018 for a set of variables including educational attainment, segregation of fields of study, employment, segregation of occupations, and remuneration. The results have shown no significant gender differences between the level of studies and their segregation, however, fewer women than men were hired during the analysed period and had lower wages. Regarding the segregation of occupations, this variable had a descending trend demonstrating that the nature of professions does not represent an important determinant of gender inequality (England et al., 2020).

All of these aspects captured by the literature help us to create an overview of gender equality and how it impacts the business environment. The findings demonstrate that gender equality has a positive influence on the company. Escamilla-Solano et al. (2022) have performed a statistical analysis in regards to the effects of gender policies on company's financial performance, taking into consideration a number of 91 publicly listed companies in the Spanish Continuous

market during period 2016 - 2018. In order to evaluate the financial performance, the authors used the return on equity and the return on assets. The gender dimension has been studied based on the sustainability reports. The control variables were represented by the following indicators: company size, asset turnover, liquidity, and financial autonomy. The results proved that financial performance is positively influenced by the disclosure of the gender policies if the company monitors these control variables (Escamilla-Solano et al., 2022).

The positive correlation between gender equality and financial performance is strengthened by the research conducted by Hosoda and Nagano, who investigated the relationship between financial and nonfinancial results within a Japanese bank which consistently pursued the promotion of gender equality even though the banking industry in Japan is male-dominated. All interviewees were employees with experience in gender equality promotions at various levels of the organisation. Their answers demonstrated that gender equality has enhanced bank's general performance, due to the remarkable results obtained by the female employees in areas like personal contact, insurance to customers and selling investment products (Hosoda & Nagano, 2023). Furthermore, it has revealed that gender equality led to an increase in market relevancy due to the attraction of prospective investors. Another benefit expressed in the interviews was related to the cash flows generated by activities related to the innovation of products where female managers were part of the planning, development, and selling of the new products. Adding to that, studies show that women's contribution to family's total income can be very important in countries where the financial opportunities are rare.

Although most of the literature states that the promotion of gender equality is beneficial and a good driver of performance, there are some areas in a company's activity which indicate that the introduction of gender equality will not necessarily mean equal salaries for both men and women. An example in this regard is the gender pay gap, which has been evaluated to be negatively affected by a higher proportion of female managers with discretionary pay-setting power (Romero et al., 2023).

3. Research Questions / Aims of the Research

The study was driven by the need to find an answer to some theoretical and practical questions. Therefore, from a theoretical standpoint we wanted to validate if the investment in technology represents a competitive advantage for a company and also if gender equality promotion can facilitate long-term revenue growth. The practical objectives of the research were to determine which indicators express the best financial performance, digitalisation, and gender equality, and whether the effects of these three dimensions of interest are beneficial and should be integrated in business models.

4. Research Methods

In order to capture the impact of digitalisation and gender equality on companies' performance, data were collected from the Refinitiv Eikon database over the period of three years (2021-2023) and analysed using EViews 12 statistical software. The sample consists of 123 public companies worldwide, the data being collected independently of the field of activity to ensure a general overview of the connection between the three dimensions of interest.

The variables were divided into three categories: performance – total revenue, digitalisation – software development costs, gender equality – board gender diversity percentage.

In terms of measuring the degree of digitalisation in a company, investment in software development was considered relevant, as it enables automation of manual processes, increasing efficiency, and reducing human error. Increased costs in this area can also imply better data integration and processing, which helps management make important decisions. Software investment is also linked with sales, as it can improve the online platforms that clients use, such as websites or apps.

Board gender diversity was used as an indicator of gender equality, as the presence of women at the highest management level indicates that a company values diversity and inclusion. Gender diversity can contribute to the success of a business, as it brings a wider range of perspectives and experiences, which can lead to better informed and balanced decisions.

Total revenue is an essential indicator of a company's performance: it represents the base for profitability, the ability to cover expenses, makes a company trustworthy by both clients and investors, and helps the business generate cash flow, which is necessary for ongoing operations and long-term financial stability.

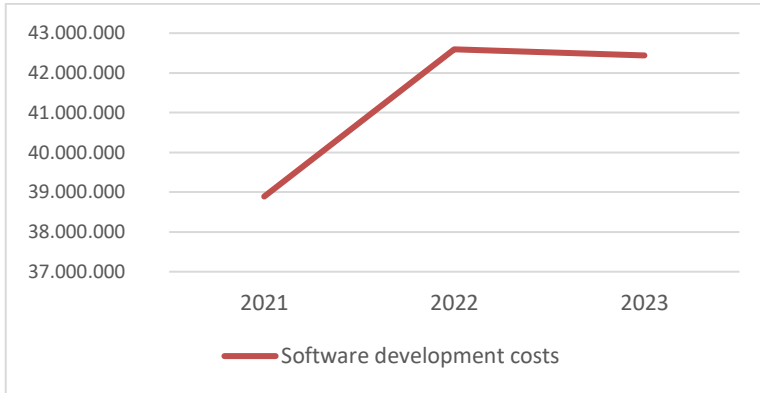
The research has a quantitative approach, using a panel data regression model based on the above indicators, where total revenue was chosen as the dependent variable, while investment in software development and board gender diversity represented the independent variables.

Total revenue is a metric that indicates if the company's strategies are leading to increased sales and business expansion and is calculated as revenue from all of a company's operating activities after deducting any sales adjustments and their equivalents. The degree of digitalisation was reflected by the investment in software development, translated into costs accumulated and capitalised to integrate technology information and automatise operations. The index for gender equality was determined by calculating the percentage of women on the board of directors.

The estimation in the regression analysis was done by using the Ordinary Least Square method (OLS). In order to enhance data comparability, total revenue and software development costs were normalised by applying the square root transformation.

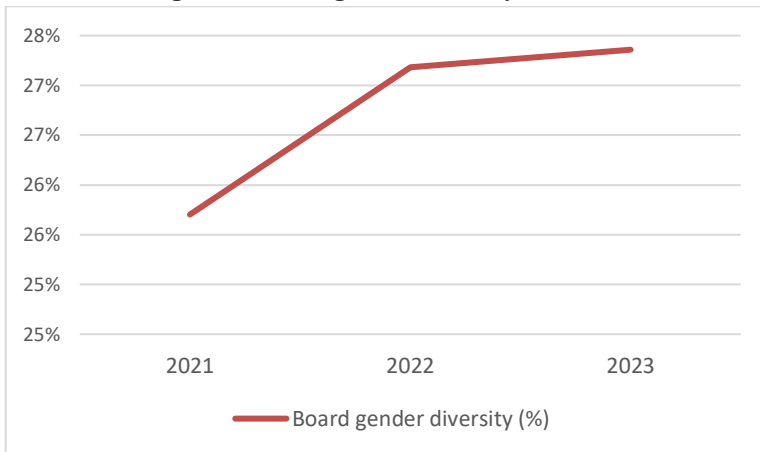
5. Findings

Figure 1. Software development costs evolution



Source: authors' own research results.

Figure 2. Board gender diversity evolution



Source: authors' own research results.

Taking into consideration the three fiscal years, a significant increase in both investment in software development and women integration in board can be observed from 2021 to 2022. In the next period, from 2022 to 2023, the costs for software development slightly decreased, while the board gender diversity percentage experienced a modest growth.

The equation of the regression model has the following form:

$$y = a + bx_1 + cx_2 + \varepsilon \quad (1)$$

where:

y – dependent variable – total revenue;

x_1 – independent variable – software development costs;

x_2 – independent variable – board gender diversity;
 a, b, c – unknown parameters of the regression function;
 ε – error term (residue) – random variable.

The first step is to perform the Hausman test, in order to determine if the estimates from two different models, namely fixed effects and random effects, are consistent with each other.

Table 1. The Hausman test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	60.371427	2	0.0000

Source: authors' own research results using EViews.

Running this test shows a probability associated with the Chi-Square test of less than 5% (0.0000). Therefore, the null hypothesis that the random-effects model is preferred over the fixed-effects model is rejected, which means that applying the least squares method with fixed-effects corrections to panel data is most appropriate.

Furthermore, the redundant fixed effects test was performed to establish if fixed effects are necessary to determine the impact that software development costs and board gender diversity have on total revenue.

Table 2. The Redundant Fixed Effects test

Effects Test	Statistic	d.f.	Prob.
Cross-section F	424.77942	-122,244	0.0000
Cross-section Chi-square	1978.991324	122	0.0000

Source: authors' own research results using EViews.

The associated probabilities of the two tests assessing the joint significance of the cross-section effects (Cross-section F and Cross-section Chi-square) are less than 5%, so the null hypothesis that the individual effects are redundant is rejected, and the inclusion of the individual effects is accepted.

Table 3. Results of the regression analysis

Variable	Coefficient	Std. Error	t-Statistic	Prob.	F-statistic	Durbin-Watson
c	34106.6887	1661.7646	20.5243	0.0000	0.0000	1.8973
Software development costs	0.8131	0.3085	2.6355	0.0089		
Board gender diversity	8827.5579	3395.1915	2.6000	0.0099		

Source: authors' own research results using EViews.

It is found that a higher degree of digitalisation implementation at the company level had a direct positive effect on the company's financial performance, statistically significant. Our results are similar to those of previous studies (Abou-Foul et al., 2021; Broccardo et al., 2023; Ribeiro-Navarrete et al., 2021) that investigated the link between digitalisation and performance considering specific indicators and including the sustainability objective. At the level of the studied sample, the impact of promoting the application of digital technologies is reduced. Also, between gender equality and performance, there is a positive, statistically significant relationship, a result similar to that of the studies carried out by Moreno-Gómez et al. (2018) and Wang et al. (2023). The presence of gender diversity on the board has a significant effect on board performance.

6. Conclusions

The findings of our study are good arguments towards the necessity of digitalisation and gender equality within an organisation. The independent variables represented by the software development costs and the board gender diversity percentage proved to be positively linked to the growth of company's total revenue. Consequently, companies should integrate in their business models the gender equality dimension as well as invest in process automation and technology in order to increase their general performance.

The main limitations of the research were represented by the small number of digitalisation and gender equality indicators determined by the companies, correlated with the short reporting period, which led to a relatively small sized sample. Data was also collected only from public companies; therefore, small enterprises were not taken into consideration for this study. Furthermore, there are many other unobserved variables that might still affect the observed relationships, such as economic factors. The results may not apply to organisations in other cultural or economic contexts and are mostly applicable to developed nations. Including a wider range of industries and geographical areas will improve the results' external validity.

As a recommendation for future research projects, the current study can be approached using other databases in order to collect representative indicators for company's performance, digitalisation and gender equality or address the research problem in different industry contexts or a in specific part of the world.

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Revisiting Cloud Enterprise Resource Planning Systems Implementations through the Lens of End Users

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Abstract

Organisations are successfully navigating Industry 4.0 by migrating from on-premises to cloud solutions, such as cloud Enterprise Resource Planning systems. These solutions allow companies to become more agile and address the current business challenges. Given the diversity and complexity of organisations, a successful implementation is based on a series of vital factors. In the last decade, various studies examined the critical success factors under several theoretical lenses, providing a wide, but scattered set of elements. This paper examines the pitfalls, successful strategies, and lessons learnt in the implementation of one of the most endorsed Cloud Enterprise Resource Planning systems for product and service centric enterprises. Based on an inductive archival analysis focusing on the reflections of end users, the present study goes beyond the limitations of geographical and industry-based factors to provide a comprehensive examination of the topic. The results target five dimensions that should be considered: change management, the implementation approach, research and due diligence, risk management and strategic planning, and support. Therefore, by presenting the most common key success factors, this study provides important insights for practitioners and researchers under the lens of mimetic isomorphism.

Keywords: cloud Enterprise Resource Planning, mimetic isomorphism, critical success factors, inductive research, end users, reflections.

JEL Classification: M15.

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1. Introduction

Driven by the need to stay competitive in the context of Industry 4.0, companies started massively to move from on-premise to cloud Enterprise Resource Planning (CERP) systems, which allows them to exceed the limitations of legacy systems. Therefore, to address the needs of their customers in becoming more resilient and agile, the major developers of CERP solutions are creating strategic partnerships with the IT industry leaders to innovate their products (Dumitru et al., 2023).

Migrating from traditional Enterprise Resource Planning (ERP) solutions to their cloud version continues to be a highly debated subject (Jiang & Wang, 2024; Naveed et al., 2021), although the first consistent attempts to understand the key success factors for adoption started more than a decade ago (Peng & Gala, 2014). By examining the impact of the institutional pressure to digitalise, Bennich (2024) considers that, unlike early adopters, late adoptions might not lead to performance improvement, the companies' decisions being determined mainly by isomorphic processes. Therefore, sometimes the challenges of digitalisation might exceed the expected benefits.

In the last 12 years, scholars have focused on the CERPs' implementation benefits, barriers, and success factors, as shown by Ali et al. (2023), highlighting through different theoretical lenses a wide but scattered range of elements, due to limitations in terms of location or industry. Thus, this research paper aims to investigate, from the perspective of end users, the key elements that lead to successful implementations, overcoming the previously mentioned limitations. To achieve the research objective, we conducted an inductive analysis using the review comments available on the Gartner Peer Insight platform, provided by the users of the most endorsed CERP solution. Starting from the institutional isomorphism (DiMaggio & Powell, 1983), we analysed the experiences of companies with the leading CERP system under the lens of the mimetic isomorphism, where in changing environments, institutions often mirror those perceived as most successful or reputable. Therefore, the present research provides new insights into the critical success factors by leveraging end users' experiences in implementing CERP solutions.

The rest of this paper is structured as follows: the first section focuses on the relevant literature on the critical factors that contribute to the successful integration of the CERP systems; subsequently, we present the methodology employed, providing details regarding the data collection and analysis processes. In the third section, we outline the findings and discuss their implications, while finally, in the last section, we include the conclusions, limitations, and future research directions.

2. Problem Statement

Through the theoretical lenses of technological diffusion and institutional pressure, Bennich (2024) argues that companies are motivated not only by rational choices when deciding to increase their digitalisation level and become more innovative, but also by social expectations. Similarly, in the context of open

innovations, Abhari and McGuckin (2023) note that although the number of companies has increased, they exhibit high failure rates. Given that the most prominent developers of ERP solutions are investing massively in creating cloud versions that will allow customers to build sustainable business networks and discontinuing the support of the on-premises versions (Dumitru et al., 2023), organisations started to implement the CERP solutions.

While the transition from the on-premises to the cloud version of the ERP systems is expected to enhance the organisations' innovativeness, in the absence of a clear understanding of the CERP systems' implementation barriers, Ali et al. (2023) argue that the companies' innovations outcomes could be significantly hindered.

In the early stages of research regarding the factors leading to successful CERP implementations, Peng and Gala (2014) discovered through a series of interviews with IT experts that having well-prepared practitioners, a thorough understanding of the cloud solutions, and reliable third-party business partners can lead to a seamless adoption. Additionally, a series of subsequent studies have focused on the importance of organisational, technological, and human resources (Gupta & Misra, 2016) along with the customisation of CERP, high availability, portability, and innovativeness, and organisational behaviour (Jiang & Wang, 2024; Naveed et al., 2021).

To achieve the expected advantages derived from using a CERP solution, organisations should focus on the perception of the end users, as their experience could have a significant impact in the post-implementation phase. In this regard, based on the Information Systems Success model, Kuo et al. (2023) argue that the users' continuance intention could be affected by a series of factors such as the ease of use, the overall satisfaction, and the degree of security. Moreover, the perceived ease of use seems to be influenced by the level of self-efficacy and convenience, while the satisfaction might be driven by the quality of the system and the information provided, along with the perceived value for money.

Based on the presented literature, the following part of the paper focuses on understanding the vital elements that lead to successful CERP implementations, under a "If you could start over, what would your organisation do differently?" scenario based on the reflections of the end users.

3. Research Questions / Aims of the Research

Through an inductive approach, this study aimed at identifying, under the lens of mimetic isomorphism, the main factors that companies should consider when migrating to a CERP system by leveraging the experience of end users after implementing the most endorsed solution of this type. In order to address the aforementioned objective, the following research questions were formulated:

RQ1: What are the factors that contribute to the successful implementation of CERP systems?

RQ2. What strategies can organisations adopt to include these critical success factors into the CERP systems' implementation approaches?

4. Methods and materials

As the research objective is exploratory, we employed a qualitative analysis based on an archival investigation through CERP systems' end users' reflections.

The selection of the solution was based on two technical reports (Magic Quadrant for Cloud ERP) published by the consulting company Gartner (2023a, 2023b). The first report focused on the most important CERP solutions for product-centric organisations, while the second one targeted CERP systems suitable for service-centred enterprises. In their Magic Quadrant reports, Gartner positions solutions and their providers in four categories: leaders, visionaries, niche players, and challengers, based on the completeness of vision and ability to execute. As per both reports, the Oracle Fusion Cloud ERP solution ranks first in terms of the two factors.

4.1 Data collection

To perform the archival investigation, we used the Oracle Fusion Cloud ERP's end users' reflections available on the Gartner Peer Insights platform. This platform represents a virtual vendor-free community where professionals are sharing their experiences regarding various IT solutions. The reviewers are verified through a multistep process meant to ensure their legitimacy (Gartner Peer Insights, 2024), thus being considered reliable and unbiased sources (Ben-Abdallah et al., 2020; Lavanya et al., 2023).

Each review consists of a series of elements: firstly, the users provide a general overview regarding the solution, followed by the aspects appreciated and disliked, reflections, and insights for potential users. The reflections are provided under the section "If you could start over, what would your organisation do differently?", which represented the base for the dataset of this research.

We collected the reviews published between 2020 and 2023 and during this period the CERP solution was evaluated by 112 end users working for service-centric enterprises and 57 end users working for product-centric enterprises. It is noteworthy that not all respondents provide their reflections along with the general overview, aspects appreciated and disliked. Thus, from the entire dataset of 169 reviews, 53 respondents provided details for the above-mentioned section.

Based on the practitioners' profiles, most of them work in IT (47.17%) or are part of their companies' management (28.30%). Regarding the industry in which the companies operate, the majority activates in the IT field (28.30%), followed by services (non-government) (13.21%), while the rest operates in various fields (14 more industries). Table 1 presents the distribution of the organisations based on their size.

Table 1. Companies' size

Size	50M - 250M	250M - 500M	500M - 1B	1B - 3B	3B - 10B	10B+
Number of companies	20	8	6	8	6	5

Source: own processing based on the collected data.

4.2 Data analysis

Following the collection of users' reflections on the section inquiring about their if-then scenario, we excluded the items that did not pertain to a specific matter (13 statements). These statements were primarily reflecting the end users' satisfaction with the CERP solution. A subsequent stage was to analyse the remaining reviews and divide them into statements if more than one aspect was highlighted by the practitioners. After this step, the dataset consisted of 53 elements which were aggregated into more general categories and clustered into dimensions, as presented in Table 2.

Table 2. Findings overview

Dimension	Category	Number of statements
Change management	Training	5
	Users' resistance	1
Implementation approach	Additional integrations	8
	Processes' re-design	1
Research and due diligence	Comprehensive requirements gathering	9
	Thorough market investigation	5
	Vendor selection and relationships	5
Risk management and strategic planning	Business workflow compatibility	3
	Continuity	2
	Structured approach	9
Support	Support	5

Source: own processing based on the collected data.

5. Findings

The first of the dimensions, **change management**, encompasses the necessity of providing adequate training to the users and addressing their resistance towards the new solutions implemented. In this context, some users emphasise that additional training contributes at decreasing the learning curve and avoid time loss, while others focus on the importance of changing the teams' mindset to improve their level of acceptance so that they can work properly with the solution and grasp the associated benefits. Other reviews point to the necessity of an initial training programme that is adequate. Furthermore, they emphasise that users could benefit from being exposed to a schematic presentation of the benefits and having more in-depth skills.

Although these two key success factors for implementing a CERP system are presented separately, they are intertwined as acquiring new skills can address to a certain extent the employees' resistance to change. Erebak and Turgut (2021) posit

that, particularly in the context of technologies that include automation, such as the CERP solutions (Dumitru et al., 2023), there is a risk that users may perceive these technologies as a threat to their jobs. Similarly, Alsharari (2021) observed that employees may be reluctant to embrace frequent changes when transitioning from an on-premise ERP to a cloud version due to a lack of expertise and a certain level of anxiety caused by job insecurity.

The **implementation approach** dimension pertains to the factors related to the companies' selection of the CERP modules and the additional features, such as RPA solutions, that will enable enhanced benefits that contribute to the overall business performance (Gašpar et al., 2023). The majority of users indicated that they should have adopted a greater number of modules from the start, in order to gain a comprehensive overview of the most critical processes within a unified system.

Such an approach can contribute to ensuring data consistency, reducing potential disruptions in business activities, and simplifying change management efforts, given the intricate nature of these solutions (Demi & Haddara, 2018). Nevertheless, in the case of complex implementations that involve a significant number of modules, there are also additional risks that could lead to failure, especially when various customisations are considered (Hansen et al., 2023).

In terms of the process redesign, one reviewer commented that the implementation strategy adopted focused on the business needs, whereas ideally the company should have considered this opportunity to reconsider and improve the business processes.

The redesign of business processes frequently introduces additional complexity during the implementation phase, which can sometimes be perceived as an adoption barrier (Peng & Gala, 2014). However, if developed adequately, it can improve reporting and reduce costs and redundant activities (Yu & Osathanunkul, 2023).

The third dimension (**research and due diligence**) includes three significant categories of factors that should be considered by companies when migrating to a CERP system. Firstly, by correctly identifying and collecting the requirements of the system and the business, the implementation teams should be able to focus on the processes' specificities and determine if the solution could address the organisation's needs. Although the users work for large entities, which should adhere to such good practices, their experience reveals that this might not always be the case. For example, one business solution manager stated that the implementation team should have spent more time focusing on the specific business cases rather than trying to standardise their processes to match those of the industry, thereby avoiding operational disruptions.

A similar situation was observed by Hagberg and Jonsson (2022), where IKEA, driven by the competitive pressure, failed to conduct adequate research into how the evolution of information technology could address the business needs.

As per the wide range of available CERP solutions, extensive market research is mandatory for selecting the optimal system. Most of the leading developing CERP companies share similar strategies (Dumitru et al., 2023), and some clients, driven

by the need for standardisation and globalisation, are trying to redesign their operations to be more generalisable. Nevertheless, the “one-size-fits-all” approach might not always yield the desired outcomes. We identified in total five statements emphasising the users’ regret at not taking into consideration the alternative options. While some respondents complain about the fact that the solution seems to be less effective than the one used by the company in the past, others reflect on its suitability and on whether an in-house solution would have been more appropriate.

Another important point emphasised by the end users is the selection of a third-party that will help companies navigate through the adoption process. As per the reflections, the main characteristics of the consulting business partners are represented by their availability, responsiveness, and flexibility in terms of the contractual agreements. However, a higher level of dependency might lead to a series of future challenges, as presented by one of the end users.

The **risk management and strategic planning** dimension encompasses the set of elements that should be taken into consideration before, during, and after the implementation. The key aspects emphasised by the end users relate to the existence of a concise strategy, back-end issues management, geographical setup, reduced need for customisations, and the development of the necessary workarounds. One reviewer provides important insights as it manages to capture the importance of the planning stage, while having in mind the organisational needs and constraints. According to the end user, the solution seems to be ideal for organisations that do not require a high degree of automations and, given the fact that the cloud experience differs from the on-premises version, it is important that the potential users understand the system’s capabilities.

Given that in the long term, the CERP systems tend to include as many features as possible to become more innovative and support the customers’ needs in the current highly digitalised environment, it is important for the company to understand how this approach suits it. Consequently, as argued by one of the end users, it is vital to examine the long-term compatibility of the CERP solution with the business workflow specificities.

The continuity refers to the selection of a solution based on the previously positive experience with the company. As per the reflections, this factor is also important as it could decrease the learning curve and reduce the potential operational disruptions.

The **support** dimension refers to the assistance that users require during and after the implementation of the solution. Given that the perceived ease of use represents an important determinant of the intention to continue adopting CERP systems and successful implementation (Kuo et al., 2023), it is recommended that developers and vendors focus on providing an adequate level of support. As argued by the reviewers, it is vital to have a professional team that can assist with on-demand support and provide the necessary guidance.

The three dimensions that capture the main categories of critical factors for successful implementations of CERP solutions have a high degree of interconnectedness. Firstly, by implementing the appropriate change management strategies, companies can navigate more effectively through the implementation

phase and develop strategic approaches to address the potential disruptions. Secondly, the implementation approach should be based on the findings of the research and due diligence activities, which will allow organisations to select the appropriate strategies and define effective risk management frameworks.

6. Discussions

Nowadays, the companies' focus is shifting from economic performance to environmental, social, and governance efficiency. In this context, CERP systems could represent a key element in this change by facilitating the redesign of the operational processes, allowing organisations to support the national and global sustainability objectives.

As outlined by Dumitru et al. (2023), the evolution of the ERP systems enables companies to redesign their processes with the objective of improving the organisations' sustainability reporting by enhancing the continuous monitoring of the ESG performance through the use of different sources of data. In this context, the effective management of the critical success elements of CERP solutions implementations can facilitate the transition to a sustainable economic approach. In addition to these factors, the intangible capabilities of CERP solutions, namely the users' knowledge and skills, can assist organisations in comprehending the associated benefits and enhancing their organisational social performance.

7. Conclusions

The objective of this paper was to identify the key factors that contribute to the successful implementation of CERP systems. An inductive archival analysis was conducted based on the reflections of the end users with regards to the most endorsed solution among large entities. This analysis revealed the existence of five dimensions with 11 categories of elements considered by the practitioners as the most important factors. By examining reviews of the leading solution for both product and service-centric enterprises, the study presents, under the lens of mimetic isomorphism, the critical aspects that can be of interest for all companies targeting the implementation of a CERP system.

The initial finding concerns the interconnectedness of the dimensions. Despite the fact that these were presented separately, as emphasised, there is a high degree of association. By effectively managing changes, examining the available options, and assessing the potential risks, organisations can select the proper implementation path and define strategic planning approaches.

The second finding refers to the variety of elements identified through the reflections of the end users. This result could be explained by the experience of the practitioners, the business needs that prompted the implementation, or industry-specific factors.

The study's objective was limited to the leading CERP system in terms of the developing company's completeness of vision and ability to execute. Although the number of reflections was limited, we were able to identify the most common

factors that should be considered for the implementation of this category of systems. This provides valuable insights for researchers, vendors, and developers. Further studies might also include top performers from other categories of Gartner Magic Quadrant CERP reports.

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A Bibliometric Analysis regarding ESG Reporting

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Abstract

The objective of the present study is to conduct a bibliometric analysis of publications in the field of environmental, social, and governance (ESG) reporting. The work is based on articles collected from the Web of Science (WoS) database. To analyse and visualise data, this paper uses VOS Viewer and Microsoft Office Excel for a large number of scientific papers. This study reveals information on science mapping and performance analysis and shows the state of the intellectual structure and emerging trends of the present research topic. Results show that research in this field has significantly increased over time. The results of the study could be of interest to scholars, as it highlights the most important research constituents and articles with the highest impact.

Keywords: ESG reporting, bibliometric analysis, performance analysis, science mapping, WoS, Vos Viewer.

JEL Classification: Q56.

1. Introduction

The global financial crisis drew attention to companies' attitudes towards risk, ethics, degree of responsibility, and ability to manage their stakeholders. However, the crisis has shown that the world is changing rapidly and that economies are inevitably interconnected. Globalisation and a changing political landscape are closely related to significant changes in populations, urbanisation, resource use, climate change, and employee and consumer behaviour. In this respect, ESG reporting plays an essential role for the business environment.

Although discussions about ESG reporting have gained momentum following this event, reporting on these indicators is not a new topic. ESG reporting emerged in the 1970s through the efforts of a small body of investors who were interested in the social and environmental practices of the companies in which they invested (Richardson, 2009). Later, ESG elements became key indicators of managerial competence, risk management, and nonfinancial performance of companies

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(Boerner, 2011). Thus, the aim of the present study is to conduct a bibliometric analysis to reveal the status of the literature and other aspects of research performance in this field to provide a starting point for those interested in studying ESG reporting.

The use of bibliometric analysis is a relatively new research method, and its use has increased over time (Donthu et al., 2021). This technique has been used by other authors to investigate the production of research in this field. For example, Galletta et al. (2022) analysed publications related to ESG performance in the banking industry between 1986 and 2021, while Khan (2022) performed a study related to ESG disclosure and firm performance. The present paper covers a different period than the other studies and focuses on ESG reporting topic in general.

Following the introduction part, the problem statement is presented. The next section provides information on the method used and data collection. Subsequently, the main results of the analysis are discussed. The last part of the paper presents the main conclusions, limitations, and future research directions.

2. Problem Statement

The literature in the field of ESG reporting offers mixed results regarding its impact on companies. First, it represents a factor influencing the financial performance of companies. According to the results of the study conducted by Friede et al. (2015), 90% of the 2,200 papers analysed demonstrated a positive effect of ESG reporting on financial performance. However, the results of Almeyda and Darmansya (2019) study do not show significant relationship between the social and governance factor and financial performance, but, nevertheless, high transparency in reporting this information can improve financial performance.

Second, ESG performance can have an impact on companies' risks. In this respect, Sassen et al. (2016) investigated the extent to which the performance of ESG indicators influences systematic risk, idiosyncratic risk, and total risk. The results show that environmental performance leads to a decrease in idiosyncratic risk, while total risk and systematic risk are only affected in environmentally sensitive industries. No significant effect of corporate governance performance has been found on firm risk. On the other hand, a study conducted on the banking sector in Europe shows a negative relationship between corporate governance performance and idiosyncratic risk for medium and high-risk levels, and this effect becomes more pronounced as the degree of risk increases (Izcan & Bektas, 2022).

Another association studied by researchers is the one between ESG performance and the market performance of companies. According to the results of the study carried out by Sahut and Pasquini-Descomps (2015) on companies listed on the capital markets of Switzerland, the USA, and the UK, ESG performance has a low but significant impact on stock performance in certain periods or certain sectors and the results vary between countries. Instead, following a study conducted on four countries in Asia between 2013 and 2017, Junius et al. (2020) did not identify the existence of a significant influence between the ESG score and the performance of firms and their market value.

3. Research Questions / Aims of the Research

In the European Union (EU), ESG reporting became mandatory for certain companies starting with 2024, and the first reports will be disclosed in 2025. Initially, the presentation of information on these elements was imposed under Directive 95/2014 of the European Union with the aim of identifying risks related to sustainability and increasing investor and consumer confidence. On the other hand, according to the Directive, the presentation of this information contributes to the monitoring and management of companies' performance and the impact they have on society. Therefore, the objective of the present paper is to investigate the status of the research before this reporting becomes mandatory in the EU. Thus, this paper aims to answer the following research questions:

RQ1: What are the most important research constituents in the ESG reporting field?

RQ2: What topics in this field have been explored until now?

RQ3: What are the potential future research paths?

4. Research Method

The present paper uses bibliometric analysis as a research method to investigate the evolution of the literature and other quantitative aspects, such as performance analysis and science mapping (Donthu et al., 2021), related to academic studies in the field of ESG reporting. Through performance analysis, the contribution of different research constituents is shown, while science mapping refers to the relationships between them. When analysing large volumes of data, bibliometric analysis is one of the most suitable techniques, having that systematic reviews or other traditional methods could only be used for tens or low hundreds of papers (Snyder, 2019), which can be manually reviewed.

Data were collected from the WoS database, having that it contains large amounts of bibliometric data (Kemeç & Altınay, 2023) and it is recommended as the one of the most preferred databases for citation information sources (Wan et al., 2023). The searching process started with a set of boundaries. To ensure the most high-quality data acquisition, proceedings papers or reviews articles have been removed and the selection was based only on English written papers. Furthermore, because the analysis refers to ESG reporting, the WoS categories selected were *Business Finance*, *Business*, *Management*, and *Economics*. The words searched were “ESG reporting” and “Environmental, Social, Governance reporting”. Upon the search procedure, the number of studies obtained was 1,243, which have been used for further analysis.

A summary of the most relevant information regarding the data set is presented in Table 1. The number of authors is 2,847, while the number of journals where the articles have been published is equal to 357. The authors involved in writing articles on ESG reporting are affiliated with 1,447 institutions and live in 94 countries. There are in total 49,869 references cited in the analysed articles. The total number of citations at the time of this analysis was 34,113, while the average number of

citations was 27,44 per article. All these numbers show a very high interest in this topic. The next section will provide an in-depth analysis regarding these data.

Table 1. Dataset summary

Ref. No.	Unit	Quantity
1	Articles number	1,243
2	Authors number	2,847
3	Journals number	357
4	Institutions number	1,447
5	Countries number	94
6	Cited references number	49,869
7	Total citations as of April 15 th 2024	34,113
8	Average citations as of April 15 th 2024	27.44

Source: author based on WoS data.

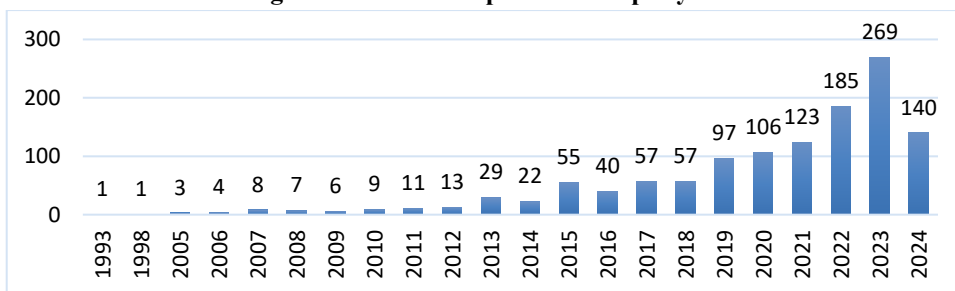
5. Findings

5.1 Performance Analysis

The most relevant measures when conducting a performance analysis are represented by the publication number that can be used as a proxy for productivity followed by the citation number, used as a proxy for articles influence or impact (Donthu et al., 2021).

Data set distribution on years is presented in Figure 1. The topic of ESG reporting is not new in the scientific literature. As the figure shows, the first article was published in 1993 with the focus on different governance approaches and the relationship between them, environmental uncertainty effect, and relational interactions (Gundlach & Achrol, 1993). The period between 1993 and 2012 could be considered an embryonic stage, given that a very small number of studies have been published per year. The scientific literature and the interest in this area began to increase in 2013, when the number of publications reached 29 in one year. The blooming development has recently started, especially in 2019 when the number of publications per year was 97, reaching 269 articles in 2023. Given that this study was conducted at the beginning of the second quarter of 2024, the number of articles published this year was smaller than in 2023, but also greater than in 2021 and the other previous years.

Figure 1. Number of publications per year



Source: author based on WoS data.

Of the total number of 357 journals, 52.38% (187) contain only one study on this topic, while 45.38% (162) published between 1 and 20 studies. The remaining 2.24% (8) of the journals accepted for publications between 22 and 77 papers about ESG reporting. Table 2 presents the most active journals and their number of publications for the entire period. *Corporate Social Responsibility and Environmental Management* journal is the most productive journal with 77 publications, followed by the Business Strategy and The Environment journal, that published 68 studies.

Table 2. Most active journals

Ref. No.	Journal name	Pub. No.
1	Corporate Social Responsibility and Environmental Manag.	77
2	Business Strategy and The Environment	68
3	Sustainability Accounting Management and Policy Journal	54
4	Meditari Accountancy Research	37
5	Corporate Governance-The International J. of Business in Soc.	35
6	Social Responsibility Journal	29
7	Journal of Business Ethics	26
8	Cogent business & Management	22

Source: author based on WoS data.

As presented in the methodology section, the number of citations represents the interest shown by researchers in a certain scientific paper and the impact this article can make. Hence, the next performance analysis presents the top articles depending on their number of citations. Out of 1,243 articles, 223 have never been cited by the time of performing this study, while 466 have been cited from 1 to 10 times. Another set of articles (469) ranges between 11 and 100 citations, and the remaining part (86) presents between 101 and 738 citations. The most cited articles from the data set are presented in Table 3. As revealed, the article with the greatest number of citations is that of Liao et al. (2015) published in the British Accounting Review Journal. This study presents an analysis of the relationship between gender diversity and the propensity to disclose greenhouse gas information. Because of its great number of citations, this article could be considered to have the biggest impact in this area.

Table 3. Most cited articles

Ref. No	Authors (Year)	Article title	Journal	Cit.
1	Liao et al. (2015)	Gender diversity, board independence, environmental committee, and greenhouse gas disc.	British Accounting Review	738
2	Hussain et al. (2018)	Corporate Governance and Sustainability Performance: Analysis of Triple Bottom Line Performance	Journal of Business Ethics	501
3	Ben-Amar et al. (2017)	Board Gender Diversity and Corporate Response to Sustainability Initiatives: Evidence from the Carbon Disclosure Project	Journal of Business Ethics	481

Ref. No	Authors (Year)	Article title	Journal	Cit.
4	Amel-Zadeh and Serafeim (2018)	Why and How Investors Use ESG Information: Evidence from a Global Survey	Financial Analysts Journal	388
5	Kolk and Perego (2010)	Determinants of the Adoption of Sustainability Assurance Statements: An International Investigation	Business Strategy and the Environment	386
6	Frias-Aceituno et al. (2013)	The Role of the Board in the Dissemination of Integrated Corporate Social Reporting	C.S.R. and Environmental Management	380

Source: author based on WoS data.

The most influential institutions are presented in Table 4. According to WoS data, University of Salamanca (Spain) could be considered the most influential institution from the data set, having 1,242 citations obtained from the 23 articles published by the authors. The second most influential one is Harvard University, with 1,187 citations from 9 articles. The other universities with a high number of citations are The University of Newcastle (Australia), Southwestern University of Finance & Economics (China), University Southampton (United Kingdom), and The University of Western Australia, each of them having a relatively small number of publications.

Table 4. Most influential institutions

Ref. No.	Organisation	Citations	Pub. No.
1	University of Salamanca	1,242	23
2	Harvard University	1,187	9
3	The University of Newcastle	839	8
4	S-W Univ. of Finance & Economics - China	798	8
5	University Southampton	794	10
6	The University of Western Australia	734	6

Source: author based on WoS data.

As presented in Table 5, the most influential country for research in the field of ESG reporting is England, presenting 7,347 citations, while the most productive country is the United States of America (USA) with 194 publications. Australia is the second most influential country, followed by USA, Italy, Spain, and China.

Table 5. Most influential countries

Ref. No.	Country	Citations	Pub. Number
1	England	7,347	164
2	Australia	5,938	133
3	United States of America	5,506	194
4	Italy	4,038	112
5	Spain	3,281	82
6	China	2,293	92

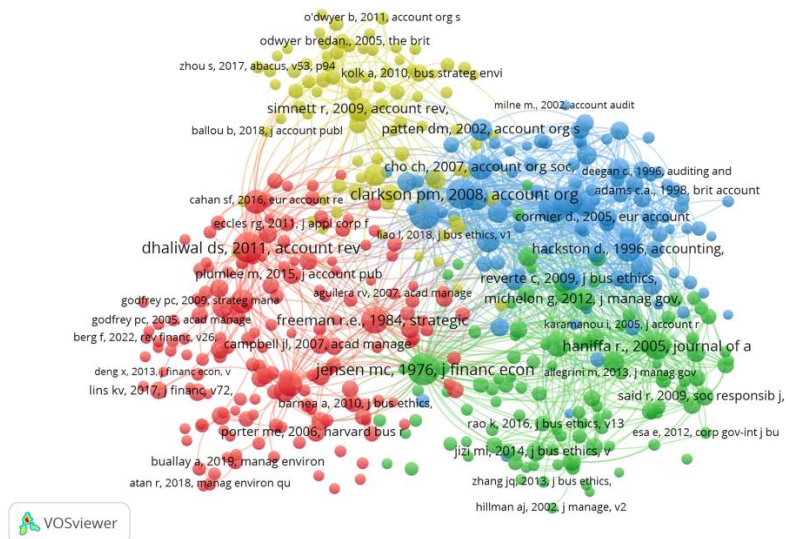
Source: author based on WoS data.

5.1 Science Mapping

The relationships between different constituents are usually presented through science mapping and the techniques often used by authors are co-citation analysis, co-authorship analysis, and co-word analysis. The first technique assumes that the studies cited among each other generally discuss similar subjects (Hjørland, 2013). The co-citation network map is presented in Figure 2.

The network of co-citations appears if a scientific study is presented in the reference list of another study. The minimum citation number for a publication was set to 20, and out of 49,869 references, 460 of them have met the threshold, obtaining four different clusters. The focus of the studies in the first cluster (red colour) is on Corporate Social Responsibility (CSR) Reporting. The second cluster (green cluster) has its focus on corporate governance in relation to CSR or other types of sustainability disclosure. The publications in the third cluster (blue colour) provide information on environmental reporting, while studies in the fourth cluster (yellow colour) refer to the assurance on sustainability reports.

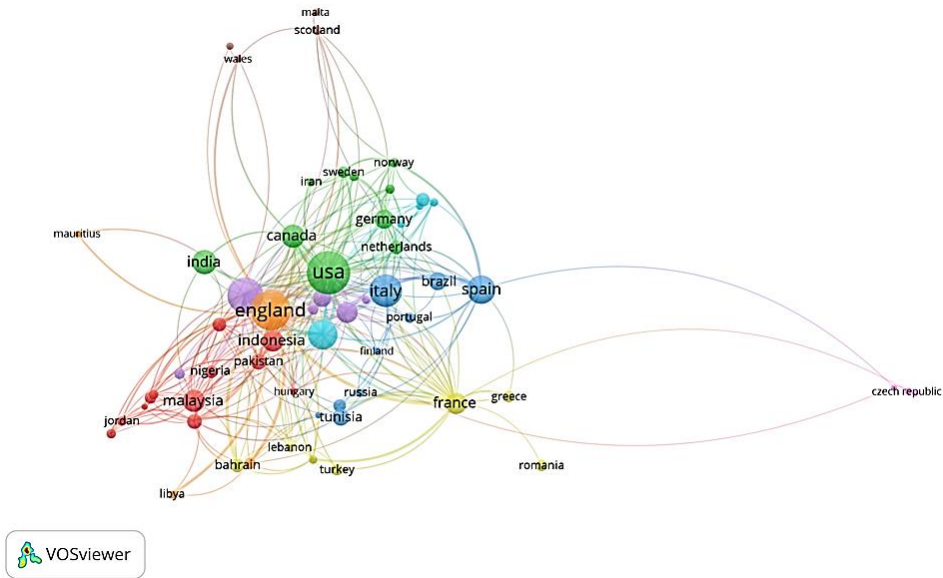
Figure 2. Co-citation network map by references



Source: author based on WoS data.

A network map of co-authorship is presented in Figure 3. The aim of this analysis is to provide an overview of the authors' interactions in a certain research field to reach insights and increase clarity (Tahamtan et al., 2016). The country of the author has been chosen as the unit of analysis and the minimum number of publications for one country was set to 5. Of the 94 countries in the study, 60 met the threshold. The importance of a country in this research field is given by the size of its circle, while the strong collaboration of the authors to produce articles is given by the size of the relationships between countries. Strong links could be observed between France and England, Spain and England, Italy and England, or between China and England.

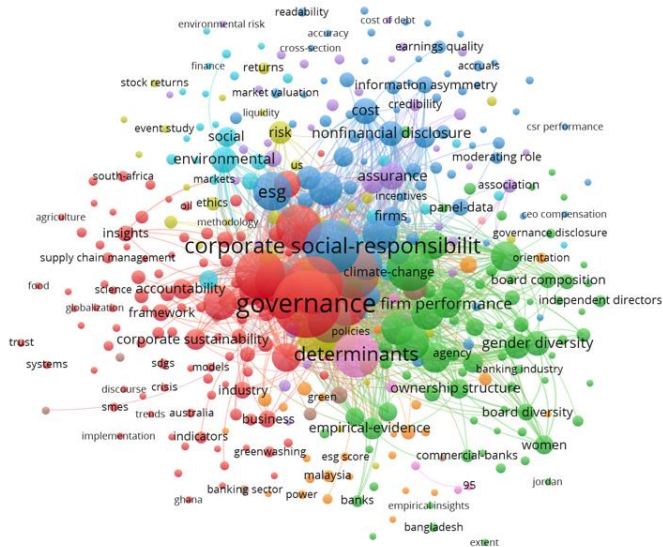
Figure 3. Co-authorship network map by countries



Source: author based on WoS data.

The third technique is represented by co-word analysis, presented in Figure 4, which examines the publication content. According to Donthu et al. (2021) a similar thematic exists for the words that usually appear together, and strong links exist between circles that have the same colour. The minimum number of occurrences of a keyword was set to 5 and of the 3,767 keywords, 404 met the threshold.

Figure 4. Keywords co-occurrence network map



Source: author based on WoS data.

As shown in the figure, the map has 10 different clusters, with the focus on similar subjects. The word that appears the most is “governance” (450 times) followed by “performance” (327 times), “corporate social responsibility” (294 times), “impact” (263 times), and “sustainability” (246 times). However, if we look at the overlay visualisation, the term “ESG” has mostly been used in 2022, meaning that, a huge attention has been given to this topic in the last years.

6. Conclusions

This paper presented a bibliometric analysis regarding ESG reporting using WoS to collect data and Vos Viewer for analysing and visualising it. The analysis shows that studies in this field have increased from one year to another. *Corporate Social Responsibility and Environmental Management Journal* is the most productive in this area, followed by *Business Strategy and The Environment*. The most productive university is the University of Salamanca, which can also be considered the most influential institution along with Harvard University, both presenting over a thousand citations for their articles related to ESG reporting. With respect to the impact, England is the most influential country, while the United States country shows to be the most productive one.

The analysis on science mapping provides information about the topics presented in each cluster of co-citation network. The focus of the biggest one is on CSR reporting. Also, it reveals information regarding co-authorship networks by countries showing strong collaborations, especially between authors from France and England. Regarding keyword co-occurrence, the most common word used in research papers is “governance”, as part of the ESG reporting.

The main contributions of this work are as follows. On the one hand, this paper gives an overview and a starting point to those interested in researching this field as it highlights the most important research constituents in terms of productivity and impact. On the other hand, this study can help researchers find peers interested in this topic to collaborate with each other.

The results of the present study should be considered in line with several limitations. First, this paper only uses the WoS database to retrieve bibliometric information. Future studies could conduct a similar analysis by using, for example, Scopus database. Second, for the bibliometric analysis, only articles in English have been selected. Future research can consider articles written in different languages, but also conference and proceeding papers.

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**The Evolution and Impact of Digital Transformation
on Internal Audit and Managerial Control in Public Institutions**

Lucia-Maria UDRESCU¹

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Abstract

This paper explores how digital transformation has changed the way internal audit and internal management controls are conducted in public institutions. From traditional audit methods to new technology-based methods, mainly driven by the development of artificial intelligence (AI) and blockchain technologies, they greatly improve the depth of analysis and reduce the need for manual work. This aspect allows the automation of everyday tasks as well as the most complex ones, where large data series are analysed, audits become more transparent and efficient. The purpose of the research is to evaluate how prepared the professionals from public institutions are to move from manual to digital work, as well as to identify the main challenges encountered in the implementation of these technologies. The objectives consist of evaluating the progress of the transition to digital work in public institutions in Romania and identifying the obstacles to a successful adoption. The methodology includes reviewing the specialised literature and conducting quantitative surveys of staff in audited public institutions. Based on these ideas, the paper presentation attempts to understand the advantages and challenges to digital transformation that the public audit may face. Finally, the digital transformation represented an important and helpful aspect in the internal audit, but it is necessary to overcome the challenges to obtain these benefits in public institutions. The paper emphasises useful aspects of the use of digital technologies in public audit: improving audit capabilities and addressing the challenges of applying new technologies to existing systems.

Keywords: internal managerial control, internal audit, digitalisation, public institutions.

JEL Classification: H83, M42, M48.

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1. Introduction

The public institutions of the nowadays times acknowledge the contemporary utilisation of internal audit methods, for instance artificial intelligence and blockchain. There has been a replacement of the ineffective and chronophagous audit methods, that were substituted by more adequate and quicker digital methods. Benefits such as work automation, great volume data processing, time saving, and task fulfilment in a minimised timeframe are advantages that appeared along with these novel technologies. Despite these advantages, the utilisation of these instruments requires the retraining of auditors to help them accommodate these activities, this process generating reluctance from their part.

To integrate the research context in the current framework, the interaction between public institutions and technological instruments such as artificial intelligence needs to be comprehended. In order to improve working time efficiency, more and more fields are adopting workplace digitalisation, and in this case, more and more public institutions are considering adopting a digital solution, following the long-term model of private companies. Like many other countries, Romania has invested in digital infrastructure to improve public services, particularly since in recent years, like many other countries, it has received non-refundable funding to achieve these objectives. The aim of the study is to assess the level of training of employees working in public institutions and the readiness to move from manual to digital audit work. The document also examines the challenges faced by auditors when using these new tools. The author researches how Romanian institutions reached progress in implementing digital solutions as well as the drawbacks associated with the adoption of such instruments. In the specialty literature, digital transformation significantly influences taxation areas such as taxation, financial accounting, management accounting, audit, internal control, risk management, and corporate governance. Technology impacted the accounting field to a great extent, modifying the way that things work and the structures permitting their support. Stark (2020) noted that people, tools, objects, plans, and money are among the noteworthy points of a proper digital transformation. Technology shifts the manner in which activities are performed, in the same way as spring reshapes the environment. Today, people prefer to use digital forms of documentation and communication in order to get rid of their work as much as possible. The layout of this study is as follows. Section 2 discusses the background of the study, highlighting the amount of effort required to elaborate a proper strategy for digitalisation in public organisations. As stated in section three, the research questions and aims of the study revolve around the preparedness of professional in public organisations, the challenges faced when implementing digital technologies. Section 4 gives details of the way in which this study was conducted, which included a review of recent literature, a questionnaire elaborated by the author that were to be used in the collection of data from employees from public internal audit departments. In section five, the results of the study are presented as well as a preliminary analysis of the questionnaire used in the survey. In conclusion, Section 6 of the paper discusses the impact of digital transformation on internal audit function in Romanian public organisations, the necessary changes, and suggestions for future research.

2. Problem Statement

2.1 Digital Transformation Today

To fully embrace digital transformation, companies need a clear plan that uses resources from all parts of the organisation. Stark (2020) argues that successful digital change requires using human resources, improving technology, making the most of physical assets like buildings and equipment, reorganising the company, and using financial resources wisely. As companies move from outdated, manual, and time-consuming systems to digital ones, they deal with much more data, showing how much technology is changing things (Reis et al., 2018).

The cloud has become very popular and very easy to use. Some of these technologies include: data analytics, artificial intelligence, processing of big data, and blockchain technology among others (Teichert, 2019). However, the knowledge about technologies is not enough. For a company to embrace digitisation, it is essential to understand; how these technology options engage the whole organisational fabric; its culture, its procedures and direction (Stark, 2020). Tax consulting, financial accounting, management accounting, auditing, internal control, risk management, corporate governance, and more are the areas that are impacted by the phenomenon of digital transformation. Based on the literature, it is evident that the accounting profession is changing significantly due to the influence of a technology (Rini et al., 2021).

2.2 Literature Review

Digitisation in audit implies the utilisation of high-performance techniques in order to make audits to be quicker and more effective, this fact determining audit organisations to employ technologies such as AI, machine learning, blockchain, and big data analytics. These steps that private companies have taken in the last 5 years (we can consider that the pandemic is also a catalyst for these decisions) have determined that public institutions should be inspired by good practices and approach such a step as well. These help auditors and professionals to carry out the day-to-day activities more accurately, quickly, and effectively. But how do public institutions face this transition?

In a study conducted by Bjerke-Busch and Aspelund (2021), the authors stated that public organisations face numerous obstacles when trying to incorporate new technology in the day-to-day work. This is because entities face different kinds of problems that refer to the infrastructure, not enough personnel specialised in using these technologies, incomplete legislation, and many other factors depend on outside groups. The study separates these obstacles into three types: external, organisational, and management. External obstacles refer to regulations, insufficient money allocation, and no tech standards. Organisational obstacles come from workplace cultures, separation between departments, and how employees use resources. Management obstacles refer to leadership's struggle with the alignment of the institution's objectives and the implementation of these technologies.

Some other authors (Vasarhelyi et al., 2010) link the recent corporate scandals that lead to regulations like the Sarbanes-Oxley Act with data analytics and the need of monitoring for continuous assurance. The authors consider that these tools are beneficial in handling enormous information from different sources, making audits more detailed and complete. These tools help in identifying trends, assessing risks, and making more informed decisions.

In the view of Yermack (2017), technologies such as artificial intelligence and blockchain have the potential to become a transformational element for managers, investors, and auditors and add transparency to the conducted activities. In addition, these technologies will permit users to keep away from unfavourable conduct, hold real-time accounting, enable investor safety, and modify the manner in which individuals invest and own.

There is clear proof for the fact that the activities operated by managers, auditors, and employees will be significantly altered. Individuals are willing to employ such improvement elements to make their tasks simpler and use the supplementary time in steady assessments and other quantitative tasks, that in the end may improve the results.

3. Research Questions / Aims of the Research

This article aims to explore two important research issues: to assess the degree of preparation of professional public institutions to move from manual practices to those that involve the use of AI technologies, and, secondly, to identify the main challenges they face during the implementation of digital technologies. The objectives are to analyse the state of the situation in terms of the digitalisation of Romanian public institutions and the results of all factors that may impede the successful implementation of these innovations. This assessment is in line with the guidelines of the National Recovery and Resilience Plan, which aims to improve the level of digitisation in relation to routine processes within institutions in an effort to improve routine tasks and overall organisational activities. In the meantime, the study will assess whether audit activities are well linked to other digitalisation objectives in public institutions or not.

4. Research Methods

From a methodological perspective, the author reviewed the specialised literature to evaluate the readiness of Romanian public institutions to implement AI in internal public audit departments. Additionally, quantitative research was conducted through the distribution of a questionnaire developed by the author to public officials engaged in audit departments of institutions such as the National Fiscal Administration Agency and its territorial institutions, the National Health Insurance House and its territorial ministries, and other relevant entities. The questionnaire administration took place between April 1st and May 2nd.

The researcher has applied Exploratory Factor Analysis to the data acquired through the survey.

5. Findings

In the specialised literature on digitalisation and AI, there are many mentions of how Romania made a lot of efforts in adapting to this change. The literature currently describes the transition from traditional auditing to continuous, technology-driven, or future auditing as a developmental cycle (Byrnes et al., 2018). Some authors say that the main problems with the audit and control idea lie in the old infrastructure and not in poor IT systems. They mention that most public organisations are still in the early stages of using digitalisation and automation for their financial control processes. This lack of modern, integrated IT systems hampers the ability to analyse financial data swiftly and effectively (Floştoiu, 2023).

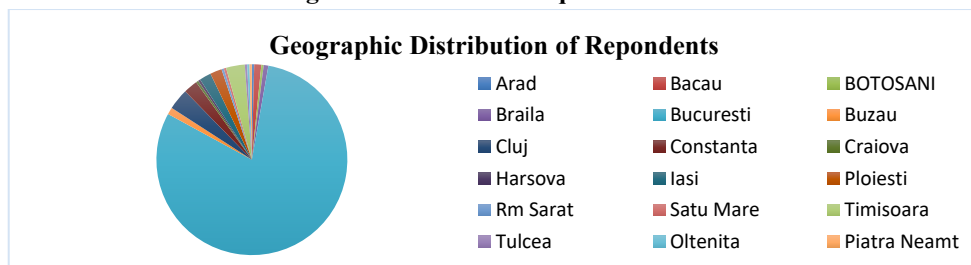
To assess the opinions of public institution employees on artificial intelligence and the transition to digital auditing, the author created and distributed a questionnaire through communication platforms and specialised groups to staff from these institutions. The interpretations of the results are presented below. The number of responses received is 252.

5.1 Exploratory Analysis of the Questionnaire

The initial survey questions are designed to collect basic information about the participants, such as where they work, how old they are, and what school they attend. This information helps us better understand the following responses and allows us to look at opinions about AI and digital auditing in public places in a more specific way.

Most of the people who responded to the survey said they work in Bucharest, then Cluj, Timisoara, Constanta, Iasi, Ploiesti, and other places.

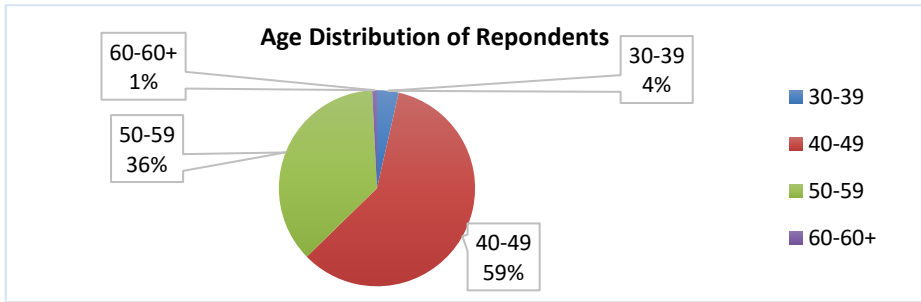
Figure 1. Results of the questionnaire



Source: own processing, questionnaire results.

When queried about the age of the respondents, the majority fell within the 40-49 age bracket, followed by those aged 50-59 years. Only nine respondents were between 30-39 years old, and two were aged 60 or older. This chart shows the average age of workers in Romanian public organisations, especially in the internal public audit department, where most people are over 45. This is different from the private sector, where younger people are more common, because multinationals tend to hire younger people more than public institutions do. Additionally, the number of responses from females was almost double that of males.

Figure 2. Age distribution of respondents



Source: own processing, questionnaire results.

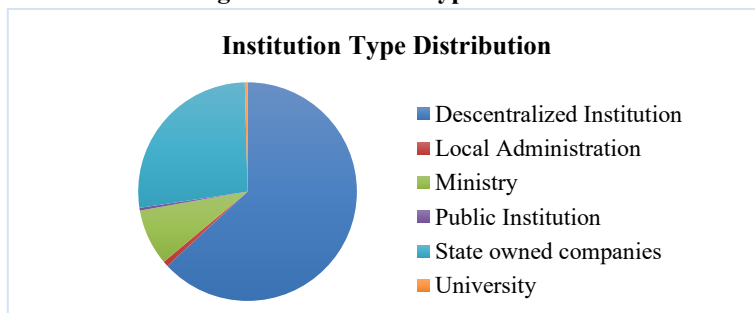
Figure 3. Gender distribution



Source: own processing, questionnaire results.

In terms of the types of institutions in which the respondents are engaged, 159 respondents are engaged in decentralised institutions (territorial health centres, tax agencies, ministries), 68 respondents work in state enterprises, followed by 21 respondents working in ministries. Only two respondents worked in city halls and only one at a university.

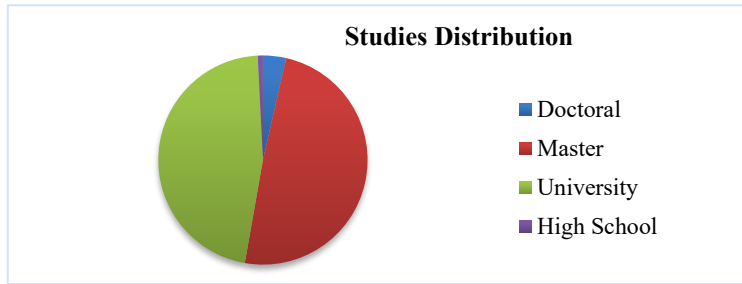
Figure 4. Institution type distribution



Source: own processing, questionnaire results.

To the question about education, 124 respondents have higher education (master's), 117 respondents have bachelor's studies, 9 respondents have doctoral studies, and only two of the respondents have only high school as a basis.

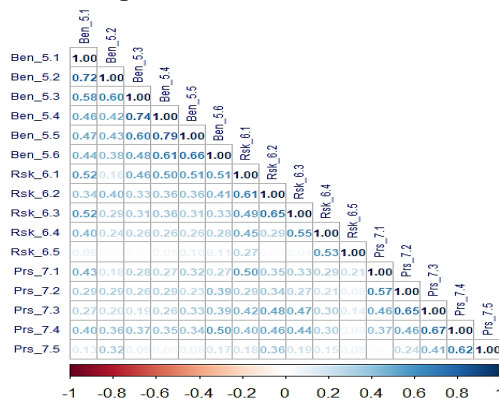
Figure 5. The distribution of studies



Source: own processing, questionnaire results.

According to the survey, Romanian public sector workers are mostly women, especially in decentralised institutions engaged in territorial administration. Most of the respondents are between 40 and 50 years old, unlike young people working in the private sector. Most people in the education sector have at least a bachelor's degree, indicating their education. These conclusions show that we need to develop strategic initiatives to attract young people who are interested in auditing and help them to develop their skills to meet changing job requirements.

Figure 6. Correlation Matrix



Source: own processing using R, questionnaire results.

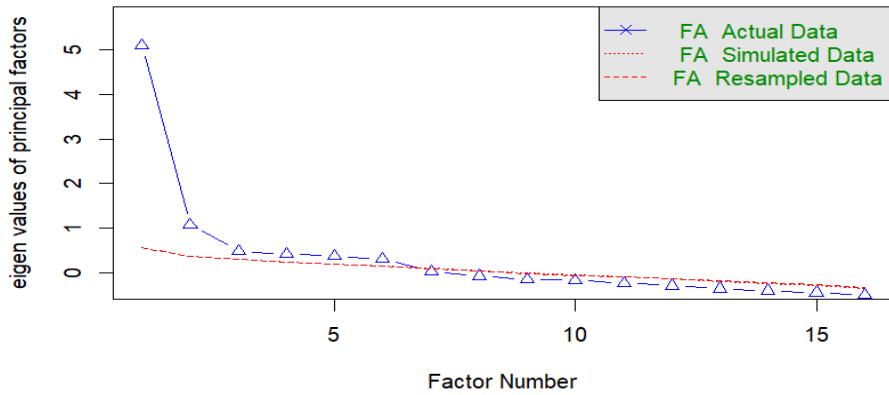
In Figure 6, we can see how correlated are the answers from the correlations closer to 1. We can see that we have correlation of 1 for the same question.

The subsequent questions have either a strong positive or a strong negative correlation. Also, the group 6.1-6.3 correlates considerably with 7.1-7.4.

After running a Kaiser-Meyer-Olkin factor adequacy, we obtain an overall MSA of 0.66 which suggests that there is a mediocre suitability of the data for the analysis. Also, the individual MSA for each item is higher than 0.5.

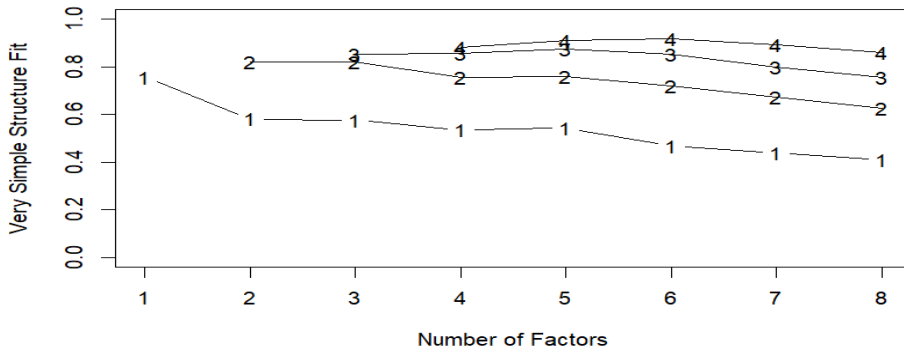
The Parallel Analysis (Figure 7) suggests a number of 3 factors, after analysing the Scree plot. The resultant factor analysis shows as follows:

Figure 7. Scree Plot and Parallel Analysis



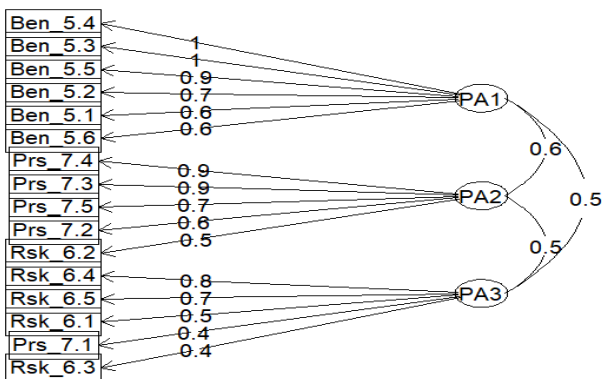
Source: own processing using R, questionnaire results.

Figure 8. Very Simple Structure



Source: own processing using R, questionnaire results.

Figure 9. Factor Analysis



Source: own processing using R, questionnaire results.

The resulting factors are grouped into three categories: benefits, personal, and risk/vulnerabilities.

Table 1. Results

Benefits	Personal	Risk/vulnerabilities
5.1 AI increases transparency	6.2 AI implementation requires important changes to the IT infrastructure	7.1 AI cannot replace me at my job
5.2 AI and secure financial records	7.2 AI helps me with repetitive work	6.1 Legal and regulation issues related to the usage of AI in Audit
5.3 AI increased efficiency and fraud risk reduction	7.3 AI is not correctly regulated	6.3 AI can experience interoperability issues when being integrated with other public institution systems, due to the infrastructure
5.4 AI facilitates access to decentralized data	7.4 One's organisation has the necessary infrastructure to support AI	6.4 AI can have a negative impact on the environment
5.5 AI increases conformity through auditable transparent records	7.5 AI usage does not facilitate work from home	6.5 AI can replace me at my job
5.6 AI can replace repetitive manual work		

Source: own processing using questionnaire results.

From the perspective of advantages, people think that AI can make audit work clearer and more trustworthy, protect financial records, and save time and money while lowering the chance of fraud, which is a common idea in the literature (Lazăr & Popescu, 2021; Rada, 2015). Cristea (2021) conducted a study that shows how IT affects auditing, which is the process of checking financial records and reports. The study says that IT makes auditing more complex and challenging, but also more useful and reliable, by using tools such as Data Analytics, AI, and Blockchain. The study also says that auditors need to keep learning and improving their skills to use these tools well, which will make auditing faster and better. Another thing that the survey suggests is how AI helps get access to decentralised data, which makes it easier to analyse and do audits. By combining AI with audits, we can get a more detailed and up-to-date look at different types of data, which could make audits faster and more accurate (Odeyemi et al., 2024; Alkan, 2022). A good aspect that defines AI is its ability to clarify matters and bring honesty to them by automatising tasks and maintaining the evidence of everything (Pearce, 2022). One good thing is that AI helps people work from home, so they do not need to use paper as much for auditing—a lot of big companies are already doing this. But for public organisations in Romania, the lack of consistent infrastructure makes it hard for them to let people

work from home. Even though there are some problems, people think that having software that lets them work from home is a good thing.

Personally, respondents claim that the AI technology operates major transformations in the IT infrastructure. At the level of Romania, public institutions experience technology struggles in response to improper infrastructural investments. Additionally, the absence of funds may represent a significant obstacle for the adoption of AI, generating challenges for the financing needs to sustain such technological progresses. Many respondents feel safe in the fact that AI helps with repetitive work (Henry & Rafique, 2021; Kokina & Davenport, 2017). While some view AI use in auditing positively, they also suggest its insufficient regulatory framework. There is a legislative void regarding advanced technologies, which leads to the need for help from the government both in the educational system, to prepare people with what AI entails and how to use it, and companies investing in AI through improved regulations and potential financial incentives (Mihai & Duțescu, 2022). Some of the respondents believe that AI can help in audit missions, but believe that there are not enough regulations to be able to control this part. The lack of adequate rules and laws for new technologies, together with the lack of clear directions for AI, makes potential users want more serious intervention from the government to step in and want better legislative tracks and rules, providing resources for those who want to implement such technologies.

Regarding risks and vulnerabilities, opinions among respondents varied on AI's role in auditing. Some respondents believe that AI could replace their presence in the office (in the near future, not necessarily now), while others disagreed, stating that while AI is beneficial in the analysis area, compilation of data, and efficiency of handling large databases, it cannot replace the professional judgment required in auditing, which necessitates human input. The findings are also strengthened by the work of Bizarro and Dorian (2017), who assert that AI cannot substitute human skills, for instance judgment, conveyance of emotions, implementation of professional scepticism, and even the realisation of expert judgments, regardless of AI's ability to make accounting and auditing tasks more efficient. The respondents also mentioned environmental matters and claimed that environmental damage can be triggered by the nurturing of AI in public institutions. These matters are justified by the fact that in auditing, AI will impose a great degree of energy usage and the employment of novel technologies, an action that will trigger a contribution to electronic waste, given the need for periodic updates and hardware substitution. Provided that institutions adopt renewable energy sources and solutions that generate minimal pollution, the effect over the environment can be a reduced one.

In Romania, the employment of AI is perceived as an advantageous process due to the benefits it holds, for instance work environment simplification, maintaining the evidence of monetary transactions in a more efficient way, as well as fraud identification. In addition, the constructive effect of AI on audit methodologies has been recognised by Romanian studies and literature, and they emphasised the requirement for the ongoing professional growth of auditors, to make possible the inclusion of this progress into their activities. Nevertheless, Romania experiences legislative drawbacks produced by the absence of formal procedures and adequate

structures. Furthermore, it has a social impact arising from the increase in energy consumption possible by AI and the growing problem of electronic waste. These various aspects imply the importance of careful coordination and therefore require careful and targeted technological and legal decision making in national environments.

An important element underlying the potential development of this field of AI in Romania, interoperability and investments is the National Recovery and Resilience Plan. This plan aims at significant improvements regarding the public sector until 2030, with an emphasis on digitisation and public services “one click away”.

6. Conclusions

In conclusion, it could be stated that these outcomes indicated the effects of the digital transformation on the internal audit of public organisations in Romania, with an interest in such essential technologies as AI. These technologies have been influential in enhancing the quality, speed, openness, and security of the audit functions. Nevertheless, such a transition seems to entail a significant degree of changes, such as retraining the auditors, and other concerns related to infrastructural and regulatory disparities. Although, the given use has a lot of potential advantages, implementing all these technologies into existing systems is a great and compulsory work, which is necessary to bring the audit practices up to the modern level and to increase the general levels of audits' efficiency.

Regarding the research limitations, the number of respondents (252 participants) is reckoned to be the major limitation, although this does not reduce the references made by researchers to public institutions. Future researchers will advance the present findings and create value and diverse angles to established thoughts.

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**Evaluating the Impact of Demographic Shifts:
A Comparative Analysis of Economic and Social
Consequences in G7 and BRICS Nations**

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Abstract

The aim of this study is to explore how demographic shifts are affecting the economic and social environments of BRICS and the G7 countries. Its focus is to spot trends in age structure, life expectancy, fertility rates, and employment tendencies in order to estimate the future economic resilience and growth prospects in these regions. Using a comparative analysis methodology, this paper collects and examines data from 2000 to 2023, covering a time period of over two decades for both BRICS and the G7 nations. Additionally, the authors have resorted to a mixed methods design that encompasses secondary data analysis along with qualitative research. This method uses several quantitative indicators such as population age structure, the life expectancy at birth, but also fertility rates, and unemployment rates to provide a comprehensive view on the impact of demographic changes. Our results show an obvious difference: While the population of G7 countries is getting older and fertility drops, in BRICS nations we find growing young populations. The G7 countries squeeze economic momentum out their dwindling workforce, while the BRICS nations ponder how best to utilise a youthful demographic. In so doing, the paper contributes significantly to our understanding of the demographic and economic trajectory for both emerging as well as established economies. This contrast underscores the direction that global economic dynamics might take in a new multipolar world. This case also reiterates the impact of demographic trends on economic policy and alludes to a growing necessity for targeted social and economic measures. This paper notes that G7 nations could emphasise innovation and immigration policies, while the BRICS countries may work toward improvements in education and employment to take advantage of their demographic dividend. In the end, this research will stand as a considerable scholarly contribution concerning how changes in

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demographics can critically impact economic conditions while offering up an action plan for future policy makers that moves at the speed of our new demographic reality.

Keywords: G7, BRICS, demographic shift, GDP, unemployment, social welfare.

JEL Classification: F63, F66, F68, J11, J13.

1. Introduction

Demographic shifts are occasionally a significant part of world politics, societies, and economies around the globe, as global dynamics always influence socioeconomic policies. Demographic factors, including changes in population numbers and age profile together with migration trends, have far-reaching economic and social impacts worldwide. These are very critical changes if you look at both G7 (Group of Seven) and BRICS. The developed world is represented in the Group of Seven (G7) composed by USA, UK, Canada, France, and Germany, while emerging markets are part of BRICS with Brazil, Russia, India, China, and South Africa. In addition to BRICS, starting from 1st of January 2024, other key oil exporters such as Saudi Arabia, United Arab Emirates, Iran, Egypt, and Ethiopia have joined the group.

The G7 countries, founded on exemplar industrial capacity and advanced economy, are now facing demographic issues. These transformations, such as falling birth rates and an elderly population, put pressure on their labour markets and social support programmes. While on the other hand, BRICS countries' economies are growing too fast and becoming autonomous to be integrated into the global market; with a rapidly growing young population ratio (under the age of 25 years), migrating from rural areas as a result of previous decades' growth in national GDP. It is important to comprehend both the social and economic ramifications of these demographic shifts within BRICS as well as the G7 bloc. Among the issues that G7 is looking at are healthcare reform, pensions, and sustainable productive workforce. In contrast, BRICS members focus on labour markets and ensure that they have an educated and expanding workforce, in addition to overseeing urban growth. A comparison of these trends reveals the differing strategies each group of countries will have to pursue in order to combat their challenges and seize as many opportunities as possible. The demographic realities should not negatively impact the economic gains.

In the next section of this research paper, we review the appropriate scientific literature. Third and fourth sections reveal the research methodology, findings, and discussion, respectively. Finally, this paper ends with the conclusion section.

2. Problem Statement

Modern studies are highlighting the significance of the demographic changes on global economic and social structures all across G7s and BRICS countries. The demographic structure and phase of development in these two blocs, the G7 –

where economies are much more developed – on one side; BRICS exerting considerable shares of influence with their emerging economies. This literature review is an attempt to provide coherent insights, knowledge, and perspectives that can help understand the distinct outcomes of demographic transitions in LICs vs. HICs.

In the G7 nations, this relationship of change in the demographic shifts and economic outcomes is examined by Biswas et al. (2021). Their research stresses the urgent call for policy reforms to reflect these shifts. It concentrates on the likely effects of economic performance, labour markets, and social welfare systems. Lastly, the study explored some of the policy tools that G7 countries can use to address economic difficulties related to the ageing population. On the other hand, Wade (2011) writes about global economic power moving from G7 nations to new economies that are part of the BRICS bloc. This paper investigates the growing role of BRICS within major multilateral organisations in light of the demographic shift. It highlights how demographic and economic shifts in these new markets are changing the way they influence global trends.

Jakovljevic et al. (2021) conduct an extensive analysis on the impact of demographic changes on crucial economic metrics in both the G7 and BRICS members. This study assesses how factors like ageing populations, birth rates together with migration trends influence economic development, labour productivity, and social security systems. It also looks into how these demographic factors shape the economic policies in these nations. In a separate comparative study, Jakovljevic et al. (2020) evaluated the various approaches that G7 and BRICS members use to address those challenges and opportunities related to ageing populations. This study suggested that different economic and social policies with a specific demographic structure are required. It also looks into the consequences of demographic ageing on economic growth, healthcare infrastructures, and pension systems. This demonstrates the conflicting policy outcomes of both developed and developing economies.

Cooley and Henriksen (2018) demonstrates that the G7 countries are facing similar challenges from shifts in demography, while Ahmed et al. (2020) studies how growing demography establishes trends in BRICS nations. Cooley and Henriksen (2018) focus on the repercussions brought by changes in population composition on labour markets, social welfare schemes, and healthcare systems in G7 nations. This highlights the challenges of an ageing society. Conversely, Ahmed et al. (2020) provides a valuable analysis of how demographic trends structural transformation should affect economic growth and development trajectories for BRICS countries. This clearly outlines the challenges/opportunities seen by these countries.

Agyei et al. (2022) looked at the financial links between BRICs and G7 economies in great detail. Their research wanted to identify what are the important factors to differentiate among the millions of people in global financial markets that link demographic changes directly with macroeconomic modelling. To evaluate

time-frequency spillovers, contagion, and contingent weights between the BRIC index as well with respect to G7 economies they employed Barunik and Krehlik (2022) Net Spillover Index. Such an approach was vital for making sense of the complicated dynamics in the financial markets. The findings showed that G7 and BRIC economies have statistically significant total spillovers in the short term, as well as net spillovers. Thus, there is a high degree of financial interdependence and rapid mutual responses. The study also found widespread contagion effects from BRIC on G7 economies during the time period 2017-2019. The global fallout from Brexit and the US-China trade spat was caught up in these spillovers. The rise of globalisation can be understood by reflecting on how some political and economic changes taking place in one could also affect globally. Importantly, the research indicated France (along with Germany and the UK) as a leading country that spreads financial disruptions to BRIC markets. The authors also pointed to the importance of leading G7 nations in influencing changes on global financial markets.

Cheng et al. (2023) highlight that the BRICS and G7 countries are trying to achieve sustainable development. The paper focuses on the importance of taking environmental implications into account during economic growth and calls for tailored solutions in different parts of the world. In particular, China showed the biggest increase in efficiency, while technology improved fastest in the United States. It shows that China is getting better at reducing their resource consumption, while the US keeps installing high tech sustainable devices. In the case of Russia and South Africa, on the contrary, significant declines in technological advancements took place. It also reflects the challenges for these countries in achieving sustainable development. Moreover, this research also found that it has a differentiated effect of GDP per capita and population size on CO₂ emissions from BRICS to G7. GDP per capita and population growth are the main drivers of CO₂ emissions in BRICS countries. This means that an increase in the economic growth – population Nexus, directly translated to emissions. On the other hand, CO₂ emissions in G7 countries are negatively affected by these factors. That means that as their economies grow, they are better able to control emissions.

Camioto and Pulita (2022) used the Slacks Based Measure (SBM) approach of Data Envelopment Analysis (DEA) to evaluate and compare sustainable development efficiency between the BRICS as well as G7 blocs. In the DEA model, the outputs were GDP and life expectancy at birth; the inputs of this model are CO₂ emissions, unemployment rates, as well as energy consumption. Surprisingly, some BRIC (Brazil, Russia, and China) including India, have proven to perform better compared to the G7 countries in global average efficiency. This shows that BRICS nations are capturing the three dimensions of sustainability (economic, social, and environmental) as well, if not better than some developed countries. The findings of such a study are essential to guide public policies and single out the few best practices in environmental, social, or economic context for each group of countries.

Sharma et al. (2022) analyse how Foreign Direct Investment (FDI) inflows have evolved over time globally and, more specifically, what has been happening with these flows in BRICS compared to G7. The research points to declining FDI inflows in G7 nations, whereas the BRICS countries are recording an increase. This is a symptom of the expanding financial attractiveness and global influence potential that BRICS countries are enjoying. Using the ARIMA model, the growth rate of FDI inflows was also forecasted for BRICS to be increasing and G7 may have stable or downward trend. For foreign investors, these results are very important in assessing the market potential. It is essential for the BRICS countries to frame good FDI policies and create an ideal market environment by initiating financial reforms.

There is a mixed landscape of financial interdependencies suggested by the literature review on demographic trends in G7 and BRICS members, their economic implications including assets utilised for investment (GDP), social cohesiveness or polarisation as well as fiscal sustainability. It also signals the progress in sustainable development effectiveness and the changes in the patterns of foreign direct investment. The main results indicate significant short-term financial spillovers across the BRIC and G7 markets. There is also significant economic efficiency in emerging BRICS countries with sustainable development versus the G7. Hence, the change of FDI inflows- rising in BRICS than G7- was crucial to mention. These findings are a function of the changes in global economics.

3. Research Questions / Aims of the Research

This study aims to examine the impact of demographic changes on the economic and social frameworks of the G7 and BRICS countries. These changes have significant economic and social welfare impacts on these countries. The authors should have a thorough understanding of how these factors differ in terms of population size, age structure, and spatial distribution. This study examines the impact of demographic trends on economic development and social structures in developing and developed countries. Furthermore, economic development encompasses the generation and application of valuable knowledge in intricate fields. The Economic Complexity Index (ECI) is utilized to assess a nation's productive knowledge, relying on country rankings provided by Harvard Growth Lab. As a result, countries have the opportunity to enhance their ECI by expanding and encouraging their thriving export portfolio.

4. Research Methods

The most important part of this study could be seen as a comparative approach, focused on demographic trends and their impacts on both the G7 and the BRICS countries. This equals population, age distribution, life expectancy, and fertility compared to GDP at purchasing power parity (PPP), namely, national income with inflation taken into account, as well as unemployment rates against economic value.

In order to achieve the objective of this research paper, secondary data analysis and a qualitative method were used by the authors. Qualitative research methodology is a necessary method to describe the specifics of human behaviour. This method has also been used in quantitative research methodology in order to understand how numerical data and statistical analysis work. Qualitative research deals with going into details and investigating social behaviour (perceptions-attitudes-feelings-human actions). It focuses on cognitive activities and experiences. On the other hand, what it does is to gather detailed observations into a topic using data collection techniques like case studies. These data are analysed to distinguish the patterns of their background, points of view, and pertinent issues concerning G7 and BRICS. Combined with its qualitative research methodology, the results are highly useful in detailing human complexities.

This process involved the collection of relevant information through desk research by sourcing the data from top leading academic journals in that particular field. The authors then organised and analysed the data systematically after a meticulous review of the literature in addition to tables and charts analysis. These data were analysed and integrated into this research paper.

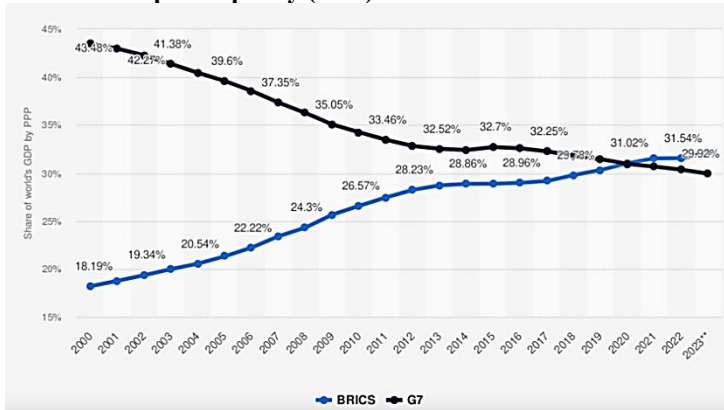
5. Findings

Different demographic shifts were revealed within these two groups (G7 and BRICS) in our analysis, with both raising different social-economic challenges. The U.S. by far had the biggest population increase of any G7 country: rising from 282 million to around 332 million between 2000 and 2021. From 128 million in 2010, Japan's population has been declining and its current estimate is about 125.7 million. Over the last few years, Italy has also lost population. The other half of the coin is that BRICS countries account for 40% of the world's population with a total population estimated to reach 3.24 billion people as of 2021. China and India come first with over 1.4 billion people in each nation, which collectively is more than the entire total of other three countries as they have less than even half a million together.

The number of people who live in all the BRICS countries is much higher than those who live in the G7 countries. BRICS nations have a population of over 3 billion people, which clearly shows their share in the global populace and also communicates how large a market they can provide together. The BRICS countries, and most prominently China and India with their emerging economies, experienced a tremendous population growth. Meanwhile, countries like Japan and Italy are seeing their populations in decline - an indicator of ageing societies with declining birth rates. Thus, the larger population of BRICS will influence the labour force and possible consumer market. This is essential for economic growth and development over the long run. Conversely, the G7 nations may turn to productivity and innovation as ways of compensating for slower population growth. This result is different demographic challenges that both groups face. The BRICS nations, on the

other hand, must also deal with large and growing populations where issues of employment, resource use, and city planning are concerned. At the same time, G7 countries are grappling with a rapidly ageing population and all of its forms – healthcare and pension systems as well as shrinking workforces.

Figure 1. BRICS and G7 countries’ share of the world’s total GDP in purchasing power parity (PPP) from 2000 to 2024



Source: Statista, 2024.

BRICS made up around 18.19% of the world’s GDP in PPP terms compared to G7’s 43.48%. By 2023, the BRICS’ share increased to approximately 31.54%, while the share of G7 decreased to 29.92% over 23 years. The share of BRICS shows a generally steady yearly increase with a more rapid growth observed in the early 2000s, while the G7’s share exhibits a gradual decrease during these years. The decrease rate slowed down in the latter part of the period. In consequence, the BRICS has grown from a less than half-share to more than G7 today (indicating a new balance of economic power in favour of developing countries over established economies). The growing share of the BRICS nations derives from their standing in the global economy and also raises questions about changes regarding international economic and political affairs. The fall in the share of the G7 might indicate that these countries face relative economic headwinds or are undergoing some form of transition. Alternatively, it could just confirm the fast growth of the BRICS members.

Table 1. A Comparative Analysis of G7 vs. BRICS Countries

Average	G7	BRICS
Fertility rate	1.58 %	1.80 %
Life expectancy	82.11	70.32
Age structure (0-14 years old)	15.55 %	22.4 %
Unemployment rate	5.41 %	10.95 %
Youth Unemployment rate	12.27 %	25.08 %

Source: authors’ own research results, 2024.

Table 1 compares the average statistics of the G7 and BRICS countries across five different socioeconomic indicators. The average fertility rate for the G7 countries is 1.58% and BRICS stands slightly higher at 1.80%. This shows that the average number of children is higher in the BRICS countries than in the G7. The birth rate also influences the working age population, which in turn affects potential economic development opportunities. But the average life expectancy is much longer in G7 countries, 82.11 years versus only 70.32 for BRICS nations. This vast discrepancy implies that the healthcare system of G7 countries is probably better than others, the quality of life much higher, and the public health policy more efficient. Life expectancy is often thought of as a summary indicator of the general health and well-being of the population. BRICS countries have 15.55% of their population in the age group of 0-14 years. This higher proportion of young population shows an expanding workforce which could be a demographic bonus if effectively utilised through education and employment creation. The G7 nations have an average unemployment rate of 5.41%, which is less than half of 10.95% recorded by BRICS. This suggests that the G7 countries may have more stable labour markets and better employment policies due to stronger economic conditions that support higher levels of employment. Also, the youth unemployment rate in G7 countries has an average of 12.27% compared to more than double that figure for BRICS countries of 25.08%. Youth unemployment is a key economic indicator to measure how able their new entrants are at finding jobs. Higher rates could indicate that the economic transitions, skill mismatches, or job creation challenges facing younger workers are specific to those countries.

The average unemployment rate of the G7 nations comes out to be about 5.41%, which, if brought in contrast with BRICS, is less than half, or a little over half, what has been recorded by it, i.e., 10.95%. This could reflect that G7 countries have relatively more stable labour markets and comparatively better employment policies because they are backed by stronger economic conditions leading to comparatively higher employment levels. Again, the youth unemployment rate in G7 countries stands at an average of 12.27%; on the other hand, it is more than double that figure for the BRICS at 25.08%. Youth unemployment is a very important economic indicator, assessing how able their new entrants are in finding jobs. Higher rates may indicate that the process of economic transitions, skill mismatch, or job creation challenges being faced by younger workers is specific to those countries.

The average unemployment rate for the G7 countries is at 5.41%, compared to an average of 10.95% in the BRICS countries, which translates that labour markets in G7 countries are more likely to be stable or there could be greater effectiveness in their employment policies or stronger economic conditions that facilitate higher employment rates. The average youth unemployment rate of the G7 countries is 12.27%, and it is more than double that, at 25.08%, for the BRICS countries. Youth unemployment speaks to core indicators of economic health, reflecting the ability of new entrants to obtain gainful employment. Therefore, its higher magnitude in BRICS would suggest that problems such as economic transitions, skill mismatches, or lagging job creation might potentially affect the younger workers.

Table 1 reflects broader economic and demographic trends and challenges in these two groups of countries. The G7, consisting of more developed economies, shows signs of better employment conditions, an ageing population with lower fertility rates but higher life expectancy. In contrast, BRICS countries, which are generally less developed but rapidly growing, have younger populations and face greater challenges regarding employment, especially for the young generations. These differences highlight the stages of economic development and demographic transitions between the two groups.

Table 2. Country complexity rankings G7 versus BRICS Countries

Countries	G7	BRICS
Canada	0.58	N/A
France	1.34	N/A
Germany	1.94	N/A
Italy	1.35	N/A
Japan	2.26	N/A
UK	1.61	N/A
US	1.40	N/A
Brazil	N/A	-0.16
Russia	N/A	0.19
China	N/A	1.33
India	N/A	0.48
South Africa	N/A	-0.15

Source: Economic Complexity Index (2021).

In general, G7 countries exhibit higher economic complexity due to more advanced and diversified economies that are able to produce several types of goods. From the BRICS bloc, China is the only that has an ECI close to the G7 group. Further, China already had a higher value of ECI vis-à-vis Canada; the remaining BRICS lag even behind more. Hence, these higher value countries experienced more significant opportunity for economic resilience and growth. Thus, it is confirmed that the G7 countries and the BRICS in the form of China will not experience significant economic adversity.

6. Conclusions

This research paper provides a profound examination of the opposing demographic trends and their socioeconomic consequences across the world's leading economies. By systematically comparing the G7 – a group of established industrialised nations – with the rapidly emerging economies of BRICS countries, this study makes several important contributions to our understanding of global economic dynamics. The main contribution of this study is the clear delimitation

of the demographic divide for each group. For G7 nations, it is required to deal with the ageing populations and lower fertility rates. What is more, the G7 group has to face the economic challenges of sustaining the social support systems without overburdening a shrinking workforce. In contrast, the BRICS countries are dealing with the simultaneous social and infrastructural needs of an increasingly young population – along with investing in education and generating jobs. It is worth noting the significance of this study, as it shows how economic policy and social structures are also influenced by demographic. It is primarily focused on the innovation and immigration policies that the G7 member states pursue. This and an increase in the labour force participation rate could counteract some of the impact from demographic changes. But the BRICS members cannot afford to lose ground; they need to leverage their diversity through skill improvement and job creation. Using an increase in population is seemingly bound to produce the economic benefits.

The implications for global economic balance, especially in the context of a power shift away from west to east, are emphasised by this research paper as well. In other words, global GDP shares suggest a future in which BRICS members may gradually dominate the shaping of global economic policies and directions.

Economists, policymakers, and social planners alike can employ these findings to project future societal outcomes and fiscal measures. Furthermore, this study can be used by multinational companies to customise investment plans and marketing strategies in line with the demographic truths.

Future studies might expand to a more thorough examination of the microeconomic implications, for example, changes in demographics workforce productivity and consumer behaviour. There is useful information from comparative studies on how countries have managed or handled similar demographic trends in the past that would come handy. In addition, by examining how technological change might combine with other advances in areas such as demographics and automation would point to further strategies for promoting economic adaptation.

This study concludes by pointing out the economic and demographic gaps that continue to widen in the most powerful economies. It also prepares the ground for a more informed discussion about how demographic trends can be framed and managed to pave way for sustainable futures.

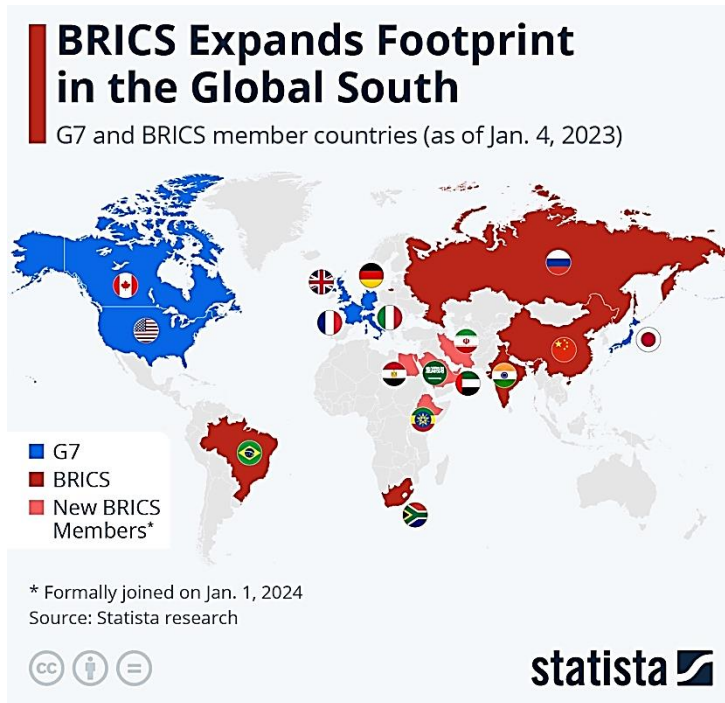
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Appendix 1



Source: Statista (2024).

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The Trustworthiness of AI Algorithms and the Simulator Bias in Trading

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Abstract

The application of AI technology is changing dramatically investment decisions in the financial and banking industry. Neural networks (NN) are a special type of machine learning algorithm employed in training trading robots. They might be associated with advanced analysis of the specific software simulators used fundamentally in algorithm training and testing to alleviate risk in the trading activities. Our research focuses on a couple of key aspects: a methodical literature review using Natural Language Processing (NLP) tools, to delve into major themes directing to the efforts of understanding of the role of algorithms and NN in trading and investment banking. We discovered that these technologies play a major role in reducing risk and effectively taking up the mission of forecasting market fluctuations and evolving shortly in automatic trading strategies. The paper examines the possibility of harnessing simulation tools utilised in the capital investments markets for practicing and examining algorithms as well as methods for reducing biases and enhancing decision-making process. The discoveries have revealed that NN rules can be efficient in attaining patterns in historical data while forecasting stock prices precisely. In terms of large applicability, this research emphasises the requirement for countering emotional and cognitive behaviours that may impact trading results, and it exposes the most effective types of NN for designing trading algorithms. An algorithmic framework for improving biases innated in a financial banking trading activities is recommended, to improve impartiality, risk management, and trading execution.

Keywords: risk management, trading algorithms, bias mitigation, trustworthiness.

JEL Classification : C11, C15, C45, D53.

1. Introduction

Taking into consideration the transition from Industry 4.0 to Industry 5.0 economy, it is vital for the financial sector to embrace the ethical AI technology

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and enhance its capability. The industry has traditionally been defined by instances connected to volatility, regulations, cybersecurity threats, technological limitations, and the disruption of settled economic activities (Goodell et al., 2021).

It is evident that, in the last ten years major studies in economics has concentrated on artificial intelligence (AI) technology. Moreover, it has experienced an acceleration in recent years and is now being implied on a large scale in all Fortune Global 500 companies as well as smaller companies across all industries. Mostly, AI has been associated with process automation in so-called “secondary sector” or manufacturing and processing sector. Recently, the scholars and the business community have observed the inception of positive applications of the technology, particularly in finance. The exponential growth of advanced analytics connected to the usage of machine learning (ML) and neural network (NN) algorithms, influenced dramatically investments. These evolutions enhance the newest methodologies and stimulate the application of data science to algorithmic trading strategies. Consequently, it is imperative for the industry to integrate algorithms aimed to calculate vulnerabilities of the market, in real time, for all types of risk. In that event, this will help to significantly avoid the magnitude of the emotional and cognitive behaviours that interfere in the trading process in the capital markets. The first objective of algorithmic trading is to generate a cost-effective trade execution process, and at the same time, harnessing risk management. This is accomplished by the utilisation of trading strategies software simulators. These software programmes cleave to preestablished mathematical rules, which mandate the entry and exit points for trades, thereby diminishing the requirement for human action (Chan, 2013).

Our paper is structured in sections: Section 2 summarises the problem under investigation, while Section 3 provides a review of the justification behind this research; Section 4 describes the methodology of the paper, while Section 5 presents the findings. Section 6 proposes a conclusion and suggests avenues for future research.

2. Problem Statement

The scholarly and major authors on the subject include an extensive array of topics, including the domain of algorithmic trading strategies (Aloud & Alkhamees, 2021), as well as the practical application of machine learning (Gerlein et al., 2016), market microstructure analysis (Osler, 2012), risk management, and regulatory considerations (Friedman, 2011). At the same time, it is imperative to assimilate concepts from finance, computer science, mathematics, and recently, emergent regulations on Artificial Intelligence formulated by the E.U and the U.S authorities.

A major proportion of research in the domain of algorithmic trading strategies is focused on to the expansion and evaluation of different types of algorithmic trading strategies. Illustrations of such strategies include those involved in market in general, trend following, statistical methods, and execution of algorithms (Hu, 2018). Simultaneously, the latest research is focused on neuronal networks as well as random forests used in the development of predictive models for

risk assessment and portfolio optimisation in the context of machine learning applications (Kissell, 2020).

One of the major verdicts after of the scientific literature review is the constant concern of risk management. Without considering the author, risk management is constantly described in a comparable practice, with specific methodologies specific to algorithmic trading. A successful trading framework can be defined as one that assimilates an assortment of advanced analytics techniques with a predesigned system that can “understand” the importance of each information and how to use it in the prediction process. The above methodology demands diligent algorithmic selection and design. The consideration of algorithmic trading strategies includes a mandatory analysis of the current regulations. This involves an examination of market supervision, compliance regulations, regulatory frameworks, and the role of the regulatory framework impacting the market structure (Pereira et al., 2019). Nonetheless, the studied research does not examine the role of trading biases in the financial industry and the final outcomes that these have in this field. Hence, our research aims to nurture the knowledge related to trading tendencies, also known as biases, determine their nature, and identify software trading simulators and neural network applications that could be engaged to enhance the trading activity in the industry.

3. Research questions. Aims of the Research

The main purpose of this research is to closely inspect the process framework engaged in trading algorithms, which utilise advanced analytics solutions that facilitate the ethical AI best practices. Moreover, the design of these processes must take into consideration an extensive awareness of biases, with an emphasis on the cognitive biases. Finally, the design will address the vital role of the latest trading simulator software systems, with the final objective of successfully countering the most important trading biases.

The research question applied in this dissertation is: How might we project a framework for a successful and responsible AI trading process that will enhance transparency, sustainability, and durable profits to financial market players?

To successfully respond to this question, we must embrace a holistic approach that can be applied to any financial ecosystem. This should be qualified as mediating the internal capacities of the ecosystem in extension to its inputs and outputs. The main objective of the financial industry is to generate stable profits through a flowless process of allocating resources. The execution of the correct measures in one market has a positive impact on other markets and on the global market as well. This law is not limited to a single market; it can be observed in a multitude of contexts.

Our objective in this study is to initiate a comprehensive research project with the aim of providing major answers to several significant questions:

- What are the main cognitive biases that have been identified and which are their characteristics?

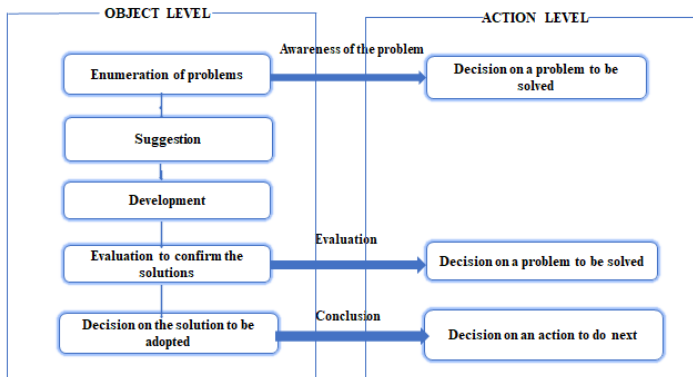
- What methods can be engaged to enhance effective information recovery within the context of the financial market?

At the same time, it is beneficial to determine which AI mechanisms are employed and which are the boundaries applied in the case of neuronal network applications that promote the implementation of transparent, ethical, and responsible trading strategies between market participants.

4. Research Methods

As part of this research study, the research method called *design experiment* (Takeda et al., 1990) is involved. We will follow specifically step (1) awareness of the problem, and step (2) suggestion, i.e. suggesting key concepts needed to solve the problem at hand.

Figure 1. The research methodology



Source: adapted from Takeda et al. (1990).

The research methodology is concentrated on the investigation of the framework designed for the various types of neural networks that can be utilised for transactions in the investment capital markets. It also contains the analysis of the complexities of trading algorithms, the implementation of complete algorithms in trading, and the development of a realistic model for the entry of the programme. The research methodology involves an analysis of the trends in decision biases and trading algorithms, based on the data they are trained with. The vital discovery of the research is the requirement to manage emotional and cognitive biases that might obstruct optimal trading behaviour (Ward, 2014). The final part of the paper is dedicated to the examination of bias reduction strategies and decision-making methodologies inherent within trading algorithms based on AI models. At the same time, our investigation proposes a potential solution (Kordzadeh & Ghasemaghaei, 2022).

The analysis of patterns in decision biases and trading algorithms is dependent on the data that determine their model. Therefore, the research methodology, as previously defined, is to address the role of emotional and cognitive processes in the trading process, with the aim of improving decision making. The paper provides an inclusive interpretation of these tendencies. Secondly, we analyse the simulation tools employed in the financial industry for training and testing algorithms, as we chose to investigate a software solution simulator. Thirdly, our research focuses on the reduction of negative trends and the methodologies engaged in the decision-making processes of trading algorithms based on artificial intelligence models.

From a definition and scientific standpoint, *cognitive bias* refers to methodical divergences from rationality in judgment, causing people to draw unreasonable conclusions about others and situations. These biases often emerge from the brain's effort to simplify the information process. Moreover, cognitive biases might precede perceptual deformation, misleading decisions, or largely, *irrational thinking*. There are several key aspects of cognitive bias: “systematic deviation” (they follow predictable patterns, they are not occasional, and they are highly repeatable); influence on decision-making; heuristics or trial-and-error methods (mental shortcuts that can lead to errors); emotion and motivation (these influence cognitive biases, affecting the objectivity of our thinking).

Trading biases establish a specific category of cognitive bias, particular and inherent to the financial sector. This theory was first defined by the Israeli psychologists Amos Tversky and Daniel Kahneman (Kahneman & Tversky, 1974). They have described this type of bias as “the systematic error in thinking, judgement and decision-making” that happen in the process of the information interpretation by humans. We advocate on the profound understanding of the biases that allows traders to predict efficiently market changes. A profound understanding of these concepts empowers traders to acquire resilient strategies and traverse the complexities of financial markets. That means that the process of conscious comprehension of their own emotional responses and those of others, allow traders to manage stress more effectively, maintain discipline, and tap into a better performance. The most common bias among those engaged in financial trading is a propensity towards optimism or pessimism. The performance of a specific trading activity is influenced by the outcomes of historical and current transactions. In the case of a successful trade, traders might experience a sense of conviction and optimism. This bias may result in overconfidence in decision making, which translates to riskier trades. On the contrary, a history of poor performance can turn out in unnecessary pessimism, which may block traders' capacity to capitalise on profitable opportunities. The most important element is to achieve a balance between these emotional behaviours to maintain a logical strategy to trading process.

Our research perspective indicates that artificial intelligence (AI) technologies, could play a major role in avoiding these biases. The utilisation of advanced analytics enables traders to decrease the influence of emotional biases and promote rational decision making.

Another element is that of *overconfidence bias*. A considerable correlation of the population exposes a trend to overestimate their expertise and abilities. Equally, traders demonstrate similar behaviours within the context of market operations. Overconfidence among traders can have a consequence in excessive risk taking and market volatility. Self-serving bias can lead to a lack of accountability and poor decision making. Education and the individual and global level foster self-awareness and enhance the inception of a more durable and rational trading process. In pursuit of reducing the cost price, traders employ a *double-down trading strategy*. Unfortunately, the market does not have the memory of its own, in other words, it does not keep the information regarding past prices and neglects the cost price. Our perspective is that the absence of a software simulator embodying historical data and cost-price algorithms will result in negative results for the trader and their company. An understanding of these tendencies can assist traders in developing more effective and less risky trading strategies. However, all these elements are to be incorporated in the simulator software system.

The notion of “loss aversion” is well known in the case of trading and market investment activities. The simple definition of loss aversion is the tendency of individuals to choose avoiding losses to gain accumulation of an equal value. The fear and the pain of losing are approximately 200% more significant than the pleasure of gaining. This bias can determine irrational decision making in the market space, such as maintaining losing positions for an extended period or selling winning positions early to avoid realising a loss. Our research demonstrates that AI technologies and more specifically algorithms can efficiently master loss aversion through a range of processes integrated into trading software simulators. These include equitable decision making, consistent strategies, risk management, behavioural analysis, which enhance active feedback and real-time adjustments, and ultimately, *backtesting*. This latter process empowers AI to simulate trading strategies using historical and current data, thereby assisting traders in understanding the long-term effects of their strategies and eliminating loss-averse behaviours.

“*The fear of missing out*” is another in key concept in trading biases and it refers to the emotional response that rolls out when traders experience anxiety about missing possible profit opportunities. As a result, investors manifest impulsive and irrational decision-making – a classic example is entering trades without sufficient analysis in pursuit of instant gains. In this case, the fear has an immediate consequence in the form of lack of clarity in decision making. As a proposed solution through this research, the trading simulator can facilitate data-driven decision making avoiding all the biases. As a functionality mechanism, algorithms continuously monitor market conditions and execute trades based on predefined criteria and rules, historical and present data, thereby avoiding the impulsive decisions driven by concepts such as “the fear of missing out”. This has the effect of reducing the emotional influence on trading activities, which in turn may result in more rational and potentially more profitable outcomes.

The last concept that we would put forward is the one of the "law of small numbers". This bias interferes in the trading activity by applying the outcomes from a limited sample of data to a larger scale. In other words, humans have a significant tendency to extrapolate their decision to a limited number of situations that manifested a specific result. In the context of trading, this bias can result in traders overestimating the reliability of recent gains, assuming that they are indicative of long-term trends. This can result in incorrect decisions based on insufficient data, which may lead to implicit losses. Using AI technology to develop very high-performing software simulators, the algorithms sort through massive data analysis and huge historical data. As a result, traders can reduce their reliance on small samples. There is also an element of pattern recognition such that the advanced algorithm identifies real patterns across large data sets, distinguishing what is random noise and what contains meaningful patterns. Adaptive algorithms and feedback processes within the system enhance continuous learning. Taking into consideration the key findings presented in the dissertation, it can be concluded that utilization of the ethical AI-driven technologies augmented by the incorporation of neural networks and machine learning methodologies, assisted all the time by the human decision depict one of the most effective methodologies for the reduction of behavioural and trading errors. The primary reason behind this is that these superior technologies can analyse huge datasets, detect patterns that the human eye would miss, and then complete the trades with accuracy and consistency. Time and again, our research brings out the suggestion that software trading simulators be improved as a way of overcoming biases. Such a system, embedded with ethical algorithms, will effectively train and guide the trader on processing all available market information and assist them on preventing cognitive biases; aiming for more justifiable and rational decisions on trading to be made in a hybrid (human-machine) approach.

5. Findings

Our results suggest that there has been quite some advancement in the capabilities, volumes, mechanisms, and techniques in trading activities over the past 60 years. The introduction of systematic advanced analytics-driven strategies into trading has changed the domain very significantly and provided a big competitive advantage, powered by increases in computing power and data availability and the development of statistical methods. This section will provide a brief summary of the findings in the research. With increasing uses of artificial intelligence systems to aid humans in making their decisions, it becomes of utmost importance to have the full understanding of the potential for these systems to guide human behaviour in ways that can be either inadvertent or harmful. Regardless of their high predictive capacity, algorithm models may lack sufficient explainability, robustness, and fairness. Consequently, they may not be regarded as trustworthy by the traders, business users, auditors, and regulators. The trustworthiness of AI algorithms in trading requires at the same time the growth of sophisticated statistical techniques to quantify associated risks. This demand is correlated with recently proposed regulations, such as the

European Artificial Intelligence Act (EU, 2022) and the American Artificial Intelligence Risk Management Framework (United States National Institute of Standards and Technologies, 2022). For a fair evaluation of the trustworthiness of AI applications in trading, it is mandatory to define a set of quantifiable indicators that are specific to AI systems in this domain. Our straightforward observation is that classical statistical metrics and descriptive indicators are inadequate or, in the most optimistic scenario, insufficient for this purpose. As a next step in our research, we will define the blend of the most suitable combined statistical metrics that can be employed to measure, manage, and mitigate the risks associated with the use of artificial intelligence in trading.

Table 1 and Table 2 depict an example of a trading algorithm simulator system (we will name it “TASS”) that leveraged the market data and applied machine learning algorithms. The trading biases, as described in the paper, have been eliminated by the algorithms. Table 3 shows the result when using TASS compared with the trader's decision. This is an alternative trading system or a trading simulator system. The research results inarguably validated that the trading simulator system, developed based on the advances of AI technology and algorithms, has generated profits. To illustrate this, we selected three positions from the overall study, all of which were profitable. The similar profitable results have been obtained for all the positions that have been studied.

Table 1. The list of trades created by the trading algorithms simulator system (buy)

Symbol	Trade Side	Buy Trade no.	Buy Price Trader	Buy Price TASS
CMP	BUY	12	0.87	0.98
ALU	BUY	13	0.65	0.67
BRD	BUY	10	11.7	11.99

Source: adapted from Vinte et al. (2019).

Table 2. The list of trades created by the trading algorithms simulator system (buy)

Symbol	Trade Side	Sell Trade no.	Sell Price Trader	Sell Price TASS
CMP	BUY	12	0.87	0.99
ALU	BUY	13	0.65	0.68
BRD	BUY	10	11.7	12.00

Source: adapted from Vinte et al. (2019).

Table 3. The return obtained by using the trading algorithm simulator system.

Symbol	Variance Buy	Variance Sell	Return %
CMP	+0.11/12.65%	+0.012/13.79%	1.14
ALU	+0.02/3.07%	+0.03/4.61%	1.54
BRD	+0.29/2.48%	+0.03/3.0%	0.52

Source: adapted from Vinte et al. (2019).

6. Conclusions

In the financial and banking industry and particularly in the investments domain, the plethora of information and data are defined by a significant level of complexity, noise, nonlinearity, and nonstationary and sometimes extremely versatile. In such a sophisticated environment, it is demanding and in most of the cases impossible for traders to develop a reliable strategy. Our research revealed that an extensive usage of a hybrid approach of ethical AI technology - which implies neuronal networks and machine learning algorithms, fostering continuous learning and feedback mechanism enhanced finally human decision - to overcome the identified biases. The algorithms, integrated as part of a software trading solution, have shown significant results in multiple areas, proving to be effective tools for the extraction of market characteristics and the avoidance of cognitive biases. Consequently, deep learning methods, neural networks, and machine learning techniques assisted by human decisions are employed in the new phenomenon of profitable and stable trading domain which will portray the characteristic of a future market imperative. At the same time, the incorporation of these algorithms might assist predictive precision, optimised decision making, and accelerated trading strategy efficiency. The research revealed that the development of a high-fidelity simulator software solution for the capital markets infused with AI algorithms will positively influence the behaviour of traders and investor bankers by allowing them to learn and test their skills in a “sandbox” like the trading environment they operate in. Such an established system can be subsequently extended to all trading markets with potential applications in other industries.

Declaration of Generative AI and AI-assisted technologies in the writing process: "During the preparation of this work the authors used *DeepL Write* in order to improve readability and language of the work. After using this tool, the authors reviewed and edited the content as needed and takes full responsibility for the content of the publication.

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**Approach of Determining Process Maturity
in Information Security Management Systems**

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Abstract

The need in companies to be compliant with their business processes and to identify and minimise possible risks is an essential task today. Thus, the consideration of the process maturity for management systems of companies is an important approach to see immediately the status of processes as well as implemented requirements. By leveraging maturity levels, numbers and metrics provide a quick look at the overall condition and can be used to derive both measures and compliance with requirements. When looking at an information security management system (ISMS), there is a lack of a general process view and evaluation based on it, and thus also a holistic view beyond the detailed requirements and hard facts. The intention of the paper is to look at the status of existing, industry-specific maturity approaches for information security management systems and to analyse the possibilities for adaptation. Furthermore, based on the evaluation, a maturity model for the ISMS will be proposed to ensure key figures for the companies over time regarding the minimum requirements and certification conformity. A mapping to standards such as CMMI for the classification of the maturity level and the consideration of similar solutions and implementations will be considered. The paper is intended to show the possibility to use a concept to enable the calculation of a percentage maturity level for the representation of the information security level in the company and to make the resulting risks in information security visible. The results of this research show that the proposed approach for a unified method will help to report the maturity of information security management system processes in combination with conformity and security risk for the decision makers in companies.

Keywords: process maturity level, information security management system, maturity level assessment.

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1. Introduction

In the area of information security and the associated standardised requirements of the international standard ISO/IEC 27001:2022, there are challenges to obtaining a detailed overview of the business processes to control or adapt them due to the several individual requirements. From the point of view of information technology, topics such as business process optimisation and associated cross-disciplinary functions such as project management, documentation, and continuous improvement are considered, but the technical aspects are always in the foreground.

If companies decide to be certified according to ISO/IEC 27001 or must implement this due to customer requirements, then many management system requirements are already covered by the ISMS built up in the process.

Moving from looking at assets such as documents, hardware, software, and premises, as well as general information such as customer data or people's knowledge, and thus protecting information, is the fundamental approach when looking at information security. With this technical approach, the holistic overview of the process-orientated aspects is sometimes lost. This process thinking mentioned above is established in standards such as quality management and IT service management, but within the standard ISO/IEC 27001, which is used as a standard for companies from all industries to assess the conformity of information security, there is no holistic process consideration with maturity levels and the resulting possibility of measuring a continuous improvement process.

In the following methodology and evaluation, a model will be shown to determine maturity levels for the information security management system (ISMS) and thus to map a possibility for the development and control of the management system even above key figures.

2. Problem Statement

There are already many research papers on maturity in business processes and management systems. Based on the classic quality management system, maturity levels within ISO 9001 are considered with the standard ISO 9004 with a definition of management systems to evaluate process improvements (ISO, 2018). Inside other management systems like environmental management systems based on the standard ISO 14001 this will be also relevant and defined as “strategic options for the development” (Negescu Oancea et al., 2019).

However, since this topic is relevant for all management systems, considerations based on the Quality Management Principles QMPs for Performance Evaluation (ISO, 2015) Subject of research and statistical surveys. “Among other things, QMP efficiency scores as a strategy by an organisation with an Integrated Management System” (Ferradaz et al., 2022).

There were also evaluated the maturity levels for integrated management systems, in detail environmental, food safety and quality management systems were

selected to propose a model for the assessment of maturity based on maturity methods (Santos et al., 2021). Since, as explained at the beginning, the problem of a holistic overview of the maturity or achievement of information security requirements for ISO/IEC 27001 is not covered by the standard, research on this topic already exists.

As an approach, the CMMI maturity levels (ISACA, 2023) will be applied on the requirements of Annex A of ISO/IEC 27001 and then a score is determined (Monev, 2020). However, the problem of the missing chapter clauses and thus the overall view of the management system are not considered here.

Other approaches use a self-assessment and external audit to determine a risk score to determine the maturity level in terms of operational excellence. Here, the Shingo model from the field of LEAN management techniques is used (Carvalho et al., 2023).

Based on the implementation status and progress models and approaches several levels and measuring are identified so the Information Security Level in Organisations (Seeba et al., 2022). In general, the possibilities of companies to measure and monitor the fulfilment requirements were also examined (Naumann et al., 2023) and evaluated.

These investigations all deal with the core topic of continuous improvement and the possibilities of management by the company – e.g. with a better overview by means of maturity levels, and thus the treatment of risks in information security. So that “the understanding and awareness of risk officers directly impacts risk and performance outcomes, and hence the “duty of care and proof” of vulnerabilities and exposures within the organisation" (Lampe, 2023).

But there remains the gap of an approach for mapping of maturity levels to the concrete ISO/IEC 270901 which will be evaluated within this paper.

3. Research Questions / Aims of the Research

Within the assessment of the level of information security in companies, there are various problems that have made it difficult to use maturity models in this area so far. On the one hand, these maturity models are usually process-based considerations that cannot be precisely measured, but can only be classified in general, while the information security reviews are based on technical controls and corporate values.

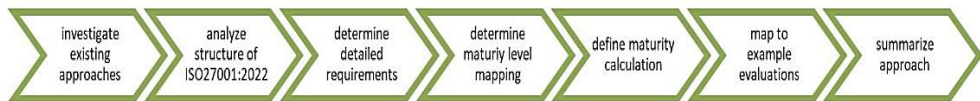
Another challenge in the measurability and applicability of maturity levels to areas of information security is the consideration of continuous improvement and efficiency, some of which are only partially required to be measured in ISO/IEC 27001. There are already approaches from the automotive industry and other industry standards that implement the necessity of considering process maturity and the information security that also supports this.

The hypothesis is that with the proposed approach companies can identify risk and nonconformities and are able to add the maturity as another level of security and performance measurement.

4. Research Methods

This paper investigates the mapping of existing approaches for information security and next analyses the structure of the ISO 27001 to identify the requirements and groups of controls and clauses which can be measured. The next steps then will be the determination of the risks and non-conformity results together with a mapping of standards maturity levels. Finally, the calculation of the maturity level with example evaluations must be defined and shall show how it could work for a company.

Figure 1. Steps to determine the maturity model approach



Source: authors own research.

Based on the proposed maturity model, an approach is developed for ISO/IEC 27001 that can represent the fulfilment of the requirements and, thus, the risk value of information security with a few figures in the form of maturity levels. In addition to covering the minimum requirements from Annex A of the ISO2701: Standards and an overall view should also be considered with the clauses from the management section. The interpretation of the degree of maturity in the context of nonconformities and risks is an important consideration to map the relevance to information security and the resulting effects. Existing procedures will be considered and analysed to see whether they can be adapted for ISO/IEC 27001. It is suggested as an example of how companies can use the approach to identify it within the regular reviews.

5. Findings

5.1 Process Maturity Assessment

The CMMI Maturity Levels of the CMMI Institute have established themselves as a standardised basis for maturity assessment. These were originally developed for software development and are now used in companies to increase process maturity, improve the quality of their products and services, reduce costs, and increase customer satisfaction. From the point of view of continuous improvement, these are divided into 5 maturity levels (ISACA, 2023):

- Maturity Level 0: Incomplete - Ad hoc and unknown.
- Maturity Level 1: Initial - Unpredictable and reactive.
- Maturity Level 2: Managed - Managed on the project level.
- Maturity Level 3: Defined - Proactive, rather than reactive.
- Maturity Level 4: Quantitatively Managed - Measured and controlled.
- Maturity Level 5: Optimising - Stable and flexible.

CMMI also enables organisations to review the processes with assessments and audits and certify them according to the CMMI level standard. These assessments are often conducted by internal or external auditors.

However, the crucial point here is that companies that must be certified and evaluated according to the ISO/IEC 27001 information security standard do not automatically receive this described added value of a process-side maturity assessment.

5.2 VDA TISAX (Trusted Information Security Assessment Exchange)

It continues to exist in the automotive industry with the VDA-ISA (Information security, 2024) of the TISAX (Trusted Information Security Assessment Exchange) mappings on maturity levels in relation to information security, but almost exclusively on requirements that are only related to the ISO/IEC 27001 Appendix A or the ISO27002 Best Practices (ISO, 2023) reference.

However, when considering the maturity levels, the view of conformity to the requirements of the ISO/IEC 27001 standard must also be considered, which is largely the basis here, but is only partially taken into account due to other requirements in the automotive industry, such as prototype protection. Among other things, the management system part of ISO/IEC 27001 with its clauses is not fully covered.

5.3 ISO/IEC 27001:2022

Within the ISO 27001, standardised minimum requirements for information security are defined and required for the certification of companies. The fulfilment of controls, which are documented in the so-called Annex A, in addition to the management system part, defines minimum organisational and technical requirements. Since the sole approach to determining the implementation status of the minimum requirements from the Annex Controls of ISO/IEC 27001 alone is not sufficient, an overall overview of the entire standard, including the Annex, is necessary.

Among other things, in a review of information security by means of an audit, the absence of implemented tasks or of missing defined processes in the clauses is the main deviation, as it poses a high risk to the functioning of the management system. Therefore, a mapping of maturity classes should ideally also include the implementation of the requirements from the management part of the ISO/IEC 27001 standard. With this approach, however, a stricter assessment or reduction of the maturity level in the absence of implementation of requirements must be defined when considering maturity levels. ISO 27001 is a management system standard that is divided into 2 separate parts. The first part is the management system part mentioned above, which consists of chapters 4-10 like the other management system standards. The second part is Annex A with 93 security controls, of which the company excludes or excludes the relevant ones in the so-called Statement of Applicability (SoA).

The question here is what would happen if controls were not applied and how this would affect the confidentiality, integrity, and accessibility of the information as the main objectives for information security. In practice, there is not that much room for excluding many controls from Annex A. Mostly, they are defined as minimum requirements.

5.4 Requirements

The chapter clauses are mandatory and form the basis of the management system. Here, non-compliance would result in a serious/major deviation within a certification audit. If a company is seeking ISO/IEC 27001 certification, these must be complied with, otherwise, the certificate will not be issued or withdrawn during the term. In the case of Annex A Control, noncompliance with these requirements leads to minor deviations in terms of conformity and thus the maintenance of the certificate. To be able to carry out an assessment of the degree of fulfilment of the requirements, the individual requirements must be defined in detail.

5.5 Approach to Maturity Assessment

With the help of the defined documented process documentation and the verifications, the next step is to carry out the process maturity with the help of the fulfilment of the requirements and a mapping on an existing maturity model.

As a reference to such a maturity model for information security, the procedure already mentioned at TISAX of the VDA-ISA is used here (Information security | VDA, 2022) as a basis, whereby this still has to be extended to the requirements from the clauses of the management part. In the TISAX approach, the defined requirements, which were largely based on the Annex A Controls of ISO/IEC 27001 and the best practices in ISO 27002, are mapped to the CMMI maturity model. In addition to assessing the requirements regarding conformity, this enables an assessment of process maturity.

5.6 Definition of Maturity Level

As mentioned, is the difference here, that additionally the conformity regarding the ISO/IEC 27001 standard requirements for the clauses and the Annex A controls will be verified and the resulting Risk for the information security be mapped. The aim is to determine a level of maturity that not only represents the implementation of a certain process maturity, but also represents the risks to the protection goals of availability, confidentiality, and integrity of information security in the company. At the same time, the reference for assessing conformity and thus the view from an audit according to ISO/IEC 27001 will be considered.

However, since the Clauses, as a mandatory requirement, would lead to a major deviation during a certification, the assessment by means of a maturity level must be stricter in the case of non-compliance than in the absence of requirements for Annex A controls.

5.7 Target Maturity Level

As suggested in the CMMI standard, the minimum target maturity level to be achieved here is Level 3. Values below this led to improvements and the need for adjustment. Maturity levels above the minimum level of 3 lead to a less measurable assessment and are therefore secondary to the fulfilment of a minimum level for information security, as this would then only be reflected in an increase in efficiency.

As already defined in the TISAX VDA-ISA standard, a maturity level of 0-1 would be the main deviant and thus associated with major or critical risks for information security, a maturity level of 2 would mean secondary deviation, and a maturity level of 3 or higher would mean compliant or without risks.

To obtain or maintain certification of an ISMS, e.g. according to ISO/IEC 27001, the maturity level of 2 with secondary deviations to be corrected would then be sufficient.

Table 1. Mapping of maturity levels to ISO 27001 clauses and controls

Mat Level	Status	IS-Risk	Conformity		Definition
			Clause	Control	
0	Incomplete	high	NC	MiNC	No process for the requirements exists.
1	Initial	medium	NC	MiNC	The process exists but it is not insufficiently documented, no evidence exists or there are significant gaps, and no regular tasks are planned and performed.
2	Managed	medium/low	MiNC	MiNC	A process with objectives is defined. Documentation and process implementation evidence is available, but there are gaps at tasks.
3	Defined	-	conform	conform	All the requirements are fulfilled. Regular tasks are documented and performed as required. A standard process has been defined and applied. Evidence exists.
4	Quantitatively Managed	-	conform	conform	A defined process exists and the effectiveness of it is monitored and measured.
5	Optimi-zing	-	conform	conform	A quantitatively managed process with continual improvement is implemented and followed.

Note: Legend: MiNC =Minor Non-Conformity, NC=Non-Conformity, IS=Information Security.

Source: Authors, CMMI (ISACA, 2023), VDA-Isa 6.0 (“Information security | VDA, 2022) .

5.8 Determination of the Degree of Maturity

The goal for companies would therefore also be to strive for a maturity level of 3 for ISO/IEC 27001 audits, at which conformity would be given and no risks would arise due to the lack of requirements for the ISO/IEC 27001 standard.

5.9 Calculation of the Overall Maturity Score

Since Annex A of ISO/IEC 27001 consists of 93 controls, and the management system part with the clauses consists of 7 chapters and 23 subchapters, the simple average value from the total number of 117 requirements can be formed as a first approach to calculating an overall maturity score.

However, if the management part is to be given a higher weighting, then a calculation must be made, e.g. with a double weighting. In the approach presented here, however, the simple calculation is considered. Analogous to the procedure for TISAX, the overall maturity level is limited to a value of 3. All higher values are reduced to this value with 3.0, analogous to the procedure from the VA-ISA (Information security | VDA, 2022). Furthermore, a traffic light system for color coding is possible to display different threshold values based on the degree of non-conformity, the risk in relation to the determined maturity level.

Table 2. Example of a maturity level assessment

ISO/IEC 27001:2022 Clauses / Controls	No. of Clauses/ Controls	Target Maturity	Assessed Maturity Level
4 Context of the org. (4.1-4.4)	4	3	3
5 Leadership (5.1-5.3)	3	3	3
6 Planning (6.1-6.2)	2	3	2
7 Support (7.1-7.5)	5	3	3
8 Operation (8.1-8.3)	3	3	3
9 Performance evaluation (9.1-9.3)	3	3	3
10 Improvement (10.1-10.2)	2	3	3
A.5 Org. controls (A.5.1-A.5.37)	37	3	2
A.6 People controls (A.6.1-A.6.8)	8	3	3
A.7 Phys. controls (A.7.1-A.7.14)	14	3	2
A.8 Techn. controls (A.8.1-A.8.34)	34	3	3
Overall Maturity Score	115	3.0	2,98

Source: Authors, ISO/IEC 27001:2022 (ISO, 2022).

5.10 Regular Assessments

There are several options for regularly checking the degree of ripeness, which are listed below.

Self-assessment / gap analysis: In some industries or for some standards, such as TISAX with the VDA-ISA, a self-assessment before audits is already mandatory.

If a maturity model approach is also introduced for an ISO/IEC 27001 ISMS, then this self-assessment should be used as part of the reviews. This form of self-assessment can be carried out at any time to demonstrate the fulfilment of the fact requirements as well as the process maturity.

Internal and external audits: As part of the regular audits, it is easy to map findings or observations for improvements to the respective requirements of the clauses or controls and to determine a trend in the development of the ISMS maturity level.

6. Conclusions

In this paper, we were able to show that with the help of the proposed maturity model for the requirements of ISO/IEC 27001:2022, it is possible to assess and read the state of compliance, as well as possible risks for information security based on maturity levels.

This enables decision-makers in companies and those responsible for information security to identify changes to the overall system briefly and to counteract trends.

In contrast to other approaches, this approach also includes the management part of ISO/IEC 27001 with its clauses, which makes it possible to assess certifiability in the first place. With the approach described, it is possible to identify targeted improvements or deterioration in individual areas or for the entire ISMS and thus to point out risks and weaknesses in information security to management.

In detail, further evaluations and investigations would then also offer opportunities to consider the evaluations of the clauses with a higher weight compared to the controls from the Annex, as this is where the greatest possibilities for interpretation are possible when classifying the maturity levels. It is also necessary to consider which risks can be represented with which financial and organisational effects under consideration of the degree of maturity or a security score.

However, this proposed approach is only to be regarded as an approach that requires, among other things, the before-mentioned provisions and the practical use in companies with the evaluation of a changed efficiency in the determination of the state of information security and the continuous improvement process.

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Longitudinal Trends in Financial Metrics
within Female-Led Software Firms

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Abstract

Investigating the domain of female leadership within the Romanian software industry, this analysis focuses on activities delineated by the NACE code 6201, pertaining to custom software development (client-oriented software). Several stringent selection criteria were applied. Most importantly, companies must have 100% female ownership and employ at least three people. Of the 26,108 firms operating under this code, only 2,067 have at least three employees. Of these, just 112 are totally owned by women – that is less than six percent of all firms. The research studies the ongoing trends in principal financial indicators among Romanian software companies led solely by females from 2019 to 2023. This paper looks into how many staff members there are against each company's performance based on different metrics like profit or turnover which have been analysed systematically over time periods used for analysis so far, giving us a chance to find out if there is any significant relationship between the number of workers employed by different businesses and their respective gains made within specified durations also looking closely at comparative growth rates between profits earned versus sales revenue generated annually while taking into consideration average yearly turn over as well as profit growth changes observed during such period under review.

Keywords: Female Leadership, Romanian Software Industry, Female Ownership, Women-Led Firms, Women Entrepreneurship.

JEL Classification: M12, J16, L86, L26, L25.

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1. Introduction

Recently, female leadership in business has attracted more attention than ever. This is especially true with regard to gender diversity and its effect on organisational performance. In fact, research indicates that businesses whose top management consists of a higher percentage of women tend to realise better financial results (Noland et al., 2016).

Currently, the widest gaps between male and female entrepreneurs exist within the Information Technology (IT) sector where for every woman entrepreneur there are over two men. This huge difference points out the persistent difficulties faced by women in technological entrepreneurship combined with an absence of adequate literature studying the intersectionality between gender equity and tech startups (Wilson & Patón-Romero, 2022). The situation is even worse in developing countries where cultural and structural impediments are more pronounced, thus exposing female founders to many challenges while starting or running their businesses (Corrêa et al., 2024).

Even though they encounter such obstacles like any other group involved in innovation activities across different industries. New evidence shows that women entrepreneurs play a significant role when it comes to innovating within their firms. The study by Madison et al. (2022) conducted among small-and medium-sized enterprises (SMEs) located in emerging markets found that contrary to popular belief about male superiority regarding creativity levels among genders: companies with at least one female leader were likely to achieve better innovative results than those led solely by males. These findings suggest that promoting female entrepreneurship may yield positive effects not only at individual level but also on broader ecosystems.

Yet still there exist numerous barriers against the entry into this field for girls who have trained themselves from school age all through their career journey upwardly as adults working professionals within IT industry settings. Canedo et al. (2019) highlight continuous sexism coupled with inadequate mentorship opportunities, which discourage females from entering performing well throughout computer science related professions. Software development projects suffer similar issues since workplaces do little to improve the conditions under which their employees work.

The issue gets complicated due to lack of participation among women developers involved in Open Source Software (OSS) projects. Trinkenreich et al. (2022) argue these situations deny women valuable chances for career growth as well as skills acquisition while depriving OSS initiatives off different viewpoints necessary towards innovative thinking processes. Most difficulties experienced by females working in such environments stem from social interactions characterised by unequal status amongst peers coupled with pervasive noninclusivity communication patterns fuelled masculine attitudes towards femininity.

In Romania's software sector specifically, there is hardly any presence of female leadership – less than six percent entirely belong to companies owned by three or more persons.

Table 1. Factors Encouraging Female Entrepreneurship in the Tech Sector

Determinant	Description	Reference
Mentorship Programmes for Female Entrepreneurs	The knowledge, connections, and confidence of female entrepreneurs can be improved by mentorship programmes, which in turn leads to better business results.	(Wanberg et al., 2006)
Female Networking Groups in Business Performance	Women’s networking groups are vital because they provide support, resources, and collaboration opportunities that can improve the business performance of female-owned businesses.	(Ibarra, 1993)
Government Policies and Female Entrepreneurship	By fostering a conducive business environment for women entrepreneurs, government policies and incentives encourage more female-owned businesses to be started and nurtured.	(Minniti & Naudé, 2010)
Access to Capital in Female-Led Firms	Capital access is important for the success of female-led companies. Women experience more significant hurdles in obtaining funding than men do.	(Brush et al., 2018)
Gender Diversity in Team Performance	Diversity of gender within teams can enhance their performance, creativity, and problem-solving abilities which are essential for the achievement of tech companies.	(Hoogendoorn et al., 2013)
Cultural Barriers to Female Entrepreneurship in Tech	Cultural attitudes towards gender roles significantly impact women's participation in tech entrepreneurship, requiring systemic changes to increase representation.	(Ahl, 2006)

Determinant	Description	Reference
Flexible Work Policies for increased Female Participation in Tech	Flexible work policies, including remote work and flexible hours, have the ability to increase the participation of women in the tech industry by providing a better work-life balance.	(Chung & Van der Lippe, 2020)

Source: structured by co-authors based on literature review.

2. Problem Statement

One persistent problem in fields like Computer Science, Engineering, Mathematics, and Physics is the lack of female students. This imbalance often leads to the marginalisation of women as employees and entrepreneurs in these areas. Many studies point to gender stereotypes and patriarchal structures as key reasons for this disparity (Kovaleva et al., 2022).

Our research fills a gap in understanding the financial performance of female-led enterprises in Romania's software industry. Despite the increasing focus on gender diversity in leadership roles, there is surprisingly little research on the financial outcomes of female-led tech firms. In Romania, only about 6% of software development organizations with more than three employees are totally women-owned. Given this remarkable underrepresentation, there is a pressing need to explore how these women-led organizations perform from a financial point of view over time. The research will focus precisely on companies that are 100% female-owned and have a minimum of three employees. It is intended to provide a detailed analysis of the component of an industry that holds a small scale but presents meaningfulness.

3. Research Questions / Aims of the Research

A major question we try to answer is if there is a significant relationship between the number of employees and profits made by companies. We want to find out whether higher numbers of personnel mean better financial results, thus indicating how crucial human resources are for an organisation's performance.

Our study also looks into another important thing which examines what happens when you increase or decrease the workforce: does it affect turnover in any way? This analysis aims at revealing revenue generation abilities influenced by the size of staff within firms thereby giving insight on their operational efficiency and market success. We do this through comparing growth rates for profit versus sales – are they moving up together or not? Knowing about such relationships might help us find other things that influence financial outcomes, too. Also worth investigating here would be whether there has been a steady increase in annual average turnover from 2019-2022 so as to assess these companies' income expansion trajectory over time.

Last but certainly not least, let us look into trends concerning yearly mean profit during the same period mentioned above; did average profits show consistent rise? Such inquiries matter because they speak volumes about overall wellbeing/viability female-led businesses possess.

4. Research Methods

4.1 Sample Selection

The sampling process was rigorous to ensure that the findings were trustworthy and applicable. The most important criterion was to identify firms owned by female entrepreneurs in custom software development, classified under NACE code 6201. This code relates to client-oriented software development activities which gives a narrow focus on a specific part of the market.

To guarantee sample specificity and relevance, these criteria were set:

- Companies must be entirely (100%) owned by women.
- Each company should employ at least three employees.
- The firms should be legally registered in Romania and the indicated NACE code used in operation. There are several reasons for this. First, by focusing on 100% women-owned firms, the impact of male partners on the challenges faced and successes achieved by the women entrepreneurs is removed. Second, the employee requirement gives the scale of operations that ensures reliable financial data, as it considers bigger businesses.

As such, the final methodology to be discussed is the Romanian companies being targeted, which has specific NACE coding that provides consistency in industry classification and the legal and economic environment surrounding them.

The data collection encompassed all Romanian companies meeting these criteria, derived from public records provided by state institutions such as the National Agency for Fiscal Administration (ANAF) (https://static.anaf.ro/static/10/Anaf/Informatii_R/doc_WS_Bilant_V1.txt).

4.2 Data Collection Instruments and Statistical Methods

The ANAF database contains public financial statements that were used for data collection. Profit, turnover, and total employees are some of the key financial indicators included in these statements. The official nature of this data source, as well as its compliance with legal reporting requirements, ensures accuracy and reliability.

For statistical analysis, several methods were employed to study relationships between variables comprehensively and identify significant trends:

Spearman's Rank Correlation Coefficient: This nonparametric measure was applied to determine how strong or weak the relationship is between employee numbers on one hand, and profit or turnover on another. It can deal with complex

nonlinearities better than other methods, which makes it suitable for dealing with statistical data.

Percentage Change Calculations: To capture growth dynamics over time, year-over-year percentage changes were calculated for profit, turnover, and employee numbers. Moreover, changes from baseline year (2019) to the following years (2020-2022), as well as cumulative change over entire study period were taken into consideration.

Trend Analysis: The aggregate annual totals of all companies for each variable were analysed to detect overall trends across industries. At industry level this approach helped smooth out firm level individual fluctuations providing clearer picture of patterns rather than at specific firm levels where noise may obscure signals due lack of sufficient observation points per firm within short periods when firms are not very different in size so that they exhibit similar responses to macroeconomic shocks resulting from business cycle phases during which firms operate simultaneously but do not necessarily always have identical characteristics like age cohort membership status etc., thus making it impossible to distinguish between them using only cross-sectional data collected at a single point in time without longitudinal studies being conducted first before any conclusions could be drawn about causal relationships involving different entities operating under diverse conditions prevailing at various times throughout history until now because otherwise they will just end up confirming preconceptions held by researchers who designed those experiments instead of yielding new insights into reality surrounding us here today.

4.3 Relevance of Methods

Statistical methods are chosen based on their capabilities in handling particular features of the data and research questions. Spearman's correlation is most appropriate here because it deals with ordinal data and aims at measuring nonlinear relationships. Percentage changes calculated together with trend analyses give clear, understandable measures of growth and performance over time which are critical for answering our research questions.

This will allow us to directly answer if workforce size affects profitability and turnover by looking at how many employees there are in relation to financial outcomes. Trend analysis also provides a wider view about these findings within industry dynamics, thus giving deeper insight into the financial paths taken by female-led software firms in Romania.

4.4 Calculation and Data Analysis Methods

Spearman's rank correlations were utilised to review the relationships between profit values, number of employees, and turnover for each company in a given year. These correlations were applied over the whole study period as well as within every single year under examination. Year-over-year percentage changes and percentage

change between first and last years of the analysed period (2019-2022) were used to calculate these financial metrics' percent variations two ways.

In order to identify general trends, the total values for each variable were computed across all companies for any particular year, which then determined changes in cumulative totals. In the cases where the cited value for calculating the percent changes was equal to zero, the percent change from zero was assigned a value of one hundred percent.

The calculations were conducted using MS Excel and JASP v0.18.3. The specific formula used to determine the percentage change was as follows:

$$\text{Change\%} = \text{IF}(\text{reference_year_value}=0, 1, (\text{current_year_value} - \text{reference_year_value}) / \text{ABS}(\text{reference_year_value}))$$

In this formula, the term "reference_year_value" represents the value of the variable for the year used as the basis for comparison. This value serves as a benchmark against the measured changes in the variable. "Current_year_value" is the value that the variable takes in the year for which a percentage change has to be computed. This is the current measure of the variable, against which a comparison has to be found and the change has to be evaluated in that respect from a base year.

The "ABS" function returns the absolute value of its argument. The effect is that no matter whether the value chosen is positive or negative, the result formula will always turn out to be a nonnegative number. Taking the absolute value guarantees that the magnitude of the change will still be correctly captured by the formula, unbiased by the sign of the change.

The "IF" logical function is used to handle situations whereby the reference value evaluates to zero. Had the formula been used as it is, in such scenarios it would return a division by zero error, which is undefined mathematically and may cause the system to yield wrong results or throw an error. In handling this, the "IF" function checks whether the "reference_year_value" is zero. In case the condition is satisfied, then the function returns 1 for the formula, meaning 100%. This approach gives a graceful avoidance of the division by zero and points to a meaningful interpretation in order to be shown that any non-zero value in the current year represents a change of 100% with respect to the zero reference value.

This formula was utilised to calculate changes in profit. For changes in the number of employees and turnover, the same formula was applied, with the exception of the absolute value function, as turnover and the number of employees cannot be negative in value.

Hypothesis 1: There is a significant correlation between the number of employees and companies' profit.

The Spearman correlation analysis was used to see if there is any relationship between the number of employees and profit in the companies from the sample. The findings revealed a significant positive correlation ($\rho = 0.371$, $p < 0.01$) for the entire sample and for every year studied. Yearly analysis showed that the correlation coefficients varied from 0.186 in 2021 to .500 in 2019 with regard to the time periods

studied which were all significantly different at least at the alpha level .05 except for one period, that is, year two thousand twenty-one where it was not statistically different at the alpha level five percent or less ($p > .05$).

Hypothesis 2: *There is a significant correlation between the number of employees and companies' turnover.*

To test this hypothesis, a Spearman correlation was calculated between the number of employees and companies' turnover. The analysis revealed a significant positive correlation ($\rho = 0.647$, $p < 0.01$) when considering the overall sample and across all years. Within individual years, the correlation coefficients varied, ranging from 0.482 in 2021 to 0.781 in 2019, all of which were statistically significant ($p < 0.05$).

Table 2. Correlations across all years

Variable	Turnover	Profit
1. Turnover	—	
2. Profit	0.753**	—
3. Employees	0.647**	0.371**
* $p < 0.05$; ** $p < 0.01$		

Source: computations performed by the co-authors.

Table 3. Highest and lowest within-year correlations (correlations between values of individuals companies within a single year)

Variable	Turnover lowest	Turnover highest	Profit lowest	Profit highest
1. Turnover	—	—		
2. Profit	0.709**	0.806**	—	—
3. Employees	0.482**	0.781**	0.186	0.500**
* $p < 0.05$; ** $p < 0.01$				

Source: computations performed by the co-authors.

4.5 Analysis of Profit and Turnover Growth Rates

Throughout the period of 2019 through 2022, the total profit of all companies in the dataset exhibited a major increase of 149%. At the same time, the total number of employees across these companies increased by only 29%. A closer look at annual growth rates shows that total profit growth rates ranged from 30% to 46%, whereas employee growth rates fluctuated between two percent (2%) and thirteen percent (13%). These findings imply that while the overall workforce size modestly expanded, company profits grew rapidly, which may indicate improvements in operational efficiency or higher levels of market demand.

Table 4. Annual total profit and total number of employees’ growth rates, for individual years and for the whole period

	2020	2021	2022	2019-2022
Profit growth	32%	30%	46%	149%
Employee number growth	2%	13%	11%	29%

Source: computations performed by the co-authors.

Table 5. Percent of companies experiencing growth and decline of profit and the number of employees

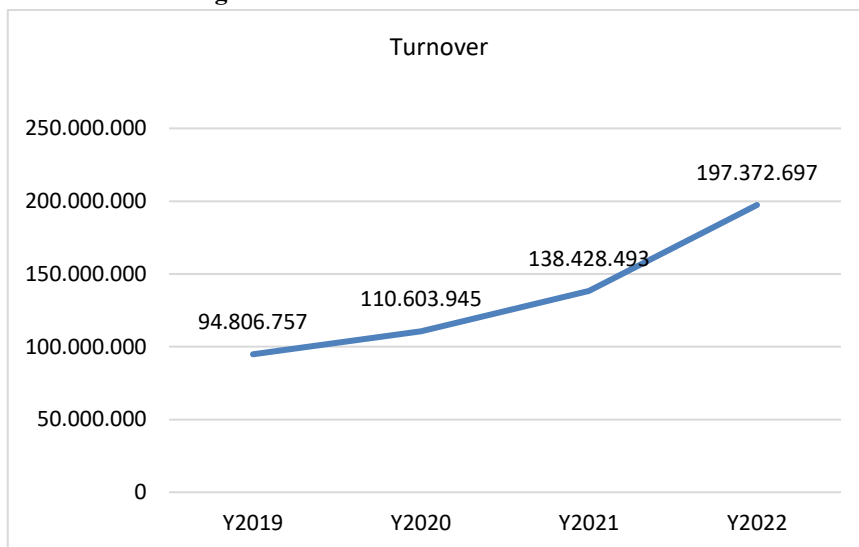
% of companies reporting	2020	2021	2022	2019-2022
Profit increase	55%	67%	59%	69%
Profit decline or stagnation	45%	33%	41%	31%
Employee number growth	42%	47%	46%	58%
Employee number decrease or stagnation	58%	53%	54%	42%

Source: computations performed by the co-authors.

4.6 Analysis of Annual Average Turnover Trends

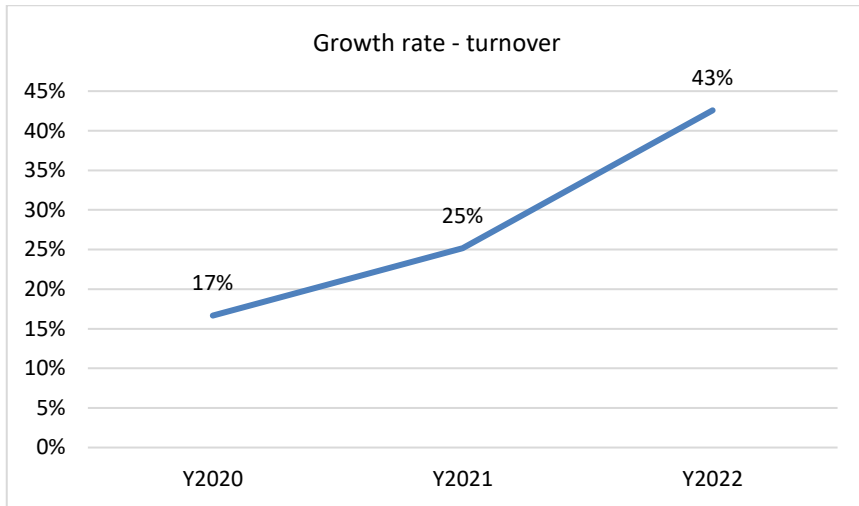
Between 2019 and 2022, the total turnover of all companies in the dataset increased by 108%. When analysing individual companies, 83% experienced an increase in their turnover, while 17% reported a decrease during the same period.

Figure 1. Total Turnover from 2019 to 2022



Source: computations performed by the co-authors.

Figure 2. Growth Rate of Turnover



Source: computations performed by the co-authors.

Table 6. Percentage of Companies Reporting Increase and Decrease in Turnover

% of companies reporting	2020	2021	2022	2019-2022
Turnover increase	66%	70%	75%	83%
Turnover decrease or stagnation	34%	30%	25%	17%

Source: computations performed by the co-authors.

Table 6 provides a detailed breakdown in the percentage of companies reporting changes in turnover each year. The majority of companies experienced an increase in turnover, with the highest percentage (83%) observed over the entire period from 2019 to 2022.

5. Findings

The research displayed a significant positive relationship between the count of employees and both profit and turnover. More precisely, the Spearman correlation coefficients were 0.371 for profit and 0.647 for turnover, in all the years and for the entire sample. This means that female-led software organisations that have more employees are inclined towards a greater degree of profitability and greater revenues compared to those with fewer workers, which underlines the meaningfulness it holds in nurturing financial performance.

The comparative growth rates of profit against those of turnover underwent rigorous examination. The findings show a considerable increase in overall profits among all firms within this dataset over the study period by 149% while the total number of staff only rose by 29%. Between thirty percent (30%) to forty-six percent (46%) were recorded annually as profit growth rates compared to two percent (2%) to thirteen percent (13%) for the number of people employed indicating operational

efficiencies may have improved or market demand increased towards services offered by these companies.

Furthermore, there was an identification within this research about trends showing a consistent annual average turnover increasing every year along with the corresponding profits. Total revenue went up from one hundred eight percent between twenty nineteen through twenty-two, where eighty-three percent experienced an increase while seventeen had declines followed closely behind is analysis indicating annual average gain steadily rising upwards over time such that sixty-nine reported growth during the same interval.

6. Conclusions

The research places light over the financial feasibility and development potential held by female-led software companies in Romania, despite their insufficient representation in this industry. The study also shows a steady increase in both annual average turnover and profit from 2019 to 2022. This suggests that Romanian women-led software firms have achieved long-term financial growth during the studied period. High percentages of companies reporting increases in turnover as well as profits reflect overall good financial health of these organisations. Such sustained growth indicates their resilience and capacity to respond to market demands which is remarkably impressive considering wider economic hardships coupled with highly competitive nature of software industry.

On the other hand, it is important to note that even if these positive trends are to emerge, a dramatic gender gap is on display within the industry: less than 6% are women-owned firms of all software development companies with more than three employees. This underrepresentation thus exposes the need for programs and initiatives aimed at supporting and promoting women entrepreneurship and leadership lines occupied by women in technology fields. More women should be encouraged to take up leadership roles or own businesses since such moves would greatly influence innovation levels as well as financial performance across industries involved.

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**The Evolution of Saudi Arabia's Investments in Romania,
in Opposition to the Framework of the Coronavirus
Pandemic and the War in Ukraine**

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Abstract

The coronavirus pandemic, together with the war between Ukraine and Russia, triggered a terrible economic and humanitarian crisis, the effects of which are still felt today. Thus, the 2020-2023 period represented a transition, both for humanity and for private entities. Production was affected, trade, workforce, capital flow, as well as foreign investments in various corners of the world. Investments are essential for the economy and for the economic policy. When a state increases its production capacity, this aspect strengthens the economy in the long term, through growth prospects. The shock caused by the coronavirus pandemic has attracted attention even in investments from advanced economies. The aim of this paper is to identify the worth of trade between Romania and Saudi Arabia in the period 2019-2022, besides the most transited goods between the two countries, through a descriptive research, based on the information assuming by the National Institute of Statistics. The descriptive research will continue with the study of Saudi Arabia's investments in Romania, in the period 2019-2023, based on the statistics assuming by the National Registry of the Trade Office, in order to identify the repercussions of the coronavirus pandemic and the war in Ukraine, on the economic relations between the two different countries. The main results demonstrate that the trade between Romania and Saudi Arabia has evolved in 2022, by 70,7%, compared to 2019, despite the economic instability. The confidence of Saudi investors is growing in the Romanian market, witnessing the number of firms with Saudi capital, which increases annually. The contribution of this paper is an important and innovative one for the economic study, because it focuses on the investments of Saudi Arabia, a country in full accelerated economic diversification, in Romania, a member state of the European Union, during an economic and humanitarian crisis.

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JEL Classification: F02, F1, F2, F21, F23, O52, O53.

1. Introduction

The study of investments began in 1930, with the Great Depression, which spread rapidly in Europe and America. The concepts of John Maynard Keynes on the theory of investments laid the foundations for the behavioural study, regarding investments. Economists usually call “fixed investment”, the transition from an aggregate value, to a healthy economy.

Internationalisation is a crucial process in the progress of a country's economy and in entering foreign markets, this concept also being the answer to globalisation. The internationalisation of companies can be recognised as the main pawn of economic growth, competition and flourishing worldwide. Internationalisation can also be associated with the establishment of international partnerships and collaborations (Dincă et al., 2019).

For example, the European Union recently emphasised the need for new investments, in the technological spheres, in the transition to Green and to digital transformation (Caetano et al., 2022). A national economy that is dependent on a single source of income is a vulnerable economy, especially if this source is one of a non-renewable type. Diverseness is the key and the secret to creating an alluring economy (Al Naimi, 2022).

The Gulf Cooperation Council (GCC) area, Kuwait, Qatar, Bahrain, UAE, Oman and Saudi Arabia, is of great importance, as it contains 30% of the global crude oil and 22% of the world's gas (IRENA, 2019). Being dependent on a single source of income, this aspect can directly impact the economy, through the prices of these resources. The diverseness of exports can give a boost to the economy, by attracting foreign investments, creating new job opportunities, and through the economic and social burgeoning of the country (Andrei et al., 2021). The GCC region represents the players from the Middle East, also characterised by a great military power, especially Saudi Arabia and the UAE. The Persian Gulf represents an area of tension and conflicts of interest, the most powerful and influential actors being Saudi Arabia and Iran (Garlick & Havlová, 2020). Most states in the GCC region are governed by authoritarian regimes, where power is concentrated in large families or elites.

2. Problem Statement

After the first explosion of oil prices in 1970, the government of Saudi Arabia introduced for the first time the plans for the burgeoning of the market. The concept of diverseness of the economy in the KSA was based on investments and education, human capital, as well as on investments in non-oil sectors, such as tourism.

Saudi Arabia is an interesting country, which opened its doors to international tourists in 2019 and is undergoing an accelerated economic reform. As part of the

reform, the government is betting on tourism, with a preponderance on religious tourism, with a giant investment of 80 billion dollars in the Mecca site, which is the largest Islamic symbol in the world. The country is attractive, not only for its oil resources, but also for its future plans. By 2023, Saudi Arabia has proposed to build the 170 km ecological city, with 0 carbon emissions, called "The Line". In addition, the Saudi government decided to allocate USD 3.5 billion for the construction of the largest hotel in the world, with 10,000 rooms and 70 restaurants.

Saudi Arabia has a population of approximately 27 million inhabitants, of which 18.6 million are Saudi residents. For example, the burgeoning of exports would represent a great advance for Saudi Arabia, given that this country imports 98%. It should be mentioned that the proximity of tense countries such as Yemen and Iran can negatively impact foreign investments in Saudi Arabia (Pontes et al., 2024).

Saudi Arabia is experiencing demographic growth, rapid growth in gross domestic product (GDP), as well as an accelerated and vast economy. Currently, Saudi Arabia is implementing the reform plan, Vision 2030. The plan also proposes the increase of foreign investments to GDP (Javid et al., 2022). The non-oil branch in the KSA can contribute substantially to new economic performances, in other fields (Callen et al., 2014). As for Saudi Arabia, this state possesses 18% of oil resources worldwide, ranking 7th in the world in terms of these reserves and 3rd among the G20 states (Brika et al., 2021). The budget of this country depends almost entirely on oil revenues.

Recently, however, Saudi Arabia has made progress in the burgeoning of other important sectors for the country's economy, such as manufacturing, transport, logistics, renewable energy production, tourism, and minerals. Saudi Arabia has a plan to reduce possible financial shocks caused by the oil sector. For example, the hydrocarbon sector is affected by instability and demand. Producers cannot thus control fuel prices, so the market can be shaken, as it was in 1997, 2022, 2008, 2014 or 2020 (Alkhatlan et al., 2020).

As far as Romania is concerned, after 1990, the country was characterised by a growing economy, through the transition from socialism to a free market, and later to the European Union. In this sense, with the collapse of communism, Romania was perceived by investors as a risky market, but gradually, the country's economy became stable. Foreign investments in Romania determined the diverseness of jobs, and the workforce was thus specialised and educated. Today, 17 years after joining the European Union, foreign investors are looking for business opportunities in Romania, because the amortisation of the investment is fast. Investors are interested in the Romanian market, to invest in strategic sectors with future potential, such as green energy, because this sector benefits from support from the government, through the National Plan for Strategic and Sustainable Development 2030. The main investors in Romania are multinational enterprises, which pursue long-term investments, and 90% of them are member states of the European Union.

For Romania, foreign investments represent the flourishing of the economy. On one hand, the COVID-19 pandemic has affected various branches of the Romanian economy, such as the real estate, textile, tourism, or transport sectors.

There were also sectors that developed oppositely to the framework of the health and economic crisis, such as digital and medical infrastructure (Dragomir & Stoian, 2024). On the other hand, with the outbreak of the war in Ukraine, foreign investments in Romania were blocked or delayed. The positive side of the proximity war consisted in the fact that Romania won in terms of technology. The country needs a rigorous plan to continue attracting foreign investments and for investors to continue to trust Romania, despite the border war. To put this aspect into practice, the country needs to invest in the quality of education, in improving the workforce, and in improving the quality of life. Also, Romania needs to invest in various sectors, such as production, reindustrialisation, research and innovation, so as to align with neighbouring states in the region, such as Poland, Hungary, or the Czech Republic (Dincă et al., 2023). These steps and efforts can be achieved with the support of the Government and the private sector (Hagiu & Barbulescu, 2022).

As stated by the National Office of the Trade Register (ONRC), in 2019, in Romania there were 226,892 enterprises with external contribution, with a registered capital of EUR 48,635,699 thousand. In that year, foreign investments in Romania were concentrated in the following sectors: Trade (48,27%) and Manufacturing and active industry (31,73%). In December 2023, there were 251,226 enterprises with external contribution in Romania, with a registered capital of EUR 54,344,201 thousand. In that year, external investments in Romania were concentrated in the following sectors: Financial intermediation and insurance (33,29%), Trade (18,43%), Transport, storage, and communications (16,86%), Construction (15,57%), and Professional activities (13,21%). Thus, following the COVID-19 pandemic and the war in Ukraine, the number of enterprises with external contribution in Romania increased by 10,7% and the worth of the registered capital increased by 11,7 in 2023, compared to 2019.

This paper is innovative, because it focuses on the commercial relations between Romania and Saudi Arabia, an interesting country, in full ascent and economic diversification, during a period of crises. It is about the economic crisis, triggered in opposite to the health crisis of COVID-19, but also after the robbery between Ukraine and Russia. The paper also shows the fact that Saudi Arabia's contributions in Romania experienced an increase in the period 2019-2023.

3. Research Questions / Aims of the Research

The purpose of this paper is to identify the evolution of trade between Romania, a member country of the European Union, and Saudi Arabia, a country with a very different culture from the European one, but with a well-defined plan, Vision 2030, with the aim of accelerating the economy and reducing the dependence on oil.

Thus, the research is based on identifying the impact of the health crisis that has affected humanity at the global level, the coronavirus pandemic, on the relations between the two states. In addition, the work innovates, in that it also focuses on the effects of the war on Romania's border, between Russia and Ukraine. As part of the investigation, it is observed whether the confidence of Saudi investors has increased or decreased in the Romanian market, following these threats.

The first part of the paper follows the evolution of trade between Romania and Saudi Arabia, expressed in euro values, besides the most transited goods between the two countries, during the crisis and tense period, 2019-2022. The values expressed in euros from 2022 are related to 2019, a non-pandemic year.

The second part of the paper follows the evolution of Saudi investments in Romania, in the period 2019-2023, by identifying the number of firms with Saudi capital on the market, besides the worth of Saudi registered capital, expressed in euros.

4. Research Methods

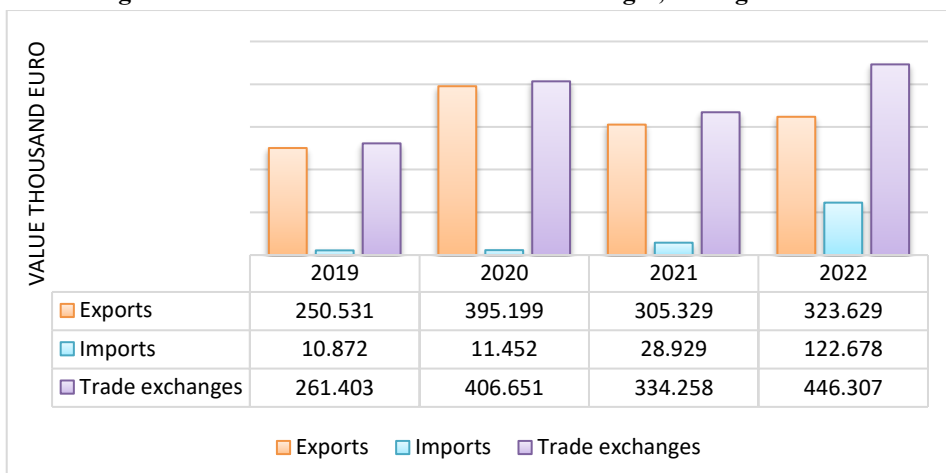
The research of this work consists of a descriptive research. In the first part of the research, on the commercial exchanges between Romania and Saudi Arabia, in the period 2019-2022, the descriptive research is based on statistical data, assuming by the National Institute of Statistics in Romania. The methods used are observation, analysis, processing, and data synthesis. In this part, the repercussions of trade between the two countries are analysed, in addition to the goods transited between Romania and Saudi Arabia, in the period 2019-2022, the period of great global economic difficulty.

The second part of the research also consists of a descriptive research on the investments of Saudi Arabia in Romania, in the period 2019-2023, based on the statistics made by the National Office of the Romanian Trade Register. The methods used are observation, analysis, processing, and data synthesis. In this part, the evolution of the number of firms with Saudi capital in Romania, in the period 2019-2023, besides the values of the investments, expressed in euros, are analysed.

5. Findings

5.1 Descriptive Research Based on Romania-Saudi Arabia Trade Exchanges

Figure 1. Romania-Saudi Arabia trade exchanges, during 2019-2022



Source: data processing from <https://insse.ro/cms/ro/publicatii-statistice-in-format-electronic>.

As stated by to the National Institute of Statistics in Romania, in 2019, the trade between Romania and Saudi Arabia was worth EUR 261,403 thousand. Romania's imports from the Kingdom of Saudi Arabia (KSA) were worth EUR 10,872 thousand. The main products imported by Romania from Saudi Arabia in the year of 2019 were plastic materials, rubber and articles thereof worth EUR 8,833 thousand. Romania exported to Saudi Arabia, in the amount of EUR 250,531 thousand. The main products exported by Romania to Saudi Arabia in the year of 2019 were vegetable products, worth EUR 83,537 thousand and live animals and animal products, worth EUR 43,246 thousand (National Institute of Statistics in Romania, 2024).

In 2020, trade between the two countries was worth EUR 406,651 thousand. Romania's imports from the KSA were worth EUR 11,452 thousand. The main products imported by Romania from Saudi Arabia in the year of 2022 were plastic materials, rubber and articles thereof, worth EUR 9,511 thousand. Romania exported to Saudi Arabia, in the amount of EUR 395,199 thousand. The main products exported by Romania to Saudi Arabia in the year of 2022 were vegetable products, worth EUR 162,047 thousand and live animals and animal products, worth EUR 106,910 thousand.

In the year of 2021, the trade between the two countries was worth EUR 334,258 thousand. Romania's imports from Saudi Arabia were worth EUR 28,929 thousand. The main products imported by Romania from the KSA in 2021 were plastic materials, rubber and articles thereof, worth EUR 21,474 thousand. Romania exported to Saudi Arabia, in the amount of EUR 305,329 thousand. The main products exported by Romania to the KSA in the year of 2021 were live animals and animal products, worth EUR 89,495 thousand and vegetable products, worth EUR 69,026 thousand.

In the year of 2022, trade between the two countries was worth EUR 446,307 thousand. Romania's imports from the KSA were worth EUR 122,678 thousand. The main products imported by Romania from the KSA in 2022 were mineral products, worth EUR 66,878 thousand and chemical products, worth EUR 30,119 thousand. Romania exported to Saudi Arabia, in the amount of EUR 323,629 thousand. The main products exported by Romania to the KSA in the year of 2022 were vegetable products, worth EUR 82,327 thousand and live animals and animal products, worth EUR 79,137 thousand.

Thus, as stated in the latest data from the National Institute of Statistics in Romania, trade between Romania and Saudi Arabia increased in 2022 (EUR 446,307 thousand), by 70,7%, compared to the year of 2019 (EUR 261,403 thousand), a non-pandemic, despite the economic crisis triggered by the coronavirus health crisis and the war in Ukraine. Romania's imports from the KSA increased by 128% in 2022 (EUR 122,678 thousand), compared to 2019 (EUR 10,872 thousand). Also, Romania's exports to the KSA increased by 29% in 2022 (EUR 323,629 thousand), compared to 2019 (EUR 250,531 thousand).

5.2 Descriptive Research Based on Saudi Arabia's Contributions in Romania

Table 1. Saudi Arabia's investments in Romania, during 2019-2023

	2019	2020	2021	2022	2023
The number of companies	220	227	235	246	254
The share in the total of firms with external contribution	0,10%	0,10%	0,10%	0,10%	0,10%
The value of the registered capital	EUR 23,912 thousand	EUR 24,117.4 thousand	EUR 24,117.7 thousand	EUR 24,221 thousand	EUR 24,262.1 thousand

Source: data processing from <https://www.onrc.ro/index.php/ro/statistici?id=254>.

The statistics produced by the National Office of the Trade Register of Romania show that in the year of 2019, in Romania there were 220 enterprises with Saudi capital, the percentage in the total of firms with private capital was 0,10%, and the worth of the registered capital was EUR 23,912 thousand. In the year of 2020, in Romania there were 227 firms with Saudi capital, the percentage in the total of enterprises with private capital was 0,10%, and the worth of the registered capital was EUR 24,117.4 thousand. In the year of 2021, in Romania there were 235 firms with Saudi capital, the percentage in the total of firms with private capital was 0,10%, and the worth of the registered capital was EUR 24,117.7 thousand. In the year of 2022, in Romania there were 246 firms with Saudi capital, the percentage in the total of firms with private capital was 0,10%, and the worth of the registered capital was EUR 24,221 thousand. In 2023, in Romania there were 254 enterprises with Saudi capital, the percentage in the total of companies with private capital was 0,10%, and the worth of the registered capital was EUR 24,262.1 thousand.

As stated by the data assuming by the National Trade Registry Office, the number of firms with Saudi capital was 220 firms in the year of 2019, a non-pandemic year. In 2023, despite the COVID-19 pandemic and the war in Ukraine, the number of Saudi enterprises increased by 15,5%, to 254. Regarding the euro value of the registered capital, Saudi investments in Romania were worth EUR 23,912 thousand. In 2023, they were worth EUR 24,262.1 thousand, thus the worth of Saudi investments in Romania increased by 1,5% from 2019 (EUR 24,262.1 thousand), until 2023. The share of Saudi investments in Romania is 0,10%, and this percentage has maintained throughout the period 2019-2023.

In the ranking of countries with external contribution to the share capital, Saudi Arabia occupied the 45th position at the end of the year of 2019, after the first place was occupied by the Netherlands, depending on the worth of the share capital expressed in euros (EUR 9,287,822.8 thousand) and Italy, depending on the number

of enterprises (48,799). Saudi Arabia occupied position number 49, after the first place was occupied by the Netherlands, as claimed by the worth of the share capital expressed in euros (EUR 9,694,836.4 thousand) and Italy, observing to the number of enterprises (52,756).

As claimed by the most recent data, assuming by the National Institute of Statistics in Romania, in March 2024, there were 254 enterprises with Saudi capital on the Romanian market. This demonstrates the fact that from December 2023, until now, Saudi Arabia's contributions have remained constant (National Office of the Trade Register of Romania, 2024).

The main Romanian company in the KSA is called Safetech Innovations, and it entered the Saudi Arabian market in 2024. The main Saudi company present in Romania is called Electroputere S.R.L. and is owned by Al-Arrab Contracting Company Ltd, 100%.

6. Conclusions

The COVID-19 pandemic, together with the war between Ukraine and Russia, triggered a terrible economic and humanitarian crisis, the effects of which are still felt today. Production was affected, trade, workforce, capital flow, as well as foreign investments in various corners of the world. Investments are essential for the economy and for economic policy. Internationalisation is important in the flourishing of a country's economy.

Saudi Arabia has made progress in the development of other important sectors for the country's economy, such as manufacturing, transport, logistics, renewable energy production, tourism, and minerals. This country has started to orient itself towards various markets, with the aim of developing its economy and investments. Investors are interested in the Romanian market, to invest in strategic sectors with future potential, such as green energy, because this sector benefits from support from the government, through the National Plan for Strategic and Sustainable Development 2030. The main investors in Romania are multinational firms, which pursue long-term investments, and 90% of them are member states of the European Union.

According to the National Office of the Trade Register (ONRC), in 2019, in Romania there were 226,892 enterprises with external contribution, with a registered capital of EUR 48,635,699 thousand. In 2023, there were 251,226 enterprises with external contribution in Romania, with a registered capital of EUR 54,344,201 thousand. Thus, following the COVID-19 pandemic and the war in Ukraine, the number of enterprises with external contribution in Romania increased by 10,7%, and the worth of the registered capital increased by 11,7 in 2023, compared to 2019.

In accordance with the descriptive research, based on the statistics assuming by the National Institute of Statistics, the trade between Romania and Saudi Arabia was worth EUR 261,403 thousand in 2019; EUR 406,651 thousand in 2020; EUR 334,258 thousand in 2021; and EUR 446,307 thousand in 2022. Thus, the trade between Romania and Saudi Arabia increased in 2022 (EUR 446,307 thousand), by 70,7%, compared to 2019 (EUR 261,403 thousand), a non-pandemic, despite the

economic crisis triggered by the coronavirus health crisis and the war in Ukraine. Romania's imports from the KSA increased by 128% in 2022 (EUR 122,678 thousand), compared to 2019 (EUR 10,872 thousand). Also, Romania's exports to the KSA increased by 29% in 2022 (EUR 323,629 thousand), compared to 2019 (EUR 250,531 thousand). The most imported commodity by Romania from the KSA is plastic materials, rubber and articles thereof, and the most exported commodity is vegetable products.

Observing the descriptive research based on Saudi Arabia's expenditure in Romania, based on the statistics assuming by the National Institute of Statistics, in 2019, in Romania there were 220 enterprises with Saudi capital, the percentage in the total of enterprises with private capital was 0,10%, and the worth of the registered capital was EUR 23,912 thousand. In 2020, in Romania there were 227 enterprises with Saudi capital, the percentage in the total of enterprises with private capital was 0,10%, and the worth of the registered capital was EUR 24,117.4 thousand. In 2021, in Romania there were 235 enterprises with Saudi capital, the percentage in the total of companies with private capital was 0,10%, and the worth of the registered capital was EUR 24,117.7 thousand. In 2022, in Romania there were 246 enterprises with Saudi capital, the percentage in the total of enterprises with private capital was 0,10%, and the worth of the registered capital was EUR 24,221 thousand. In 2023, in Romania there were 254 enterprises with Saudi capital, the percentage in the total of enterprises with private capital was 0,10%, and the worth of the registered capital was EUR 24,262.1 thousand. According to the data assuming by the National Trade Registry Office, the number of firms with Saudi capital was 220 enterprises in 2019, a non-pandemic year. In 2023, despite the COVID-19 pandemic and the war in Ukraine, the number of Saudi enterprises increased by 15,5%, to 254. Regarding the euro worth of the registered capital, Saudi investments in Romania were worth EUR 23,912 thousand. In 2023, they were worth EUR 24,262.1 thousand, thus the worth of Saudi investments in Romania increased by 1,5% from 2019 (EUR 24,262.1 thousand), until 2023. The share of Saudi investments in Romania is 0,10%, and this percentage has maintained throughout the period 2019-2023. As stated by to the most recent data, assuming by the National Institute of Statistics in Romania, in March 2024, there were 254 firms with Saudi capital on the Romanian market. This demonstrates the fact that from December 2023, until now, Saudi Arabia's expenditures have remained constant.

In a nutshell, the coronavirus pandemic and the war in Ukraine did not affect the economic relationship between Romania and Saudi Arabia, as trade exchanges increased in the period 2019-2022, by 70,7%. Also, Saudi investments in Romania increased in the period 2019-2023, by 1,5%, from 220 enterprises to 254. This aspect demonstrates Saudi Arabia's interest in the Romanian market, but also the fact that Saudi investors have not lost their confidence in this market, despite the recent economic instability, starting with 2020.

In the future, the study of Romanian investments in Saudi Arabia will continue, because it is possible that in the future this country will appear on the Romanian map as an investment destination, especially since the Saudi government has

proposed to attract investments by 2023 foreign investments in the tourism sector, worth USD 80 billion, through the Vision 2023 programme. Thus, in the future, the Romanian enterprises present in Saudi Arabia will also be investigated. Regarding the firms with Saudi capital present in Romania, the research will continue, regarding the fields of activity of the enterprises.

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**Artificial Intelligence and Employee Stability:
The Mediating Effect of Job Engagement
in Romania's Health Tourism Sector**

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Abstract

This paper investigates the influence that Artificial Intelligence (AI) has on job security, which in this study includes the severity of threats (ST) and feelings of powerlessness (PO), within the Romanian health tourism sector. Additionally, we analyse how AI-driven job engagement (ENG) impacts employees' turnover intentions (TI), providing perspectives about how to maintain workforce stability. As the recent literature indicates, there is growing concern among employees in various sectors regarding to the potential that AI have to replace human labour, mostly with a specific focus on roles requiring interpersonal skills, such as those in health tourism. Utilising the Self-Determination Theory (SDT) and also by employing a quantitative methodology, we surveyed 131 spa and hotel employees using validated and multi-item scales to measure job engagement components and job insecurity dimensions. Our results reveal significant relationships between perceived powerlessness, job engagement, and turnover intentions, showing the mediating role of job engagement. In the current study, we found that educational level moderates the relationship between perceived job, threats, and turnover intentions. This indicates an interaction between employee characteristics and perceptions of the threats that AI is bringing. With this study, we contribute both to the theoretical understanding of how AI impacts employee psychology in the market of health tourism, and also by offering insights into managing workforce transitions in the face of technological advancements.

Keywords: artificial intelligence (AI), job security, health tourism, employee turnover intentions, Romanian spa.

JEL Classification: C100; M500.

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1. Introduction

The emergence of the digital era applied to artificial intelligence utterly redefined the playing field for most industries, as it also does for health tourism, bringing many benefits for consumers and for the organisation of work (Sharma et al., 2023). However, the more extensive implementation of AI in health tourism raises a series of questions about employee perceptions of job security and how these new technologies are viewed as potential threats or opportunities. Previous research has documented that, in various industries, workers have found AI to pose a threat to their job existence; particularly, workers such as technicians and those whose jobs can be easily automated tend to fear it the most (Abdullah & Fakieh, 2020; Koo et al., 2020). In the context of health tourism, where the nature of work and the offer of empathy between the worker and the client is high, the perceived threat of AI can be identified from the relational point of view, even if interpersonal skills are still difficult for machines to replicate with ease (Huang & Rust, 2018). In their paper, Huang & Rust (2018) develop a theory of job displacement through AI, arguing that AI first replaces some job tasks and then progresses to the complete take-over of human labour. If, in the previously cited studies, the fears of employees were underlined regarding the impact of AI on job security and workforce adaptation to the new technological reality in broadly represented fields, the present study goes a step further and tries to extrapolate this research regarding the fears to a niche-focused and insufficiently researched area of activity: health tourism, at a particular moment and in a particular space context. It is equally important to explore these perceptions in the context of understanding how technological changes can be managed effectively and humanely in the health tourism sector.

2. Problem Statement

2.1 Self-Determination Theory

Self-determination theory is a psychological theory that is widely accepted by scholars, asserting that human motivation turns out to be of two types, either autonomous or either controlled; and that type and source of motivation affect types of behaviour, performance quality, and individual well-being. This theory was first introduced by Deci and Ryan in 1985, and since then SDT has been applied in the context of employee new technology adoption. Within previous research, it has been found that the adoption of new technologies was related to pleasure and acceptance only when people used it because of their intrinsic motivation (Mitchell et al., 2012). Another approach to SDT, related to new technologies, posits that perceived job insecurity influenced by the introduction of AI has a significant effect on reducing workplace commitment and increasing the intention to leave the job (Koo et al., 2020). Primarily, to the far end of our knowledge, the application of SDT to health tourism literature has not targeted employees working in this industry; for this reason, we believe that this effort to investigate the threats perceived by employees in health tourism regarding the adoption of new technologies is relevant.

2.2 Perceived Severity of Threats, Feelings of Powerlessness and Job Engagement

The previous literature has probed the meaning of job insecurity in an SDT framework in two dimensions of job insecurity: the perceived severity of a threat and powerlessness (Greenhalgh & Rosenblatt, 1984). Perceived severity is influenced by the belief in the possibility of job loss, which is amplified by adopting new technologies that replace less specialised workers. Feelings of powerlessness arise when employees believe they cannot counteract threats to the continuance of their jobs, thus enhancing the perception of risk (Greenhalgh and Rosenblatt, 1984). Job engagement is the extent to which employees show interest regarding their jobs and the organisation. It involves physical, cognitive, and emotional components (Kahn, 1990). Higher engagement is positively related to better job performance and lower turnover intentions, while job insecurity may diminish engagement (Staufenbiel & König, 2010). As explained earlier, the existing literature argues that perceived job insecurity erodes engagement, thus reducing the motivation for employees to exert effort and spend time on their tasks because of the uncertainty in their professional future. Given the above, we hypothesise the following. *H1: Perceived powerlessness directly affects the job engagement at workplace among health tourism employees; H2: Perceived severity of threats at work directly affects the job engagement at workplace among health tourism employees.*

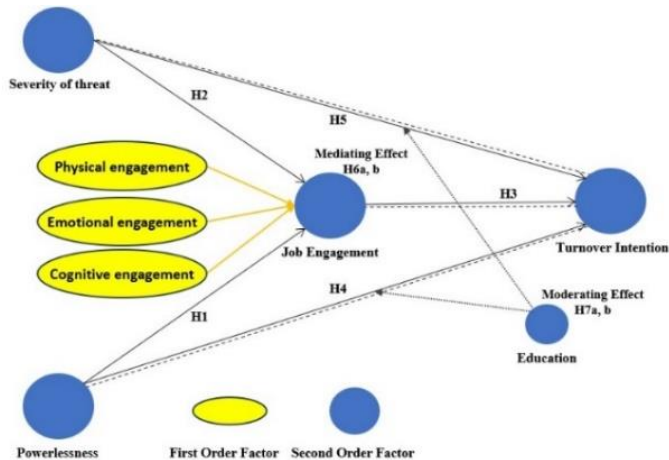
2.3 Job insecurity, Job Engagement and Turnover Intention

Job engagement (ENG) and the intention to leave the organisation (turnover intention / TI) are often analysed in the job insecurity context. Most studies denote an adverse relationship between job insecurity and commitment, suggesting that feelings of insecurity are supposed to reduce the levels of dedication and involvement in the organisation (Staufenbiel & König, 2010). Another relevant example of the important role engagement plays in the health tourism industry is offered by Koo et al. (2020). Their research observed how artificial intelligence affected the job security of hotel workers and found that engagement moderates the relation between job insecurity and intentions to leave the organisation. Also, Karatepe et al. (2020) found that job engagement could work as a mediator in the relationship between intentions to leave the workplace and perceived job insecurity. These results underscore the negative effects of job instability on employees and show how job engagement can decrease the risk of turnover. Therefore, we hypothesise: *H3: The job engagement directly affects the turnover intention among health tourism employees; H4: The feelings of powerlessness directly affect the turnover intention among health tourism employees; H5: The severity of the threats directly affects the turnover intention among health tourism employees; H6a: Job engagement mediates the relationship between the severity of threats and the intention to turnover in health tourism employees; H6b: Job engagement mediates the relationship between powerlessness and the intention to turnover in health tourism employees.*

2.4 Moderating Effect of Education Level

Education level is seen as a dimension that might contribute to the extent in which employees can identify with their professional group, and this will influence the motivation to remain employed within the company, despite other threats to job security posed by technology (Knippenberg, 2000). Another research regarding the implications of social identity theory for learning and development in organisations says that if education level is a moderator, that might influence the relationship between social identity and employees' engagement with professional development, is therefore needed for employees in the tourism industry, where is a constant need to adjust to the new market requirements (Koo et al., 2020). Based on the preceding discussion, we can assume that differences in education attainment among employees will have different perceptions of the threat that technological development might have on their jobs. In this regard, we postulate the following hypotheses: *H7a: Education moderates the relationship between feelings of powerlessness and turnover intention among health tourism employees; H7b: Education moderates the relationship between the severity of threats and turnover intention among health tourism employees.*

Figure 1. Proposed research model



Note: Orange lines are formative indicators and bold lines are hypotheses. Dashed lines denote mediated role (H6a, b). Dotted lines denote moderated role (H7a, b).

Source: Developed by authors.

3. Research Methods

3.1 Measurements

This study involves multi-item scales, attempting to expand the limitations that single-item scales have. We incorporate 18 items to measure six significant constructs, such as physical engagement (PE), emotional engagement (EE) and

cognitive engagement (CE), all constituents of job engagement (ENG)—apart from the dimensions of job insecurity: severity of threats (ST) and powerlessness (PO), and finally, turnover intention (TI). The ST measures of evaluation were borrowed from past research, including Ashford et al. (1989) (e.g., “The change could occur in the variety of tasks I perform”). The PO measure was measured in four items based on the work of Ashford et al. (1989), with questions such as “I have sufficient authority within this organization to influence events that might impact my job”. PE was measured through three items extrapolated from a study by Koo et al. (2020), such as “I will still try my hardest to perform well on my job”. Similarly, EE was measured through three items also taken from Koo et al. (2020), for example, “I will still try my hardest to perform well on my job”. The evaluation of EE and CE included each, three items from the same source, namely Koo et al. (2020), with items as “I will still feel positive about my job”, or “At work, I will still focus a great deal of attention on my job”. Behavioural intention (BI) was conceptualised based on three queries from a study by Zopiatis et al. (2014). A 7-point Likert-type scale was used as an evaluative method. The questionnaire was prepared in English and then translated into Romanian by two bilingual professionals, backtranslated into English, and carefully reviewed in case of any inconsistency.

3.2 Data Collection

Hung and Law (2011) noted that as the Internet became more widespread, more and more researchers in the field of hospitality started to use online surveys as a method to get a broader target group. This study used the Google Forms online survey questionnaire tool, while the respondents were targeted at employees of hotels and SPAs - three hotel complexes with integrated health tourism facilities (wellness and/or medical spa), arranged in three different geographical regions of Romania (seaside, mountain, capital). In total, a number of 131 questionnaires were gathered, as the data was collected from April 6 to April 17, 2024. Data as gender, age and education was measured in the questionnaire, as subjects related to demographic and social characteristics, using various scales of measurement.

3.3 Data Analysis

The collected data have been analysed in SmartPLS 4.1.02. Partial Least Squares-Structural Equation Modelling (PLS-SEM) was used to analyse the statistical influence of the independent variables used in this study on a dependent variable. In the PLS-SEM methodology, both formative and reflective indicators are examined simultaneously (Chin et al., 2010). The initial step involved in evaluating the measurement model was confirmatory factor analysis, which determined the configuration of systematically measured factors and variables within underlying constructs, thereby minimising multicollinearity or correlations of error variance among indicators (Hair et al., 2020).

4. Findings

4.1 Respondents Profile

Regarding the gender distribution of the participants, it was identified that 63.6% of the sample represented women, and 36.4% corresponded to men. Most of the participants declared having received higher education, to a percentage of 61.4%, and 38.6%, in the following order, claimed to have received up to the following levels of education: 10 grades; high school; and post-high school. In terms of age segmentation, the distribution of respondents was: 13.6% were under 25 years old, followed by 23.5% who were between 25 and 34 years old, followed by 28% between 35 and 44 years old, succeeded by 20.5% who were between 45 and 54 years old, and the seniors group, represented by 15.9% of the respondents, included participants being 55 years old or older.

4.2 Measurement Model

In this research, we used confirmatory factor analysis on the measurement model following the guidelines of Hair et al. (2020). As indicated in Table 1, 18 items were maintained for further analysis. Subsequent assessments of reliability and validity were conducted. Cronbach's alpha, a measure of internal consistency reliability, indicated that all values exceeded the recommended threshold of .700 (Taber, 2017), (CR) composite reliability tests, which also assess internal consistency between measurement items, showed all values were above the .600 guideline (Ringle et al., 2018), with figures ranging from .917 to .983. For evaluating the convergent and discriminant validity, the values average variance extracted (AVE) were calculated, all surpassing the minimum recommended value of .50, with a range of .788 to .952. Moreover, all squared AVE values were higher than the correlations between any pair of constructs (Fornell & Larcker, 1981). Therefore, the reliability and validity are thoroughly established.

Table 1. The results of measurement model (n=131)

Variable	CE	EE	PE	TI	PO	ST	Factor loading	Cronbach's α	CR	AVE ($\sqrt{\text{AVE}}$)
CE								.971	0.981	.945
CE1	1						.965			(.972)
CE2							.985			
CE3							.967			
EE								.975	0.983	0.952
EE1	.790	1					.974			(.975)
EE2							.973			
EE3							.979			
PE								.963	.976	.932
PE1	.801	.766	1				.967			(.965)
PE2							.979			
PE3							.950			

Variable	CE	EE	PE	TI	PO	ST	Factor loading	Cronbach's α	CR	AVE ($\sqrt{\text{AVE}}$)
TI								.925	.952	.869
TI1	.184	.172	.072	1			.910			(.932)
TI2							.938			
TI3							.948			
PO								.865	.917	.788
PO1							.814			(.888)
PO2	.485	.480	.566	.113	1		.926			
PO3							.918			
ST								.878	.925	.804
ST1							.869			(.897)
ST2							.933			
ST3	.212	.208	.265	.418	.342	1	.888			

Source: Developed by the authors based on calculations from SmartPLS.

ENG is quantified as a formative variable comprising three sub-constructs, making it a Second Order Factor (SOF) in the study, based on three First Order Factors (FOF): CE, EE, and PE. This formative approach identifies several attributes, each with multiple dimensions. To establish the validity of the SOF, outer weights, *t*-statistics, *p*-values, outer loadings, and the VIF were checked (see Table 2). The outer loadings were strong (Hair et al., 2020) and more significant than the rule of thumb of 0.50 for all SOFs (Sarstedt et al., 2019). Multicollinearity has also been checked using VIF values, indicating them below the threshold of 5 (Hair et al., 2020). According to the previous status, the SOF is agreed to be valid.

Table 2. Second Order Factor (SOF) Validity

SOF	FOF	Outer Weight	T Statistics	P Values	Outer Loadings	VIF
ENG	CE	0.189	0.649	0.258	0.872	3.168
	EE	0.206	0.859	0.195	0.853	2.807
	PE	0.676	2.331	0.010	0.975	2.885

Source: Developed by the authors based on calculations from SmartPLS.

4.3 Structural Model

The structural model displays the paths between constructs in the proposed study model. The R² values are 29.4% for job engagement, and 45.4% for behavioural intention. Given the absence of multivariate normality in the data, path estimates and *t*-statistics for these relationships were analysed using the bootstrapping method (Hair et al., 2020). We used the PLS bootstrap method to assess the sampling distribution's shape non-parametrically by involving 5000 resampling. H1 assesses whether PO is positively related to ENG. The results showed PO with a significant impact on ENG ($\beta=0.508$, $t=7.263$, $p=0.000$). Consequently, H1 is accepted.

H2 exposes if ST has a significant impact on ENG. Our results showed that ST does not have a significant impact on ENG ($\beta=0.090$, $t=1.020$, $p>0.05$), this meaning that H2 is rejected. H3 assesses whether ENG has a significant impact on TI. The results indicated that ENG has a significant negative impact on TI ($\beta = -0.232$, $t = 3.406$, $p = 0.000$), so H3 is accepted. In the next relation, PO has a significant impact on TI ($\beta = 0.148$, $t = 2.010$, $p = 0.022$), so H4 is also accepted. The results showed that ST has a significant impact on TI ($\beta=0.142$, $t=1.859$, $p= 0.032$), therefore, H5 is accepted.

4.4 Mediation Analysis

H6a assesses whether ENG mediates the relationship between ST and TI. The results show that the total effect (H5) was found positive and insignificant ($\beta=0.121$, $t=1.557$, $p=0.060$). When we introduced the mediator into the model, the direct effect remained significant ($\beta = 0.142$, $t = 1.859$, $p = 0.032$), and the indirect effect with the inclusion of the mediator in the analysis was also found to be insignificant ($\beta = -0.020$, $t = 0.963$, $p = 0.168$). This shows that the effect of ST on TI does not pass through ENG, and therefore, H6a is rejected.

H6b assesses whether ENG mediates the relationship between PO and TI. Because PO has a significant impact on TI ($\beta=0.148$, $t=2.010$, $p=0.022$) and the indirect effect with inclusion of the mediator in the analysis was found to be negative and significant ($\beta=-0.118$, $t=2.942$, $p=0.003$). The results reveal a partial mediation. This shows that the effect of PO on TI partially passes through ENG. Therefore, H6b is accepted.

4.5 Moderation Analysis

For the moderation analysis presented in this study, we proposed H7a: Education does not moderate the relationship between PO and TI ($\beta=-0.001$, $t=0.008$, $p>0.5$), so H7a is rejected. H7b: Education positively moderates the positive relationship between ST and TI, so that increased education strengthens the relationship between ST and TI. The obtained results assessed the moderating role of education on the relationship between ST and TI. Without the inclusion of the moderating effect (STxEdu), the R² for TI was .224. This shows that the 22.4% change in TI is accounted for by ST. With the inclusion of the interaction term, the R² increased to 45.4%. This shows an increase of 45.4% in variance explained in the dependent variable (TI). Furthermore, the significance of the moderating effect was analysed, the results revealed a positive and significant moderating impact of Edu on the relationship between ST and TI ($\beta=0.427$, $t=2.567$, $p=0.010$), supporting H7b. F-Square effect size was .071, and according to Cohen (1988) proposition, 0.02, 0.15 and 0.35 constitute small, medium, and large effect sizes of moderation respectively. There is a small to medium significant moderating effect, and this shows that moderating effect does contribute in explaining the endogenous construct (TI).

5. Conclusions

This study investigated the effects of AI on job security in Romania's health tourism sector, focussing on the severity of threats and feelings of powerlessness and their influence on job engagement and turnover intentions. The results showed that, contrary to our expectations, the perceived severity of AI-related threats did not significantly influence job engagement. This finding contrasts with the premise suggested by Greenhalgh and Rosenblatt (1984) that perceived job threats reduce employee engagement. Perhaps employees in the health tourism sector are aware that, with AI, roles that are unique to their professions and call for interpersonal skills, such as empathy and communication, are less threatened, which could reduce the perception of threat to their jobs (Abdullah & Fakieh, 2020). However, powerlessness significantly lowered job engagement, which is consistent with the earlier assertion by Greenhalgh and Rosenblatt (1984) that powerless employees withdraw from their roles. Job engagement was, in turn, a significant negative predictor of turnover intentions, thereby supporting the assertion by Karatepe et al. (2020). In addition, feelings of powerlessness and the severity of the perceived threats directly impacted turnover intentions, thus reinforcing the notion that employees who feel unable to influence job security-related events are more likely to consider leaving (Koo et al., 2020). Besides, the mediation analysis established that job engagement proved to be a partial mediator in the feelings of powerlessness and turnover intentions since the feelings of powerlessness directly affect turnover intentions and an indirect impact through job engagement. The level of education moderated the relationship between perceived severity and turnover intentions, pointing toward the fact that employees with high educational levels are sensitive to the perceived job threats that AI may pose. However, no significant moderating effect on feelings of powerlessness and turnover intentions was discovered. Job engagement strategies should be at the top of the organisational agenda, and educational and training opportunities can be given to minimise anxieties arising from the employment of AI, providing a hint into how workforce transitions could be managed amid advancements in technology.

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**Does The Organisational Culture Play a Role
in Choosing a Job in Tourism?**

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Abstract

As the younger generation represents the future of the tourism labour market, it is important to understand what attracts them to a company. This is especially true for companies looking to hire top young talent for the tourism sector. It is widely recognised that young people place great importance on their well-being and how work fits into their lives and identity. The well-being of a person in a company can be seen through the lens of organisational culture. Therefore, a study was conducted with 101 students to find out what type of organisational culture (according to the Competing Values Framework model) is most interesting to younger people, if they are interested in a job in tourism and how much they value the presence of an organizational culture when making a job decision. The results indicate that most students view organisational culture as an important factor in their career choice. Additionally, students value a collaborative culture and students with previous work experience in tourism are more likely to be interested in a long-term career in tourism. They would also accept a job offer in the tourism sector if they had the opportunity. These results show that in general students are interested in working in tourism, especially in companies with an open and friendly cultural work environment.

Keywords: organisational culture, job attractiveness, job in tourism.

JEL Classification: M14, M54, Z32, O15.

1. Introduction

Everyone talks about culture, but probably not everyone knows what culture is. Of those who do know, even fewer understand what constitutes a culture or, more importantly, why business leaders should pay attention to it.

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In short, culture is the combination of a company's attitudes, values, beliefs, and behaviours and encompasses the way people think and act in the various situations they encounter in the organisation. These defined standards enter every facet of the organisations' existence and they can vary from elementary routines, for instance establishing the duration of a work break, to more intricate dilemmas concerning the manner in which the introduction of a new idea should be approached.

Culture is not a dimension of employee fulfilment or engagement, but the effect of culture and in addition, it does not represent a measure of emotions. Many companies still describe their "culture" with emotional adjectives such as "fun" or "a happy workplace". Some companies incorrectly describe their culture based on their operating strategy, such as "fast" or "customer-focused". None of these definitions or terms describe the behaviours or attitudes expected of members of the organisation.

The term "organisational culture" first appeared in the academic literature in an article by Pettigrew in *Administrative Science Quarterly* (Pettigrew, 1979; Hofstede et al., 1990), although Jacques spoke of the culture of a factory as early as 1952 (Scott et al., 2003).

Over time, the culture of an organisation has been defined in various ways, and there is still no unanimously accepted definition. Thus, culture refers to a wide range of social phenomena, including the agreed dress code of organisational members, language, behaviour, beliefs, values, assumptions, symbols of status and authority, myths, ceremonies, and rituals, and forms of deference and subversion, all of which help to define the character and norms of an organisation. As a result of this diversity of phenomena, it becomes understandable why is a moderate agreement on a specific definition of organisational culture, on how it should be observed or measured, or on how different methods can be used to manage change.

Taking into account all these aspects, the aim of this paper is not to find out what respondents understand by organisational culture, but whether they value the presence of an organizational culture when they want to be employed in a company.

2. Problem Statement

Culture is a varied topic which includes all the common values, attitudes, beliefs, assumptions, artefacts, and behaviours of a group. Culture goes beyond various aspects of internal and external relationships, and holds a meaningful impact by determining people's conduct with such magnitude that they may not be conscious of its effect. Academics consent that the culture of an organisation relies on a basis of hypotheses regarding the essence of the world and human interactions. These beliefs are deeply rooted and frequently stand invisible, unspoken, and unknown to the members of the organisation. Due to these matters, there is one question that appears: is it possible to understand in a complete manner the culture of an organisation? Even if the full assessment of all the elements of the organisational culture could appear a disheartening process (some individuals considering that is unrealisable), the overarching features can be identified to a general extent. By analysing "effective organisations," researchers revealed multiple meaningful and critical dimensions.

2.1 Competing Values Framework

There are many models that explain organisational culture, some of which include many variables. While this theoretical richness may offer certain benefits, organisations may face challenges in practically integrating and addressing such a wide array of dimensions. Robert Quinn and John Rohrbaugh (1983) examined the results of numerous studies on this topic and found that two main dimensions can explain such a wide range. Their competing values framework combines these two dimensions into a 2x2 matrix with four clusters (Tharp, 2009).

The first dimension places the values of flexibility, discretion, and dynamism at one end of the scale, whereas stability, order, and control are at the other end. This means that some organisations emphasize adaptation, change, and organic processes, while others, in fact emphasize stable, predictable, and mechanistic processes.

The second dimension is characterised by internal orientation, integration, and unity at one end of the scale and external orientation, differentiation, and rivalry at the other end. Some companies are efficient when they focus on themselves and their internal processes. Others excel by concentrating on the market or their competitors.

Kim Cameron and Robert Quinn (1999) further explored how each of the four quadrants (resulting from the combination of the two dimensions) relates to company characteristics. Each quadrant represents the characteristics that a company considers to be the best and most appropriate for its operations. In other words, these quadrants represent the core assumptions, beliefs, and values, components of culture. None of the quadrants - Collaborate (clan), Create (adhocracy), Control (hierarchy), and Compete (market) - is inherently better than another, just as no culture is necessarily better than another. However, some cultures may be more appropriate than others in certain contexts. The key to using culture to improve performance is to align the culture or its features with business objectives.

The „Collaboration (Clan)” culture describes an open and friendly workplace where people expose a lot about themselves, similar to an extended family. Managers are seen as mentors or even parental figures. Loyalty to the group and a sense of tradition are strong, and group cohesion is highly valued. The emphasis is put on the long-term benefits of staff development, a strong concern for people being and an important characteristic. The organisation places a high value on participation, teamwork, and consensus.

“Creation (Adhocracy)” culture describes a dynamic, entrepreneurial, and creative workplace. Innovation and risktaking are embraced by employees and managers. A commitment to experimentation and thinking differently is what creates unity within the organisation. Both employees and managers strive to be at the top. The long-term focus is on evolution and the acquisition of new resources. Success is measured by the development of unique and new products or services since it is important for the company to play a leading role in the industry. Individual freedom and initiative is encouraged.

“Control (Hierarchy)” culture means a highly structured and formalised workplace. Rules and procedures govern behaviour. Managers try to be good coordinators and organisers, concentrating on efficiency. Therefore, it is very

important to maintain a flat organisation. Formal policies are what hold the group together. Stability, performance, and efficient operations are the long-term goals of organizations. Success means hassle-free programming, reliability, and low costs. Management wants certainty and predictability.

The „Competition (Market)” culture describes a results-orientated organisation focused on getting things done. Employees are competitive and goal-orientated. Managers are demanding, directive, and productive. The focus on profit unites the organisation. Reputation and success are common concerns. Long-term focus is on being competitive and achieving measurable goals and objectives. Success is measured by market share. Competitive pricing policy and market leadership are important.

2.2 What do employees want from a workplace?

Today, employees no longer make decisions based solely on salary and benefits when choosing a job. In general, people choose jobs that they enjoy and help them satisfy certain psychological needs (Burlea-Schiopoiu et al., 2022).

However, in an effort to attract and retain valuable employees, many managers continue to place a high value on salary because it is something they can easily control in the short term. High salaries may attract or retain some employees, but companies that do not have a culture that employees can match will not be able to keep those employees satisfied and engaged for the long term. Therefore, the investment in cultivating a corporate culture represents a genuine long-term approach aimed at both attracting and retaining staff members (Zemke, 2022).

Another dimension that is gaining more recognition among employees is continuous initiatives. Numerous employees feel that their organizations fail to provide a satisfactory orientation process. Consequently, they experience a lack of connection with the organisation and inadequacy in being ready for their designated responsibilities within the organization. Experts believe that an organisation of this nature is probable to encounter escalated staff turnover rates and increased costs related to employment in the foreseeable future (ClearCompany, n.d.).

Several studies examined the expectations of Generation Z (individuals born between 1995 and 2009, according to Goh and Lee, 2018) regarding the characteristics of a workplace. According to Ozkan and Solmaz (2015), Generation Z wishes team spirit, expects flexibility in the workplace, assurances for their future career, work-life balance, faster career development, and seeks independence and happiness at work.

It is important that employees do not leave their jobs or seek other employment exclusively for financial reasons. They are considering the meaning of work and the relationship of their work with their life and purposes. For this reason, they seek employers with good management, transparent communication, flexible working arrangements, and a robust organisational culture that prioritises the well-being of all employees.

2.3 How attractive is a job in tourism?

The tourism industry includes many activities that together create a complete tourism experience. The tourism value chain links together many sectors such as transportation, accommodation, hospitality, entertainment, and others. Each sector plays an important role in a tourist's trip and contributes to the success of the industry. All of these activities create many jobs and provide income for millions of employees and their families worldwide.

Young people represent an important part of hospitality employees in many countries, but some researchers have shown that they are not fairly remunerated (Mooney, 2016). As a result, young people employed in the hospitality industry perceive their jobs as temporary and insecure, rather than as opportunities for career development (Alacovska et al., 2021). A survey of four-year tourism management students revealed that they perceive various aspects of working in the hospitality industry as unfavourable (Sigala, 2021), and a study of tourism students found that they believe that aspects such as a friendly work environment, job security, good opportunities for advancement and an attractive starting salary are not important to hospitality employers (Hoque and Ashif, 2020). Other students indicated that a job in tourism is interesting and rewarding, requires reasonable skills, you can use your skills, and the work is fun over time, but some negative perceptions of the industry have emerged (Tuzunkan, 2018).

Goh and Lee (2018) point out that Gen Z employees in the hospitality industry are motivated by job satisfaction, so to attract talent, employers should develop the ability to offer their employees dynamic, enjoyable, interesting and stable international careers. In the same vein, Self et al. (2019) show that Generation Z seeks opportunities to travel and work in different countries and receives constant feedback during annual reviews.

Based on the hypothesis that young people are a distinct group of the labour force, Golubovskaya et al. (2017) point out that jobs in the hospitality industry provide a central developmental context for young people because the hospitality industry is dominated by young, often inexperienced workers. As a result, there is a strong need for greater attention to the talent development and a more employee-centric approach that creates jobs that offer career opportunities. Recent conclusions state that talent recruitment and retention is a recurrent challenge for hospitality employers (Financial Times, 2021; Goh and Okumus, 2020). According to Sakdiyakorn et al. (2021), Generation Z is characterised by a set of values: harmony, justice, fairness, truthfulness and helpfulness, honest relationships and personal connections, autonomy, recognition, appreciation, evolution, and security. These studies offer valuable insight into Generation Z and underline the need to pay more attention to their expectations in order to provide them with jobs that meet those expectations (Kapuciski et al., 2023). Numerous studies have examined what Generation Z wants from a workplace, but there is still room for research on the type of organisational culture that young people desire. Therefore, this study seeks to establish a link between the expectations and aspects that young people value on the job and

the culture of the organization that provides the framework for the manifestation of these values.

3. Aims of the Research

The purpose of the paper is to explore whether young people value the presence of an organisational culture when considering employment within the tourism sector and which (out of the four) organizational culture types would be most attractive to them. Therefore, the following four research questions are considered: (R1) To what extent are business students interested in a job in tourism? (R2) How much do business students value the presence of organisational culture when choosing a job? (R3) What type of organisational culture is most attractive to business students?

4. Research Methods

Based on the literature, a questionnaire was developed to identify aspects such as the interest of young people in employment in tourism and what type of organisational culture is most attractive to business students if they value the organisational culture. The survey was conducted online between 28 September 2023 and 4 April 2024. The 101 respondents were mainly students from the Faculty of Business and Tourism, within the age category of 18-26 years.

Regarding the questionnaire content, for this study, the organisational culture type model (Tharp, 2009) was used to find out which culture is the most valued by students; each variable had its own scale, consisting of 6 items per culture type (Clan = C; Adhocracy = A; Hierarchy = H; Market = M). The reliability test showed internal consistency, as Cronbach's α coefficients were positive and greater than 0.7 (Hair et al., 2019) in each case (C=0.92; A=0.92; H=0.89; M=0.91). Additionally, participants were asked to rate if they would be interested in (1) a long-term career or (2) a short-term career in tourism and (3) accepting a job in tourism if offered, for which a Mann-Whitney test was performed in relation with previous experience; to see if students with previous work experience in tourism are more or likely to be interested in a job in tourism

All elements were rated on a 5-point Likert scale ranging from 1 (not at all or strongly disagree) to 5 (very much or strongly agree).

In terms of the profile of the people respondents, the majority of the surveyed were females, accounting for 71.3%. It is also important to note that, with regard to employment status, most of the respondents fell into two categories, with 32.7% of them being employed and 31.7% being unemployed and never worked before. In terms of location, almost half (47.5%) were from Bucharest.

5. Findings

5.1 Job Interest within the Tourism Sector

Students were asked if they would consider a long-term or short-term job in tourism. The results show that the majority (58,5%) of the students responded in a positive

way (agree and highly agree) when asked if they would be interested in working in tourism for a short period of time. Regarding working in tourism for a long period of time, 53,5% of the respondents said that they are willing to have a career in tourism even for a long period of time. This finding contradicts previous research (Alacovska et al., 2021) stating that young people are looking for a career in tourism only for a short period of time, due to job insecurity and low wage. For the scenario in which students would be given the opportunity of working in the tourism industry, only 1% of them said they would definitely decline the offer and 70.3% leaned toward agreement (agree and strongly disagree).

The results of the Mann-Whitney test, with respect to previous work experience in tourism and interest in pursuing a job in tourism, are shown in Table 1. Students who had previous tourism work are more likely to be interested in pursuing a long-term career in tourism (MR = 66.87) than those without experience (MR =45.5), and the difference between the two groups was statistically significant ($z = -3.32, p < 0.05$). Additionally, the results indicate that those with previous experience had significantly greater interest (MR =60.31) in accepting a job in the tourism sector compared to those without it ($z = -1.98, p < 0.05$). Concerning the interest in a short-term job in tourism, the student without previous experience had a higher mean rank (MR = 53.35), which means they showed more interest in a short-term job opportunity. However, the difference was not statistically significant ($z = 1.42, p > 0.05$).

Table 1. Influence of previous experience on job interest

Item	Mean Rank		Mann-Whitney		
	1	2	U	Z-score	Sig.
To what extent would you be interested in working in tourism for a relatively short period?	44.21	53.35	1151.5	1.42	0.155
To what extent would you be interested in pursuing a long-term career in tourism?	66.87	45.5	562.5	-3.32	<.001*
If an employer offered you a job in tourism, to what extent would you accept it?	60.31	47.77	733	-1.98	0.048*

Note: "1" = with previous experience in tourism; "2" = no previous experience in tourism.

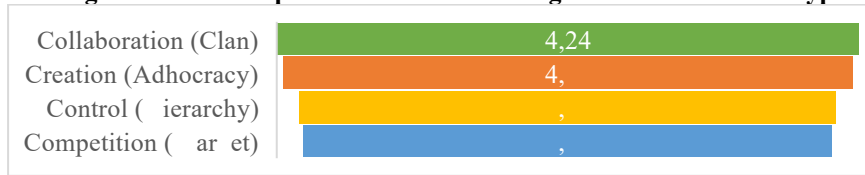
Source: authors' own work.

5.2 Expectations and Importance of the Organisational Culture

In Figure 1, the average index of the four types of organisational culture rated by the respondents. Collaboration has the highest index of 4.24. Indicating that, on average, students value a workplace in which people are a central part of the company, where openness and teamwork are highly encouraged. On the other hand, a competitive environment, where managers are demanding and orientated toward profit maximization, is the least preferred organisational culture – the competition culture

scoring a 3.85 mean. In addition, the index ranking reveals that the more rigid and less people-centred the culture is, the less preferred it is by students.

Figure 1. Index Importance of the Four Organisational Culture Types



Source: the author’s own work.

Table 2 shows the extent to which participants are in the organisational culture when choosing a job within the tourism sector. Results show that most respondents (38.6%) strongly consider that culture would be a factor of interest when choosing a job and only 6.9% disagree with that statement. Overall, this indicates that students place great importance on the organizational culture. As previous literature suggests, younger generations value relationships, recognition and security Sakdiyakorn et al. (2021), therefore it could explain why students place importance on learning about the organisational culture before planning – to see if the company is also a good fit for them.

Table 2. Value of organisational culture (%)

Item	1	2	3	4	5
If you were to attend a job interview for a company in the tourism industry, to what extent would you be interested in learning details about organizational culture?	1	6.9	20.8	32.7	38.6

Note: ‘1’ – highly disagree; “5” – highly agree.

Source: authors’ own work.

6. Conclusions

The purpose of this study was to explore the role of organisational culture for the younger people when considering employment in the tourism sector. To answer the three research questions proposed in this paper, a questionnaire was conducted in the students (N=101). It was found that, in relation to *R1* (ie, interest of business students in tourism job), students are interested in both short- and long-term job opportunities in tourism. This is particularly true for those with prior experience. Our findings suggest that students with previous work experience in tourism are more likely, if offered, to accept a job position in this sector and pursue a long-term career in tourism. For *R2* (that is, the value of organisational culture in job decision), the results confirmed the importance of organizational culture when considering a job in tourism. More than 70% of the students considered it important (highly agree and agree) to enquire and learn about the organizational culture of the company in which they interview. Lastly, the most preferred type of organisational culture would be

collaboration or clan, followed by *creation (adhocracy)*, *control (hierarchy)*, and *competition (market)*. The *collaborative (clan)* type is considered a highly supportive and open work environment, where people matter more than profit, and students seem to appreciate it more than a dynamic and demanding one such as the *competition (market)* culture.

Taken together, this shows that the young generation or generation Z is eager and interested in working in tourism, for both short- and long-term, despite the obstacles they may encounter (low pay, job insecurity, not enough opportunities for advancement). Furthermore, since young people take a great interest in their well-being and work-life balance, they tend to lean towards workplaces that have an open and cultural organization.

One limitation of this paper was that only people over 26 years old were included in the research and the sample small. Future research, however, could extend it to wider and more diverse participants; where the difference between age groups could be analysed in terms of their preference of the four organisational culture types.

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**Destination Brand Equity of Cultural Destination:
The Case of Hue City, Vietnam**

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Abstract

Along with the development of tourism, the competition between tourist destinations is growing. Therefore, destinations must compete fiercely in many forms to survive and develop. Fierce competition among tourist destinations requires them to create competitive advantages over others. At this time, the destination brand is essential to help the destination achieve its development goals and ensure its position. Previous research has acknowledged the added value that brands bring to tourism destinations. However, research on destination brand equity must continue, especially for destinations with outstanding characteristics, such as cultural and heritage destinations. This article explores the factors that make up the brand equity of a cultural destination. From there, we can have a more specific view of the differences in evaluating destination brand equity. The research was carried out based on a survey of 251 tourists in Hue City, Vietnam, the cultural city of ASEAN. The results show that the dimensions of cultural property of the destination brand equity positively influence the structure of destination brand equity. The equity aspects of the cultural destination brand include the equity of the cultural destination brand, Positive associations about the cultural destination, quality of the cultural destination brand, and loyalty. Through this research, destination managers can identify the advantages of the cultural destination brand in Hue City and then have solutions to improve the equity of the destination brand there. The paper ends with a discussion of the results and implications of the study.

Keywords: brand equity, destination brand equity, cultural destination brand equity, Hue City, Vietnam.

JEL Classification: L80, L83, M10.

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1. Introduction

Hue City, Vietnam, is a diverse destination of cultural tourism resources with many famous landmarks, great appeal, and the ability to attract international tourists and domestic people. Along with tourism development, competition between tourist destinations is increasingly fierce. Therefore, destinations must compete fiercely in many forms to survive and develop. While customers are increasingly smart and demanding, they need more time for choice. Furthermore, many tourist destinations have similar characteristics and types of services. Fierce competition among tourist destinations requires them to create competitive advantages over others (Pike and Page, 2014). Furthermore, brands are essential to help destination achieve its development goals and ensure their position in the market. Competitive advantage can be achieved by developing strong brands that deliver high value to customers. A powerful brand that is known by many customers is the quickest and the most efficient approach through which a destination can expand its profits with a minimal cost.

Tourism increasingly focusses on investing in facilities, landscapes, and environments that are genuinely convenient for tourists to visit, relax, or come on business. However, Hue City tourism faces many challenges due to the intrusion and fierce competition of current and potential competitors. Hue city currently attracts fewer tourists (3.2 million tourists in 2023) than other cultural tourism destinations in Vietnam such as Hanoi City (24 million tourists in 2023), Hoi An City (4 million tourists in 2023), etc., or South East Asia such as Chiang Mai in Thailand (3.9 million tourists in 2023), Bali in Indonesia (5.2 million tourists in 2023), etc. However, Hue has more historical and cultural relics and world cultural heritage than other destinations, with seven world heritages recognised by UNESCO.

Hue City needs to determine that creating a truly profound image in customers' minds is a factor that determines the survival and existence of the tourism industry. Along with the efforts to build and advance the brand, many tourists acquired knowledge about Hue's tourism brand through the upshifting number of international tourists. Contrasting to tangible goods, destinations reflect multidimensionality and are they able to supply tourists with distinct experiences. Destinations are perceived as intangible products hence they display subjectiveness and they rely on the travel itinerary, culture, purpose of the visit, level of education, and past tourist experiences.

For this reason, destination brands become riskier because much of what makes up a brand can sometimes be altered by human influences, natural events, or purposeful intervention, etc. Another factor is that the destinations are unique and not traded on the market. Therefore, other destinations cannot directly determine the equity of the destination brand equity. Instead, brand equity must be assumed based on spending, tourist return to renewal rates, and overall visitation rates (Chekalina et al., 2018).

Previous research has acknowledged the added value that brands bring to tourism destinations. Thus, it is crucial to understand and manage the determinants of brand equity for tourism destinations (San Martín et al., 2019). Therefore, research on Hue City's destination brand equity becomes even more

urgent. Provides characteristics of destination brand equity and then offers solutions to enhance, develop and protect destination brand equity and attract more and more tourists.

This paper is organised into the following sections: The first part provides a brief review of destination brand equity and cultural destination brand equity. In the second part, the research methods used by the authors are provided. The third part covers the research results. The last part is the conclusion and discussion of the research results, establishing future research directions and limitations of the study.

2. Problem Statement

2.1 Destination Brand Equity

Research in destination brand equity is mainly based on research on corporate and product brand equity. Although there is still debate as to whether brand equity can be applied from a product to a tourism destination, as the concept becomes quite complex and challenging to grasp when connecting it to a destination (Konecnik and Gartner, 2007); however, there have been practical studies on brand equity that have been applied to tourist destinations (Kim et al., 2019; San Martín et al., 2019).

Conceptually, tourism destination-based branding includes both tangible and intangible elements (Boo et al., 2009). Tourists perceive these elements as a unique combination of the functional (physical, measurable) and psychological (abstract) components of the destination brand. The attractiveness and value of a tourist destination brand can vary depending on the product/service assets that tourists recognise. The elements of a destination brand and the measurement methods used are still relatively new and controversial. Thus, this issue has not been extensively researched to date (San Martín et al., 2019); in the first research on destination brand equity, Konecnik and Gartner (2007) used four dimensions: awareness, image, quality, and loyalty. Kim et al. (2019) used six dimensions: awareness, preference, value, uniqueness, popularity, and price. San Martín et al. (2019) used five dimensions: awareness, image, quality, loyalty, and tourist satisfaction.

According to research by Aaker (1991), brand equity measurement is divided into five aspects: awareness, association/image, perceived quality, loyalty, and brand equity. In destination brand equity, the first four dimensions are included in the respective models (San Martín et al., 2019). In this context, perception refers to the name and characteristics of the destination and the association/image with the perceived value and personality. Perceived quality is related to organisational aspects and loyalty to review and recommendation (Boo et al., 2009). However, Pike (2007) argued that the asset dimension, addressed mainly by the financial measure of the destination brand, has little practical value. Furthermore, Mansur et al. (2021) argued that the entertainment and interaction aspects strongly impact the loyalty aspect of the destination brand equity.

Despite its potential application to tourism destinations, research on brand equity has only recently attracted the attention of academic researchers (Kaushal et al., 2019), with very little experimental work on a destination-based brand equity model related to destination branding (Pike and Bianchi, 2013).

2.2 Cultural Destination Brand Equity

Cultural heritage and public awareness of its importance are among the main factors contributing to socioeconomic and cultural development (Carbone, 2016). Cultural heritage assets constitute a resource for the area in question, offering the potential to act as a tourist attraction and thus contribute to the development of the territory (Carbone, 2016). In this regard, Carbone (2016) notes that cultural heritage is important for the development, attractiveness, and competitiveness of tourist destinations. As a result, countries, regions, and cities around the world are now competing for the attention of tourists to attract them to their heritage (Koufodontis & Gaki, 2022). Among heritage sites, those classified as World Heritage Sites by the Organisation for Educational, Scientific and Cultural Rights of the United Nations (UNESCO) are particularly interesting because of this recognizable label, making them authentic heritage brands (Kim et al., 2019).

Culturally attractive places provide great motivation to travel and creating culture. However, this connection has become even more profound in recent decades, encapsulated in cultural tourism (Richards, 2018). In the 1980s, the number of international tourists visiting the world's foremost cultural sites and attractions increased, so the label 'cultural tourism' created a new niche market. Today, cultural tourism is one of the fastest growing emerging products in the world's tourism industry. According to the UNTWO Report on the Synergy between Tourism and Culture (2018), cultural tourism is estimated to account for more than 39% of the total value of international tourism.

When a heritage site is designated as a World Heritage Site, this recognition constitutes a powerful heritage brand (Koufodontis & Gaki, 2022) with important status, perceived quality, and authenticity (Lak et al., 2020). This heritage brand has a positive impact on demand patterns in the relevant territories (Halpenny et al., 2018), thus contributing to reducing the perceived risks of tourists associated with choosing a destination (Halpenny et al., 2018) and, ultimately, increasing tourists' trust in the destination in question (Hassan and Rahman, 2015). Regarding heritage destination branding research, Kladou and Kehagias (2014) found that the present study follows a customer-based approach to help destination managers recognise which assets are considered unique and thus constitute cultural brand equity of a cultural destination.

Camarero et al. (2012: 1533) introduced the concept of cultural brand equity (CBE) to cultural organisations and activities, defining it as *“the added value of a cultural brand, which is rewarded”*. The reason is the market's growing attachment to the brand and organisation. These authors found that cultural brand equity positively impacts satisfaction and revisited intention toward a cultural activity (Camarero et al., 2012). It can be seen that heritage sites classified as world heritage are considered to be of particular interest due to their globally recognisable mark (Koufodontis & Gaki, 2022). Therefore, one can expect that they are likely to enjoy high levels of cultural brand equity, contributing to increased: tourist preference for visiting a cultural heritage destination (Koufodontis & Gaki (2022); visitor flow (Ramires et al., 2018); and visitors' willingness to pay entrance fees (Wang & Yotsumoto, 2019), etc.

In short, as noted by Koufodontis & Gaki (2022), the World Heritage sign creates positive brand equity that will attract tourists to locations bearing that sign. Similarly, Rahman et al. (2021) argued that the experience of the heritage brand of tourists, cultural intelligence, and destination loyalty affect the formation of the equity of the heritage destination brand. This will result in high brand awareness, high perceived brand quality, solid mental associations, and other significant assets. However, very few studies have examined brand extensions related to cultural heritage (PradosPena and Del Barrio-Garca, 2018).

3. Research Questions

Previous findings on destination brand equity have provided the foundation for four dimensions of brand equity: awareness, association (image), quality, and loyalty (San Martín et al., 2019). When discussing customer-based brand equity, Konecnik and Ruzzier (2008) argued that although many researchers have addressed the destination brand equity model in the literature, specific shortcomings still exist. In this study, we analyse the brand equity of the cultural destination of Hue City from the point of view of tourists with the following research questions:

1. How do tourists evaluate the brand equity of the cultural destination in Hue City?
2. How do tourists evaluate the characteristics of the Hue City cultural destination brand equity?
3. What are the differences in tourists' assessments of tourists about the characteristics of the Hue City cultural destination brand equity?

4. Research Methods

The methodology includes a review of the literature on the equity of the destination brand, descriptive research, one-way ANOVA, an independent sample T-test, and research based on a questionnaire to identify the tourist's evaluation. Furthermore, Turkey analysis in post hoc multiple comparisons of the One-way ANOVA method will provide an in-depth analysis of each cultural destination brand factor to provide more robust conclusions.

The survey subjects are tourists who have visited Hue City. Data were collected using survey questionnaires. The survey questionnaire consists of three parts: the first part provides information on tourists' travelling, and the second part assesses the cultural destination brand equity of the respondents. The surveys were carried out in person in the cultural tourist areas of Hue city, such as the Hue monument complex, the Thien Mu Pagoda, and the Minh Mang tomb. These are tourist areas recognised as cultural heritage by UNESCO in Hue City. The sampling method is convenient, not probabilistic. The interviewees were randomly selected regardless of gender, age, etc. The survey was conducted in February and March 2024. Finally, 251 complete and valid observations were used to perform the analysis. To capture quantitative information from tourists on cultural destination brand equity, a 5-point Likert scale (1: strongly disagree to 5: strongly agree) was used in most of the questionnaires.

5. Findings

5.1 Description of the Samples

The statistical results described in Table 1 present the demographic characteristics of tourists to Hue City, Vietnam. With respect to gender, the results show that the ratio between male and female tourists is quite balanced. Specifically, male tourists account for 43.4%, while female tourists account for 56.6%.

Regarding age, the most significant proportion of tourists were under 30 years of age (57.4%). This shows that the heritage destination still attracts many young tourists who want to visit and learn about the cultural history. Next is the group of tourists aged 30 to 60 (34.3%) and over 60 (8.4%).

Regarding jobs, tourists are mainly students (27.5%), office workers (24.3%) and businessmen (18.3%). These tourist groups represent a higher proportion than other tourist groups.

Regarding income, the research results show that tourists earn mainly between 5 and 10 million VND (41.8%), followed by tourists with incomes over 10 million VND (around 400 USD) (30.7%) and tourists with incomes under 5 million VND (around 200 USD) (27.5%).

Table 1. Descriptive statistics

	Criteria	Number	Percentage (%)
Gender	Male	109	43.4
	Female	142	56.6
Age	< 30 years old	144	57.4
	30 - 60 years old	86	34.3
	> 60 years old	21	8.4
Job	Student	69	27.5
	Office worker	61	24.3
	Entrepreneur	46	18.3
	Worker	22	8.8
	Retire	10	4.0
	Others	43	17.1
Income	< 5 million VND	69	27.5
	5 - 10 million VND	105	41.8
	> 10 million VND	77	30.7

Source: author's research result.

5.2 Assessment on Cultural Destination Brand Equity

To examine tourists' assessments of Hue City's cultural destination brand equity, the study analysed the differences in assessments of tourist groups using the Independent Sample T-test and One-way ANOVA for each characteristic of cultural destination brand equity.

- Cultural destination brand equity (see Table 2): The tourists give the highest rating to the criterion "What makes this city unique are the monuments/heritage" (mean 4.538). This is understandable because Hue City is a prominent city with seven sites of world cultural heritage recognised by UNESCO. The city's cuisine (mean=4.466) and traditional (mean = 4.327) factors are also highly appreciated. However, tourists do not rate the city's nightlife activities highly (mean=3.470). Regarding the difference in evaluation between tourist groups, tourists with differences in evaluation are mainly tourist groups with different income levels, age, and gender.

Regarding gender, the female tourist group rated the criteria “What makes this city unique are its cultural events” and “What makes this city unique are the monuments/heritage” higher than the male tourist group. This shows that female tourists have a higher awareness of cultural destinations than male tourists.

Regarding age, the older the age group of tourists, the higher the rating for the criteria of cultural destination brand equity. The reason is that these are subjects that require extensive research and knowledge of culture.

Regarding income levels, the results show that tourists with lower income levels rate the criteria of “cultural destination brand equity” higher. Low-income people have high ratings because they feel the cultural destination is suitable for their payment level.

Table 2. Evaluation among tourist groups on Cultural destination brand equity

Criteria	Mean 4.049	Gender ^a	Age ^b	Job ^b	Income ^b
What makes this city unique is its entertainment/nightlife	3.470	0.563	0.329	0.499	0.397
What makes this city unique are its traditions	4.327	0.924	0.510	0.095	0.018*
What makes this city unique is its cultural events.	4.199	0.014*	0.390	0.211	0.005*
What makes this city unique is its street culture.	3.590	0.736	0.898	0.642	0.635
What makes this city unique are the monuments/heritage.	4.538	0.033*	0.242	0.836	0.014*
What makes this city unique is its cuisine.	4.466	0.204	0.683	0.178	0.003*
What makes this city unique are its art centres.	3.765	0.132	0.953	0.805	0.740
What makes this city unique is its contribution to the world of heritage.	4.299	0.273	0.017*	0.792	0.011*
What makes this city unique are its museums.	3.789	0.166	0.037*	0.266	0.748

Note: (a): Independent Sample Test; (b): Oneway ANOVA

P > 0.05: not statistically significant; (*): P ≤ 0.05: statistically significant

Source: author’s research result.

- Awareness of the cultural destination brand (see Table 3): Regarding the awareness of the brand of the cultural destination, the research results show that tourists assess the criteria quite well in the characteristics. Specifically, tourists appreciated that 'Hue is a famous cultural destination' (mean = 4.227) and that 'Hue has a good name and reputation' (mean = 4.183). Regarding the difference in evaluation between different tourist groups, the results do not show any difference in evaluation between tourist groups (Table 3).

Table 3. Evaluation among tourist groups on Awareness of cultural destination brand

Criteria	Mean 4.112	Gender ^a	Age ^b	Job ^b	Income ^b
Hue is a famous cultural destination	4.227	0.213	0.207	0.520	0.156
When thinking about culture, Hue comes to mind immediately	4.044	0.210	0.731	0.285	0.057
The characteristics of this city appeared in my mind immediately	3.992	0.080	0.900	0.673	0.056
Hue has a good name and reputation	4.183	0.562	0.053	0.436	0.117

Note: (a): Independent Sample Test; (b): Oneway ANOVA

P > 0.05: not statistically significant; (*): P ≤ 0.05: statistically significant

Source: author's research result.

- Positive associations (see Table 4): Tourists highly appreciate the criteria "The people here are very hospitable" (mean=4.406) and "This city has a rich history" (mean=4.386). This shows that tourists have a very high appreciation for the local people and history. Therefore, tourists have an excellent impression of these features. However, the rating for this city with personality is low (mean=3.558) compared to other criteria.

Regarding the differences in the evaluation between tourist groups for some of these criteria, it shows differences between tourist groups with different incomes. In detail, the results of the Turkey analysis show that tourists with lower income levels rate the criteria of "Positive associations" of cultural destinations higher. The reason may be that low-income people do not have many opportunities to explore the culture and travel to cultural destinations in detail. Therefore, they rate highly compared to those with higher income levels. From there, cultural destination managers must pay more attention to the positive experiences of high-income tourists.

Table 4. Evaluation among tourist groups on Positive associations

Criteria	Mean 4.085	Gender ^a	Age ^b	Job ^b	Income ^b
The culture here is interesting.	4.175	0.554	0.211	0.525	0.051
I can trust Hue for a complete cultural experience	4.175	0.640	0.725	0.751	0.016*
In Hue, I can get an authentic cultural experience	4.155	0.370	0.595	0.968	0.618
This city has personality	3.558	0.434	0.936	0.415	0.837
My friends will appreciate me if I visit	3.940	0.244	0.429	0.783	0.100

Criteria	Mean 4.085	Gender ^a	Age ^b	Job ^b	Income ^b
Hue					
This cultural destination suits my personality	3.976	0.173	0.193	0.663	0.039*
This city has a rich history	4.386	0.321	0.258	0.628	0.075
Hue has a strange atmosphere	3.996	0.113	0.457	0.326	0.026*
The people here are very hospitable	4.406	0.321	0.216	0.521	0.237

Note: (a): Independent Samples Test; (b): Oneway ANOVA

P > 0.05: not statistically significant; (*): P ≤ 0.05: statistically significant

Source: author's research result.

- Cultural destination brand quality (see Table 5): The results show that tourists highly appreciate the criteria for quality characteristics of the cultural destination brand. Other travellers gave the highest ratings to 'This experience improved my cultural knowledge' (mean=4.195) and 'Hue offers quality cultural experiences' (mean=4.179). The difference in the evaluation between the tourist groups for this expenditure shows differences between the tourist groups with different incomes.

In detail, the results of the Turkey analysis show that tourists with lower income levels rate the criteria of "Cultural destination brand quality" of cultural destinations higher. The reason is that low-income tourists do not have high requirements for destination quality compared to high-income tourists.

Table 5. Evaluation among tourist groups on Cultural destination brand quality

Criteria	Mean 4.144	Gender ^a	Age ^b	Job ^b	Income ^b
I can count on having a good atmosphere	4.159	0.214	0.138	0.402	0.025*
Hue offers quality cultural experiences	4.179	0.202	0.290	0.302	0.004*
I admire the way the city's cultural aspects are organized.	4.044	0.094	0.342	0.199	0.004*
This experience increased my cultural knowledge	4.195	0.434	0.395	0.181	0.016*

Note: (a): Independent Samples Test; (b): Oneway ANOVA

P > 0.05: not statistically significant; (*): P ≤ 0.05: statistically significant

Source: author's research result.

- Destination brand loyalty (see Table 6): The tourists all said that they liked to visit Hue (mean = 4.263) and that they wanted to introduce friends/relatives to visit Hue (mean = 4.283). However, Hue's response to tourist expectations is also an issue that still needs attention (mean=3.948). Regarding differences in the evaluation of tourist groups on the characteristics of destination brand loyalty, the results show differences between tourists of different genders.

About the income, the results of the Turkey analysis show that tourists with lower income levels rate the criteria of "Destination brand loyalty" of cultural destinations higher. About gender, female tourists have higher ratings than male tourists.

Table 6. Evaluation among tourist groups on Destination brand loyalty

Criteria	Mean 4.151	Gender ^a	Age ^b	Job ^b	Income ^b
I love visiting Hue.	4.263	0.006*	0.559	0.534	0.199
Hue would be my favourite choice for a cultural vacation	4.108	0.021*	0.155	0.792	0.420
Hue met my expectations	3.948	0.089	0.559	0.406	0.136
I would recommend friends/relatives to visit Hue	4.283	0.039*	0.360	0.543	0.024*

Note: (a): Independent Samples Test; (b): One-way ANOVA

P > 0.05: not statistically significant; (*): P ≤ 0.05: statistically significant

Source: author's research result.

6. Conclusions

For a tourist destination, the attraction of tourists plays an essential role in the development of tourism, especially for cultural destinations, specifically cultural destinations in Vietnam. Places with cultural appeal provide great motivation to travel and to create culture. However, in Vietnam, cultural destinations attract fewer tourists than other destinations. The reason is that cultural destinations still need to be more exciting, attracting tourists to experience, relax, enjoy, etc., at those destinations. Therefore, evaluating the brand assets of cultural destinations is necessary in the current context. Cultural tourism and destination branding documents lead to recognising specific cultural assets that tourists can value as significant cultural brand equity.

The results show that building and promoting brand development is essential for destinations, mainly the cultural destination of Hue City, a cultural city of ASEAN (Association of South East Asian Nations). Furthermore, the research results show that tourists evaluate Hue and its cultural characteristics well. This is an essential basis for destination managers to develop solutions to attract tourists to Hue City. In particular, they must focus on the property's assets, including monuments/heritage, events, street culture, cuisine, traditions, contribution to world heritage, entertainment, nightlife, cultural festivals, museums, and art centres (Konecnik and Gartner, 2007). However, the results still show that there are differences in assessments between different tourist groups in terms of gender, age, and income. Therefore, destination managers need to focus on overcoming these differences to enhance the cultural destination brand equity of Hue city.

In addition, this study still has some limitations. The first limitation of the study is the application of convenience sampling, which is often criticised for the representativeness of the data. In addition, the number of collected research samples still needs to be increased with 251 observations. The third limitation pertains to the analysis method. Further research should conduct the comparison between various cultural destinations. In addition, the number of investigated samples can be improved in order to assure the generalisability and the representativeness of the study. Moreover, more in-depth analysis methods need to be put in place for every

factor of destination brand equity. Furthermore, research can be carried out on specific scales and combined with other subjects in tourism development, such as local people and destination managers.

The research results analysed above show that destination brand equity contributes to attracting tourists and enhancing the destination's competitiveness. Therefore, when understanding the factors affecting tourism development at cultural destinations, destination brand equity is one factor that needs to be paid attention to and considered. This paper is a reference document that provides a practical outcome of the cultural destination brand equity of a destination in a developing country with outstanding cultural characteristics.

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**European Capitals of Smart Tourism –
A New Direction in Tourism Research**

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Abstract

Tourism is an important activity both globally and in the European Union (EU). Although the COVID-19 pandemic hit tourism hard, the sector was able to recover in a relatively short period of time. Smart tourism took a strong lead during the pandemic, demonstrating that it is responding to new challenges and adapting quickly to change. In 2018, the EU launched the smart tourism capital competition, encouraging cities to find new solutions to help attract more tourists and improve the quality of life of residents. The city designated as a smart tourism capital can benefit from some advantages from EU specialists, such as more intense promotion through different media channels in order to make the destination better known and thus attract more tourists. The aim of this paper is to investigate possible correlations between the number of tourists visiting cities designated as smart tourism capitals and the popularity gained as a result of acquiring this status. The paper presents quantitative research based on secondary sources. Three hypotheses were formulated and tested using SPSS software. The main results that could have implications for the field revealed that: 1) the attractiveness of a destination is determined by its cultural heritage tourism potential; 2) higher investments in research lead to an increase in the number of patents in the field of new technologies (including smart technologies) and to improving tourism activity in EU cities to attract more tourists, grow the local economy and better the quality of life of residents.

Keywords: Smart tourism capitals, cultural heritage and creativity, digitalisation, sustainability, accessibility.

JEL Classification: R12, Z32, Q52.

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1. Introduction

Tourism is a very important sector for EU countries. Before the COVID-19 pandemic, Europe received 742.42 million international tourists, representing 50.8% of the world total. EU Member States were the main receivers of tourists coming to Europe (72.6% of all tourists coming to Europe) (UNWTO, 2024a). These figures demonstrate the growing interest in European destinations that continue to be of increasing attraction today. A recent study indicates the interest shown by tourists from countries on other continents: Australia, Brazil, Canada, China, Japan, South Korea, USA, which ranked France first as a tourist destination, followed by Italy or Germany, then Spain and other non-EU countries (UK, Switzerland) (European Travel Commission, 2024).

The increased tourist interest in the European area and especially in the EU is largely due to the very valuable cultural heritage as a result of long habitation, a rich history, and a large number of empires that have left a valuable cultural legacy. This cultural heritage is exploited in cultural tourism, which continues to attract tourists, especially since innovative methods are now being used to involve tourists in various creative projects (Arcos-Pumarola et al., 2023; Remoaldo et al., 2020). The ecological, digital and accessibility transitions are some of the solutions that can increase the resilience of European tourism (Muštra et al., 2023) especially as the last few decades have subjected tourism to successive shocks. The fact that tourism is a sector that can adapt and has weathered shocks well, especially the one caused by the COVID-19 pandemic, is also demonstrated by the fact that in the first quarter of 2024, Europe reached 94% of its 2019 level, supported by intraregional demand and US travel. Furthermore, by the end of 2024, a full recovery to 2019 levels is expected (UNWTO, 2024b).

A particular importance for tourism in the 21st century is given to new technologies designed to increase the attractiveness of tourism, to highlight new tourist destinations, which is why the EU has a permanent concern for the development of tourism and especially for the implementation of new intelligent technologies. The year 2018 was named the European Year of Cultural Heritage, when the New European Agenda for Culture (EC, 2018a) was launched, which targets three areas of strategic interest: the social dimension, the economic dimension, and the external dimension. Therefore, the EU supports both culture and tourism, creating synergy between these two areas. In order to develop tourist destinations that are as accessible as possible to all people, both in terms of mobility and communication, in an environment that is as clean as possible, the EU launched in 2018 the first competition to designate cities as smart tourism capitals. European capitals of smart tourism (EC, 2018b), follows on from previous efforts to support both tourism as an economic activity and to provide a range of facilities for tourists and residents. Investments in tourism contribute to improving urban infrastructure, increasing accessibility, preserving cultural and natural heritage, sustainability, and also digitalisation. Investment in green infrastructure (reduced pollution, more efficient means of transport) also contributes to making cities smarter and greener, which impacts both tourists and residents (UNWTO &

UNDP, 2017). The EU's aim is to mobilise through this competition the participation of an increasing number of cities to use new technologies, to be more accessible and environmentally friendly (Fernández-Díaz et al., 2023). This EU initiative can also be linked to the Sustainable Development Goals SDGs, the UN project (UNWTO & UNDP, 2017) on some pillars, such as sustainability and digitalisation for cities entering the competition.

This article presents the EU's initiative to implement new technologies to support and improve tourism activity in EU cities to attract more tourists, grow the local economy, and improve the quality of life of residents. The aim of this research is to see how this EU initiative can help European cities become more attractive to tourists. The article introduces the topic to be analysed and a review of the literature. This is followed by a presentation of the methodology used in the research, which is quantitative, using secondary data to validate or invalidate the research hypotheses, and the next sections present the findings and the conclusions.

2. Problem Statement

The proliferation of innovative technologies is increasingly present in different sectors of activity, including tourism (Romão & Neuts, 2017). It is noted that worldwide there is a growing concern about innovative development in smart tourism destinations (Boes et al., 2016; Coros et al., 2023). Information and communication technology (ICT) plays an increasingly important role in tourism (Gretzel & Koo, 2021) and is a key factor in improving competitiveness (Aramendia-Muneta, 2020). Smart tourism contributes to the improvement of services (Chang et al., 2024), but also of the tourism experience (Azis et al., 2020; Ionescu & Sârbu, 2024; Um & Chung, 2021) by providing new opportunities for tourists to access information and services within the cities they visit more easily (Shi et al., 2021), and personalised tourism recommendations are becoming increasingly important in tourism marketing (Yang et al., 2024), while smart cities encourage development and innovation in tourism (Gursoy et al., 2024).

Ivars-Baidal et al. (2024) examine the extent to which the relationship between tourism governance and smart city initiatives contributes to the emergence of new governance models, such as smart city governance. Furthermore, systems that provide personalised recommendations to residents are very important in the convergence between ICT and smart city urban management (Andrade-Ruiz et al., 2024).

The EU has also created the Smart Tourism Capitals project to highlight the special role of smart tourism. The tourism industry is able to adapt quite quickly to changes in society in a relatively short period of time (Arbidane et al., 2023). Smart cities have the ability to attract potential tourists from anywhere in the world, but also to protect the environment through sustainable development (El Archi et al., 2023) as they focus on promoting innovation (Aramendia-Muneta, 2020; Lee et al., 2020). Cavalheiro et al. (2021) provide a longitudinal analysis of patent applications and the profile of tourism technology developers, highlighting technical progress and innovative activity in tourism.

The concern to showcase Europe's smart tourism capitals started to be present with the launch of this initiative by the European Commission in 2018. However, there is a lack of theoretical approaches and a descriptive approach of the cities designated as winners, by presenting the projects that have been carried out to obtain this title and an orientation towards the smart components of tourism (Coros et al., 2023; Trip et al., 2021). The most numerous articles target the smart tourism component, or smart city (Coros et al., 2023), to boost sustainable tourism, also providing a framework to measure sustainability (Aguirre et al., 2023) and to promote the city through culture (EC, 2018a). An empirical study addressing smart city initiatives in the EU is the one by Correia et al. (2022), which looks for a relationship between the level of development of countries and the focus areas of smart cities within them. The novelty of this research lies in an in-depth approach to this initiative, to present the benefits that both the cities entering the competition and the residents of the winning cities can obtain.

3. Research Questions / Aims of the Research

This article focusses on exploring the way European Union initiative on smart cities helps European cities become more attractive from a tourism point of view, and at the same time how it contributes to the increase in the quality of life for residents. Worth mentioning is the fact that in this field of research there is a gap for the aforementioned focusses. To address this gap, this research aims to make the first steps to unveil, from tourism perspective, if it is profitable for cities to engage in this competition. As a result, three research questions were formulated:

- Q1.** Does smart tourism capitals attract more tourists?
- Q2.** What makes a destination attractive?
- Q3.** Is it worth investing in research and developing for the candidates' cities?

In line with these goals, we have stated the following hypotheses:

- H1:** Smart tourism capitals attract a higher number of tourists after receiving this title;
- H2:** The attractiveness of a destination is determined by its cultural tourism potential;
- H3:** Higher investments in research lead to an increase in the number of patents in new technologies (including smart technologies).

4. Research Methods

This research used a standard methodology commonly used when dealing with secondary data. The method used is quantitative, through the empirical analysis of statistical data obtained from various specialised sources, such as UNWTO (2024a), Statista (2024), from 2019 (prepandemic year) to 2023, or Alberti et al. (2023).

The Statistical Program for the Social Sciences (SPSS) v.26 was used to test the hypothesis.

5. Findings

The Smart Tourism Capitals Competition is an EU initiative with funding from the Single Market Programme (SMP) and is aimed primarily at cities in EU member countries, but also other cities in non-EU countries (Albania, Armenia, Bosnia and Herzegovina, Iceland, Kosovo, Moldova, Montenegro, North Macedonia, Serbia, Turkey, Ukraine, UK, Iceland, Liechtenstein and Norway) with more than 100,000 inhabitants in general (EC, 2024a). The applying city must consider all four categories: accessibility, digitalisation, sustainability, creativity, and cultural heritage. The first winners were designated in 2019, and the 2021 edition was suspended due to the pandemic crisis, continuing with the 2022 edition until now (Table 1).

Table 1. The European capitals of smart tourism between 2019-2024

	2019	2020	2022	2023	2024
Winner	Helsinki	Malaga	Bordeaux	Pafos	Dublin
	Lyon	Gothenburg	Valencia	Seville	
Finalists	Ljubljana - sustainability	Gothenburg- sustainability			
	Malaga- accessibility	Breda – accessibility			
	Copenhagen- digitalisation	Ljubljana- digitalisation			
	Linz- cultural heritage & creativity	Karlsruhe- cultural heritage & creativity			
Short list		Ravenna	Venice	Aarhus	Bremerhaven
		Bremerhaven	Dublin	Gijon	Cork
		Nice	Florence	Porto	Genoa
		Bratislava	Ljubljana	San Sebastian	Helsingborg
		Turin	Palma	Zagreb	San Sebastian

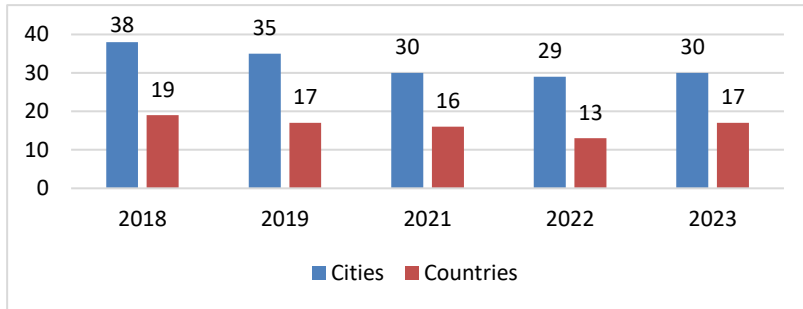
Source: made by the authors based on data provided by EC (2024).

The number of candidates is relatively constant (Figure 1) and it is noted that many of the candidate cities have previously held the honorary title of UNESCO Capital of Culture or stand out through a series of other cultural events that have earned their recognition. Year after year, these cities have been supported by the visibility they have even if they did not make it to the finals, and the achievements of the cities that made it to the final selection stages are widely presented.

Malaga is one of the cities designated as the Capital of Smart Tourism in 2020, but it also participated in the previous edition, where it won the title in the accessibility category. The results of this competition have been appreciated by

both tourists and locals, by improving the quality of life (Karakas & Atay, 2023). It can be said that Malaga has achieved the goal of starting this project, being recognised especially in the accessibility component, but also in mobility.

Figure 1. Candidates for the European Capitals of Smart Tourism



Source: made by the authors based on data provided by EC (2024).

In order to achieve our objectives for this research we used SPSS V.26 to perform the tests in order to determine the existence of any relations between the analysed variables.

For Q1 we performed a linear regression test in order to find if there is any connection between “Smart city index” (Smart Cities Index emphasises the environmental, social and governance values is meaningful to be incorporated into the weight of sustainability and inclusiveness) as an independent variable and the “Number of tourists” as a dependent variable. Looking at the significant value of our model of 0.183, which is greater than 0.05, we conclude that our model is not statistically significant (Table 2).

Table 2. Correlation between Smart city index and Number of tourists

Elements	F	Sig.	df
N of Valid Cases	20	-	-
ANOVA	1.907	0.183	1

Source: made by the author based on research, data provided by Alberti et al. (2023) and UNWTO (2024).

The results infirm H1 – “Smart tourism capitals attract a higher number of tourists after receiving this title”.

For Q2 we performed a linear regression test in order to find if there is any connection between “Tourist overnight stays” as an independent variable and the “Museums and art galleries” as a dependent variable. Looking at the significant value of our model of 0.000, which is less than 0.05, we conclude that our model is statistically significant (Table 3). The significance of the model can be stated as follows:

$$F(1,19) = 21.970, p = .000$$

Table 3. Correlation between Tourists overnight stays and Museums and art galleries

Elements	F	Sig.	df
N of Valid Cases	20	-	-
ANOVA	21.970	0.000	1

Source: made by the author based on research, data provided by Alberti et al. (2023) and UNWTO (2024).

The model summary displays the percentage of variance accounted for, which in our analysis is 51.2%. The value can be interpreted as follows: 51.2% of the total overnights stays are the result of the existence of museums and art galleries for the analysed cities. The results confirm H2 – “*The attractiveness of a destination is determined by its cultural tourism potential*”. These come to complete (Ćulić et al., 2021) who claims that the positive direct effects of destination attractiveness factors on satisfaction and revisit intentions.

For Q3, we performed a linear regression test in order to find if there is any connection between “gross expenditure in research and development” as an independent variable and the “ICT patent applications” as a dependent variable. Looking at the significant value of our model of 0.001, which is less than 0.05, we conclude that our model is statistically significant (Table 4). The significance of the model can be stated as follows:

$$F(1,19) = 16.938, p = .001$$

Table 4. Correlation between Gross expenditure in research and development and ICT patent applications

Elements	F	Sig.	df
N of Valid Cases	20	-	-
ANOVA	16.938	0.001	1

Source: made by the author based on research, data provided by Alberti et al. (2023).

The model summary displays the percentage of variance accounted for, which in our analysis is 47.1%. The value can be interpreted as follows: 47.1% of a patent application can be the result of the investment made in research and development for new technologies. The results confirm H3 – “*Higher investments in research lead to an increase in the number of patents in new technologies*”. A prerequisite in the smart city strategy is a sufficient number of technological innovations and at the same time the ability of the city to implement them (Dai et al., 2024).

6. Conclusions

The cities designated as capitals of tourism are part of the tourist cities, many of them being designated European Capital of Culture (Linz, Aarhus, San Sebastian, Helsinki, Bordeaux, Lyon, Cork, Dublin, Florence, Genoa, Porto), UNESCO Creative City (Seville and Turin) or famous for festivals (Zagreb, Venice, Gothenburg). The countries to which they belong are important tourist-receiving

countries, such as France, Spain, and Italy, which favours the increase in the number of tourists. Given the relatively short period of time since the European Capitals of Smart Tourism project was launched (2018) and the fact that tourism has lost a lot due to the Covid-19 pandemic, both in terms of number of tourists and revenue, it is difficult to analyse in this period whether the newly acquired title has led to an increase in the number of tourists in the targeted destination or not. From the analysis carried out, this hypothesis was not validated. On the other hand, the rich cultural tourist heritage continues to be of interest to tourists, and new technologies are increasingly present, the large number of patents also reflecting the interest of the authorities in implementing new technologies in tourism. This also facilitates tourist activity, but also provides an accessible environment for residents. Tourism must take into account all these changes and adapt to all changes to keep up with technology and face any challenges. In the research carried out, the limitations were mainly related to the lack of sufficient statistical data and the difficulty to access them.

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**Erasmus Experiences' Influences on Students'
Entrepreneurship Competences**

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Abstract

In a context in which the Erasmus programme has become one of the most important international study programmes and entrepreneurs are highly acknowledged as a driving force of any economy, the present paper aims to investigate the influence of Erasmus mobilities for studies on the development of entrepreneurship competences among participants. The article is based on qualitative field research carried out during the second semester of the 2022-2023 academic year, following the EntreComp framework. This consisted of the development of semi-structured interviews with incoming Erasmus students at the University of Economics in Bratislava (Slovakia), mainly from both Western and Eastern European countries. The study revealed that, following the students Erasmus experience, the interviewed developed various entrepreneurship competences like opportunity identification, creativity, ideas capitalisation, self-awareness, motivation, perseverance, financial literacy, initiative taking, dealing with uncertainty, teamwork, and learning from experiences. The study sets premises for future research, at the same time, impacting practical policies in mobility areas developed at university level.

Keywords: entrepreneurship, entrepreneurship competence, EntreComp, students, Erasmus programme.

JEL Classification: I23, I25, M19.

1. Introduction

In a European context characterised by uncertainty, unfavourable economic perspectives, threats of conflicts (Ioan-Franc et al., 2023) or of those deriving from technological advancement, increased digitalisation, or the development of

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artificial intelligence (Grădinaru et al., 2024), hope resides in its young population. Highly educated young people, with strong humane and ethical values, with a sound sense of responsibility for both societal and environmental concerns, and with skills that cannot be replaced by artificial intelligence, such as entrepreneurship competencies, might represent a proper leverage for an adequate step forward for European societies. Therefore, in addition to ensuring young people convenient access to education, their participation in projects aimed at their personal and professional development should be highly encouraged and supported. The effort acknowledged in this sense is represented by the Erasmus programme (Grosu and Batros, 2022) designed to facilitate the exchange of students between partner universities, mainly in Europe (European Commission, 2023).

In such a context, the present paper aims to investigate the influence of Erasmus mobilities for studies on the development of entrepreneurial competences among participants, focussing on a sample of incoming Erasmus students at the University of Economics in Bratislava, Slovakia, being based on qualitative field research, as further outlined.

2. Problem Statement

In recent decades, the Erasmus programme has become one of the most important international study programmes, attracting the attention of scholars interested in studying its benefits on participants, in particular, and on society, in general. Over the years, studies have been carried out to investigate the effects of Erasmus mobility on participants' skills and competencies, including those related to entrepreneurship. For example, Stamenovic (2020) investigates the relationship between international mobility and entrepreneurship, the impact of the Erasmus programme on entrepreneurial skills and attitudes, and the effects that these exchanges produce. The study outlines that the Erasmus programme is an important factor in developing mentalities that can influence entrepreneurial characteristics such as the ability to take risks, the capacity for problem solving, maturity, and the ability to function independently (Stamenovic, 2020). In the same line, Engel (2010) reveals that an Erasmus mobility can have a positive impact on different qualities of students that will help them in the future to find a better job or to follow an entrepreneurial career, such as problem-solving capacity, initiative, assertiveness, determination, persistence, planning, coordination, and organisation. In addition, Onderoglu et al. (2010), following a study carried out on outgoing students on Erasmus mobilities – all, students at the same university, with the same cultural background – reveal that an Erasmus mobility can have a significant positive impact on students' entrepreneurial thinking. Overall, the presented studies outline that Erasmus mobilities have a positive contribution to participants' entrepreneurial spirit, helping them to develop essential entrepreneurial skills and competencies. In this context, the present study aims to validate these findings by implementing a novel approach. Unlike previous research, this one addresses the influence of Erasmus programmes on the development of entrepreneurship competences in participants through the lenses of the Entrepreneurship Competence Framework

model (Bacigalupo et al., 2016) – EntreComp; the envisaged entrepreneurial competencies are explicitly approached as described in EntreComp.

3. Research Questions / Aims of the Research

The developed research aims to investigate the influence of Erasmus mobilities for studies on the development of entrepreneurship competences among participants, approached as a set of skills and abilities that individuals possess and/or can acquire and improve to become proactive and to exhibit initiative and entrepreneurial spirit (Floris and Dettori, 2020). In a more specific regard, the target research objectives were to identify the entrepreneurship competences that are most influenced by Erasmus mobilities for studies and to analyse the factors contributing to their development among Erasmus participants.

4. Research Methods

The present paper is based on qualitative research developed in April-June 2023, implying 16 semi-structured interviews with students benefiting from an Erasmus mobility in the second semester of the 2022-2023 academic year, at the University of Economics in Bratislava, Slovakia. Interviews were carried out with 16 participants (10 females and 6 males), aged between 20 and 29 years. The countries of origin of the participants represented a cultural mix between well-developed and less developed countries such as Italy, Germany, Spain, Turkey, Greece, United Kingdom (UK), Luxembourg, Romania, and Kazakhstan (Table 1).

Table 1. Structure of the interviewed sample of Erasmus students

Age	Sex	Level of education	Level of interaction with entrepreneurship	Country of origin	Interview type	Sending Date (2023)	Receiving Date (2023)
23	Female	Master	Minimal	Italy	Written	May, 4	May, 4
25	Female	Master	Minimal	Italy	Written	May, 4	May, 11
24	Female	Master	Minimal	Italy	Written	May, 4	May, 11
23	Female	Bachelor	Moderate	Germany	Written	May, 4	May, 12
20	Male	Bachelor	Minimal	Turkey	Written	May, 4	May, 11
21	Male	Bachelor	Moderate	Spain	Written	May, 4	May, 8
20	Female	Bachelor	Minimal	Spain	Written	May, 4	May, 18
20	Female	Bachelor	Moderate	Greece	Written	May, 4	May, 12
20	Male	Bachelor	No Interaction	Germany	Written	May, 4	May, 13
21	Male	Bachelor	Minimal	Germany	Written	May, 4	May, 12
29	Female	Master	Moderate	Kazakhstan	Written	May, 4	May, 12
20	Female	Bachelor	No Interaction	Greece	Written	May, 4	May, 7
21	Male	Bachelor	Moderate	The UK	Written	May, 4	May, 11
27	Female	Bachelor	Minimal	Germany	Written	May, 13	May, 19
25	Male	Bachelor	Moderate	Luxembourg	Written	May, 4	May, 22
24	Female	Master	Minimal	Romania	Written	May, 13	May, 21

Source: developed by the authors.

As the research was carried out at the end of the mobility semester, during the final exams, considering the limited free time of the respondents, the interviews were carried out entirely in the form of written interviews using online means of communication such as WhatsApp, Instagram, Facebook, and e-mail. The interviews were carried out mainly in English, except one that was in Romanian, based on an interview guide (Table 2) developed in accordance with the purpose and objectives of the research and following the EntreComp framework. The average response time was approximately one week between the date the guide was sent and the date the responses were received, with exceptions where the response time was extended due to the reduced availability of students. Reminder messages and e-mails were also sent during the research period to facilitate its development.

Table 2. Interview guide

No.	Question
1	Please specify the following information: age, sex, level of academic degree, country of origin, and level of interaction with entrepreneurship. For interaction with entrepreneurship, please choose one of the following: <ul style="list-style-type: none"> • No Interaction – you have no exposure to entrepreneurship; • Minimal Interaction – you may have some basic knowledge about entrepreneurship, but have not yet engaged in any entrepreneurial activity; • Moderate Interaction – you have had some level of practical experience with entrepreneurship, such as starting a small business or working in a startup environment; • High Interaction – you have significant experience with entrepreneurship, such as founding or running multiple successful businesses; • Expert Interaction – you are recognized as an expert in entrepreneurship.
2	How has the Erasmus mobility influenced your ability to recognize opportunities, generate ideas, and take initiative? Please explain how you developed these competences.
3	In what ways has your Erasmus mobility experience developed your ability to persevere, take calculated risks, and manage ambiguity and uncertainty? Please exemplify the context in which you developed these competences.
4	Have you developed any new competences related to financial literacy, business planning, or marketing during your Erasmus mobility? If so, can you describe them and how have they contributed to your entrepreneurial mindset and skillset?
5	How has the Erasmus experience helped you to build and maintain relationships, collaborate with others, and create value through networks?
6	Have you been involved in any entrepreneurial activities during your Erasmus mobility that have allowed you to apply your competences in a real-world context? If so, can you describe them and the impact they had on your entrepreneurial development?
7	How has your cultural experience during Erasmus impacted your ability to adapt to new environments, understand diverse perspectives, and leverage cultural differences as a source of creativity and innovation?

Source: developed by the authors.

The respondents were contacted through the International Mobility Department of the International Relations Office of the University of Economics in Bratislava, and they were not forced to participate in the research. Their involvement was only on a volunteer basis, and they were informed about the purpose of the research and its way of development. Taking into account the confidential reasons, the identity of the respondents is not revealed. Content analysis was used to process the information gathered during the interviews. Considering the limited number of interviewees, this was accomplished manually, and its results, following an inductive approach, are further presented.

5. Findings

According to the interviewees, the experience gained from the Erasmus mobility has a significant impact on their way of thinking; adding such an experience to their personal portfolio opens new horizons and helps them develop new competences. For example, generally, during the mobility program, students are placed in situations where the ability to take initiative is crucial. *“This was the moment when I had to take the initiative to start talking to the rest of the participants and build friendships.”* (Student from Romania, 24 years old); *“Working in a team, made me aware that taking initiative when everyone around you is sceptical could be really challenging.”* (Student from Greece, 20 years old) As the Erasmus experience is not only about academic activity that takes place during courses and seminars, but also about the free time students spend with people from different cultures and the places they explore, respondents felt that taking initiative was also very common when planning activities outside the academic environment.

When students were asked about their ability to manage ambiguity and uncertainty, they raised the issue of language barriers. However, to overcome this, the solution they found was to enrol in the Slovak language course for beginners offered by the University of Economics in Bratislava. *“I looked for resources to help me improve my language skills and I enrolled in the Slovak language module for beginners.”* (Student from the UK, 21 years old). When dealing with the adaptation to new living environments and the management of unfamiliar situations, students improve their motivation and perseverance as well. During the Erasmus mobility, students are exposed to new cultures, languages, and habits. These experiences help them develop their adaptability, flexibility, and resilience, while improving their motivation and perseverance to succeed. *“Being in a completely different environment improved my ability to adapt to new circumstances as I became more confident in handling unusual situations.”* (Student from Germany, 23 years old); *“Adapting to a new environment was a difficult but rewarding experience. I had to be open, flexible, and patient to adapt to the new country and culture.”* (Student from Italy, 24 years old) Their capacity of dealing with uncertainty relates to their risk-taking ability, too. As during mobility students don't have anyone known to support them when needed, making them manage the risks they take differently. Contrastingly, respondents confessed that they have learned how to act on their own in critical situations and not to be afraid of the unknown.

Erasmus is a beneficial experience in terms of developing self-awareness and responsibility, as well. Brought into the new living environment, where they must take care of all the daily responsibilities on their own, such as weekly shopping, preparing meals, doing the laundry, etc., respondents became more self-aware of their capacities and have been able to become more responsible, especially in terms of budgeting. Managing the budget and allocating it responsibly plays an important role in an Erasmus experience. The respondents revealed that they have learnt to be more responsible in their consumption and limit things that were not absolutely necessary, in order to stay within the proposed mobility budget. *“You must be aware that the Erasmus grant has to help you throughout the whole period, so you have to manage money according to your preferences. If you don’t manage it properly you won’t be able to afford certain activities and expenses.”* (Student from Spain, 21 years old); *“Since I have arrived in my Erasmus mobility, I have developed a new sense of financial literacy because I had to manage my money by myself for several months.”* (Student from Greece, 20 years old) The Erasmus mobility is an opportunity to develop and deepen financial literacy. *“Living away from home, I realized the meaning of money, how much it’s worth and how quickly it’s spent, and I learned to manage my spending.”* (Student from Spain, 20 years old)

Creativity and innovation are other competences that students developed by taking part in Erasmus mobilities for study. According to the interviewees, by embracing diverse perspectives and ways of thinking, they were able to develop a new sense of creativity and became more innovative in their approaches to problem solving. *“I learned to value cultural differences as a source of creativity and innovation.”* (Student from Italy, 24 years old) Especially in team projects, students used the cultural differences between participants as an advantage to generate new ideas. Working on teams in different projects during the mobility period also contributed to the development of teamwork as a competence amid interviewees.

The students’ responses show that once they are in a foreign country without connections, they seek to connect with people and develop friendships. The fact that they are all away from home, makes students more open and receptive to forming new friendships. *“Living and studying abroad often requires students to engage with other people, which can help develop interpersonal skills such as active listening, empathy, and respect.”* (Student from Italy, 25 years old). The Erasmus mobility is a great opportunity to meet new people, from very different cultures, whom participants would not have had the opportunity to meet in other circumstances, this way, developing their networking skills. *“Erasmus mobility is the best way to build international relationships from an early age. In all my life, I have never had the opportunity to meet so many international people in such a short time and establish contacts at a very close level.”* (Student from Germany, 20 years old) Spending so much time together, so many experiences, so many emotions, Erasmus students support each other, understand each other, and share the good and bad moments of this experience. One reason why Erasmus students are willing to form close bonds with other participants is their desire to belong and empathize. In a new environment, students want to feel understood and heard, and they tend to express their feelings

more freely than they normally would. Furthermore, respondents felt that during the experience they noticed a change in their empathy towards others and were able to interact differently, improving their networking skills and teamwork competences as well. *“During the Erasmus programme, I had the opportunity to meet and interact with people from different backgrounds and fields of study, which taught me how to communicate effectively, respect other people’s opinions and empathize with other people.”* (Student from Italy, 24 years old) Although cultural differences can be an impediment to forming new relationships, the students interviewed felt otherwise. *“Cultural differences don’t matter, on the contrary, they connect us.”* (Student from Germany, 20 years old) The respondents that differences between students have a greater impact on building a bond than similarities between them. *“I have realized that people from different cultures offer new perspectives that can enhance a project, rather than being alone with your mindset and ideas.”* (Student from Kazakhstan, 29 years old)

The Erasmus experience helped students face new problems and discover new opportunities. Respondents reported that when they arrived in the new environment where they were going to spend the next four months, they discovered new needs that they were not aware of in the past. *“When you go on an Erasmus experience, you leave your comfort zone, your home, your country and you realize what is like to live alone.”* (Student from Spain, 20 years old) When they became aware of the needs, they started to identify new opportunities, as well. *“There are different businesses in my residence designed to meet the needs of Erasmus students: hairdresser, massage, ethnic restaurants, etc.”* (Student from Spain, 20 years old)

In terms of new ideas generation and capitalisation, respondents specified that certain courses they took at the University of Economics in Bratislava, such as Change Management, Corporate Social Responsibility and Cost Control, had a considerable impact on their ability to generate new ideas and put them into practice in their daily life or even at the workplace. Furthermore, the business models identified in the host country can be translated into ideas that are worth implementing in the country of origin. For example, one of the interviewees was very surprised when he first arrived in Bratislava and realized how common vending machines for soft drinks and snacks, but also for traditional Slovak products (e.g., cheese) are. Different from how this type of commerce is developed in his country of origin, the Slovak business model, might be replicated in the British environment, according to the interviewee: *“This gave me the idea to own a vending machine in the future and sell items in London with a high demand for London’s culture.”* (Student from the UK, 21 years old) Erasmus mobilities are also an opportunity to generate new business ideas for the host country. Respondents mentioned that they identified some business opportunities in Slovakia, based on the tested, successful business models in their origin country, that they already discussed with their Slovak peers. Furthermore, during the mobility period, the interviewees realised how beneficial is to carry out market research in the process of business idea generation and business planning. *“[...] I came to the conclusion that I will carry out online surveys and try to get as many responses as possible and then make a calculated decision on whether*

or not it is financially viable to put my idea into practice.” (Student from the UK, 21 years old) In the same line, another student emphasised that due to the Erasmus experience he was able to understand the needs and demands of young people in terms of relaxation and entertainment, making him want to capitalize his idea into a business in the future. *“I think that if I set up an entertainment organisation, I’d do a pretty good job because now I know what students want most and I can meet the demand.” (Student from Turkey, 20 years old)*

During the Erasmus experience, some of the interviewees had the opportunity to attend to different entrepreneurship-related classes, as well, that led to the development of their knowledge in the field. Management, marketing, production, and financial related information was acquired. At the same time, practical skills were developed mainly targeting business idea generation and pitching, and there was involvement in business simulation, as well, increasing this way, students’ capacity of learning from experiences. Overall, such classes left interviewees with a clearer image of what running a business implies. In such a context, in the interviewing process, students were asked if during their Erasmus mobility they had been involved in entrepreneurial activities that helped them apply their acquired knowledge in a real context, but no positive response was received.

During their Erasmus experience, the respondents identified a multitude of changes in their lifestyle, their skills, and the way they approach problems. The interviewed students consider that they have learnt a lot from the Erasmus experience, and this helped them to obtain a range of competences that could not have been acquired or understood in the same way through other activities. *“Everyone who goes on Erasmus comes back changed, with skills to adapt to change and cope with adverse circumstances that not everyone can have.” (Student from Spain, 20 years old)*

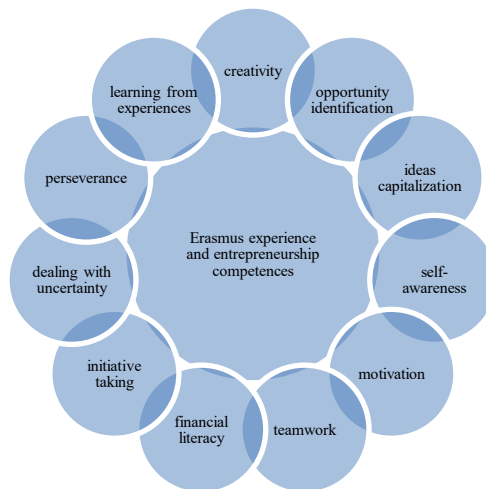
6. Conclusions

The developed research revealed that the experiences to which students are exposed during an Erasmus mobility influence the development of their entrepreneurship competences. For example, the interviewees who participated in this study perceived improvements in their ability to take advantage of new opportunities and capitalise on their ideas and enhanced their financial literacy. The mobility has helped them to become more financial aware, learning to prioritize their needs, and to properly manage their budget. In the direction of ambiguity and uncertainty, students gained confidence in managing unforeseen situations. By eliminating fear of the unknown, interviewees opened their horizons to new opportunities and gained the courage to explore them, while developing their perseverance and motivation. Other skills where improvements were observed after the mobility period were the degree of self-awareness and the ability to take initiative. Students were put in different situations where taking initiative was essential for the smooth running of activities, many of which were developed in teams, improving this way their teamwork ability, as well. Furthermore, the Erasmus programme is a great opportunity for participants to develop their creativity and

to be innovative, especially when dealing with different situations involving people from different cultures, with different backgrounds. Overall, according to the interviewees participating in this study, during Erasmus mobility, they have learnt invaluable lessons from the experience, while at the same time, acquiring a high level of independence and responsibility.

Considering the previously presented information, to provide a clearer image on the entrepreneurship competences – according to EntreComp – developed by the interviewed students following an Erasmus experience, an illustrative summary is depicted in Figure 1.

Figure 1. Entrepreneurship competences developed by the interviewed students following the Erasmus experience



Source: developed by the authors.

The present paper brings a contribution to the enrichment of studies in the area of “Erasmus’ influences on participants” advocating the positive effects the program has on students’ personal and professional development, focusing on their entrepreneurship competences’ enhancement. However, this has some limitations in regards the number of interviewees, the fact that only incoming students to the University of Economics in Bratislava were interviewed, and the fact that only one university was subject to investigation. Expanding the research to more universities and countries, and to investigating a larger sample of both incoming and outgoing Erasmus students might represent viable future research directions. Also, comparisons among countries in the area of the investigated topic are worth exploring in future research. There is an imperative need for stimulating students to enrol in mobility programmes as these have enormous positive effects on their development. Such a transformative experience on students will make a great impact on their origin country, upon return, especially for less developed European countries confronted with massive waves of emigration and ageing population (Grosu and Constantin, 2013; Dragusin et al., 2015; Grosu and Dinu, 2016). Thus, future

research directions can also investigate the impact on the long-term Erasmus programmes they can have on their participants and on the origin countries, focussing on the labour market insertion, business development, or economic contribution, especially in less developed countries. Furthermore, from a more practical perspective, the present study could establish important guidelines for university representatives in designing coherent strategies aimed at strengthening their mobility policies. As demonstrated in the present study, Erasmus mobilities positively influence the development of competences in participating students, and these should be part of any university's advancement strategy.

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**Practice Generated Knowledge – Monitoring of Tourism
Educational Process based on Self-Assessment Analysis**

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Abstract

The topic of this paper leads to the field of practice-generated knowledge. Its importance for the institutional educational process in the Tourism specialty, University of Veliko Tarnovo is being proved. The researched literature shows the need of transferring the teaching in high education from theory-based to practice-based, without belittling the lecture approach. The main method, used is the survey method where self-assessment analysis is applied. Some findings show that practice-generated knowledge is accepted as a useful one for the targeted respondents – they learnt new things in the course of the project/activity done, they acquired necessary skills and consider university practices useful for their career development. Students gave their highest marks for the responsiveness of the lecturers who lead those practices, as well as for their methodology approaches.

Keywords: practice-generated knowledge, tourism, education, self-assessment analysis, practice-based learning.

JEL Classification: A2, A12, M5, M510.

1. Introduction

The last decade is typical for its extremely flexible conjuncture of the world market and the great dynamics in the tourism sector. The tourism industry itself has met plenty of challenges related to the workforce engaged in it. These changes, not only decrease the revenue part of business enterprises but even frighten their existence on the market at all. Academic institutions are already recognised as shareholder sides in solving these problems. With both their research expertise and their educational functions, they are becoming much more involved in economic life. Generating adequately skilled and knowledgeable young people becomes their

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strategic task. They should apply and test different methods of teaching and adopt the most appropriate ones for the needs of labour users. Practice-based knowledge is increasingly tested and considered to be very effective for the formation of applicable workforce. Its leading however, implies active institutional monitoring. This fully applies to tourism education which turns to deeply influence the tourism business itself.

2. Problem Statement

Hereby a literature review is made which is to make the relation between two main types of education approaches – theory-based and practice based. This will inevitably lead to the question how knowledge and contemporary students' perception about it has changed and lead to the idea that knowledge management process should be applied. Thus, a portion of the gap about possible methodology applicable in this sense would be filled.

The question about compatibility between academic and needed by entrepreneurs' knowledge, is getting more and more actual nowadays. According to Hristova (2022), now the economy is at its next level when a kind of leap is happening in the perceptions and concepts of the workplace (Hristova, 2022). This also led to different perceptions in young people. Current generations comprehend quite different the sense of career development. The same is true for the acquired knowledge in educational institutions, which just a decade ago, used to be nearly fully theory-based. According to Kim and Davies (2014), the lecture-theoretical method emphasises the control imposed by the teacher during the educational process. However, the picture now is essentially changed and institutions of high education are pointing the focus on students – their perception of career development, attitudes to the process of learning and readiness for sharing knowledge. Van de Ven and Johnson (2006) speak about a “gap between theory and practice” known also as “knowledge transfer problem” (Van De Ven & Johnson, 2006). They claim that the understanding of a relation between theory and practice is a difficult problem (Van De Ven & Johnson, 2006). According to some authors, it is a renowned inevitable phenomenon that contemporary students prefer “doing hands-on experience” (Mosca et al., 2019) rather than lecturing. Lecture-based learning focused more on the teacher himself (Garrett, 2008) than on learners, gives the last, the inner feeling of non-usable, un-working for the sake of the career development on the labour market, education. The described situation is valid, especially for generation Z representatives (born in the period 1995-2012). The perception of the currently-forming generation “Alpha”, where no authorities are respected, (as theory knowledge represents works of authorities in different scientific fields), the so observed processes seem to be even with stronger power. Because of the changed reality on the educational market, some authors commence discussions about “management of learning” (Cameron, 2008). Cameron (2018) defines it as developing attractive skills in order to greatly increase the chance of a profitable and fulfilling career (Cameron, 2008). This term is still used in 1966, where in their work “Training in industry-the management of learning”, Bass and

Vaughan (1966) explain the complexity of learning process by treating the principles of a learner's behaviour in a laboratory environment (Bass & Vaughan, 1966). Colin Riches (1998) argues that the management of educational activities is in strong relationship with the management of motivation. The author considers that the benefits for organisations are in correspondence with work behaviour, and work behaviour itself should be modulated during one's education (Riches, 1998).

Knowledge management, together with the management of the educational process, are necessary institutional activities, an essential part of the academic work environment, whose aim is to put students' skills in their proper place on the labour market. In order not to be alone in their work, organizations can establish networks to share their resources, knowledge, and experience (Yordanova, 2022) to engage students' capacity inside the structures. Acquiring the right working set of skills, gives a higher motivation of learners and assures their successful career realisation.

3. Research Questions

The research questions in the report are limited to the scope of the presented point of view, concerning the institutional model of tested practical forms, applied with the idea of generating contemporary knowledge in the field of tourism. The main ones can be reduced to several. Why practice forms of learning turn to be necessary for students studying "Tourism" in Veliko Tarnovo University (VTU)? How are the practice-based forms implemented checked and assessed within the department so that continuous monitoring takes place? Which type of questions are the most appropriate for a feedback survey to receive reliable results? What show some of the most essential results, given by students? What is the final level of satisfaction of the learners? While the object of this paper is the practice-generated knowledge, the subject turn to be students' opinion given in a survey and analysed by the lecturing team of VTU.

4. Research Methods

The aim to find how useful for the students is the obtained by practising knowledge, is achieved by monitoring. The main method turns out to be a survey, analysed by self-assessment. It is with an open-end duration. The target respondents are students who have passed any form of practice activity, suggested in the speciality during the eight-semester education. The periodic analyses point out the level of importance, adequateness, and usefulness of those practices and are to prove the need of practice generated knowledge in the speciality. The answers are statistically processed. The survey starts in the 2020/2021 academic year and currently receives data. The survey is voluntary and results hereby are based on 165 respondent answers. They are nearly 18% of the students that took part in the practice-based learning forms of the speciality. They are considered to be a representative sample; however, for the self of a more quality self-assessment ways to increase active respondents are sought. Literature review, use of historical content, data visualisation, data extrapolation, and conceptualisation are secondary methods that contribute to reveal how effective is the knowledge generated by practising.

5. Findings

The basis of the current research is a survey distributed among students in the Tourism speciality of Veliko Tarnovo University. Two main aims are laid down with its launching:

Firstly: To receive current and adequate feedback from the students in the speciality about their attitudes and opinion on led practice generated knowledge, and thus a monitoring process of the practice-based activities (including practical disciplines) to be led.

Secondly: To achieve an attractive and competitive educational product on the market, responding to all requirements according to Bulgarian legislation and especially those that concern involving business in the academy. The national body responsible for assuring the quality of the education is the National Evaluation and Accreditation Agency (NEAA), which regulates the criteria related to the quality, role, and shareholder parts involved in Bulgarian high educational teaching. Usually, those criteria are being changed for the sake of specialities' accreditation an according to the conjuncture on the national labour market.

5.1 Survey Key Specifics

Ground for survey launching

The idea of launching such a survey is discussed in the framework of a Tourism Department, after certain changes occurred in the official criteria of NEAA (2024). In 2018, when the accreditation period of the tourism speciality at Veliko Tarnovo University was due, it was quite obvious that the necessity of practice-based learning in the educational process is required. The indication of that gave some moments, met among the rich variety of accreditation criteria. Some of these new moments were:

- 1) Requirements about strong relation between curriculums and practical training of students;
- 2) Clearly defined share of practical disciplines in the overall educational preparation of students in the specialities;
- 3) Clearly defined practice opportunities pointed to students in the speciality;
- 4) Clearly traced relation between lecture-based and practice-based teaching hours;
- 5) Complimentary regalement and documentation at the department level concerning practice-based learning in the speciality;
- 6) Selection of business enterprises – partners of the specialities and collaboration with their representatives (designated by the term "labour users");
- 7) Preparation of a set of practice-based cases / situations that stimulate the creativity of students during their education;
- 8) Contracts between business enterprises and universities arranging relationships on student practices;
- 9) Availability of students reports about practice activities and their duration during their practices in the organizations;
- 10) Required specialists from business enterprises included in the decision-making process of the Department (when elaborating schedules, as members of commissions of semester and national exams);

- 11) Other evidence to show that the department has effective interaction with business organisations.

Based on all that evidence, that persistence of business in the academy is an inevitable process both of the current and future education, the Tourism department’s council took the decision to launch a perpetual survey, aiming to follow up attitudes of students, their perception on the applied test forms of practice activities and study disciplines and thus a monitoring process to be led.

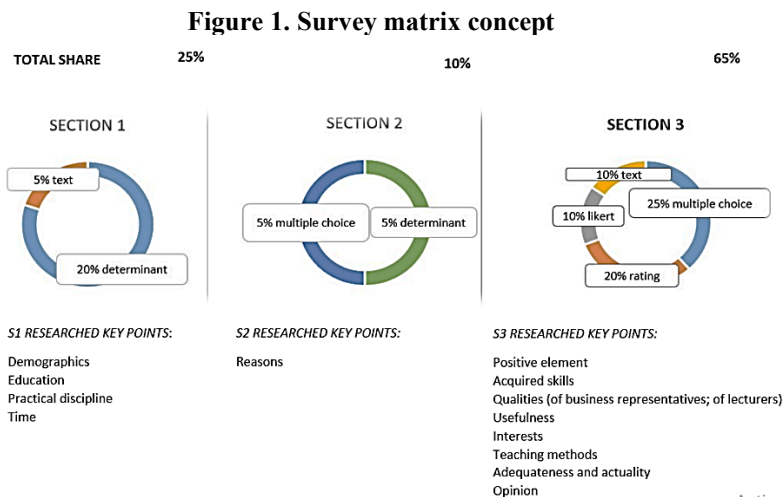
The survey form was prepared and launched in the 2020/2021 scholar year and gathers responses until now.

Survey matrix concept

A survey matrix was prepared and discussed (Figure 1). It included three main sections. The first (S1) aims to define student’s profile. Back-information from this section is to be used about taking informed decisions on a department level about the target group of future students in the speciality. This section contains five questions and consists of 25% of the whole survey.

The second section (S2) plays the role of a barrier section. The purpose of this project is to filter students who really took active part in practice-based activities of the speciality from those who chose an alternative form of practice. Lecturers from the department, responsible for the practice-based teaching, landing on their experience, concluded that not all of the students have the qualities and the willingness to work on such tasks. The questions in this barrier section were only two, holding 10% of the survey. Another main function of the section is to reveal reasons for that lack of willingness to demonstrate activity and proactivity in practical disciplines.

The third section (S3) is the most essential, with 13 questions and a share of 65%. These were questions defining attitudes, opinions, and quality of the tested practice-achieved knowledge in different forms.



Source: author’s own elaboration.

The concept of the survey matrix, shown in Figure 1, presents that each of the sections determines some main key research points that should define its effectiveness. According to the aim of the section, certain types of questions are used. The most used one is the multiple-choice question. It is defined as close-ended type of question which is easier to answer, requires lower communication skills from the respondents, and the data driven is quickly coded, entered, and analysed (Human & Sierra, 2016). S3 contains the widest variety of questions, including text, “Likert”, rating, multiple choice. In the frame of the matrix, some quality and quantity information is gathered.

Basing on official data from the National Centre for Information and Documentation (NACID, 2024) and matched with Tourism departments’ own collected data, a picture of students’ activity in practice-base process can be seen. It is necessary to lay the foundations of future institutional surveys regarding the knowledge received by practice forms. The data collected overwhelms the six-year period in which the Tourism department exists independently in the structure of University of Veliko Tarnovo, Faculty of Economics. Figures in Table 1 show that the department is comparatively active in organising practice activities while in one academic year the average number of such activities is 7.

Table 1. Activity of students taking part in practice-based learning forms

Academic year	Number of students* (Na)	Number of students that took part in the practice-based learning forms (Np)	Relation Np / Na	Share for the whole period	Number of the led practice forms	Average annual share (Aas) per one practice form	Average annual share for the whole period
2022/2023	390	272	69,7 %	77,7 %	8	8,7 %	11,3 %
2021/2022	357	192	53,7 %		5	10,7 %	
2020/2021	291	310	106,5 %		9	11,8 %	
2019/2020	256	162	63,3 %		5	12,65 %	
2018/2019	206	193	93,7 %		8	11,7 %	
2017/2018	151	154	101,9 %		8	12,47 %	

Source: author’s own work.

In the table, *Na* shows the total number of students per each academic year. *Np* corresponds to the number of students who participated in practice-based forms of learning initiated in the speciality. The results show that the share of students who are actively included in practice forms for the entire period is 77,7%. The share is calculated as weigh average value. In two of the years, the percentage is exceeding 100% as the values do not reflect their absolute number but the real one, so each student may have participated in two or more activities. The last column shows that, on average, for the six-year period, 11,3% of all students in the specialty have visited one practice activity or discipline.

5.2 Survey Results

The current number of students who participate in the survey is 165. We should mention that the answers are cumulative and aim to trace the changes in results through the years.

The results of S1 show that 63% of the respondents are women and 69% of the students who answered the survey questions are part-time students. This figure can be explained by the fact that part-time students exceed the number of full-time students nearly three times. 41% of the respondents come from professional secondary schools with tourism teaching. Secondly, with 18% share, come students graduated from language schools. These data are to show the management of the department where the candidate student campaign so that more and proper candidates become part of the specialty.

The importance of the filter second section is well visible in the results. They show that nearly 20% of students chose an alternative type of practice-based forms. These alternative tasks are, in fact different kind of activities organised in non-practice environment. They are not typical practices, but they give students the opportunity to be rated. If S2 is not included in the survey and the percentage is not divided from the others, the data would be distorted. From S2 can also be understood the reasons for those students to choose a non-practice teaching exercise. One of the main ones is that *they find the tasks within the project/activity difficult* – 28% of the students, but there are some other reasons as well that need to be clarified. The last fall under the option *Other reasons*.

S3 contains 13 questions (as shown on the survey matrix) divided into four groups. For the group of **multiple-choice questions** there can be generated the following results, shown in Table 2.

Findings from this type of questions show that students do think that practices generate new knowledge. This in fact makes the current paper quite reasonable. Also, visible in the results of second question, students admit that the most positive from the practices led in the specialty are the knowledge and skills. 62% pointed to that option. A detailed look at skills shows that *responsibility* is the most frequently marked answer for Q3. The remaining two leading answers are *communication skills* and *initiative*. In Q4, it can be seen that students do appreciate the professional approach that business representatives, included in the practice, demonstrated. Regarding the lecturer, who leads the practice, they highly evaluate the excellent explanation of the tasks.

Table 2. Results from multiple-choice questions in S3

Question (Q)	First three options with largest share
1. Which of the below best express your opinion about this practice?	I learned new things 72%
	Useful for my future career development 67%
	Useful for my personal development 56%
2. Which of the elements you consider POSITIVE for this practice form?	Acquired/confirmed knowledge and skills 62%
	The way the practice was led 47%
	The tourist area I researched 44%
3. Which of the skills are formed by this practice form?	Responsibility 68%
	Communication skills 59%
	Initiative 53%
4. Which of the below mentioned you can refer to the BUSINESS RERPERENTATIVE in this practice?	Professional in his area 63%
	Respectful approach to me 47%
	Dedicated in experience sharing 42%
5. Which of the below mentioned you can refer to the LECTURER in this practice?	Explained excellent what is the practice about 68%
	Answered on time if any questions occurred 63%
	Chose an interest practice-based initiative/project 57%

Source: author's own elaboration.

Rating questions express four main sides of the led/tested practices:

1. Level of usefulness (code U);
2. Level of interest according to the topic of the practice activity (code I);
3. Level of adequateness of lecturer's teaching methods (code A);

4. Level of appropriateness of the business representative (if such is included in the relevant activity) (code Ap).

The questions are asked formulaic and the rate range is between 1 and 5: 1 – for lowest rate, 5 for highest rate. Table 3 presents the rates for each question.

Table 3. Level of satisfaction from practices

Code of the rating question	Share of respondents that rated between 4 and 5	Average rating	Mode rating
U	90%	4,50	4,48
I	83%	4,34	
A	92%	4,61	
Ap	86%	4,47	

Source: author’s own work.

It can be noticed in the results that the highest marks are given for question code A (92%) concerning lecturer’s teaching methods. This is to show that the academic staff of the Tourism puts into practice quite relevant methodology. The second most appreciated is the usefulness of the rated practice – another proof for the necessity of knowledge, generated by practitioners and/or any academic collaboration with them.

The last three questions are the richest in content and are subject to investigation in another report. Respondent’s answers can be complementary analysed both by quantity and quality research methods including content analysis.

There is one “**Likert**” question that consists of seven positions. The aim of this question is to establish a kind of final brainstorming and to enrich the feedback information for the Department about practice-generated knowledge in the speciality. The last two are **text questions**, aiming to form opinion and recommendations from respondents, as well as to define *the idea of the perfect practice-based learning process* in the university.

6. Conclusions

Practice generated knowledge turns to be an inevitable phenomenon in contemporary education. Current results based on the institutional survey analysed show that it is being adequately integrated into students’ schedules and respondents are more inclined to highly evaluate its benefits. Further discussions and results are to be delivered after detailed analysis of the last “**Likert**” and text questions of the considered survey and explained as a part of author’s monography work. The results of the centralised survey will be shown in the last. The monitoring process applied in the Tourism department of Veliko Tarnovo University is an essential part in the politics of supplying contemporary, working and, at the same time, attractive educational process in the speciality. For the sake of the more effective self-assessment process and a more proper practice-based knowledge to be led, the future direction put by the author is gathering a larger percentage respondent. Limitations, however, are to be widened and the survey should overwhelm at least several “**Tourism**” departments in Bulgarian academic institutions.

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Trends in Labour Resources in Romania

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Abstract

Currently, the labour market is characterised by workplace flexibility, life skills training, employer support for skills development, company concern for the society in which it operates, and increasing labour productivity through technology. The current research makes a forecast for the average monthly nominal net earnings for Romania and for the availability of labour resources for Romania for the period 2023-2025. The work will help employers to find the right way to keep employees in the company. The research methods used are the average dynamic index and linear trend analysis, by choosing the forecasting method that presents the highest accuracy. The conclusions present proposals and recommendations for the Romanian labour market.

Keywords: labour resources, productivity, linear trend.

JEL Classification: F16, F66.

1. Introduction

According to Giese & Haldane (2020) "the company's impact on society" represents a key issue for attracting potential employees. The labour resources in Romania are changing in a blink of an eye due to the evolution of the digitalisation and the desire for work flexibility.

In the perspective of the 2030s, according to HR experts, two trends will have an effect on the way we work. On the one hand, acquiring the skills to become experts in digitisation and on the other hand, increasing productivity at work (Brown & Rocha, 2020).

Personalising salary benefits is a priority for employees looking for a job. The benefits must be tailored to the employees' wishes according to their lifestyles (Portuguez Castro & Gómez Zermeño, 2020).

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In light of the above, we see the need to analyse the figures of the available labour resources in Romania, by total and by development region, the analysis of the average monthly nominal net earnings by total Romania and by development region, as well as the analysis of the unemployment rate by total Romania and by development region, for the period 2018-2022. Furthermore, we forecast the three macroeconomic indicators for the period 2023-2025, highlighting the results and related discussions.

2. Problem Statement

Due to the technology advancements the workplace is changing rapidly (Nagurney, 2022). In this way, the employees are looking for personalising their work contracts and really want the support of their employers as a partner in the real life also.

Not easy to impress, the new employees are looking for a salary package that includes along with the salary others incentives (Pelau et al., 2023). So, the success of a company lies in the respectful relationship between the employer and employees. The company of the future will offer not just a simple job, but more than that, like support, understanding, flexibility, and stimulants (Tirau et al., 2022).

The employees will be more and more absolve by their work attributes, and the companies will seek to offer job related to the circular economy.

The technology will help workers to be highly productive and involved in their tasks (FutureStation, 2023 and de Mena et al., 2024).

A change in Romanian employees is observe, as they look for hybrid works, more than just one job, the switch between jobs rapidly, high payed salaries, and the desire to create their own career portfolio, which allow workers to be engaged in multitude projects (Rinne, 2021). Therefore, in the near future, companies will need to perfect their HR departments.

According to Maha et al. (2023), future employees will want a flexible schedule, the desire to work remote, to stay at home as much as possible, the possibility to create and innovate at the work place.

The HR strategy will need to be involved in the wellbeing of the employees, in their health, family, and teamwork activities (Kwortnik, 2003).

In the Romanian context, the workers are looking for a more friendly-business environment, the possibility to affirm themselves, the possibility to create and innovate at the workplace (Tapescu, 2015).

In this research paper, we will use statistical indicators helping us to see the labour market evolution through the years. Only in this way the future labour strategies can be put in place.

3. Research Methods

The research database was created using Tempo Online, the portal of the Romanian National Institute of Statistics. The indicators for analysis were selected and the five-year time period under investigation was defined as 2018-2022.

The total of the labour resources in Romania was analysed and forecast, and the average monthly nominal net earnings for Romania were analysed and forecast. More than that, the research paper examines the evolution, by economic development regions, for Romania, for three macroeconomic indicators: labour resources, average monthly nominal net earnings, and unemployment rate. For each indicator, the rate of change was calculated and analysed on a fixed basis.

Two statistical methods are used to see which of them best adjusts the data series. The first one is the dynamic index, and the second one is the linear trend. In statistics, the best method for forecasting is the one with v (the coefficient of variation) as lower as possible, usually less than 5%. The lower v it is the best the forecast method it is.

The equations for adjustment and forecasting are given below, i.e., equation 1 represents the root mean square deviation and equation 2 the coefficient of variation.

$$\sigma = \sqrt{\frac{\sum_{i=1}^n (y_i - \tilde{y}_i)^2}{n}} \quad (1)$$

$$v = \frac{\sigma}{\bar{y}} \cdot 100 \quad (2)$$

4. Findings

The initial objective was to examine the total labour resources available in Romania, both in aggregate and by development region, over the period from 2018 to 2022.

Labour resources are defined as the category of population with the physical and intellectual capacity to perform useful work in one of the economic activities. This includes the working age population, as well as those who are under or over the working age but still working.

The working age is 16-61 years old for women and 16-65 years for man. The following labour resources are included in the calculations: the working age population who are able to work is determined by subtracting the number of people who are permanently incapacitated to work and the number of pensioners of working age who do not work from the total working age population; and the number of people who are actively employed, both under and over the age of working age.

Thus, the total labour resources available to Romania in 2022 amount to 11986.4 thousand persons, a decrease of 2.06% compared to the base year 2018. By region, the Bucharest-Ilfov region recorded the largest increase of 10.19% and the Western region the largest decrease of 9.78% in terms of labour resources in the analysed period 2018-2022 (Table 1).

Table 1. Labour resources by total and by development regions in Romania

Labour resources in Romania	Year 2018	Year 2019	Year 2020	Year 2021	Year 2022	Change % 2022/2018
	Thousands of persons	Thousands of persons	Thousands of persons	Thousands of persons	Thousands of persons	
TOTAL	12238.9	12198.3	12216.8	12201.4	11986.4	-2.06
Region NORD-VEST	1626.8	1621	1625.7	1630.5	1586.3	-2.49
Region CENTRU	1453.9	1447.3	1448.7	1454.7	1389.7	-4.42
Region NORD-EST	1965.5	1954.7	1956.9	1958.7	1985.1	+1.00
Region SUD-EST	1489.2	1473.1	1468.1	1461.5	1433.9	-3.71
Region SUD-MUNTENIA	1813	1789.5	1793.8	1770.7	1721.9	-5.02
Region BUCURESTI - ILFOV	1535.2	1575.6	1589.3	1600.1	1691.7	+10.19
Region SUD-VEST OLTENIA	1204.5	1193.4	1194.2	1185.2	1139.5	-5.40
Region VEST	1150.8	1143.7	1140.1	1140	1038.3	-9.78

Source: calculated by the authors based on Tempo Online (2024).

The average monthly nominal net earnings by total and by development regions in Romania show significant discrepancies between the earnings of the Bucharest-Ilfov region compared to the other regions in Romania. In 2022, the average monthly nominal net earnings increased by 43.58% compared to 2018. The North-West region recorded an increase of 50.27% in 2022 compared to 2018 for the average monthly nominal net earnings (Table 2). The foreign investment in the Western region of Romania created an infusion of financial capital proper for the Romanian specialists to be more prosperous. Their earnings have been doubling over the past five years, representing a very important issue for the prosperity of the region.

Table 2. The average monthly nominal net earnings by total and by development regions in Romania

Average monthly nominal net earnings	Year 2018	Year 2019	Year 2020	Year 2021	Year 2022	Change % 2022/2018
	RON	RON	RON	RON	RON	
TOTAL	2642	2986	3217	3416	3801	+43.87
Region NORD-VEST	2419	2781	2997	3203	3635	+50.27
Region CENTRU	2453	2757	2953	3153	3489	+42.23
Region NORD-EST	2317	2674	2876	3014	3349	+44.54
Region SUD-EST	2257	2551	2770	2883	3173	+40.58
Region SUD-MUNTENIA	2370	2697	2885	3024	3355	+41.56
Region BUCURESTI - ILFOV	3559	3947	4263	4576	5110	+43.58
Region SUD-VEST OLTENIA	2324	2630	2828	2954	3247	+39.72
Region VEST	2545	2879	3079	3313	3650	+43.42

Source: calculated by the authors based on Tempo Online (2024).

Unemployment is a key indicator that reflects the situation in the labour market. For Romania, a significant improvement in the economic situation is observed in the five years of the economic analysis, 2028-2022, with the unemployment rate decreasing by 9.09% (Table 3). The situation is most favourable for the Bucharest-Ilfov region, where the decrease in unemployment is 25% in 2022 compared to 2018. This proves that there are jobs available and potential employees willing to occupy them. Together with the increase in the average monthly nominal net earnings, a strong inverse relationship is observed between the two macroeconomic indicators. The higher the earnings and the lower the unemployment rate, the more attractive and desirable the job is for the available labour resources. The favourable climate for increasing earnings will also lead to a favourable climate for reducing the unemployment rate in Romania.

Table 3. Unemployment rate by total and development regions in Romania

Unemployment rate in Romania	Year 2018	Year 2019	Year 2020	Year 2021	Year 2022	Change % 2022/2018
	Percentage	Percentage	Percentage	Percentage	Percentage	
TOTAL	3.3	2.9	3.4	3	3	-9.09
Region NORD-VEST	2.3	2	2.6	2.3	2.1	-8.70
Region CENTRU	2.9	2.6	3.3	2.7	3.1	+6.90
Region NORD-EST	4.8	4.3	4.7	4.3	4.2	-12.50
Region SUD-EST	4.6	4.2	4.8	4.2	4	-13.04
Region SUD-MUNTENIA	4	3.4	3.9	3.7	3.8	-5.00
Region BUCURESTI - ILFOV	1.2	1.1	1.2	1	0.9	-25.00
Region SUD-VEST OLTENIA	5.9	5.2	5.5	5.4	5.6	-5.08
Region VEST	1.8	1.7	2.2	1.9	1.7	-5.56

Source: calculated by the authors based on Tempo Online (2024).

In the following, we will adjust and then forecast the macroeconomic indicator: total labour resources in Romania.

Table 4. Adjustment using the average dynamic index of the total labour resources in Romania

	Real data	Adjust data	
Years	Total Labour resources Thousands of persons	$\tilde{y}_i = y_1 \cdot \bar{T}^{t_i}$	$(y_i - \tilde{y}_i)^2$
2018	12238.9	12238.9	0
2019	12198.3	12175.3	530
2020	12216.8	12112.0	10985
2021	12201.4	12049.0	23216
2022	11986.4	11986.4	0
			34730
The average dynamic index Formula and calculation	$\bar{T} = \sqrt[n-1]{\frac{y_n}{y_1}}$	Sigma	83.34
	0.9948	v	0.68%

Source: calculated by the authors.

Table 5. Adjustment using the linear trend method of the total labour resources in Romania

Years	Real data Total Labour resources Thousands of persons	t _i	t _i ²	y _i *t _i	Adjust data	(y _i - \tilde{y}_i) ²
					\tilde{y}_i	
2018	12238.9	-2	4	-24477.8	12269	890
2019	12198.3	-1	1	-12198.3	12219	410
2020	12216.8	0	0	0	12168	2346
2021	12201.4	1	1	12201.4	12118	6927
2022	11986.4	2	4	23972.8	12068	6655
			10	-501.9		17229
The linear trend Formula and calculation	$\tilde{y}_i = a + b \cdot t_i$				<i>Sigma</i>	58.70
					v	0.48%
	$a = \bar{y}$ (The mean)					
a	12168.4					
	$b = \frac{\sum y_i t_i}{\sum t_i^2}$					
b	-50.19					

Source: calculated by the authors.

Comparing the coefficient of variation (v) of the two statistical-mathematical adjustment methods, we can see that v of the linear trend method (0.48%, Table 5) is smaller than v of the average dynamic index method (0.68%, Table 4), which means that the smaller v is, the more suitable this method is for forecasting. Thus, the forecast for the total labour resources in Romania will be made with the linear trend. We will see what will happen in the next few years in terms of labour resources in Romania.

Table 6. Linear trend forecast of total labour resources in Romania

Years	t _i	$\tilde{y}_i = a + b \cdot t_i$
		Thousands of persons
2023	3	12018
2024	4	11968
2025	5	11917

Source: authors' own calculations.

We observe a slight decrease of -0.6% in total labour resources in Romania in 2025 compared to 2022. This slightly decreasing trend is influenced by the migration of young people to Western European countries in search of better-paid jobs. To counteract this decline, it is worth analysing the level of earnings in 2025.

The next step is to adjust and then forecast the macroeconomic indicator: total average monthly nominal net earnings in Romania.

Table 7. Adjustment using the average dynamic index of the total average monthly nominal net earnings in Romania

Years	Real data	Adjust data	$(y_i - \tilde{y}_i)^2$
	Total average monthly nominal net earnings (RON)	$\tilde{y}_i = y_1 \cdot \bar{T}^i$	
2018	2642	2642	0
2019	2986	2894	8556
2020	3217	3169	2309
2021	3416	3471	2983
2022	3801	3801	0
			13847
The average dynamic index Formula and calculation	$\bar{T} = \sqrt[n-1]{\frac{y_n}{y_1}}$	Sigma	52.63
	1.0952	v	1.64%

Source: authors' own calculations.

Table 8. Adjustment using the linear trend method of the total average monthly nominal net earnings in Romania

Years	Real data Total average monthly nominal net earnings (RON)	ti	ti ²	yi*ti	Adjust data	$(y_i - \tilde{y}_i)^2$
					\tilde{y}_i	
2018	2642	-2	4	-5284	2662.8	433
2019	2986	-1	1	-2986	2937.6	2343
2020	3217	0	0	0	3212.4	21
2021	3416	1	1	3416	3487.2	5069
2022	3801	2	4	7602	3762	1521
			10	2748		9387
The linear trend Formula and calculation	$\tilde{y}_i = a + b \cdot t_i$				Sigma	43.33
					v	1.35%
	a = \bar{y} (The mean)					
a	3212.4					
	$b = \frac{\sum y_i t_i}{\sum t_i^2}$					
b	274.8					

Source: calculated by the authors.

Comparing the coefficient of variation (v) of the two statistical-mathematical adjustment methods, we can see that v of the linear trend method (1.35%, Table 8) is smaller than v of the average dynamic index method (1.64%, Table 7), which means that the smaller v is, the more suitable this method is for forecasting. Therefore, the forecast for the total average monthly nominal net earnings in Romania will be made with the linear trend. We shall see what will happen in the next few years in terms of total average monthly nominal net earnings in Romania.

Table 9. Linear trend forecast of total average monthly nominal net earnings in Romania

Years	t _i	$\tilde{y}_i = a + b \cdot t_i$
		RON
2023	3	4037
2024	4	4312
2025	5	4586

Source: authors' own calculations.

It is hopeful to note that the total average monthly nominal net earnings in Romania are on the rise year on year. This optimistic trend is expected to last, with an estimated 4586 RON monthly nominal net earnings in Romania by 2025.

5. Conclusions

After analyse and forecast the total number of labour resources in Romania and the total average monthly nominal net earnings in Romania, we can present the following remarks.

First, the Romanian employees are becoming more prosper year after year, as a result of the rise of their earning each month. The companies are wealthier and can afford better wages for their employees.

Second, the linear trend observed in the forecast is advantageous for the Romanian labour sector, and the implications for employers in creative services are essential as they need to offer an open-minded solution in attracting and maintain their workers.

Third, the analysis and the forecast of the labour resources and employees' earnings offer solutions for better market understanding.

Last but not least, in order to attract the Romanian specialists, a group of services is needed like: better salaries, work flexibility, freedom of expression, and innovation enhancement.

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**Professors versus Students: An Introductory Bibliometric
Review of AI Acceptance in Higher Education's
Specialisations of Tertiary Sector**

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Abstract

The increasing development of artificial intelligence (AI) technology has raised considerable interest in its application within educational environments, particularly in higher education. This study examines the dynamics of AI technology acceptance among service sector academia with the intent of delineating the critical determinants that influence its adoption and utilisation. Emphasising a comparative analysis, this investigation juxtaposes the perceptions of both students and professors. A systematic keyword search was implemented to evaluate pertinent studies encompassing these determinants, in conjunction with relevant theoretical constructs and academic fields. Although the existing literature offers substantial information on AI adoption factors within the service sector, a lacuna persists in understanding the variables and conceptual frameworks that characterise the acceptance of AI technology in higher education in the service sector. Identifying these drivers of adoption could be of great benefit to students, professors, but mostly to policy-makers who are poised to devise and execute strategic initiatives advocating for the seamless integration of AI into pedagogy, scholarly inquiry, and the broader academic field.

Keywords: artificial intelligence, technology acceptance models, higher education, professors, students.

JEL Classification: I23, O33, O14.

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1. Introduction

The tertiary sector of higher education has developed rapidly in recent decades, driven by technological advances, changing demographics, and needs. The emergence of artificial intelligence (AI) technologies has had a significant impact not only on individuals, but also on organisations and societies in various fields. The context of higher education is no exception, with AI teaching assistants or bots (e.g., Bilquise et al., 2023; Pillai et al., 2024) and especially ChatGPT (e.g., Duong et al., 2023; Romero-Rodríguez et al., 2023) playing an essential role for all stakeholders in the tertiary sector. Although technology adoption is one of the most studied topics related to AI in various fields, and some studies since 2020 (Kim et al., 2020) have started to engage in the empirical investigation of factors influencing the usage behaviour of students or professors, there is still little consensus on the main determinants of AI adoption or usage in the case of tertiary sector actors from higher education. Moreover, some of the existing work is limited to theoretical acceptance models and their standard constructs that do not fit the specificities of AI technology (Polyportis and Pahos, 2024). This study thus contributes to previous research on the adoption of AI technologies in higher education, in the service sector, by providing an introductory bibliometric analysis of the main variables used to analyse AI acceptance by both students and professors. In addition, a third subject category was found to be relevant, relating to professors who hold leadership positions in these institutions.

2. Problem Statement

As AI technology continues to advance, its integration into higher education requires a comprehensive understanding of the factors that influence its acceptance by both professors and students. In order to assess the degree of acceptance of such innovative technologies, a brief overview of the most important acceptance models with their defining variables was considered relevant. The Technology Acceptance Model (TAM) was developed by Davis (1989) as one of the most important models to evaluate technology acceptance following the creation of theories such as Ajzen's (1991) Theory of Planned Behaviour (TPB), which focusses on human behaviour. In the TAM, there are two main variables that determine the behavioural intention (BI) to use a technology: perceived usefulness (PU), which refers to the impact of the technology on improving performance, and perceived ease of use (PEOU), which focusses on the technical use or the ease and pleasure of using a particular technology. Venkatesh and Davis (2000) extended the TAM theory to the Technology Acceptance Model 2 (TAM2), in which constructs such as the subjective norm or output quality were included, and adapted it more closely to the Internet and online technologies. In addition, the Technology Acceptance Model 3 (TAM3) has emerged with new factors such as self-efficacy (SE), perceived enjoyment (PE), or anxiety (Venkatesh and Bala, 2008), which have also been adapted to the characteristics of AI technology (Zhang et al., 2023). The Unified Theory of Acceptance and Use of Technology (UTAUT) model (Venkatesh et al., 2012) has been implemented in previous research on user acceptance and use of AI, AI

assistants, and even ChatGPT. The new predictors of technology use added to the initial TAM are performance expectancy (PE), effort expectancy (EE), social influence (SI), facilitating condition (FC), BI, and user behaviour (UB). Moreover, the UTAUT2 model has included hedonic motivation (HM), price value (PV), and habit (H) as relevant variables. Both UTAUT and UTAUT2 consider in the analysis sociodemographic factors as age and gender (Venkatesh et al., 2012). Despite the recognised importance of attitude in the early stages of technology adoption, its role in educational research has been largely undervalued, with studies favouring the use of TAM or UTAUT models. In addition to the traditional variables, there are many factors, such as those included in the Meta-UTAUT model (Dwivedi et al. 2019), that have been shown to be successful and useful in areas such as AI-integrated customer relationships, mobile banking, tourism, or education and are briefly explained in the current research.

3. Aims of the Research

The study consolidates and compares existing research to identify key determinants and theoretical frameworks that influence the adoption of AI in higher education. The article attempts to fill a literature gap by providing an introductory bibliometric analysis of the adoption behaviour of key educational stakeholders in education and highlighting the importance of adapting new acceptance variables to traditional models. The aim is to make a small contribution to the future development of strategies that facilitate the effective integration of AI into educational practice and institutional structures in the tertiary sector.

4. Research Methods

A systematic keyword-based review of the AI acceptance literature in higher education in the tertiary sector, using the Web of Science, was conducted to analyse the uptake of AI technologies among stakeholders: students (undergraduate and/or postgraduate) and professors and/or academics. Initially, the keywords and conditions were defined: “artificial intelligence in higher education” OR “AI in higher education”, as topics, with the condition AND “technology acceptance model” OR “technology acceptance” OR “technology acceptance” “technology acceptance”. The search was conducted from 2000 to the present and resulted in a set of 14809 published articles. Further restrictions were made in terms of research area (services), participants (students, professors/academics and staff), and language. After analysing the abstracts of 248 articles, the selection was narrowed down to 49 publications, of which 21 were finally selected because they were in line with the objectives of the study and provided an introductory basis for future research on AI implementation in tertiary education.

5. Findings

The 21 studies identified were published between 2020 and 2024 in 6 main research areas: 57% in Education and Educational Research (12), 19,05% in Computer Science and Engineering (4), Information Science and Library Science

(1), Business and Economics; Education and Educational Research (1), Science and Technology - Other Topics (1) and Psychology (1). Twenty of the 21 studies encompass a range of service sector areas from multispecialisation universities, apart from a single study that surveyed medical students (Li and Qin, 2023). As shown in Tables 1-3, regardless of the research subjects (students, professors, or in some cases academic staff), TAM (Davis, 1989) and TAM extensions are the predominant models used in the studies. Polyportis (2024) opted for the implementation of PBC (Ajzen, 1991) focussing on trust, emotional creepiness, perceived behavioural control. Among the groups of constructs used (Table 1-3), PU and other functional beliefs (e.g., perceived risk, trust, perceived value), are the most widely accepted technology-related beliefs (Kim et al., 2020; Duong et al., 2023; Wang et al., 2021). Constructs pertaining to personal traits such as technological pedagogical content knowledge (Jain and Raghuram, 2024), work engagement, job relevance, anxiety (Abdaljaleel et al., 2024; Zhang et al., 2023), behavioural control beliefs as PEU, SE and FC (Rahiman and Kodikal, 2024; Romero-Rodríguez et al., 2023) or affective/hedonic responses such as interactivity (Pillai et al., 2024), anthropomorphism (Bilquise et al., 2023), attitude (Xu et al., 2024) hedonic motivation (Romero-Rodríguez et al., 2023) were also found to be relevant. One study was conducted using a mixed method (Pillai et al., 2024), in which both a survey (students) and the interview (academics) were used. Xu et al. (2024) opted for a qualitative research method (peer-to-peer interview), and 19 studies conducted surveys (Likert scale items) in accordance with the constructs used. Other variables such as gender, age, major, experience, or grade were also taken into account (Polyportis, 2024; Romero-Rodríguez et al., 2023).

5.1 Students

To assess AI teacher bots or assistance (Table 1), various authors (e.g. Kim et al., 2020, Ayanwale and Molefi, 2024) have used the TAM framework (Davis, 1989) in combination with other variables such as interactivity, anthropomorphism, or personalisation. To investigate the acceptability of AI-enhanced academic support and its impact on students' performance, Dahri et al. (2024) chose the UTAUT framework (Venkatesh et al., 2003) in combination with other variables (e.g., information accuracy, pedagogical fit). Ka et al. (2023) opted for an adapted version of the EVT framework (Wigfield, 1994), considering knowledge, perceived value, perceived cost, and intention to use. Authors like Li and Qin (2023) focused only on medicine students, using the UTATUT2 (Venkatesh et al., 2012) and found that students' willingness to use medical AI is influenced by how useful they think it is, how much they enjoy using it, their habits, and how much they trust it. Students' intention to adopt AI-based (T-bots) or assistants was found to be influenced by factors such as perceived ease of communication (Kiet et al., 2020), PEU, PU, personalisation, interactivity, perceived trust, anthropomorphism, and perceived intelligence (Pillai et al., 2024). While PU, autonomy, and trust showed no significant influence on the acceptance of chatbots, Bilquise et al. (2023) emphasised the importance of these functional elements in shaping students' attitudes toward AI-

driven academic advising tools. In addition, students' willingness to engage with chatbots for educational purposes is higher if they believe that these tools increase their learning efficiency (Ka et al., 2023; Dahri et al., 2024) and correspond to their learning habits (Ayanwale and Molefi, 2024).

Table 1. Research subjects: students

Authors	Themes	Methods & instruments	Framework	Variables
(Kim et al., 2020)	Explores students' perceptions of <i>AI teaching assistants</i> in higher education.	Quantitative (survey)	TAM	Perceived Usefulness, Perceived Ease of Communication, Attitudes Toward New Technologies, Intention to adopt AITA
(Pillai et al., 2024)	Examines students' adoption of <i>AI-based teacher-bots</i> in higher education.	Mixed methods (survey & interview).	TAM + other variables	Perceived Ease of Use, Perceived Usefulness, Personalization, Interactivity, Perceived Trust, Anthropomorphism, Perceived Intelligence
(Duong et al., 2023)	Explores <i>ChatGPT</i> impact on higher education students' learning adoption and knowledge sharing.	Quantitative (survey)	TAM - education	Effort Expectancy, Performance Expectancy, Behavioural Intention to use, Actual Use, Knowledge Sharing
(Romero-Rodríguez et al., 2023)	Explores <i>ChatGPT</i> 's acceptance by university students.	Quantitative (survey)	UTAUT2	Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, Hedonic Motivation, Price Value, Habit, Behavioural Intention, Use Behaviour
(Bilquise et al., 2023)	Examines the factors influencing university students' acceptance of <i>academic advising chatbots</i> .	Quantitative (survey)	TAM UTAUT sRAM SDT	Perceived Ease of Use, Perceived Usefulness, Social Influence, Perceived Trust, Perceived Autonomy, Anthropomorphism, Behavioural Intention
(Li and Qin, 2023)	Explores the factors that influence the acceptance and use of <i>AI in medicine</i> education	Quantitative (survey)	UTAUT 2	Performance Expectancy, Effort Expectancy, Social Influence, Hedonic Motivation, Price Value, Habit, Facilitating Conditions, Technology Fear, Trust, Behavioural Intention, User Behaviour
(Abdaljaleel et al., 2024)	Factors influencing <i>ChatGPT</i> usage and attitudes in university students from domains like: medical, healthcare, education, mathematics.	Quantitative (TAME-ChatGPT survey)	TAME-ChatGPT	Perceived Usefulness, Behavioural/cognitive factors, Perceived risk of use, Perceived ease of use, General perceived risks, Anxiety, Technology social influence, Attitude to technology/social influence
(Polyportis, 2024)	Examines <i>AI adoption</i> and <i>ChatGPT usage</i> in higher education.	Quantitative (longitudinal survey)	PBC	Trust, Emotional Creepiness, Perceived Behavioural Control, Usage Behaviour
(Ayanwale and Molefi, 2024)	Analyses the factors influencing students' adoption of <i>AI chatbots</i> for educational purposes.	Quantitative (survey)	TAM IDT	Relative Advantages, Compatibility, Trialability, Perceived Trust, Perceived Usefulness, Perceived Ease of Use, Behavioural Intention
(Dahri et al., 2024)	Investigates <i>AI-based academic support</i> acceptance and impact on students' performance.	Quantitative (survey)	UTAUT + other variables	Performance Expectancy, Facilitating Conditions, Students' Engagement, Assessment Effectiveness, Students' Interaction, Information Accuracy, Personal Innovations, Pedagogical Fit, AI Tools Use, Behavioural Intentions, Students Satisfaction
(Xu et al., 2024)	Explores students' perceptions and experiences with <i>ChatGPT</i> .	Qualitative (peer-to-peer interview)	TAM	Perceived Usefulness, Perceived Ease of Use, Attitude towards use, Behavioural Intention
(Polyportis and Pahos, 2024)	Examines factors driving students' use behaviour of <i>ChatGPT</i> in higher education.	Quantitative (survey)	meta-UTAUT + other variables	Performance Expectancy, Effort expectancy Social influence, Facilitating conditions, Perceived anthropomorphism, Trust Design novelty, Institutional policy, Attitude, Behavioural intention, Use behaviour
(Tian et al., 2024)	Investigates <i>AI Chatbot</i> acceptance among Chinese graduate students	Quantitative (survey)	UTAUT ECM + Personal Innovativeness	Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, Confirmation, Satisfaction, Personal, Innovativeness, Behavioural Intention, Use Behaviour.
(Alshammari and Alshammari, 2024)	Factors influencing students' use of <i>ChatGPT</i> in higher education.	Quantitative (survey)	UTAUT	Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, Behaviour Intention
(Ka et al., 2023)	Explores student perceptions of <i>GenAI</i> in higher education	Quantitative (survey)	EVT	Knowledge, Perceived Value, Perceived Cost, Intention to Use

Notes: TAM=Technology Acceptance Model; UTAUT=The Unified Theory of Acceptance and Use of Technology; sRAM= The Service Robot Acceptance Model; SDT= The intrinsic motivation Self-Determination Theory (SDT) model; TAME-ChatGPT= TAM edited to assess ChatGPT acceptance; PBC= Perceived Behavioural Control; IDT= Innovation Diffusion Theory, EVT= Expectancy-Value Theory; ECM=Expectation-Confirmation Model

Source: developed by authors (2024).

The second common theme analysed in the students' category refers to students' adoption and use of ChatGPT in the learning process with the following theoretical models implemented: PBC (Polyportis, 2024), TAM (Xu et al., 2024; Duong et al., 2023), TAME ChatGPT (Abdaljaleel et al., 2024), UTAUT (Alshammari and Alshammari, 2024), UTAUT and ECM (Tian et al., 2024), metaUTAUT (Polyportis and Pahos, 2024), UTAUT 2 (Romero-Rodríguez et al., 2023). The predominant theoretical model for AI learning technologies is TAM, often with variations, whereas UTAUT and its iterations are frequently chosen by researchers studying ChatGPT. EE directly impacted students' actual use of ChatGPT (Duong et al., 2023) meaning that students are more likely to use ChatGPT if they perceive it to be easy to use and require minimal effort. The positive attitude and use of ChatGPT is influenced by the ease of use, positive attitude toward technology, SI, PU, behavioural/cognitive factors, low perceived risk, and low anxiety (Abdaljaleel et al., 2024). They are more inclined to use ChatGPT if they believe it will improve their academic performance (Alshammari and Alshammari, 2024), if they have experience using it (Romero-Rodríguez et al., 2023), if they feel supported by their social environment, and if they have the necessary resources (Polyportis and Pahos, 2024), indicating the importance of PU and community support in the adoption of new technologies. Students' positive attitudes toward ChatGPT are significantly influenced by anthropomorphism, trust, and novelty of design, suggesting that the more likeable and trustworthy a technology is, the more likely it is to be accepted (Duong et al., 2023; Polyportis and Pahos, 2024). Personal innovativeness was found to be a significant determinant of behavioural intentions, suggesting that greater openness to new technologies leads to higher adoption rates (Tian et al., 2024). User satisfaction was a central factor in the decision to continue using AI chatbots, emphasising the importance of meeting users' expectations to keep them engaged with the technology (Tian et al., 2024). Furthermore, a decrease in emotional creepiness was observed from the initial phase to follow-up, suggesting that the students became comfortable with ChatGPT over time (Polyportis, 2024).

5.2 Professors

Research on the acceptance of AI technologies by professors in higher education in the tertiary sector has so far proven to be scarce. Three studies were found relevant using the TAM model (Wang et al., 2021; Rahiman and Kodikal, 2024) as well as TAM3 (Zhang et al., 2023) and UTAUT (Rahiman and Kodikal, 2024). All papers were quantitative with the survey as a main instrument. While two articles focused on professors who have graduated and are using AI in their activity, Zhang et al. (2023) focused on future professors enrolled in education programs. PEU was found to have a significant positive direct effect on PU, suggesting that professors who perceive AI applications as easy to use also perceive them as useful (Wang et al., 2021). SE (Wang et al., 2021), the institution's conditions, and their awareness of new technologies (Rahiman and Kodikal, 2024) are also factors that positively influence the attitude towards AI, emphasising professors' belief in their ability to use AI technologies effectively. Anxiety does not have a significant impact on BI

(Rahiman and Kodi kal, 2024), suggesting that professors' level of anxiety does not play a significant role in their decision to use AI technologies in the classroom.

Table 2. Research subjects: professors/academics

Authors	Themes	Methods & instruments	Framework	Variables
(Wang et al., 2021)	Explored factors influencing teachers' adoption of AI in higher education (AIEd).	Quantitative (survey)	TAM + Self efficacy + Anxiety	Perceived Usefulness, Perceived Ease of Use, Attitude towards use, Behavioural Intention, Anxiety, Self-efficacy
(Zhang et al., 2023)	Explores pre-service teachers' acceptance of AI in education.	Quantitative (survey)	TAM3	AI Self-Efficacy, Perceived Enjoyment, AI Anxiety, Perceived Ease of Use, Perceived Usefulness, Job Relevance, Subjective Norm, Behavioural Intention.
(Rahiman and Kodikal, 2024)	Explores AI's impact on higher education, focusing on faculty engagement.	Quantitative (survey)	TAM UTAUT	Facilitating Conditions, Awareness, Perceived Risk, Performance Expectancy, Effort Expectancy, Adoption, Attitude, Behavioural Intention, Work Engagement, Artificial intelligence in Higher Education.

Notes: TAM=Technology Acceptance Model; UTAUT=The Unified Theory of Acceptance and Use of Technology.

Source: developed by authors (2024).

Professors' perceptions of ease of use, SE, and attitude towards AI are key factors influencing their intention to use AI-based applications in higher education (Wang et al., 2021; Rahiman and Kodikal, 2024). The UTAUT model emphasises that PE, EE, SI, and FC significantly influence the acceptance and use of technology, including AI, in education (Rahiman and Kodikal, 2024). PEU and PU were also found to be significant factors in pre-service teachers' intentions to use AI-based educational applications (Zhang et al., 2023). Gender differences in AI anxiety and perceived enjoyment were observed among pre-service teachers (Zhang et al., 2023).

5.3 Students, professors, and Academic (Management) Staff

Although the main purpose of the research was to analyse the most common variables in AI acceptance by two main stakeholders in higher education, the research led to the creation of a third category, professors holding management positions (e.g., dean, director) at universities.

Table 3. Research subjects: students, academics and staff

Authors	Themes	Methods & instruments	Framework	Variables
(Chatterjee and Bhattacharjee, 2020)	Explores AI adoption in higher education in India.	Quantitative (survey)	UTAUT	Perceived Risk, Performance Expectancy, Effort Expectancy, Facilitating Condition, Attitude, Behavioural Intention.
(Jain and Raghuram, 2024)	Explores factors influencing Gen-AI adoption in Higher Education.	Quantitative (survey)	TAM + UTAUT + other variables	Perceived Risk, Perceived Ease of Use, Perceived Usefulness, technological pedagogical content knowledge, Perceived Trust, Intention to Use
(Sharma et al., 2024)	Investigates AI adoption (e.g. applications, dimensions) in Indian higher education institutions.	Quantitative (survey)	UTAUT SCT HCI	Perceived Organisational Support, Perceived Ease of Use, AI Self Efficacy, Perceived Effectiveness, Perceived Risk, Behavioural Intention, Adoption of AI.

Notes: TAM=Technology Acceptance Model; UTAUT=The Unified Theory of Acceptance and Use of Technology; SCT= Social Cognitive Theory (SCT); HCI=Human-Computer Interaction.

Source: developed by authors (2024).

In these studies, while EE and FC are consistent positive predictors of AI adoption (Chatterjee and Bhattacharjee, 2020; Jain and Raghuram, 2024; Sharma et

al., 2024), the influence of PU varies. SE, trust, and demographic considerations also play significant roles, as vital elements in a broader understanding of AI acceptance in the educational sphere.

6. Conclusions

This paper contributes to the existing literature by identifying the most common determinants of AI acceptance in higher education and providing a clearer analysis of the level of adoption among students and professors. Overall, the studies indicate that AI acceptance in higher education in the tertiary sector is multifaceted, with factors belonging to traditional acceptance models having a significant impact on the current research landscape. In addition, a number of new variables adapted to higher education and AI technology have emerged. Most articles focus on the factors that influence students' AI acceptance, while comparatively little attention is paid to professors. Future research on AI adoption in higher education may also examine cross-disciplinary adoption patterns to understand how different academic areas of the higher education sector respond to AI integration, allowing the development of customised AI applications that meet discipline-specific needs. The development of AI-based predictive modelling is another innovative approach that could help institutions anticipate trends in AI adoption and prepare targeted responses. Such research efforts will be critical to creating adaptive, inclusive learning environments and facilitating the strategic adoption of AI across the educational spectrum, shaping the future of teaching and learning in an era of AI integration. While this analysis is comprehensive, its limitations lie in elements such as the use of a single database, limited areas of research, or language.

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**The Evolution of Female Leadership Research:
A Bibliometric Review of Publications
over the Past 20 Years**

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Abstract

Recently, there has been great interest in female leadership due to the forces of globalisation and evolving dynamics in leadership influence, even beyond formal authority structures. The objective of this study is to conduct a bibliometric analysis of female leadership research from the past two decades, with the aim of discerning changing trends, patterns, and prominent themes in the literature. To accomplish this, we searched relevant databases and used bibliometric methods, including tracking publication trends, analysing authorship patterns, performing keyword analysis, and examining the distribution of papers in scholarly journals. This systematic approach was designed to bring together a comprehensive collection of publications on women's leadership. The findings reveal the evolution of female leadership research, highlighting shifts in theoretical frameworks, emerging topics, and influential authors. This research contributes to the existing literature by offering information on the trajectory of female leadership research and identifying areas for future exploration. It underscores the increasing recognition of gender diversity in organisational leadership and the significance of addressing gender disparities in leadership positions. The insights derived from this study can inform scholars, practitioners and policymakers seeking to advance gender equality in leadership roles. By identifying key themes and trends, this research provides valuable guidance for fostering inclusive leadership environments and promoting opportunities for women in leadership positions.

Keywords: female leadership, woman, leadership, leader, gender gap.

JEL Classification: J16, M21.

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1. Introduction

This research paper presents a descriptive and evaluative analysis of the development of topics related to female leadership, from articles listed in the Scopus International database. It aims to provide an answer to the following questions:

- What is the distribution of descriptive information of published papers on female leadership in the scientific database Scopus?
- What is the distribution from the evaluation information of published research on female leadership in the Scopus scientific database?
- What are the main research aspects presented in the female leadership articles?

In the following sections, we will put forward the literature review, research methodology, and the outcome of our analysis about female leadership. This article will be a valuable source of inspiration on the topic of gender diversity in leadership.

2. Literature Review

Goenthal & Hoyt (2017) talk about trajectory of women's leadership in various fields of activity, concentrate on the progress of role of women in society and the barriers they meet. Their research underlined that women still suffer from problems arising from domestic duties and stereotypes, although they are very likely to exercise participative and transformational leadership styles. The paper concludes by calling for strong support of women's attempts at leadership, with an acceptance of their historical contributions; encouragement of the dismantling of structures that hinder their upward progress, as well as appreciation of their unique perspectives. Finally, it seems that the level of female representation in boardrooms is already quite high and sensitivity towards these issues is now greater. Discrimination concerns have catapulted debate on gender in leadership to the forefront. While conceptual studies into the leadership styles of men and women periodically render differences, there is a question of the nature of the significance of these differences. Certain arguments are of the view that organizational frameworks ought to assimilate objectivity that provides equal opportunities to human being irrespective of gender. For organizations to realize the aspect of gender equality, it is suggested that they should embrace ethical practices and take into account specific challenges for women, including maternity commitments and family caring responsibilities. Săseanu et al. (2019) underline the increasing interest in the concept of gender diversity in organizations, especially in Western countries, targeting the top managerial level. Not being influenced by the fact that women represent the majority of the population worldwide and a significant proportion in the workforce, their presence on management boards and among the world's prosperous individuals remains disproportionately low. It is a matter, the author underlines, of mutual esteem for the competencies of each and an acknowledgment of personal limitations across genders. From 2003 to 2022, the share of women occupying senior managerial positions has demonstrated an impressive surge, with undeniable nations experiencing exponential expansion. Norway consistently appears as a leader in female representation in superior management roles, while Malta falls behind.

In all parts of Europe, there has been a visible growth in female leadership in the last two decades, imputed in part to opposed social attitudes, and Western Europe mostly demonstrate more developing positions contrasted to eastern counterparts. In the face of regional dissimilarity, the direction towards strengthened female representation in leadership positions appears durable, reflective of developing societal rules (Ene, 2023).

Smith et al. (2022) investigate the changes of leadership within human societies, with a certain focus on the positions acted by identity and social structures. Their investigation elucidates women's influential roles in areas such as marriage, dispute resolution, and the public criticism of nonconformist response.

3. Research Methodology

In this paper, a bibliometric technique was utilised for investigation. Both the Scopus database and the VosViewer software were utilised to conduct an inclusive examination of the articles.

To identify relevant studies on female leadership, a meticulous search was conducted using the Scopus database. This search utilised an exactly crafted string that merged five key terms: female leadership, women leadership, gender, leader, concentrate on articles published between 2004 and 2024 period.

After finishing the filtering process, a total of 3,077 articles were initially fetched. Subsequently, at the second level, only documents written in English were retained, resulting in reducing in the number of documents to 3,006.

Table 1. Literature review technique: inclusion and exclusion parameters

Stage	Content	Description
Stage 1	Scientific database	Scopus
	Indexation	All
	Date	02.04.2024
	Search Period	1 January 2004 – 02 April 2024
	Searched keywords	(TITLE-ABS-KEY (female AND leadership) OR TITLE-ABS-KEY (woman AND leadership) AND TITLE-ABS-KEY (gender) AND TITLE-ABS-KEY (leader)) AND PUBYEAR > 2004 AND PUBYEAR < 2024 AND (LIMIT-TO (LANGUAGE , "English"))
	Initial result	3.077 documents
Stage 2	Language	English = 3.006 documents
	Final result	3.006 documents

Source: data processing after Scopus (2024).

4. Findings and Discussion

To understand female leadership, this section evaluates the main topics and research patterns. Relevant articles were identified through the Scopus database and subjected to specific criteria for detailed analysis.

“diversity” suggests exploring strategies to support women in becoming leaders and promote inclusion in leadership position.

The green one appears to centre on quality research methods used to explore social problem, particularly those concerning gender identity, family dynamics and natural rights. The use of term like, “focus group”, “interview” and, “motivation” suggests research focus on the angle and experiences of individuals using qualitative data collection method.

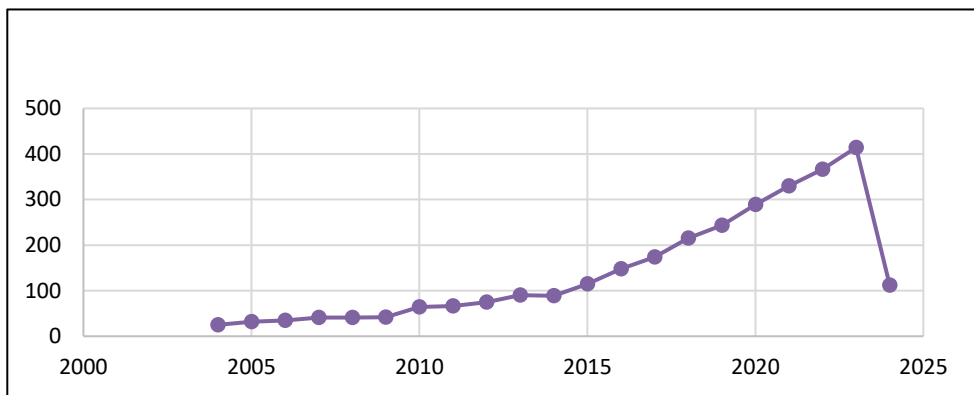
The blue cluster focus on the experiences of women in the workplace. Keywords like “education”, “career mobility” suggest a focus on professional development, while “job satisfaction”, “work environment” and “work-life-balance” indicates interest in how these factors influence women’s experiences.

The yellow cluster appears to centre on the concept of employee mind-sets within the organisational context. The cluster highlight term like “race”, “ethnicity” and “middle-ages”, suggesting an emphasis on how demographic characteristics influence employee mindsets.

Cluster no. 5 studies the effectiveness of educational strategy through research methods such as human experiments. Keywords like “teacher”, “student”, “curriculum” and “outcome assessment” suggest the research evaluates teaching methods, skill development, and formative assessment.

Last, but not least, cluster 6 highlights the interplay between psychological concepts like achievement, self-concept, emotions, and social behaviour. This graph visualisations map offers a origin for future research. It identifies the key central themes and relationship within women’s leadership, highlighting areas where emerging trends, information gaps and further investigation are needed.

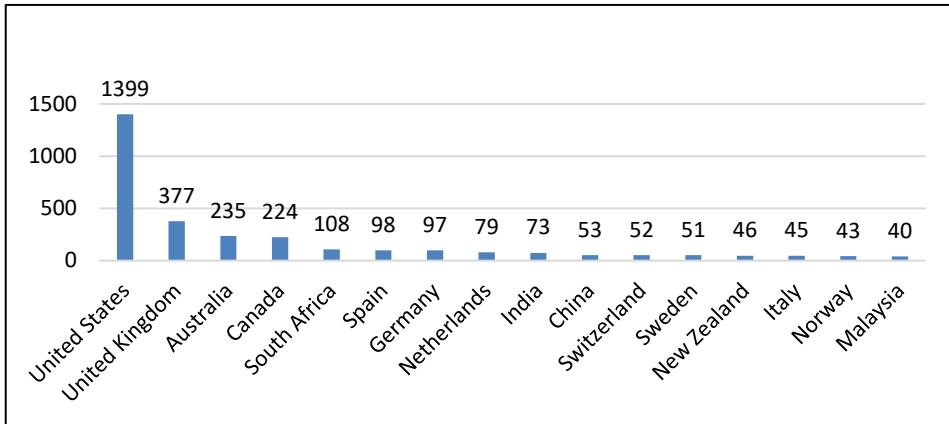
Figure 2. Editorial trends over time



Source: data processing after Scopus (2024).

The growth in the number of articles published in the examined period is highlighted in Figure 2, marking a growing educational attention and research productivity in the domain of female leadership. The fall in 2024 can be attributed to the small time frame investigated, rather than implying declining interest.

Figure 3. Country-level academic output



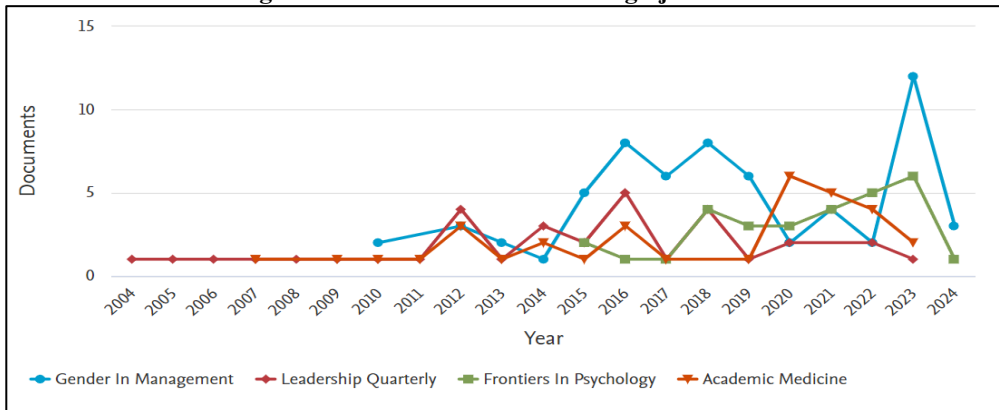
Source: data processing after Scopus (2024).

This chart reveals the geographic distribution of research articles on female leadership.

Regardless the fact that some nations, such as the United States, the United Kingdom, Canada and Australia, stand out as significant producers based on publication output, the interest in this subject is still intense across the world, in countries like Germany, Spain, India, Italy, Malaysia, Sweden, etc.

The concentration on women's leadership subject in a variety of areas indicates a partnership study perspective in which academics from around the world look for learning more regarding women's leadership.

Figure 4. Publication trends through journals



Source: Scopus (2024).

The journal allocation demonstrates the comprehensive kind of women's leadership, reaching fields such as management, medicine, sociology, psychology, and more. This heterogeneous image accentuates the complex approach needed to figure out and address women's leadership topics in various fields of work.

Moreover, the large variety of journals publishing on female leadership displays the validation of its value and relevance over academic subjects.

This approach aims to understand the obstacles and benefits managed by women in leadership positions, contributing to the promotion of gender balance and organisational productivity.

Table 2. Allocation of articles in academic journals

Position	Journal name	Number of documents
1	Gender in Management	64
2	Leadership Quarterly	34
3	Academic Medicine	33
4	Frontiers in Psychology	30
5	Sex Roles	30
6	Plos One	27
7	Gender Work and Organization	24
8	International Journal of Environmental Research and Public Health	24
9	Journal of Women’s Health	22
10	Educational Management Administration and Leadership	20

Source: data processing after Scopus (2024).

Table no. 2 offers a hierarchy of journals based on their publication count, focussing on those that have made major contributions to the research of female leadership.

Managing journals in this domain play a central role as fundamental platforms for spreading research, underscoring their conceptual target and influence within the academic sector.

Table 3. Top 10 authors and institutions making outstanding input in female leadership

Authors			Rank	Institution		
Author name	Papers	%		Institution name	Papers	%
Mavin, S.	12	0.40%	1	Gender in Management	64	2.13%
Carnes, M.	10	0.33%	2	Leadership Quarterly	34	1.13%
Jagsi, R.	10	0.33%	3	Academic Medicine	33	1.10%
Ryan, M.K.	10	0.33%	4	Frontiers in Psychology	30	1.00%
Cook, A.	9	0.30%	5	Sex Roles	30	1.00%
Glass, C.	9	0.30%	6	Plos One	27	0.90%

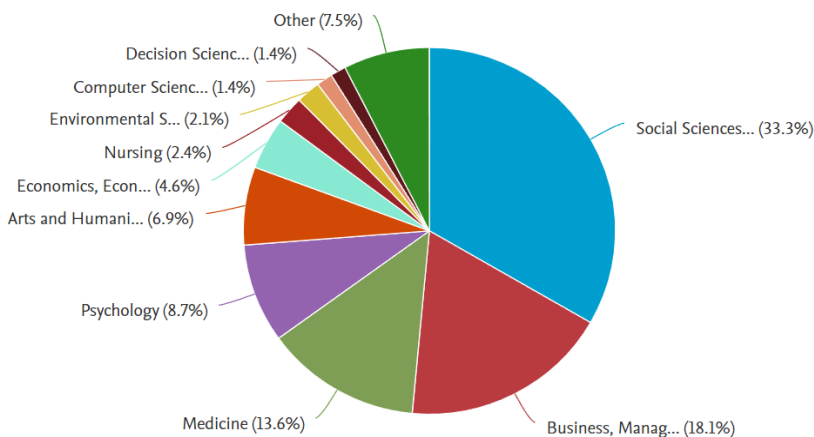
Authors			Rank	Institution		
Author name	Papers	%		Institution name	Papers	%
Hoyt, C.L.	9	0.30%	7	Gender Work and Organization	24	0.80%
Khosa, F.	8	0.27%	8	International Journal of Environmental Research and Public Health	24	0.80%
Spector, N.D.	8	0.27%	9	Journal of Women's Health	22	0.73%
Baxter, J.	7	0.23%	10	Educational Management Administration and Leadership	20	0.67%

Source: own processing after Scopus (2024).

Table 3 presents profound results on the prominent researchers and universities at the forefront of exploration in female leadership. Although no one writer is dominant, scholars such as Mavin S. and Hall C.M. differentiate themselves with remarkable participations, each having created over 10 papers. In particular, universities appear as meaningful research centres, presenting substantial research results in this branch.

The collective side of research in female leadership is underlined by the table's outcomes. In spite of certain authors generating a higher publication number, the percentages stay humble, suggesting that expertise share is characterized by a collaborative circuit of specialists.

Figure 5. Papers by domain



Source: Scopus (2024).

The diagram represents a network chart illustrating the interest fields about female leadership.

The largest area of interest is related to social sciences, with 33.3%. This indicates a focus on social problems and their impact on society about women leaders. The next area of interest is business and management, consisting of 18.1%. This shows an involvement in leading and managing organisations for women leaders. A major interest is also found in medicine at 13.6%. This shows concern for health and prosperity among female leaders. Psychology comes to light as another important area of interest with 8.7%. This points out interest in the understanding of interpersonal relationships for female leaders. Economics and econometrics are also exemplified with a combined 4.6% share. Arts and Humanities are presented similarly with 6.9%. The residual 7.5% includes.

Diversified fields of interest, like engineering, environmental, and computer science.

5. Conclusions

The paper is initiated with a network visualisation map showing the most commonly co-occurring keywords in articles about female leadership. Six different thematic clusters emerge, giving the key area of research in this field.

Those clusters emerge from themes directly related to female leadership and gender equity, to qualitative research methods, workplace events, employee opinions, educational support, emotional concepts.

Visualisation thereupon provides an important sense of the thematic emphasis and range of topics within research into female leadership, providing a signpost for future research and focussing for future exploration.

The collaborative nature of research is thus apparent, as evidenced by the small quantities of individual author contribution, pointing to a network of collaboration in it identifies academic circles within female leadership. It presents the diversified area of interest within the investigation of female leadership. Social Sciences come as the main focus, denoting a concern for social problems. Business & Management stays close, showing an interest regarding organizational leadership. Medicine also attracts much attention, suggesting a priority on public health. Psychology is significant in its emphasis on understanding the social factors.

Economics & Econometrics, Art & Humanities and several other fields contribute to the multidisciplinary study of female leadership. In general, the visualisation underlines the interdisciplinary kind of research in this area and highlights many and varied interests among female leaders.

To sum up, research into female leadership carried out with the reputable Scopus international database has provided significant findings on numerous facets of this critical domain. In the course of researching descriptive information such as publication years, institutions, authors, journals, and countries, we have established comprehensive understanding of the academic landscape surrounding female leadership.

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**National Examination in Romania between 2017 and 2023 –
A Microdata Analysis**

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DOI: 10.24818/ICISS/2024/035

Abstract

The National Examination in Romania holds significant importance for students, determining high school admissions and shaping future opportunities. Analysing 2023 results, it was found that despite passing grades, many students faced admission challenges, especially rural students. Disparities persist between rural and urban students, intensified by factors such as absenteeism and limited access to educational resources. The digitalisation of the 2024 National Examination reflects a changing educational landscape, presenting both opportunities and challenges. This paper highlights the interaction of sex, residency, and online teaching experience on National Examination results from 2017 to 2023, using microdata retrieved from data.gov.ro. Rural students and those who did not experience online teaching generally obtained lower scores compared to urban students and those who had online teaching exposure. The correlation between performance in the National Evaluation Exam and school dropout rates underscores the critical importance of education in societal inequalities. It is crucial to keep investigating ways to reduce educational gaps and make education more inclusive in Romania. While this study provides valuable insights, it is not without limitations. However, limitations, such as variations in examination difficulty and disruptions due to external factors like teacher strikes, should be considered in interpreting the findings. Future research should continue to explore strategies for mitigating these disparities and promoting educational equality in Romania.

Keywords: Education, National Examination, Average Score, Final Score, Secondary Educational Level.

JEL Classification: I200, I210.

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1. Introduction

Education is fundamental to societal development, contributing to the development and wellbeing of individuals, communities, and nations. The impact of events like the SARS-CoV pandemic has highlighted the need to adapt education by integrating new methodologies and technologies in order to nurture creative and critical thinking. Portuguese-Castro (2024) states that it is crucial to prioritise experiential learning opportunities, to prepare students for the dynamic and collaborative environments they will encounter in their future careers. For example, in business education, we need to shift from traditional teaching methods to innovative approaches to better meet students' evolving needs.

The academic performance across European countries is influenced by various factors such as books at home, school type, and location (Bonacini et al. 2024). By identifying these key factors and their implications, policymakers, and educators develop specific strategies, ensuring that students receive the support they need to succeed academically.

The National Evaluation Exam in Romania is extremely important for students because, based on the final score, high school admissions are decided. Analysing the results for the 2023 examination round, Mirica et al. (2023) revealed that many students who were not admitted in a high school competed outside of their county and had a passing grade in their evolution. This underscores the need for a deeper understanding of the implications of the National Examination results, especially concerning issues of educational equity and access.

2. Problem Statement

The results of the 2020 National Evaluation Exam in Romania generated a heated debate among researchers during the pandemic. Several studies pointed out the gap between rural and urban students in terms of absolute performance (Ceban et al., 2021a), relative performance (passing or failing the exam as well as absenteeism (Ceban et al., 2021b). Taking into account a larger time frame (2019- 2021), Ceban et al. (2023) concluded that the performance gap at this exam between urban and rural students deepens. These discrepancies are not only observed in education. Fina et al. (2021) point out that in counties with a high share of rural population, especially from south-east and north-east, people often do not have access to public infrastructure (like the sewage system), there is a low share of workers in knowledge-based domains and high share of workers in agriculture; moreover, such counties are characterised by high rates of school dropout and negative migration.

Achieving low results at the National Evaluation Exam or not attending the exam is directly linked to the school dropout rate (Ministry of Education, 2021). Reducing school dropout rate and thus increasing the level of education is essential, as the level of education is one of the main determinants of wage inequalities in Romania (Petcu, 2022). Moreover, increasing the educational level has a significant impact on child and maternal health: in a survey among pregnant women during

the pandemic in Romania, Sandu et al. (2023) concluded that women with a low educational level often neglect healthcare due to financial reasons.

In 2024, the simulation of the National Evaluation Exam included a strong digitalised component: students' papers were scanned, anonymised and introduced in an online platform, where evaluators could access; moreover, each teacher can discuss with the students the results in the classroom (Ministry of Education, 2024). This approach permitted an in-depth analysis by item and formulating suitable recommendations (National Centre of Policies and Evaluation in Education, 2024a, 2024b).

3. Research Questions / Aims of the Research

This paper aims to answer the following research questions:

- Is the interaction between sex, area of residency, and whether or not the student experienced online teaching relevant for explaining differences in final scores at the National Evaluation Exam?
- Is the interaction between sex, area of residency, and whether or not the student experienced online teaching relevant for explaining differences in the Average Score for the Secondary Educational Level?
- Is there a difference Score at the National Evaluation Exam by subject and is the interaction between sex, area of residency, and whether or not the student experienced online teaching for explaining differences in these scores respectively?

4. Research Methods

For the purpose of this paper, microdata comprising the results from the National Evaluation Exams were retrieved from the <https://data.gov.ro/> portal (accessed March 15th). The chosen time frame is 2017-2023 in order to cover equally the pre-pandemic and the post-pandemic period: students who took this exam in 2017, 2018, and 2019 did not experience online teaching, while students who took the same exam in 2021, 2022, and 2023 experienced at least one semester of online teaching. Students who participated in the examination in 2020 will be considered as if they have gone through a semester of online school, even if it was only for a shorter period of time.

The final database comprises several raw variables: year of the examination, sex (male/female), area of residency (urban/rural), Final score at the National Evaluation Exam, Final score at the Maths exam, Final Score for the Romanian Language Exam, Average Score for the Secondary Educational Level. Only data for those students who were present during all stages of the examination were considered. Eight categories of students were defined based on a combination of Sex, Area of residency, and whether or not the student experienced online teaching at least one semester. These categories were marked into a new variable (Combined_category) and are as follows:

- Combined_category_1: female student, from rural area, who experienced at least one semester of online teaching;
- Combined_category_2: female student, from urban area, who experienced at least one semester of online teaching;
- Combined_category_3: female student, from rural area, who did not experience online teaching;
- Combined_category_4: female student, from urban area, who did not experience online teaching;
- Combined_category_5: male student, from rural area, who experienced at least one semester of online teaching;
- Combined_category_6: male student, from urban area, who experienced at least one semester of online teaching;
- Combined_category_7: male student, from urban area, who did not experience online teaching;
- Combined_category_8: male student, from urban area, who did not experience online teaching.

In order to answer the research questions, the One-Way ANOVA test is used as follows:

- For the first question, the null hypothesis is that there is no difference in the means for the Final Score at the National Evaluation across the defined categories;
- For the second question, the null hypothesis is that there is no difference in the means for the Average Score for the Secondary Educational Level across the defined categories;
- For the third question, the null hypothesis is that there is no difference in the means for the Score at the National Evaluation Exam by subject (Maths and Romanian Language) and by category;
- The significance level is 1%.

According to the Pennsylvania State University (2024), ANOVA assumes that series are normally distributed, that these distributions have the same variance and the observations are independent. However, according to the same source, minor violations of the first two assumptions are acceptable, as the sampling distribution of the test statistic is quite robust, especially for large sample sizes; moreover, as a general rule of thumb for equal variances, the ratio between the largest standard deviation and the smallest standard deviation should be between 0.5 and 2. Also, according to Lumley et al. (2002), the least squares linear regression (which incorporates ANOVA) does not require any assumption of normality if sample sizes are over 500 observations.

5. Findings

As students are not allowed to collaborate at this exam, observations can be considered independent. The number of observations in each combined category varies as follows: in the first category fall 113960 observations; in the second category, 179513 observations; in the third category, 94957 observations; in the fourth category, 125999 observations; in the fifth

category, 111148 observations; in the sixth category, 181837 observations; in the seventh category, 85866 observations; in the eighth category, 122864 observations. Thus, no normality tests were necessary. Table 1 displays the descriptive statistics for the Final Score at the National Evaluation, the Average Score for the Secondary Educational Level, the final score in Maths and the final score in Romanian Language by category. The average score for the secondary educational level is at least 1.5 points higher compared to the final score at the National Evaluation, while the variance is at least 3 times lower. This may suggest that the final exam better reflects the differences between students' competencies compared to the evaluations performed during the secondary school cycle. Moreover, the final score in Maths is considerably lower on average compared to the final score in Romanian Language, yet the variances are similar. For each variable, the ratio between the largest standard deviation on a category and the smallest standard deviation of a category is between 0.5 and 2, therefore equal variances can be assumed.

Table 1. Descriptive statistics for the Final Score at the National Evaluation, the Average Score for the Secondary Educational Level, Final Score for Maths National Evaluation Exam, Final Score for the Romanian Language Exam by category

	Final Score at the National Evaluation		Average Score for the Secondary Educational Level		Final Score for Maths National Evaluation Exam		Final Score for the Romanian Language Exam	
	Average	Variance	Average	Variance	Average	Variance	Average	Variance
Combined category 1	6.17	3.52	8.79	0.81	5.56	4.20	6.69	4.11
Combined category 2	7.55	3.15	9.21	0.52	7.11	4.21	7.94	3.09
Combined category 3	5.95	3.60	8.72	0.81	5.03	4.22	6.78	4.24
Combined category 4	7.40	3.34	9.11	0.58	6.67	4.77	8.06	3.06
Combined category 5	5.42	3.60	8.28	1.03	5.23	3.97	5.54	4.46
Combined category 6	7.07	3.63	8.88	0.75	6.93	4.32	7.16	3.89
Combined category 7	5.16	3.75	8.22	0.99	4.61	3.87	5.62	4.82
Combined category 8	6.86	3.90	8.74	0.81	6.39	4.91	7.28	3.99

Source: designed by the authors using data from data.gov.ro.

Table 2 contains the results of the ANOVA test for the Final Score at the National Evaluation by category, the Average Score for the Secondary Educational Level by category and the Score at the National Evaluation Exam by subject (Maths and Romanian Language and category). All the tests show significant results at 1%, resulting in the rejection of the null hypothesis. Thus, there are significant differences in these scores by the selected categories.

Table 2. Results of the ANOVA Test

Tested series	ANOVA F value
Final Score at the National Evaluation by category	27611.47*
Average Score for the Secondary Educational Level by category	19783.75*
Score at the National Evaluation Exam by subject (Maths and Romanian Language) and category	30865.52*

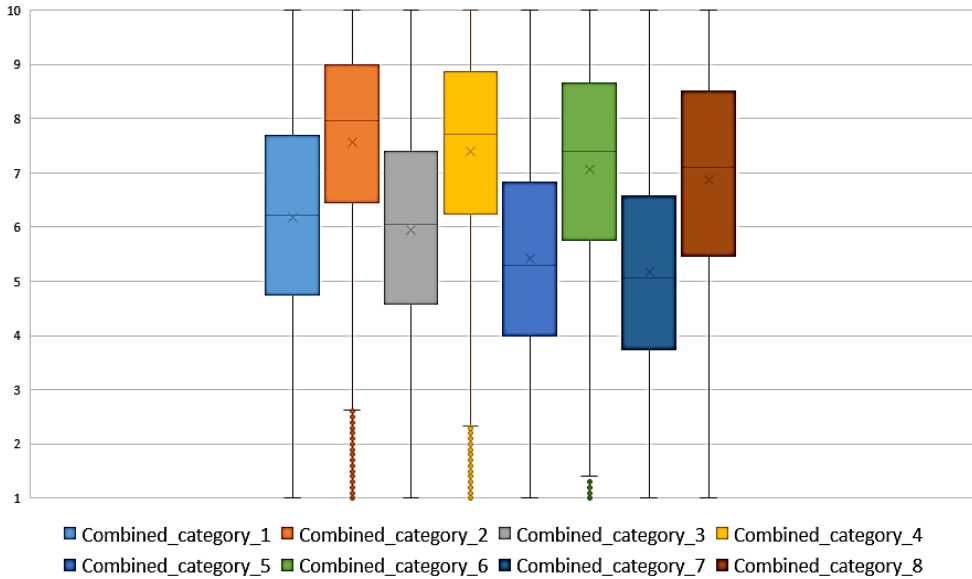
Source: designed by the authors using data from data.gov.ro.

The results of the ANOVA test should be interpreted together with the boxplots for the Final Score at the National Evaluation by category (Figure 1), the Average Score for the Secondary Educational Level by category (Figure 2) and the Score at the National Evaluation Exam by subject (Maths and Romanian Language) and category (Figure 3).

The Final Score at the National Evaluation is considerably lower for students from rural areas compared to urban areas and lower for male students compared to female students. However, the median for this variable computed for students who did not experience online teaching is a little lower compared to students who experienced at least one semester of online teaching.

This may be explained by the fact that during the pandemic years (2020, 2021, and 2022) the exercises had lower difficulty and only in 2023 they were of increased complexity (see the declaration of the Secretary of State in the Ministry of Education Sorin Lixandru, 2023). Also, in 2021, the subjects were restructured so that they are similar to the PISA tests, while in 2020 the exam curriculum was significantly reduced, both measures having a considerable impact on high school classifications (Firescu et al., 2022).

Figure 1. Boxplot for the Final Score at the National Evaluation by category

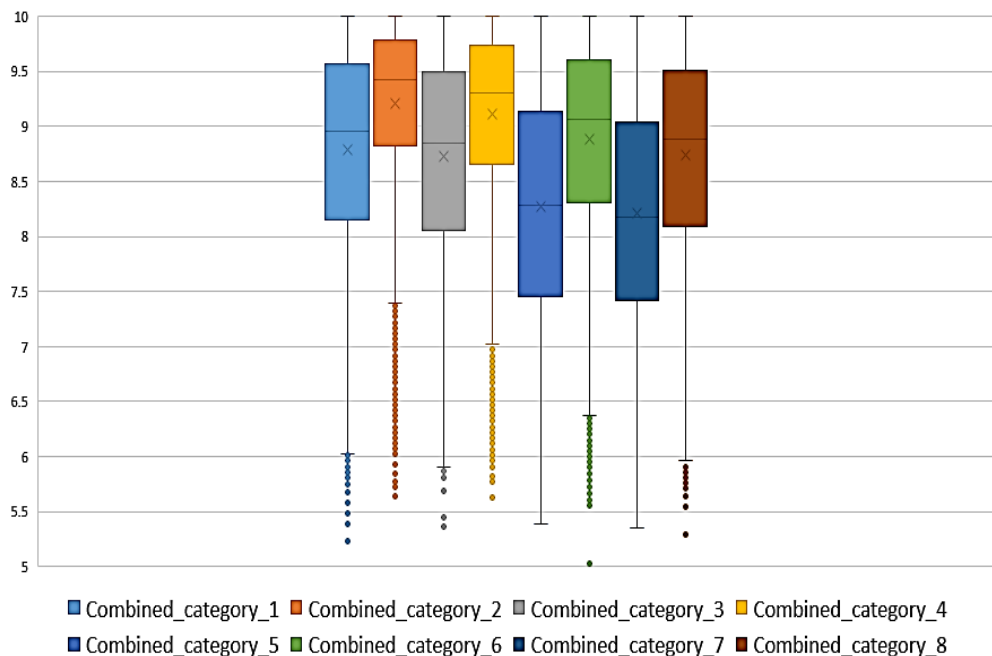


Source: designed by the authors using data from data.gov.ro.

Considering the average score during the secondary educational level, the median was lower for the students in rural areas compared to urban areas and higher for female students compared to male students. However, the scores are lower for those students who did not experience online teaching compared to those who did. This may be due to the lack of adequate assessment methods and the increased prevalence of cheating.

For example, Malik et al. (2023) concluded that during the pandemic, approximately 60% of the Pakistani students admitted that they cheated in online assessments. Moreover, the research of Comas-Forgas et al. (2021) suggests that there was a significant increase in the Google searches related to exams cheat sheets during the lockdown period.

Figure 2. Boxplot for the Average Score for the Secondary Educational Level by category

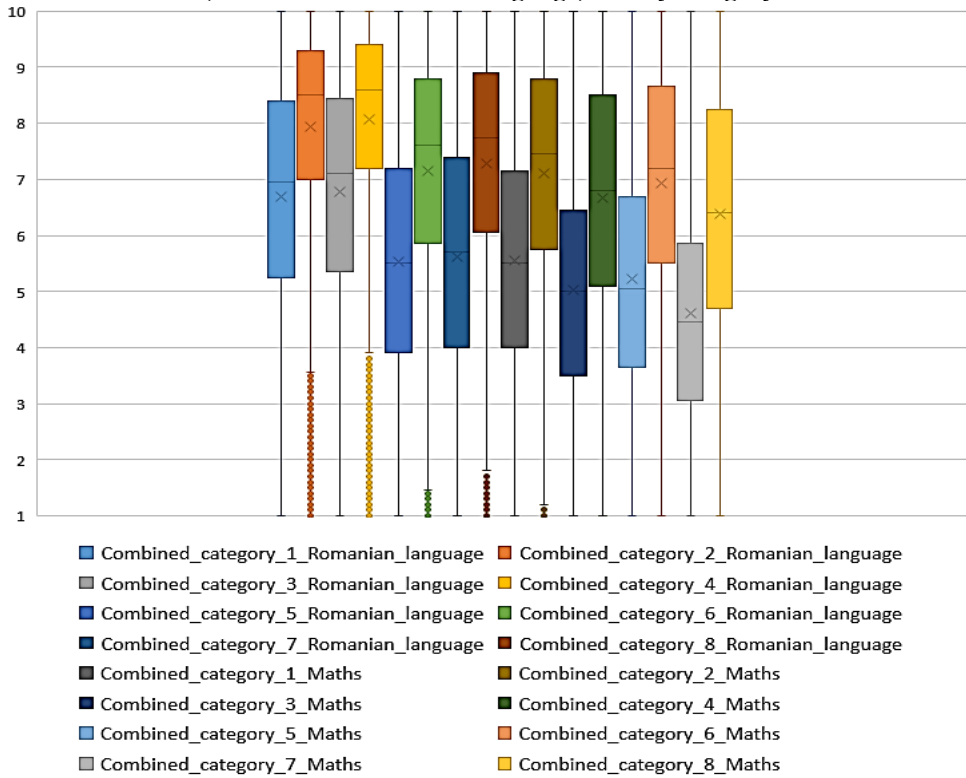


Source: designed by the authors using data from data.gov.ro.

The results in Figure 3 reveal that the score in Maths is lower compared to the score in Romanian Language and especially for pupils who experienced online teaching.

This result is not surprising because even in the higher education area in very advanced countries like Norway “advanced technology and the Internet were not entirely successful in supporting many students and lecturers to adjust to the lockdown environment” while “some mathematics lecturers were not aware of several challenges that students experienced following the switch” (Radmehr & Goodchild, 2022, p. 581).

Figure 3. Boxplot for Score at the National Evaluation Exam by subject (Maths and Romanian Language) and by category



Source: designed by the authors using data from data.gov.ro.

6. Conclusions

This paper analysed the results at the National Evaluation Exam as well as the results obtained during the secondary educational level on the six-year time frame from different perspectives: area of residency, sex, and the experience of online teaching. The results are generally in accordance with previous literature.

There are some limitations to this research. First, the difficulty level of the subjects in the evaluation is adapted to the students' cohort level of competency (see for example the declaration of the Minister of Education, Ligia Deca, 2024), which is not necessarily comparable across years. Second, the number of semesters on online teaching varies for the 2020-2023, yet, in order to have approximately comparable categories in terms of number of observations, we decided to merge this time frame and consider it a period when students experience at least one semester of online teaching. Moreover, in 2023 a general strike among the teachers occurred so that the lost classes were generally reduced to 25 minutes in order to be recovered, generating low quality lessons (see the declarations of Bodea, 2023). This strike was not accounted for in this paper.

Acknowledgment

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**Exploring the Economic Effects of Sustainability
in a Knowledge-Based Circular Economy**

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Abstract

Given the rapid decline of Earth's resources, one of the world's priorities is to improve the circular economy of waste, given the huge quantities produced at the micro-level by each citizen. By creating new opportunities and jobs in the recycling and remanufacturing industries, the transition to a circular economy encourages innovation in the way products are made and increases recycling capacity. In a functioning circular economy, waste management must be the last link in a supply chain to feed the secondary materials market and provide raw materials for recycling companies. Aligning to the goals of sustainable development, it is important to establish solid waste management strategies that improve waste collection, recycling, and recovery processes. Based on data collected from EUROSTAT, from 2000 to 2022, for countries of the European Union, this study wants to investigate ways to optimise recycling processes and identify potential improvements at both macro- and microeconomic levels, quantitatively. Furthermore, this research provides an extensive overview of the current state of waste management in Romania, examining the recycling opportunities available to individuals for their active participation in the circular economy, within the framework of sustainable development. To analyse each person's wishes and perceptions to take part in a more sustainable community, a questionnaire was launched in April 2024, with respondents of all ages (over 18), categorised on age buckets (18-24, 25-24, 35-44, 45-54, 55+), genders, regions, environment and level of education. The results of the research are analysed and discussed in this paper.

Keywords: sustainable development, circular economy, recycling, economic effects, knowledge.

JEL Classification: I0, M0, O1, R1, Q5.

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1. Introduction

The 2030 Agenda for Sustainable Development (United Nations, 2015) provides a new global framework that contributes to reducing poverty, fighting inequality, and combating climate change. The agenda includes 17 goals and 169 targets. Since 1990, the EU has introduced waste policies and targets. As the EU aims at sustainability, each member state, including Romania, must tailor these policies to their unique challenges. The issue of municipal waste management in Romania has gained attention mainly due to the need to meet the accession criteria and align with the European standard, and the country's waste generation rate is increasing. This increase is due to the degree of urbanisation, industrialisation, and the behaviour of the population.

For the present study, we started from the detailed analysis of data concerning the waste situation in Europe, based on official statistics provided by the competent institutions of the European Union (Eurostat, 2024) and we followed with the statistics for Romania. For both the European Union and Romania, the analysis was performed in a comparative and quantitative manner, highlighting how Romania is one of the biggest waste producers with very few ways of responsibly recycling in the European Union. The main method of waste disposal in Romania is landfill use, with more than 90% of municipal waste going to these sites each year.

A questionnaire was launched in April 2024. The results indicated public readiness to improve waste management practices. However, there is a lack of accessible information on recycling processes, including locations, benefits, and methods, leading to public difficulty in engaging with sustainable practices. Some participants were also demotivated due to the lack of support from the authorities. Very few campaigns reward households for correctly managing waste, which is happening on a national level. It is a guarantee and return system, which involves various stakeholders like citizens, producers, importers, and retailers, especially in the HoReCa sector (Hotel/Restaurant/Café). The system aims to enhance the efficiency and quality of materials' collection processes, such as packaging. Until now, this has been the most motivating for citizens, as machines collecting through this programme are offering coupons that can be used for shopping in supermarkets or converted to cash.

In the first part of the article, we performed a comparative analysis between Romania and the EU, focusing on the Sustainable Development Goal 11. Romania's progress and challenges in urban sustainability are analysed and compared to EU standards. Then, the article is contouring the responses from a questionnaire, first mapping out the fixed-response questions. These provide a structured insight into public opinion. Also important are the open-ended responses, which give us an image of the actual needs and desires of the population. It is through these honest responses that we gain a deeper understanding of what truly motivates people to walk the path towards sustainability. Towards the conclusion, the article proposes how individuals and companies can improve their recycling efforts, and the necessity of support from authorities in this mission.

2. Problem Statement

There is a difference between countries that joined the EU earlier before 2000 and countries that joined in the past 20 years, Western and Central Europe having the best results when it comes to managing waste (Marković et al., 2023). On average, in the EU, in 2016, 49% of waste was recycled - 4% in Romania (European Environment Agency, 2024). In Romania, most of the waste generated is thrown into landfills. On the other hand, it was noted that this situation is actually an opportunity (Nițu, 2024) for the future, because with the help of a pro-attitude of the population, proper waste management can be achieved along with some circular economy goals (Agovino et al., 2023). When questioned, Romanian respondents from earlier researches are aware of the impact of poor waste management and agree that circular economy business models are desirable, but the attitude towards a change done by each individual is a bit reserved. (Lakatos et al., 2016).

Recent research discovered that high-income countries have a bigger capacity of recycling (over 50% of waste), while low-income countries are able to recycle almost a quarter of that (16%) (Shovon et al., 2024). Furthermore, lower-education citizens (middle school, high school) were shown to be less interested in recycling and waste management than those with higher education (university and above), demonstrating a direct correlation between the knowledge individuals have and their attitude toward the environment (Pelau & Chinie, 2018). The social and demographic attributes were included in numerous studies, where it was also noted that sometimes results based on the level of education, income, and age contradict each other (Kirakozian, 2016). On a microeconomic level, the most important factors seem to be the size of the household, age, gender, and income (Rybova, 2019). Women are more likely to adopt the mentality 'reduce, reuse, recycle' than men, and marital status also counts, married couples supporting the environment more, because of habits that are developed together over time and for future generations (Ahmadi et al., 2022). It has been shown that people with sustainable behaviours that are compensated (coupons, discounts) are far more likely to adopt a healthier attitude related to sustainability (Shevchenko & Laitala, 2019) – especially in countries where the legislation is not clear, because in these cases emerging recycling companies will become a part of circular economy, helping both institutions and citizens to align to a new era of reusing waste.

3. Research Questions / Aims of the Research

The purpose of this article was to explore whether a shift in the general attitude towards waste management could begin with each of us. Why do people not recycle more? What would make them recycle more? These were the foundational questions for this article, helping us to outline a path to a cleaner environment. Analysing the responses, we gathered relevant information that sheds light on citizens' attitudes towards recycling: how often they manage their waste sustainably, what would motivate them, and what measures competent institutions should take to support the community in this mission.

4. Research Methods

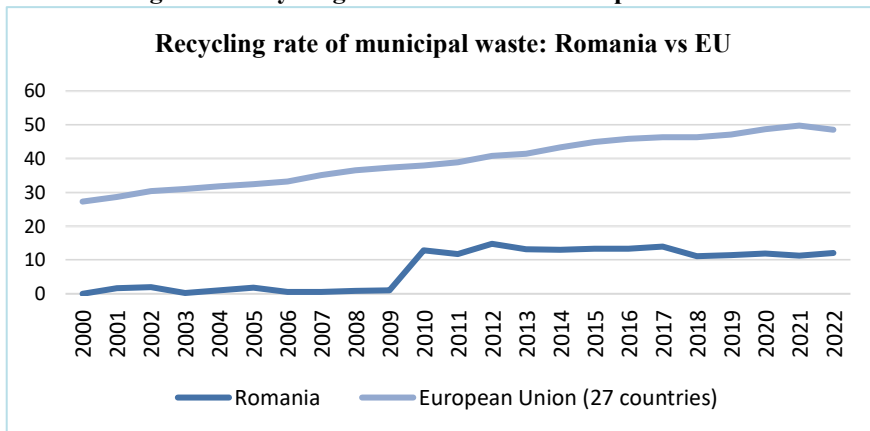
The research is based on the perception of the respondents, a survey being launched in April 2024 and gathering 252 responses from Romanian participants. Approximately 72% of the people who replied are women and 28% are men. 17% live in the rural area and 83% in the urban area. The level education (last finished) is split between 5 categories: 6% of respondents finished only middle school, 22% high school, 5% post-secondary education, 44% graduate studies, and 23% post-graduate studies. In the second part of the questionnaire there are seven questions, with the possibility of answering freely. Both the statistical information and the questionnaire data have been analysed in Microsoft Excel, SPSS 26.0.0.0 and EViews 10, offering us a clearer view of the economic effects of sustainability at a microeconomic level.

5. Findings

The country is placed in the bottom positions in the European Union when it comes to waste recycling, having a municipal waste recycling rate of just 11.9%, compared to the EU average of 48.7%. An improvement was occurring until 2017 (Aceleanu et al., 2019), and since then the percentages did not improve considerably.

Basic Descriptive Analysis, frequency, and linear regression were used to analyse the statistical data collected from EUROSTAT and the survey responses.

Figure 1. Recycling rates for Romania compared to the EU



Source: Eurostat, 2024, own contribution.

In 2020, there were 27 countries in the EU. 4,256,889 tonnes of household waste and 141,364,457 tonnes of total waste were generated in Romania only, 2.09% respectively, 6.56% of the total generated in the EU. The most concerning is the recycling rate of municipal waste. This is influenced by many factors, including the recycling infrastructure, which is limited, regulatory issues, citizen awareness and participation, and financial will.

Table 1. Waste rates for Romania compared to the EU

Indicators	Unit of measure	2020	
		Romania	European Union
Generation of waste by households	Tonnes	4,256,889.00	203,430,000.00
Generation of total waste	Tonnes	141,364,457.00	2,153,950,000.00
Circular material use rate	Percentage	1.50%	11.60%
People employed in circular economy sectors	People	91,467.00	4,232,633.00
Municipal waste recycling rate	Percentage	11.90%	48.70%
Waste generation	Kg/capita	4,815.00	7,338.00
Generation of packaging waste	Kg/capita	116.38	177.87
Generation of municipal waste	Kg/capita	290.00	519.00
Generation of plastic packaging waste	Kg/capita	24.95	34.55
Average years in school	Years	11.4	
Average net income	EUR	4,589.34	14,979.20

Source: Eurostat, 2024, own contribution.

Focusing on the public awareness of Romanian people, our questionnaire investigated the responses and it has successfully highlighted the level of public involvement regarding recycling. Analysing the responses revealed that a significant majority of the participants acknowledge the importance of recycling but often lack specific knowledge about proper recycling practices. When asked about what materials can be recycled, 92.4% of respondents mentioned paper, cardboard, and plastic, 74.60% mentioned glass, and 59.52% mentioned metal and aluminium. Less than 5% mentioned food and fibres, electronics, wood, rubber, batteries, or food scraps. Of the 17.06% respondents from rural areas, 76% had a recycling system at home, whereas in urban areas, of the 82.94% participants, 73% did. Most people who recycle at home have a system for paper (55.15%), plastic (70.63%), glass (57.93%), and organic waste (26.19%).

Gender plays a role in the discipline of waste management as a habit: significantly more women than men recycle their waste daily or weekly, but added up, 75% of respondents recycle at least once a week. Interesting is that the youngest generation does this more than anyone else, even though older people are on average more used to recycling: people in between 18-44 years old recycle three to four times as much as people over the age of 45.

To analyse EUROSTAT data, we have compiled indicators from Table 1. *Recycling rates for Romania compared to the EU* and, based on multiple panel regressions, the dependable variable “Generation of packaging waste per capita” has provided the most relevant correlations with the other indicators. Periods 2014, 2016,

2018, and 2020 were taken into consideration for 23 EU countries, with a total panel observation input of 92.

Table 2. Panel Least Squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-177.475500	226.289700	-0.784285	0.435800
ANNUAL_NET_EARNING	-0.005400	0.001800	-2.999930	0.003800
AVG_LIFE_EXPECTANCY	-2.203674	2.610739	-0.844081	0.401800
AVG_YEARS_IN_SCHOOL	49.281720	8.007826	6.154194	0.000000
PERSONS_EMPLOYED	-0.000075	0.000073	-1.035167	0.304500
CIRCULAR_MATERIAL RATE	-1.134983	0.635514	-1.785927	0.078800

Source: EViews, own contribution.

The analysis identified the statistically significant predictors of packaging waste generation per capita: the average years in school and the annual net earnings per capita. There is a strong inverse association between the creation of packaging trash per capita and yearly net earnings, as indicated by the coefficient of -0.0054 with a p-value of 0.0038. This shows a correlation between decreased packaging waste creation and increased earnings. There is also a positive correlation between the average years of schooling and the generation of packaging trash, as indicated by the coefficient for the average years in school, which is 49.28172 with a p-value of 0.0000.

Table 3. Panel Least Squares

Cross-section fixed	Values	Cross-section fixed	Values
R-squared	0.976485	Mean dependent var	149.944500
Adjusted R-squared	0.966565	S.D. dependent var	43.555610
S.E. of regression	7.964253	Akaike info criterion	7.233594
Sum squared resid	4059.477000	Schwarz criterion	8.001094
Log likelihood	-304.745300	Hannan-Quinn criter.	7.543363
F-statistic	98.433150	Durbin-Watson stat	2.022225
Prob(F-statistic)	0.000000		

Source: EViews, own contribution.

The model explains roughly 97.65% of the variation in the dependent variable, as indicated by the R-squared value (0.976485). The Adjusted R-squared (0.966565) accounts for approximately 96.65%. The Durbin-Watson indicator (2.022225) is close to 2, indicating that there is no significant autocorrelation in the residuals of the regression model. This suggests that the residuals are independent.

Table 4. Hausman Test Results

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	32.511789	5.000000	0.000000

Source: EViews, own contribution.

The Hausman test results indicate a significant difference between the fixed- and random-effects models. With five degrees of freedom, the Chi-Square Statistic is 32.511789, and the p-value is 0.000000, which implies that the random effects model is inappropriate for this data set.

For the responses of the questionnaire analysis, we have taken into consideration as dependent variable for the below statistical analysis the age group of the respondents. For each, a value from 1 to 5 was assigned.

Table 5. Age intervals

Age					
	Values (age)	Frequency	Percent	Valid %	Cumulative %
Valid	18-24	86	34.1	34.1	34.1
	25-34	54	21.4	21.4	55.6
	35-44	54	21.4	21.4	77.0
	45-54	40	15.9	15.9	92.9
	55+	18	7.1	7.1	100.0
	Total	252	100.0	100.0	

Source: SPSS, own contribution.

Table 6. Descriptive statistics

Statistics		
N	Valid	252
	Missing	0
Mean		2.40
Median		2.00
Mode		1
Std. Deviation		1.295
Variance		1.676
Skewness		0.456
Std. Error of Skewness		0.153
Kurtosis		-0.976
Std. Error of Kurtosis		0.306

Source: SPSS, own contribution.

There are no missing values among the 252 valid entries in the dataset. The average age group of the respondents is 2.40, which suggests that they are generally between the ages of 25 and 34, with a little emphasis towards younger age groups. The median age code is 2.00, corresponding to the 25-34 age bucket, meaning that at least half of the respondents fall within that range of ages. The dataset's mode 1 indicates that the age group that occurs most frequently is

18 to 24 years old. With a standard deviation of 1.295, the distribution around the mean age code is modest.

Conducting a linear regression analysis offers valuable insights into the relationship between age and recycling-related attitudes and behaviours. The impact of individual actions, financial contributions, participation in recycling events, the existence of home sorting systems, the inclusion of recycling education in school programmes, attitudes towards recycling, and the frequency of recycling were all assessed as a function of age using ANOVA. The predictors used are the closed-ended questions.

Table 7. ANOVA

ANOVA					
Indicators	Sum of Squares	df	Mean Square	F	Sig.
Regression	46.360	8.000	5.795	3.762	.000 ^b
Residual	374.355	243.000	1.541		
Total	420.714	251.000			

Source: SPSS, own contribution.

The ANOVA table indicates a significant effect of the predictors on age, with an F-value of 3.762 and a p-value of .000. This suggests that the attitudes towards recycling, accessibility of recycling information, and participation in recycling events significantly vary with age.

Table 8. Coefficients of linear regression

Coefficients ^a							
Questions	Understandardised		Standardised		Sig.	95% Confidence interval for B	
	Beta	Std. Error	Beta	t		Lower bound	Upper bound
(Constant)	0.104	0.930		0.112	0.911	-1.729	1.937
Do you have a sorting system at home?	0.581	0.228	0.197	2.553	0.011	0.133	1.029
Do you consider information related to recycling is easily accessible?	-0.055	0.087	-0.039	-0.633	0.528	-0.227	0.117
How often do you recycle?	0.494	0.115	0.332	4.293	0.000	0.267	0.721
Do you think individual actions can have an impact on recycling?	-0.336	0.139	-0.156	-2.416	0.016	-0.610	-0.062
Have you ever participated in a recycling event?	0.166	0.160	0.064	1.043	0.298	-0.148	0.481
Do you think education related to recycling should be included in school programmes?	0.352	0.501	0.045	0.703	0.483	-0.634	1.338

Coefficients ^a							
Questions	Understandardised		Standardised		Sig.	95% Confidence interval for B	
	Beta	Std. Error	Beta	t		Lower bound	Upper bound
Are you available to financially contribute to recycling solutions?	0.035	0.107	0.020	0.323	0.747	-0.176	0.246
How do evaluate recycling in the matter of sustainable development?	-0.050	0.092	-0.033	-0.539	0.590	-0.230	0.131

Source: SPSS, own contribution.

The regression analysis coefficients table illustrates how different factors affect age. Among the important predictors are the information accessibility – the results show that older people are more likely to find recycling information easily available (B = 0.196, p = 0.015). This relationship is positive and significant, and the recycling frequency is also positive and significant (B = 0.226, p = 0.033 indicate that recycling is more common among older people). The impact of individual activities on recycling, the presence of a sorting system at home, financial donations, and involvement in recycling events were not significant predictors.

In rural areas, information about sustainability and ways of recycling is unavailable or partially available, while in urban or more developed areas, information is more available. A common ground was found when researching how people would like to receive information related to the environment, sustainability, recycling, reusing, and social media.

Table 9. Analysis on how people would like to receive information

Responses	Percentage
Others	1.19%
Public campaigns and social media	94.44%
Public campaigns	40.47%
Social media	21.42%

Source: Respondent replies, 2024, own contribution.

Almost everyone, no matter the gender, age, and level of education agreed that this is the most accessible way, along with public informing campaigns performed by authorities either online (mail), on TV, or in different means of transports.

In Romania, at the beginning of 2024, RetuRO (RetuRO Sistem Garanție Returnare S.A., 2023) was implemented, based on a return or deposit system. This implies retailers to ask for a 0.50 RON guarantee for every bottle of glass or plastic they sell, motivating the buyer to return the bottles in exchange for the guarantee back as coupons or cash. This approach not only promotes recycling, but

also supports sustainable practices in the beverage industry by reducing the need for new glass production. The project was successful, and people all over the country have started collecting all their bottles for return.

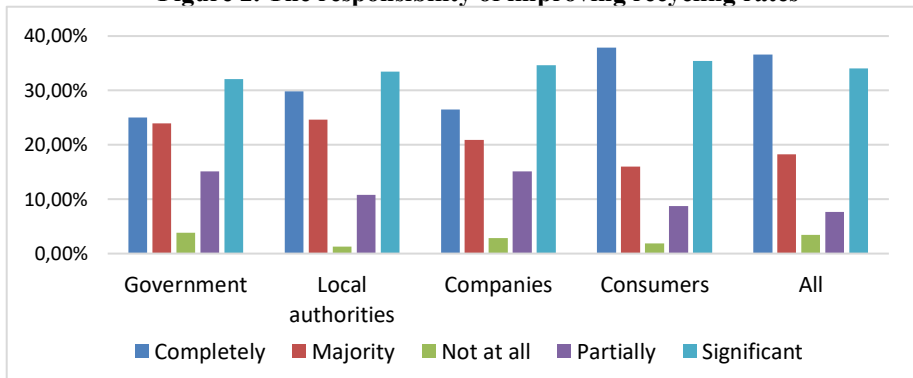
The changes we are making now are the future we will live in tomorrow: 97.22% agreed that the way we see our environment starts from a very young age - only 2.78% of respondents consider that education for sustainability should not be implemented in schools. 76.98% found the matter of reinforcing and teaching people about sustainable development to be urgent and very important.

People who do not recycle or have separate waste systems at home mentioned that waste disposal is not very accessible: there are not enough sorting points; if they have a few in their community, they are difficult to access because of the distance. Many noted that the sorting points do not offer enough categories of recycling, lacking textiles containers, separate containers for paper, cardboard, plastic. Having these included in a potential recycling system would also increase the rates in both urban and rural areas, and the ease of it would also stimulate older generations to participate.

More than half of the respondents said they had never participated in a movement to help the environment, highlighting the issues in the education systems. Participants were, though, very responsive to contributing financially to these matters: 75% are willing to help the community they are a part of if they consider the amount acceptable. Here also lies the power of example: A community where many properly manage waste will also encourage others who do not, while one that does not act for the environment is hard to educate and encourage for the better.

To reinforce eco-friendly behaviours, the questionnaire helps us see what can improve the mentality of “reduce, reuse, recycle”: more recycling points, more containers at existing points, education in schools, flyers, modern technologies, and also providing incentives and even applying fines to people who do not respect this. Besides the legal reinforcement of all categories mentioned, people aged 18-34 are excited to act for a more sustainable environment by selectively collecting waste, but if they receive something in return.

Figure 2. The responsibility of improving recycling rates



Source: Respondent replies, 2024, own contribution.

These actions are also beneficial for waste management companies. This means more material for them to process and recycle, giving birth to new materials to be used in industries such as fashion, engineering, eco-friendly housing, and furniture, etc. This is a great opportunity for these companies to develop and extend more with the funds help from the National Recovery and Resilience Plan (PNRR, 2022), to help implement the projects that the authorities have, by the end of 2026 (Barac, 2022). Companies like Pakire Polymers, Italplast Group, RematHolding, and GreenTech are already dedicated to creating new raw materials ready to be shipped to production.

Table 10. Economic effects of business expansions

Business name	Revenue in 2022	Net profit in 2022
Pakire Polymers SRL	688,388.00	362,879.00
Italplast Group SRL	14,488,150.00	765,384.00
REMAHOLDING CO. SRL	556,269,071.00	8,044,074.00
ROMCARBON SA	265,048,639.00	51,471,690.00
SIGEMO IMPEX SRL	133,323,513.00	7,531,643.00
ECO RECYCLING C.N.E. SRL	2,184,850.00	1,856,756.00

Source: www.termene.ro, 2024, own contribution.

6. Conclusions

Romania is at the beginning of a new era of sustainable development. Now is the chance of people, companies, and public institutions to make a change for the better. People do not yet have the culture of collecting and recycling. Therefore, many business opportunities arise: a change of the education system starting from the most rudimentary levels when it comes to sustainability (preparing youth to face the challenge of reusing whatever they can as much as possible), the growth of companies that process waste into raw materials (significantly reduce waste), the expansion of businesses focused solely on waste collection (revenues from recycling, also reducing waste), the proliferation of consultancy, repair services (maintains a circular flow of materials, decreases consumption), and firms generating energy from waste (reduces environmental impact), the production of new packaging types (reusable packaging). All of this increases the availability of job opportunities and helps educate the general population.

To align people with healthier choices when it comes to producing waste and littering, this study has shown that if a more robust infrastructure is created, public perception about waste and recycling will change for the better, as many people are facing issues at the moment with waste disposal. The promotion of educational campaigns and ads on social media has a positive impact on recycling rates. 87.70% of the participants said that recycling by individuals has a beneficial effect on the environment, regardless of their place of residence.

We consider relevant the answers of the respondents, ideas that can be generalised at the country level - there is an impulse in the desire of the population to recycle.

Romania has great potential: if people, companies, and public institutions work together, waste management and circular economy rates will improve to align to the EU. Romania must use its resources to aid the efficiency and effectiveness of waste management systems. The greatest resources are people: The more stimulated an individual is to recycle, especially financially (or equivalent), the more involved in these actions they will be, and significant improvement will be noticed by all, including the people who are stimulated to do this for a better future for younger generations.

This study has provided information on the dynamics of waste management in Romania; however, it is not without limitations. Also, the questionnaire does not cover uniformly all regions in Romania. Future research should utilise the logistic regression to identify factors that influence the likelihood of participation in sustainable practices, exploratory factor analysis (EFA) to analyse the influences upon recycling and sustainability, and K-means clustering to identify distinct profiles of individuals who are more or less likely to engage in sustainable practices. Also, expanding the geographic scope to include a more representative sample from various regions across Romania would improve the overall findings.

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**Transformative Education: Economic and Political
Implications of the Conflicting Dynamics
within Traditional Schooling**

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Abstract

This paper delves into the conflictual nature of transformative education, exploring the intricate dynamics at the intersection of race and social class within educational structures, aiming to unravel the conflicts that shape and perpetuate educational, economic, and social inequalities. Drawing inspiration from influential thinkers such as Paulo Freire, Angela Davis, Ivan Illich, or Bell Hooks, the aim of this paper is to showcase the power dynamics and conflictual nature that lead to and are created by educational inequalities. The current scientific literature on the matter underscores the critical need to address conflicts within the educational system, shedding light on power dynamics and systemic oppressions present in traditional educational models, in a world affected by postcolonialism, immigration, or gentrification. Regarding this paper, the emphasis is placed on the intersectionality of race and class, and how they influence educational inequalities and lead to economic disparities. Moreover, critically analysing the current educational approaches contributes to understanding its flaws and how the field can or should improve in the future. The study examines how systemic educational inequalities contribute to conflict and sustain cycles of disadvantage, advocating for changes in traditional education to foster inclusivity. It challenges the Eurocentric views and will call for the emergence of an educational system that validates the diverse cultural experience of all races, this being motivated by the need of inclusive and equitable educational environments. Insights urge policymakers, educators, and researchers to address root causes of conflict for positive change. The paper contributes by synthesising ideas from transformative education, offering nuanced perspectives on the impacts of race and social class in the educational processes. This foundation informs future research and actionable steps toward creating more equitable and inclusive educational systems. The contribution lies in deepening understanding and provoking critical discourse on transformative approaches to traditional education amid systemic conflicts.

Keywords: education, inclusivity, inequality, conflict, economy.

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JEL Classification: I21, I24, I25, A20, J15.

1. Introduction

The discussion about (pervasive) unequal social relationships and (the need for) inclusive education is commonplace in today's world, especially with the advent of globalisation via trade, finance and, notably, knowledge, notwithstanding the plethora of assorted technological, ecological, and ideological acceleration/attenuation/alteration phenomena. But this forwarding march of globalisation, either viewed as emerging spontaneously or being project-designed by intergovernmental or corporate institutions/organisations, whilst by no means a syncope-proof process, accommodates cultures, nations, and even regions/continents at different points of societal development, the cooperation between them implying unsteady interactions and unbalanced positions in the world order.

In this vein, the context of this research is defined around the idea of globalisation, a state/process understood (positively and normatively) as a synergy of nations and not as a simple sum of solitary, secluded, sheltered societies. But this perspective is not always easy to observe in practice, since concepts such as "culture of silence", "Eurocentric views", and "non-inclusivity" are challenging the (hoped-for) solidarity between the world's nations and highlighting a bias towards more powerful, mainly occidental nations/states' needs, interests, and viewpoints. These biases are also heavily manifested within the educational field, the present research looking into how they inflict both the "civilised" and the "underdeveloped" world and how this impacts the configurations of the societal landscape.

Summing up, the present review essay will acknowledge and assess how the educational sector influences systemic inequalities and conflicts within our world, while also trying to understand what "transformative" actions might be required in order to combat all these social injustices. Moreover, it will delve into the economic implications of unequal educational opportunities and the interconnectedness of economic and educational dimensions. Not least, this research is meant to be followed by a "symmetrical" overview of the phenomenology of transformative education as seen from the "classical"/"conventional"/"conservative" perspective on education, screening and signalling the unintended and the unforeseen consequences of the "diversity-equality-inclusivity", top-down, public policies.

2. Problem Statement

The literature regarding education is vast and was covered by many important intellectuals throughout each era of human thought. Starting from the simplest storytelling, education had the scope of bonding human communities while trying to explain the biggest questions regarding life, afterlife, and even the creation of life. According to Emile Durkheim, school was a society in miniature, serving also as a place to socialise, developing their social solidarity and also specialist skills (Chapman, 2017). Thus, according to Karl Marx, via the educational processes, both nature and humans are active in a humanising process with the goal of achieving

their material and spiritual freedom, by posing questions regarding their being and by achieving praxis (Ferreira Jr. & Bittar, 2008). A more modern view on education is that of Paulo Freire, who saw the classroom as a place of potential social change, believing that students are more than passive recipients of knowledge, constantly switching their role with the educators in the process of knowledge sharing.

Considering these views, this paper will look, obviously not in an exhaustive manner, into how the modern and past classrooms forged the men of today, while also trying to understand how to better the men of tomorrow. One aim of the study will therefore be to underline the (cor)relation between education and social change, understood as the transformation of society's structure and institutions driven by economic, political, and cultural forces. The present themes will be the ones that gained momentum in the contemporary times, as landmarks for progress (iveness), that is, inclusivity, social change, and conflicts, observing how educational processes are affected and affect them in a dialectical manner. The study will then turn its head into the problematic called the "circle of disadvantage", discovering the connection between the economic and educational fields and how the problematic of oppression fits into the discussion. This mashup of viewpoints and the addition of the problems of oppression and inclusivity serves as the topical novelty within this work.

3. Research Questions / Aims of the Research

What is the relationship between education and social change? This will serve as the core research question. Additionally, questions about the economic implications of unequal opportunities in education and the need for transformative education will also be posed in order to complete the work. Moreover, the main objectives are to better understand the various facets of transformative education and the magnitude of the interconnectedness of "power-and-statute structures".

The aim of the study is to highlight the importance of education and the way it transcends the classroom. The work also aims to reach extra-educational system audiences, trying to help to pave the way for inclusive education and a better understanding of conflicts, whilst also acknowledging the cultural peculiarities of different societies, their different scopes and speeds in processing change and the balance between "bottom-up" and "top-down" approaches.

4. Research Methods

This study will examine how institutional relationships shape human behaviour. The effect that education has on people's ability to accept rules and hierarchies will also be analysed, observing the multidimensional function of education in society. Moreover, concepts from economics will also be incorporated in the discussion, seeing how the educational and economic domains intertwine and do affect each other.

The research methods used in order to obtain and understand the aforementioned concepts and ideas will be mainly qualitative, asking open-ended questions throughout the text and looking for information within intellectuals from various

fields of study. The selection of the questions and authors relies on each particular situation, economic problematics calling for the usage of academics from the economic field.

Moreover, writers with different viewpoints will be analysed in order to complete the study, including both the supporters and critics of both educational systems that are going to be analysed, that is the “traditional” and the “transformative”. The study will be based on previous studies conducted by Paulo Freire or Ivan Illich as well as other authors that dealt with the subjects of education, power, resistance, conflicts, and capitalism.

5. Findings

In this part of the paper, the suppositions made in the previous sections are to be tested, according to the methodology and following the theme of the paper.

5.1 Traditional and Transformative Education. Their Impact on the Individual

Firstly, we must clearly define “traditional” and “transformative” education in order to be able to circle around the concepts with ease. So, by traditional education we understand a way of learning that is classroom-based, teacher-centred, and focused on content delivery, rote learning, and standardised examinations (Gowda & Suma, 2017). More so, by these concepts we understand the need for face-to-face interactions, the position of power of the teacher over its students by the need of the educator to be the main focus object, the transmission of fixed information via discourse or writing that has or usually is to be memorised, and finally by the assessment via tests of the aforementioned information that generates a grade. Oppositely, transformative education focuses on encouraging critical thinking and self-reflection, acknowledging and challenging fixed beliefs and stereotypes, implying that each student and teacher pave the way for positive change in their own lives and communities. The fundamental concept of transformative education lies in the different way of viewing the status quo, allowing the existence of questions regarding ingrained biases and assumptions, calling for a sense of awareness and responsibility of both students and teachers. Moreover, according to Paulo Freire’s definition of “critical pedagogy”, a different way of naming transformative education, the students and the teacher constantly swap their roles, almost completely ditching the idea of roles in the classroom. According to him, the teacher “is learning while in dialogue with the student [...] the students learn while teaching”. Therefore, the student is not limited to storing banking information, he has a “real opportunity to recognise reality and to act on that recognition” (Freire, 1970).

Now, having fundamentally defined both concepts, what are their implications on its subjects and what type of society do they form? Being teacher-based, traditional education becomes student-negligent. Dialogue, the most important aspect of the educational process according to Freire, is unequal in such a system of

teacher-based rules. Students are forced to listen, while teachers are forced to speak, being far from co-investigators of the present reality, but participants in an exhibition of the educator regarding his understanding of his reality, from a position of power. While students may pose questions to the leading figure of the classroom, the interaction will be one defined by power dynamics and unequal social positions. Therefore, the educational process is flawed by the existence of the assumption that the teacher should always understand and explain the codifications of reality better than its students, who are in a position of only listening and accepting the educator's views. The lack of acceptance of the teacher's reality by the enrolled student will affect his grades and future academic route, since the words of the teacher must be replicated within the examination at the middle or end of the semester or year. This brings up the problematic of oppression and the reality that traditional education aims to produce safe and sound citizens, while transformative education paves the way for subjects to critically assess their reality and to be able to call for change when needed. Regarding the teacher, under the reign of traditional education, he falls under the paradigm that while he underwent the oppressive reality of schooling, he shall become the new oppressor of his future students. Oppression in this situation is better understood as a controlling treatment that the teacher is expected to impose on his students. According to Paulo Freire, the teacher, whose role today is similar to that of the oppressor, should strive for the liberation of students and himself and not continue the legacy of oppression. But this oppression, according to Freire, cannot happen without the active participation of the students, who must differ from "objects that must be saved from a burning building". Thus, the need for problem-posing and critical pedagogy, since according to Freire liberation without dialogue is oppression (Beckett, 2013).

Moreover, the questions posed via traditional and transformative education, while similar, are way different in structure. Transformative education questions the world and leaves the chance of viewing it in another way, while traditional education tries to understand the world of today, without having to change it. This difference in the nature of the questions lies in the lack of need for the teachers to understand the subject they are teaching beyond the syllabus, while the student might find the need for extra-work to understand the subject better useless, since that might imply both the questioning of their superior, the teacher, and also the learning of information that will not be examined and, therefore, not approved by him. The difference then lies in a top-down and down-top views of understanding education and social change, Paulo Freire being in the first category via his critical pedagogy, while philosophers like John Dewey fall into the traditional category. Social transformation versus individual growth and dialogue versus experience are some of the different ways in which the two philosophers understand the subject. While both call for social progress and individual growth, the difference lies in the fact that critical education creates agents of social change capable of transforming the world, while traditional education creates individuals that grow and develop within the system they were educated in.

These differences within the two ways of viewing education not only produce individuals with contextual and strict aspects, but also to future systems that nurture the existing systems. Therefore, the problems of discrimination and inclusivity emerged in the context of traditional education failing to keep up with the problems posed by the modern world. In the following sub-chapter, the problems of inclusivity and discrimination will be analysed, while also mentioning Ivan Illich's impact on understanding education and educational institutions.

5.2 Inclusivity and Discrimination within the Educational System

In the reality of formal and institutional education, according to Ivan Illich's "Deschooling Society", school became the primary and almost only vehicle of education that occurred within a specific time, space, and under the unquestionable supervision of teachers. Learning became the materialisation of schooling, just as petrol became the product of the oil industry. Schools are the industries of learning and of truth, leading to the need to participate in this industry to acquire a "schooled mind". According to Illich, the industrialisation of education led to the centralisation of power of knowledge in the classroom and also contributed to need to need to take part in the schooling process, as previously stated (Illich, 1971).

Therefore, combining the information mentioned in the previous section and the institutionalised view of education provided by Ivan Illich, the problems of inclusivity and discrimination rise in the context of existence of societies based on racism, gender biases, and other forms of discrimination. In a state where traditional education is applied and gender and racial laws are also present, the problems of inclusivity and discrimination within the educational system and even beyond it arise. In apartheid South Africa, the education system discriminated racially by unequally allocating resources to schools. The emergence of white and non-white universities also led to racialisation of different areas of the country, since cities such as Cape Town or Witwatersrand, translated as white-water ridge, became essentially white cities with rich universities, while non-white universities and cities were located in remote areas and had limited academic offerings. Both the funding and infrastructure of white-based universities were higher compared to their non-white counterparts. This reality had a profound impact on both students and teachers, perpetuating racial inequalities and limiting opportunities to achieve the full potential (Beale, 1998).

Even if the educational system in South Africa was traditional, aiming to promote and not question the state's view on the present situation, resistance and protests rose in the non-white community. Even if transformative or critical education was not applied in the context of South Africa's schooling system, through the processes of dialogue and critical thinking the need to achieve critical consciousness and engage in collective action outside the classroom was heightened. SASO, South African Students' Organisation and Black Consciousness Movement called for resistance against the apartheid policies regarding education, being inspired by ideas of black consciousness and empowerment, conducted protests and academic resistance, even if they were subjects of traditional education that promoted the apartheid. In the

context of globalisation, individuals and organisations from other countries supported the anti-apartheid movement via boycotts and advocacy efforts.

Apartheid South Africa also presented sexual divisions. According to Beale Mary Alice, “African women constituted less than 10% of African student enrolments, while white women constituted over 20% of white student enrolments. Educating women at universities was often seen as a “waste” of both time and money, as women were generally expected to spend their adult lives in unpaid employment in the home.” Moreover, education was perceived as unsuitable for women, not leading to particular advantages for them. As an example, in Beale Mary Alice’s study, it is mentioned that members of staff from the dentistry and law universities did not find women as well fitted for these domains. Moreover, the rules regarding dress codes restrictions and residential options for women limited the free movement and the desire of women to adhere to the higher education field. This also applies to female professors, seniors, and other lectures, accounting only 3% and 18% of all available positions. The absence of female personnel in the educational field led to the lack of potential role models for young women students. Moreover, the aforementioned study also mentioned that women students and professors were also discriminated against with a repertoire of other less formal practices like sexist assumptions (Beale, 1998). The need for the liberation of women is evident, the lack of it leading to the creation and perpetuation of a misogynistic society that has effects on both male and female citizens. “There is no true social revolution without the liberation of women. May my eyes never see and my feet never take me to a society where half the people are held in silence”, said Thomas Sankara, the former president of Burkina Faso (Sankara, 1987).

The need for transformative education is therefore illustrated in the historical pages of South Africa, when traditional education is rooted for racism, ethnic, and gender biases as universal and philosophical truths. Transformative or critical education denies the existence of universal truth, leaving space and paving the way for contextual truths and for the constant bettering of society and individuals, by listening to their needs and wants and acting upon them as a community.

5.3 Economic Impact of Traditional Education

While the societal impact of education is obvious, what is the impact within the economy and on the economic nature of individuals? The educational system is the leading industry in the human capital production. It also has a strong influence over the dynamics of the economy, playing also a central role in any ideological project. According to Henry Giroux, education cannot be invisible in terms of ideology, since it possesses a large content on power, knowledge, social values, agency, and narratives about the world. Moreover, according to him, the neoliberal economic model also serves the role of a public teacher, which strives for the individualisation of citizens. This system strives for a way of understanding the world that is market-driven, which also leads to the use of traditional education to supply skilled workers for the economy, rather than encouraging critical thinking and emancipation. Therefore, the education was “commodified”, schools being viewed

as economic entities, while students are its consumers. Moreover, via the implementation of traditional education, these consumers act in the classroom as if they were in the market, prioritising competition, individualism, and efficiency. So, according to Giroux, the privatisation of the educational system highly influences the marketisation of the economy, while the marketisation of the economy demands from the educational system characteristics that are easily obtained by applying traditional education policies. The rule of maximum profit with minimum investment, which used to apply to manage material resources, has now found its way into the human resources rhetoric (Giroux, 2005). Moreover, this formula of infinite growth of profit, even if applied only in the field of material resources and nonhuman entities, has a strong impact on humanity, the material being highly influenceable in how humans develop. Education was also affected by this formula, leading to what Giroux also mentioned in his works, but it is simply put by Cruz Flores-Rodriguez and Miguel Martin-Sanchez in their article titled “Neoliberalism and Western Education crisis. Causes, consequences and opportunities for the change”. In this paper, the authors mention that education is viewed as a tool of increasing performance and productivity being a mere preparation for employment, while also being used for constructing identities in the context of the hegemonic ideology of neoliberalism.

The Marxian concept of “fetishism” can also be used in the concept of analysing education and the economy. Via the marketisation of education and by trying to obtain an economic value out of it, education is commodified, used for its exchange value, and not for its intrinsic worth. Education is accessed in order to obtain a future social status or pecuniary gains by acquiring degrees, diplomas, and certificates that are themselves commodified. Therefore, the emergence of inequality and exclusion within the educational system, those lacking the financial means needed to obtain those commodities being marginalised and even excluded, depending on their financial power (Marx, 1867). Leaving behind the concept of fetishism, since the educational processes are built around the idea of job hunting and usefulness of an individual in the market, marginalised groups have a difficult time in adapting to the needs of the market. Therefore, students with disabilities, low-incomes or of colour have different experiences in the educational field compared to their colleagues (Flores-Rodríguez & Martín-Sánchez, 2023).

6. Conclusions

In conclusion, education is an important, if not one of the most important factors in the discussion on societal change, all the more noticing the plurality of perspectives surrounding it (Jora et al., 2020; Jora et al., 2022). Both ways of understanding education, the traditional and transformative ways, affect the individual in the classroom and even outside of the classroom. While the discussion on the best way of viewing education is more profound and complex than this paper, the debate on this subject is to be analysed in the future via more comprehensive and contextual papers on the matter. The role of education for the economy was also highlighted as important in the text, understanding their symbiotic relationship in

forging an individual, also looking into how they can minimise his importance and decelerate his development. Also, the problematic of inclusivity and discrimination in the educational field and created by the educational field was discussed, observing the insides of the system in South Africa in the apartheid period, and recognising that these problems might persist today with the lack of social change.

Moreover, this paper stands as a call for transformative change within the educational, economic, and political fields, aiming to raise awareness about the importance of the relationships between the three. The paper therefore addresses to students, teachers, economists, sociologists, activists, and even entrepreneurs and politicians, in the hope of achieving an inclusive society whose goal is to forge a better sense of community and a greater level of acceptance. Although important, the study also exhibits limitations, mainly the lack of quantitative data, narrowing the ability of validating the findings within the text. The distinct philosophical leaning of the paper towards authors like Paulo Freire or Ivan Illich can also lead to neglecting their counterparts and to inadequately capture the diversity of educational and economic experiences or conditions. Therefore, this study calls for the need of another paper that focuses on traditional education, observing it in a similar way to the transformative approach, discerning, in an educated manner, between rationality that is informing reasonability and narrative aspiring to normative.

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**Generational Perspectives on Sustainable Consumption:
Exploring Consumer Behaviour
of Millennials and Generation Z**

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Abstract

Consumerism has become a worldwide problem, impacting not only the economy but also the way we live. One of the major problems resulting from consumerism is global pollution, which obviously affects the environment and has serious consequences, including on people's health. It is essential to take sustainable measures and encourage waste reduction and the choice of eco-friendly products. The main objective of our research paper regarding the generational perspectives on sustainable consumption is to explore the consumer behaviour of two generational cohorts, Millennials and Generation Z, and to provide a general understanding of their attitudes, motivations, and behaviours in relation to environmental sustainability. First, we collected information from the specialised literature about the researched subject, after which we carried out quantitative research using the survey method. The results of the research helped us identify the impediments and challenges faced by Millennials and Generation Z in adopting sustainable practices related to consumption, as well as the factors that encourage them to engage in sustainable consumption. In the last part of our research, we presented some recommendations aimed at improving the culture of sustainable consumption within the Millennials and Generation Z cohorts. This paper contributes to the field by providing essential details about these two generations perspectives regarding sustainable consumption so that, especially companies, can tailor their products and marketing strategies to align with the values and preferences of Millennials and Generation Z, fostering a more sustainable future.

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JEL Classification: Q50, E20, M30.

1. Introduction

It is essential that current and future generations are informed about contemporary topics such as sustainable consumption so that we can live in a healthy and sustainable environment, in which even the economy has a healthy way of growing without harming the environment.

Once consumers meet with a very large supply of goods, their desire to consume and own as many of them as possible appears. This desire turns into an action of mass consumption, a term known as consumerism. This consumption, usually has an expiration date, because of factors such as: the expiration date of the products, and new trends that appear and make us get rid of the old things to make room for the new ones to intervene. Well, all of this turns into waste, each of which contributes to global pollution, having a negative impact on people's health, the environment, and a safe future for future generations. Due to these aspects, this topic has become one of interest for the researcher but also for companies, NGOs, and government institutions as it has become crucial to live and develop in a healthy environment.

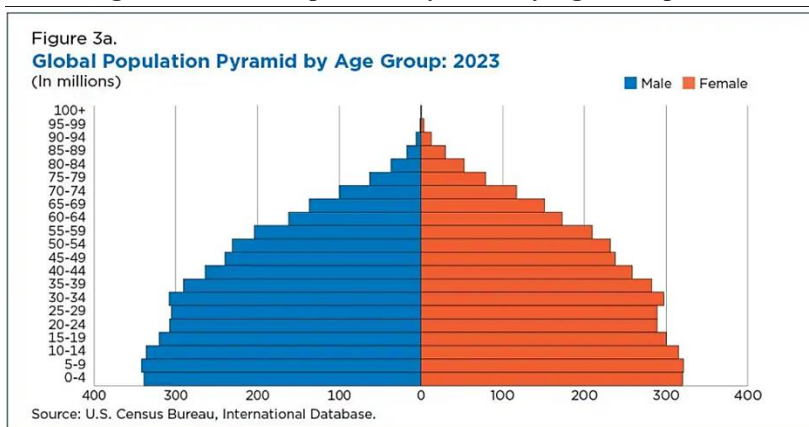
In a world where achieving economic growth is crucial for all nations to maintain their place as superpowers, consumerism has expanded to encompass social and environmental aspects.

From a certain point of view, it is considered that consumerism is a good thing that promotes economic expansion, according to a Keynesian belief that consumer spending is the main generator of the economy and that encouraging people to spend is a governmental objective (Hayes, 2024). Although this phenomenon is beneficial from a strategic and political point of view for economic growth, it also brings a series of negative elements that affect the environment, the way we live, and even our health. Thus, sustainable consumption and production concerns have become a topic of international interest to stop the negative effects of consumerism. In 1992, as a result of the United Nations Conference on Environment and Development, The Johannesburg Plan of Implementation was created (United Nations, n.d.). All countries were called in 2002 to promote sustainable consumption and production patterns, where industrialised and developed nations led the way (Wang et al., 2018).

2. Problem Statement

Considering the fact that Millennials are born between 1981 and 1996 and their current ages must be 28-43 years old and people from Generation Z are born in the interval between 1997 and 2012 and must be 12-27, Figure 1 shows that, according to 2023 data, there are more people from Generation Z than Millennials, and we observe a relatively larger distribution of men.

Figure 1. Global Population Pyramid by Age Group:2023



Source: <https://www.census.gov/library/stories/2023/11/world-population-estimated-eight-billion.html>.

Millennials together with Generation Z make up most of the consumer population today. Lee and Kotler (2016) characterises millennials as people born between 1989 and 2000. They are the most business activity-aware generation as they were the most affected by the digital revolution (Stewart et al., 2017). They are also the most ethical generation and show greater resistance to unethical practices in the workplace (Payton, 2015). Generation Z has been called the “first true digital native generation” (Lanier, 2017).

2.1 Sustainable Consumption Patterns among Millennials and Generation Z

Millennials are a generation of young people. Recent studies argue that millennials are much more concerned about corporate social responsibility practices. Price does not take the height spot in their priorities. It still is an important factor but does not take the top spot (Chatzopoulou & de Kiewiet, 2021).

Social media has been playing an important role in creating awareness regarding sustainable consumption and helped refine the millennial mindset over sustainable consumption (Ali et al., 2023). Millennial students exhibit sensitivity to sustainability issues, endorse labelling and certification systems to communicate production information, and express a desire for innovative processes to mitigate environmental impacts (Bollani et al., 2019).

Generation Z has more spenders than savers (Vojvodić, 2019). Regarding sustainability, Gen Z is commonly defined as a consumer cohort that feels that businesses and their goods ought to be sustainable (Williams & Hodges, 2022). This concern over sustainability has even caused new industries to be set up towards green consumption. Modern technologies play a vital role in defining consumer experiences for Gen Z. Studies have shown that Gen Z relies on and expects to make informed decisions using technology (Vojvodić, 2019).

Gen Z is more attentive towards problems such as climate change and poverty. This makes them believe that businesses have a responsibility to tackle these challenges and operate in a manner that addresses these issues. Gen Z prefers to buy from brands that address these issues over those companies that overlook them (Porter Novelli/Cone, 2019).

2.2 Barriers to Sustainable Consumption

Being eager to move towards sustainable consumption does not always lead to the same purchasing behaviour. The attitude-behaviour gap delineates the disparity between consumers' attitudes and their actual purchasing actions, frequently associated with younger consumers due to their perceived inconsistency in buying patterns (Sudbury-Riley & Boltner, 2010). The gap exists because the intent for sustainable approaches does not always allow consumers to go beyond their purchasing abilities (Carrington et al., 2010).

Recent studies highlight various barriers to sustainable apparel consumption, including consumer cynicism, lack of knowledge about environmental impacts and sustainable options, and indifference toward social and environmental concerns in purchasing decisions. While adolescents express concern about sustainability, factors such as cost, convenience, peer pressure, and fashion influence their consumption behaviours more than sustainability considerations (Williams & Hodges, 2022). There is also a common conception that the changes in their consumption towards sustainability will cause no effect on the larger scale of things (Morgan & Birtwistle, 2009, p. 196).

3. Research Questions / Aims of the Research

The aim of the research is to identify the elements that impact sustainable consumption across two distinct cohorts, Generation Z and Millennials, while also gaining insight into their behaviour and knowledge about environmental sustainability. We created a series of objectives to gain a comprehensive understanding of this subject:

Objective 1: Determine the level of awareness and education regarding environmental sustainability within the Millennials and Generation Z and how this impacts their consumption behaviour; Objective 2: Examine and calculate the media exposure frequency with information about sustainable consumption and what is the order of the channels; Objective 3: Identify the main motivations and barriers to sustainable consumption within the two generations. This includes what drives their sustainable behaviours and the challenges they face in maintaining these habits; Objective 4: Measure how Millennials and Generation Z perceive their impact on the environment through their consumption choices and who they believe should be responsible for educating the public about sustainability.

4. Research Methods

In the first part of our research paper, we made exploratory research on the existing literature that gave us a general framework about the Generational Perspectives on Sustainable Consumption: Exploring Consumer Behaviour of Millennials and Generation Z. For the second part, we made quantitative research using the survey method to gain essential insights from the two generations investigated. We administrated the survey on the Google Forms platform during January 2024 and March 2024 and we focused on finding respondents who meet the main criteria for participating in the study, that is, being part of one of the generations: Generation Z or Millennials. Our sample size was 207 respondents, both male and female, which can be observed in Table 1. We have decided to present a part of our findings in form of graphs and for a better understanding, we made a description followed by an interpretation and some general conclusions of the most relevant graphs that help us fulfil our objectives.

Table 1. Sample Structure

Characteristics	Frequency	Percent (%)
Gender		
Female	104	50.24
Male	103	49.76
Age Group		
Generation Z	121	58.45
Millennials	86	41.55
Education		
Master's Degree	160	77.29
Bachelor's Degree	33	15.94
Doctorate	12	5.80
High School	1	0.48
Other	1	0.48
Environment		
Urban	70	33.83
Suburban	78	37.68
Rural	59	28.50
Prefer not to say	0	0

Source: author's contribution.

5. Findings

Objective 1: Determine the level of awareness and education regarding environmental sustainability within the Millennials and Generation Z and how this impacts their consumption behaviour.

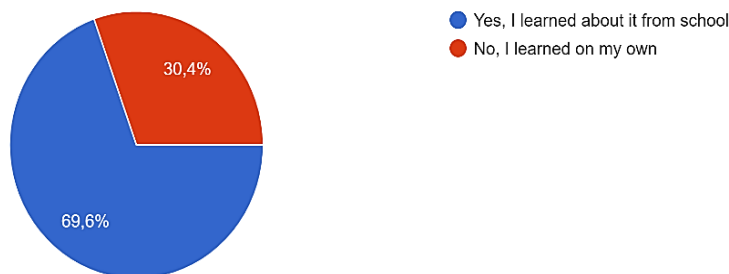
In order to do this analysis, we focused on Question number 3 where 30.4% of respondents said that they learnt on their own while 69.6% learnt about it from

school. After making a crosstab between the two generations and Question 3, our findings based on our sample size of 207 respondents were the following:

Figure 2. Google Forms graphic result from the survey

Did you receive education or participate in activities related to environmental sustainability during your schooling years?

207 răspunsuri



Source: Google Forms Platform.

Table 2. Cross-tabulation results

Millennials		Generation Z	
Learned on their own	24	Learned on their own	39
Learned from school	62	Learned from school	82

Source: author’s contribution.

After making a cross-tabulation analysis, we went further to see if there is any statistical difference in the results, and we performed a chi-square test. The findings were:

Table 3. Statistical analysis

χ^2 =Chi-square	<i>p</i> -value=Probability value	<i>df</i> = Degrees of Freedom
0.263	0.608	1

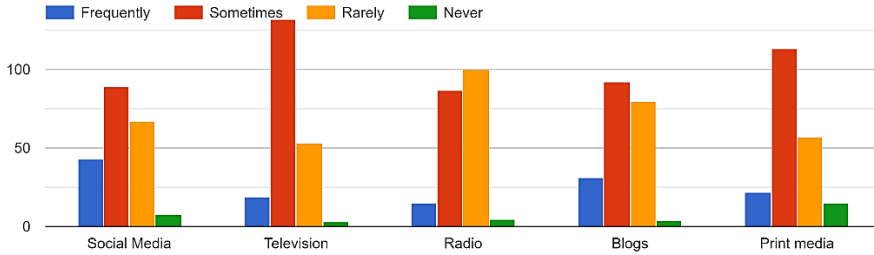
Source: author’s contribution.

Based on the p-value, we can assume that there is no statistical difference between how Millennials and Generation Z learnt about environmental sustainability. In the context of our survey, both generations had similar exposure to education regarding the environment.

Objective 2: Examine and calculate the media exposure frequency with information about sustainable consumption and what is the order of the channels. This objective will help identify the most effective channels for disseminating information on sustainable practices.

Figure 3. Google Forms graphic result from the survey

How often do you come across information or discussions related to sustainable consumption on those information sources?



Source: Google Forms Platform.

Table 4. Semantic Differential Scale Analysis

	4	3	2	1
	Frequently	Sometimes	Rarely	Never
Social Media	43	89	67	8
Television	19	132	53	3
Radio	15	87	100	5
Blogs	31	92	80	4
Print Media	22	113	57	15

Source: author's contribution.

Using the semantic differential scale, we assigned decreasing scores from 4 to 1 for each frequency level as seen in Table 3. Further, we calculated the average score for each channel and established a top of the channels where the respondents of the study found information about sustainable consumption. The scores showed that the most frequent information was on social media and television channels followed by Blogs, Print Media, and Radio. These results show us the fact that both generations found information on the mentioned channels and that they were not deprived of it.

$$\text{Medium Score Social Media: } 43 \times 4 + 89 \times 3 + 67 \times 2 + 8 \times 1 : 207 = 2.80 \quad (1)$$

$$\text{Medium Score Television: } 19 \times 4 + 132 \times 3 + 53 \times 2 + 3 \times 1 : 207 = 2.80 \quad (2)$$

$$\text{Medium Score Radio: } 15 \times 4 + 87 \times 3 + 100 \times 2 + 5 \times 1 : 207 = 2.54 \quad (3)$$

$$\text{Medium Score Blogs: } 31 \times 4 + 92 \times 3 + 80 \times 2 + 4 \times 1 : 207 = 2.72 \quad (4)$$

$$\text{Medium Score Print Media: } 22 \times 4 + 113 \times 3 + 57 \times 2 + 15 \times 1 : 207 = 2.68 \quad (5)$$

Objective 3: Identify the main motivations and barriers to sustainable consumption within the two generations. This includes what drives their sustainable behaviours and the challenges they face in maintaining these habits.

After performing a frequency analysis of the motivations among the respondents, our findings were: Concern about future generations: 57 responses; Ethical values:

54 responses; Personal health: 46 responses; Environmental concern: 40 responses; Social influence: 10 responses.

We used a Chi-Square test to determine if there are statistically significant differences in the distribution of motivations and challenges across different age groups. The results were the following:

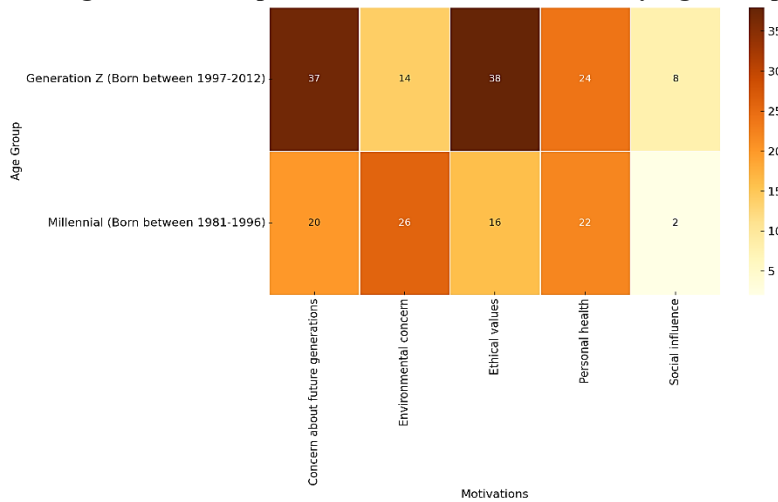
Table 5. Statistical analysis

χ^2 =Chi-square	<i>p</i> -value=Probability value
15.86	0.0032

Source: author’s contribution.

Since the p-value is less than 0.05, we can conclude that there are statistically significant differences in motivations between the two age groups. This indicates that the factors motivating sustainable behaviours vary depending on the age group of the respondents.

Figure 4. Heatmap of Distribution of Motivations by Age Group



Source: author’s contribution.

We can see in the Heatmap that Generation Z shows a higher inclination towards ethical values and concern for future generations, while Millennials are more motivated by environmental concern and personal health.

We conducted a similar analysis of the barriers faced by the two generations, and the results were:

Table 6. Statistical analysis

χ^2 =Chi-square	<i>p</i> -value=Probability value
0.76	0.944

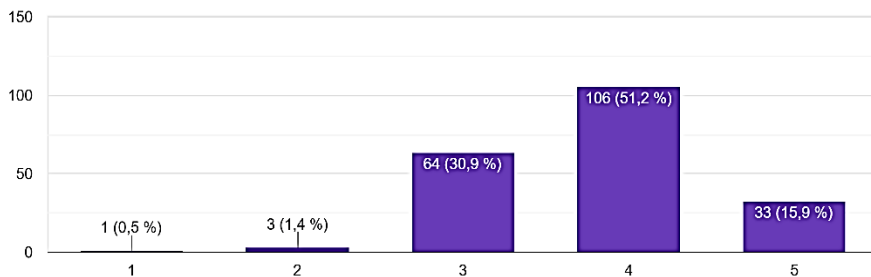
Source: author’s contribution.

Since the p-value is significantly higher than 0.05, we can state that there is no statistically significant difference in the challenges faced by the two age groups. This implies that both Generation Z and Millennials encounter similar barriers when trying to maintain sustainable consumption habits.

Objective 4: Measure how Millennials and Generation Z perceive their impact on the environment through their consumption choices and whom they believe should be responsible for educating the public about sustainability.

Figure 5. Google Forms graphic result from the survey

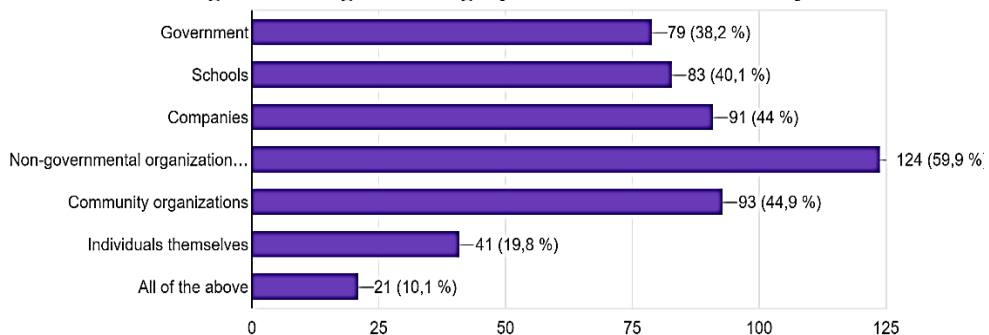
How effective do you think your individual sustainable consumption efforts are in making a positive impact on the environment? 1- Not effective at all 2...r/Nor effective 4- Effective 5- Extremely effective
207 răspunsuri



Source: Google Forms Platform.

The responses from the two generations on how effective they think their individual sustainable consumption efforts are making a positive impact on the environment are distributed as follows: 51.2% find their efforts effective; 30.9% see them as Neither/Nor effective; 15.9% believe they are extremely effective; Only 1.9% view their efforts as either Slightly effective or Not effective at all.

Figure 6. Google Forms graphic result from the survey



Source: Google Forms Platform.

Respondents considered that responsible for educating the public about sustainability should be NGOs, followed by Community organisations, companies, schools, government, and individuals themselves, and 10.1% of respondents considered that all of the above options should be taken into account.

The results suggest that Millennials and Generation Z generally perceive their sustainable consumption habits as effective and think that a collective approach regarding sustainability education would be effective.

6. Conclusions

Our research has focused on the generational perspectives of Millennials and Generation Z regarding sustainable consumption and consumer behaviour. Based on our findings, we provided information about their motivations and barriers regarding sustainable consumption, determined the level of awareness and education into the subject and the channels that provided them with this information, as well as how effective they think their efforts are in making a positive impact on the environment and who did they consider responsible for educating the public about sustainability.

We discovered that both generations had similar exposure to education regarding the environment and also were not deprived of information. The main channels where they found information were Social Media, Television, Blogs, Print Media, and Radio. Our recommendation to those who want to communicate on this topic is to integrate both the channels less frequented by respondents and the most common ones. We believe that a general and harmonious integration of all channels can bring results in increasing the level of awareness.

We found some differences in motivations between the two age groups and we discovered that Generation Z shows a great interest in ethical values and concern for future generations and Millennials are motivated by environmental concern and personal health. These differences between motivations can help us better understand why each generation gets involved and what stimuli that make them act on sustainable consumption. Regarding the barriers, we found out that they encounter similar ones to maintain sustainable consumption habits. Also, both generations perceive their sustainable consumption habits as effective and think that the approach for this topic on the public should be done collectively but mainly by NGOs, community organisations, companies, schools, government, and individuals themselves.

However, our study was limited by the sample size and we believe that future studies could have a larger number of respondents. These results can help companies that address the public from the two investigated generations to adapt their business, communication, and marketing strategies according to the behaviour and expectations of Generation Z and Millennials in order to obtain the most satisfactory results.

In conclusion, sustainable consumption is a practice that must be integrated into the everyday life of all current and future generations in order to reduce as much as possible the negative effects of consumerism and also to live in a healthy and sustainable environment.

Acknowledgment

We are grateful to everyone who participated in our study on: “Generational Perspectives on Sustainable Consumption: Exploring Consumer Behaviour of Millennials and Generation Z”.

Their insights were invaluable in understanding the attitudes, motivations, and behaviour of younger generations towards sustainable consumption practices.

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**Student Attitudes towards the Circular Economy:
A Comparison between Bulgaria and North Macedonia**

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Abstract

The circular economy involves three main processes - waste reduction, resource reuse, and material recycling. This makes it a more sustainable alternative to the linear nature of today's aggressive production and consumption. The need to implement this model requires exploring the interest of younger people in their proactive involvement in the circular economy. The present study is based on a comparative analysis of surveys conducted in the period December 2022 - January 2023 among 204 students in various bachelor's and master's majors with a business focus from the University of Ruse "Angel Kanchev" - Bulgaria and University American College in Skopje - North Macedonia. The research was carried out within the framework of the international Erasmus project - Leaders of the Green Economy, investigating the knowledge, attitudes, motivation, and behaviour of students regarding the circular economy. The conclusions drawn show that students are largely aware of the concept and are motivated to engage in the transition to the circular economy. The presentation and implementation in the curricula of examples of companies that have successfully implemented the principles of the circular economy in their business and production processes could further encourage the participation of young people in these sustainable economic activities. The current study is anticipated to enhance curricula by boosting interest and commitment among future entrepreneurs. In this sense, the research enriches the existing practices and theoretical knowledge in the field of training in corporate social responsibility, economics, and management.

Keywords: circular economy, students, Bulgaria, North Macedonia, sustainable development.

JEL Classification: F64, I25.

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1. Introduction

Climate change, long periods of aridity, fluctuations in precipitations, the decrease in biodiversity, the contamination of air and water, and increasing quantities of waste constitute a set of difficulties that the planet undergoes. The functioning of the contemporary society has been threatened by natural calamities which influenced different areas with distinct severity degrees and results. Nevertheless, the greatest challenge is the irreversible climate change. These problems are partly the result of natural changes – climate is not a constant. But at its core, what is happening today is the result of anthropogenic activities involving the unwise exploitation of natural resources and economic models that are out of sync with ecosystems.

It is obvious to all that the exponential growth of the global economy is built on a vicious circle of depletion and disposal. Overconsumption, a feature of the linear economy, combined with a doubling of the world's population, is driving the world towards an irreversible depletion of its resources. The paradox is that society is aware of the devastating consequences of its predatory behaviour, but the crisis of sustainability is deepening. This shows that a radical cultural and social transformation is needed if, indeed, the common goal is to achieve a more sustainable future (van Dijke et al., 2024). In this sense, it can be argued that the path to this goal is the circular economy (CE), but the key lies in transforming desire and knowledge into real action. That is where the role of education comes in (Gavkalova et al., 2023).

According to the Organisation for Economic Co-operation and Development (OECD), education and vocational training have a leading role in the process of transitioning to a more sustainable economy (Ugwu & Aquino, 2023). Hence, educational systems should focus on equipping individuals with the necessary skills and knowledge for employing circular thinking across all aspects of life, from childhood to postgraduate studies (Gavkalova et al., 2023). The OECD focuses on the role of higher education in the transformation towards CE and sustainable development (Tiippana-Usvasalo et al., 2023). It not only creates a workforce adequate to reality but also ensures its sustainability through continuous retraining and adaptation to new technologies and knowledge in the industry (Antonova et al., 2018). Education, therefore, plays a crucial role in building an environmentally skilled workforce capable of addressing the dynamic needs of the CE (Ugwu & Aquino, 2023).

This study seeks to assess the attitudes and preparedness of students from Bulgaria and North Macedonia to engage in the circular transformation process. The data are the result of the activities of the Erasmus+ Leaders of the Green Economy (LGE) international project, which includes four higher education institutions (HEIs) – American University College Skopje (North Macedonia), University of Rijeka (Croatia), University of Ruse “Angel Kanchev” (Bulgaria), and DOBA Business School (Slovenia). The paper follows this structure: 1) Analysis of the nature of CE and the role of education in this context; 2) Definition of the research purpose; 3) Examination of the obtained results, alongside the identification of study limitations and its fundamental contributions; 4) Formulation of concluding remarks.

2. Problem Statement

Natural issues such as climate change, disturbed biodiversity, overexploitation of natural resources, and pollution, which stem from the ambition for quick financial gain, have been recognised as significant problems for more than 50 years. The environment and its management are fundamental to human well-being and, therefore to human survival (van Dijke et al., 2024). Nakhle et al. (2024) argue that human activity is directly responsible for altering at least 70% of the earth's surface, 66% of the ocean surface, and about 85% of wetlands. The most crucial action is to stop endless consumption and to hurry the transition from a linear economy to a carbon-neutral CE. Meanwhile, the interdependence of global ecosystems makes addressing environmental problems and their transboundary impacts impossible without cooperation and shared responsibility (van Dijke et al., 2024).

Gavkalova et al. (2023) describe CE as an alternative to the traditional linear economy, with three main principles applied: consumption reduction, material reuse, and recycling. They believe that switching to CE can bring substantial economic advantages to various stakeholders, including job creation and, especially, environmental preservation. In 2015, the 2030 Agenda for Sustainable Development, consisting of 17 sustainable development goals (and 169 sub-goals), was approved by UN member countries. These goals aim to guide the global community towards sustainable development through impactful and extreme measures. All of them are based on the three main pillars: social progress, economic growth, and environmental protection. According to the UN, only through joint efforts and an adequate educational process can ecosystems continue to support the well-being and survival of humanity (Nakhle et al., 2024).

In eradicating environmental issues, HEIs hold a particularly meaningful role. These institutions aggregate researchers, innovators, the public and private sectors, and surrounding communities with the aim to look for and integrate solutions. Universities are requested to stand as knowledge issuance and management centres, a link between current knowledge and the formulation of new structures meant to resolve environmental obstacles. The future of universities is closely linked to the provision of training, research, and innovation programmes. These programmes must convey the necessary knowledge and skills to deal with environmental problems at the national and transnational levels (European University Association, 2023).

At the same time, the integration of CE into society and the global economy requires complex and dynamic (systemic) changes in technical and behavioural aspects. These changes involve every sector of society. In order to create a more sustainable society, people must understand the importance of reducing their consumption (Tiippana-Usvasalo et al., 2023). In addition, there is a need to increase knowledge about CE and new sustainable solutions for society. However, without concrete tools, it is difficult to make changes in daily life (van Dijke et al., 2024). Ivanova (2021) argues that the transition to CE cannot happen quickly or automatically, giving the example of the countries of the European Union (EU), which have different traditions and implement various policies to promote

the ecological transition. This is to some extent due to the diverse production structures that are located on the territory of these countries and require different adaptation times.

A 2021 report reveals that Bulgaria is far below the EU average in terms of green transformation. However, the country hides unused potential, not only for more efficient use of resources but also for a radical change of business models. The report highlights the need for swift action to accelerate the green transformation, in which HEIs play a crucial role (Pavlov, 2022). Through education, they can prepare personnel capable of implementing new business practices and technologies that are resource efficient and environmentally friendly. Companies can attain various benefits from the enactment of these practices, for instance cost minimisation, the improvement of competitiveness, and the encouragement of the export potential. To fulfil these goals, however, it is imperative to build a workforce that has the understanding, ability, and willingness to adopt CE standards (Ivanova, 2021).

The second participant in the current research, North Macedonia, also expresses commitment to the process towards sustainable development. Faced with a number of environmental challenges, such as climate change, resource depletion, and pollution, the country has set itself the ambitious goal of smoothly transitioning to CE and proactively solving existing environmental problems. An OECD analysis points to the leadership role of the Ministry of Economy of North Macedonia in the transition to a CE throughout society. National strategic documents aimed at this transition have been developed and the organisation reports remarkable changes in civil society and business. Despite these steps, the OECD concludes, tangible results are still limited by infrastructure deficits, low awareness, and knowledge among stakeholders, and insufficient financial support (OECD, 2024).

One way to mitigate the adverse effects of climate change, uncontrolled use, and overconsumption is through awareness of the need for concerted efforts on the part of the individual and society as a whole. The research of Zheng et al. (2023) asserts that societies owning a greater level of education are more prone to integrate green practices and operate investments in cleaner technologies, which further trigger enhanced environmental quality. This fact endorses the statement that education is the most efficient point through which individuals can be encouraged to participate in a conscious and independent way in the green transformation process. The onset should begin as early as preschool, progress through university, and continue throughout an individual's life (Tiippana-Usvasalo et al., 2023). The infusion of all these aware and educated individuals into a global workforce and entrepreneurs is becoming an increasingly significant factor. The aim is to enable all people to experience CE (van Dijke et al., 2024) so that one can speak of a global circular economy and not just regional experiences.

3. Aims of the Research

Based on the fundamental characteristics determining the transition to GO in Bulgaria and North Macedonia, the authors of the current study examine the

perspectives of students pursuing business-oriented majors in both countries. Student attitudes and local community engagement are as important factors as regulations or sector-specific target operations (Pavlov & Ruskova, 2023). Universities that respond dynamically to societal issues and adapt their educational offerings will have a maximum impact on generations of graduates. This impact can be enhanced through continuing professional development schemes and retraining opportunities (European University Association, 2023).

The main purpose of the research is to capture students' current attitudes towards inclusion in PG. Additionally, comparing the results between the two groups of respondents seeks to point out differences or effective practices within educational programmes that can then be addressed or expanded more comprehensively and effectively.

4. Research Methods

The research methodology was developed within the LGE international project, which started in 2022. The project involves a consortium of four independent educational institutions from Bulgaria, Slovenia, North Macedonia, and Croatia, particularly their business faculties and departments. It aims to investigate students' knowledge, attitudes, opinions, and experiences regarding sustainability and the green and circular economy (Misoska et al., 2023). The current paper focuses on data generated by two of the LGE partners: the University of Ruse Angel Kanchev (URAK) – Bulgaria, and the University American College Skopje (UACS) – North Macedonia. The study timeframe is *December 2022 - January 2023*. The project includes students enrolled in various bachelor's and master's programs of the Faculty of Business and Management (URAK) and the School of Business Economics and Management (UAKS). The project partners unite around the claim that businesses should proactively initiate changes to a more sustainable and green future. And today's business students are largely tomorrow's entrepreneurs who will be expected to implement the CE in their business models.

An online Google Form application was used, with each participating institution disseminating a link to its students through various channels: student email, official groups, etc. The questionnaire aimed to capture information on students' experiences, opinions, and the extent to which CE principles are integrated into relevant university programs (Misoska et al., 2023). At the same time, a significant goal of LGE is, on the one hand, to identify gaps in curricula regarding the principles of sustainability and the CE and, on the other hand, to highlight academic disciplines and practices that stimulate more responsible business thinking. The research analysed the responses to question 5, investigating students' intention to engage in the circular and green economy. The question offers 4 main statements, with the possibility of an answer on a 5-point Likert scale, where 1 is equivalent to “Strongly Disagree” and 5 – “Strongly Agree”.

5. Findings

105 students from URAK and 99 students from UACS responded to the survey. The gender ratio is as follows: 80 (76.2%) women vs 25 (23.8%) men at URAK and 41 (41.4%) women vs 58 (58.6%) men at UACS, respectively. 80 (76.2%) students from undergraduate courses and 25 (23.8%) from master's programmes took part in the URAK study. At UACS, the data are, respectively, 75 (75.8%) bachelor and 24 (24.2%) master. While not denying a potential relationship between various demographics (gender, age, major) and student attitudes, the study did not seek or analyse such correlations. The authors aim to gain information about the general picture, where green and sustainable thinking is not the result of gender and age, but of the educational process and social culture.

According to the research methodology, by studying four main claims, this project examines the readiness of students to be included in CE. Table 1 contains information on the first statement: *I am determined to get involved in the CE*. The research shows that a large number of students from Bulgaria and North Macedonia are ready to join CE. Exactly 53 URAK students (50.48%) and 58 UACS students (58.59%) expressed varying degrees of agreement with the statement. A total of 15 students (14.28%) from URAK and 22 students (22.22%) from UACS disagreed or strongly disagreed. There is a discrepancy between the two institutions regarding the lack of clearly expressed student opinion. Over 35% (37) of URAK participants did not give an answer about their participation in CE, while in UACS this number was much lower, with just over 19% (19 students) choosing a neutral answer.

Table 1. Answers to the question: I am determined to get involved in circular economy (number/percentage) – 1 (Strongly Disagree) to 5 (Strongly Agree)

Question #1	1	2	3	4	5
URAK (N=105)	5 (4.76%)	10 (9.52%)	37 (35.24%)	35 (33.34%)	18 (17.14%)
UACS (N=99)	10 (10.10%)	12 (12.12%)	19 (19.19%)	40 (40.40%)	18 (18.19%)

Source: Leaders of the Green Economy project (2023).

Concerning the next statement, there are no notable variations in the attitudes of students hailing from Bulgaria and North Macedonia (Table 2).

Table 2. Answers to the question: My professional goal is to become involved in the circular economy (number/percentage) – 1 (Strongly Disagree) to 5 (Strongly Agree)

Question #2	1	2	3	4	5
URAK (N=105)	12 (11.43%)	22 (20.95%)	42 (40.00%)	21 (20.00%)	8 (7.62%)
UACS (N=99)	18 (18.19%)	11 (11.11%)	38 (38.38%)	21 (21.21%)	11 (11.11%)

Source: Leaders of the Green Economy project (2023).

About a third of the students from the two educational institutions, to varying degrees, confirm that they have set a professional goal to participate in the CE proactively – 29 (27.62%) of the students from URAK and 32 (32.32%) from UACS express agreement and strong agreement with the statement My professional goal is

to become involved in the CE. The proportion of students who disagreed and categorically disagreed with the statement was similar – 34 (32.38%) for URAK and 29 (29.30%) for UACS. In both higher schools, there is a significant number of students who are not confident that they would link their professional development to the principles of the CE – 42 (40.00%) from URAK and 38 (38.38%) from UACS mark a neutral response to the formulated statement. In general, the data show that a significant share of students from both educational institutions – over 72% of URAK and over 67% of UACS have not included the CE principles in their professional goals.

The following statement reflects the confidence of students from Bulgaria and North Macedonia regarding their inclusion in the CE (Table 3). The statement *I am ready to do anything to become involved in the CE* is supported to varying degrees by 33 (31.42%) of the students of URAK and 29 (29.29%) of the UACS respondents. Accordingly, 39 (37.15%) of URAK and 38 (38.39) of UACS survey participants disagreed and strongly disagreed. 33 (31.43%) from URAK and 32 (32.32%) from UACS have a neutral opinion. Apparently, the results are similar to those derived from the previous statement. The sum of those who disagree to varying degrees and those who did not state a clear position with the statement shows uncertainty among students regarding their readiness to be included in the CE – at URAK, this total share is over 68%, and at UACS – over 70%.

Table 3. Answers to the question: I am ready to do anything to become involved in the circular economy (number/percentage) – 1 (Strongly Disagree) to 5 (Strongly Agree)

Question #3	1	2	3	4	5
URAK (N=105)	19 (18.10%)	20 (19.05%)	33 (31.43%)	23 (21.90%)	10 (9.52%)
UACS (N=99)	18 (18.19%)	20 (20.20%)	32 (32.32%)	19 (19.19%)	10 (10.10%)

Source: Leaders of the Green Economy project (2023).

The next statement – *I will make every effort to become part of the CE* reflects the desire of the students to actively get involved in the CE (Table 4). The willingness of the respondents can be distinguished from their readiness and confidence, considered in the previous questions, which is to some extent confirmed by the results obtained. To varying degrees, 46 (43.81%) of the respondents from URAK and 38 (38.38%) from UACS show agreement with the statement, and 28 (26.67%) from URAK and 27 (27.27%) from UACS respectively disagree. The number of those who did not express a position remains similar to the previous statements – 31 (29.52%) from Bulgaria and 34 (34.35%) from North Macedonia. Again, we have a high percentage of students who disagree or do not have a position.

Table 4. Answers to the question: I will make every effort to become part of the circular economy (number/percentage) – 1 (Strongly Disagree) to 5 (Strongly Agree)

Question #4	1	2	3	4	5
URAK (N=105)	13 (12.38%)	15 (14.29%)	31 (29.52%)	29 (27.62%)	17 (16.19%)
UACS (N=99)	13 (13.13%)	14 (14.14%)	34 (34.35%)	25 (25.25%)	13 (13.13%)

Source: Leaders of the Green Economy project (2023).

In conclusion, the results of the research show that a significant proportion of students from Bulgaria (50.48%) and North Macedonia (58.59%) express a determination to be included in the CE (Table 1). The results are weaker in terms of their professional commitment (Table 2): URAK – 27.62%, UACS – 32.32%, and confidence (Table 3): URAK – 31.42%, UACS – 29.29%. That gives reason to indicate gaps in the practical orientation of training related to CE. Students' uncertainty is a likely indicator that they are not aware of what business expects of them in terms of implementing CE principles in business operations and planning.

It is also important to note that both URAK and UACS recognise that there are not enough examples from the practice of local organisations that have implemented CE principles in their curricula (Misoska et al., 2023). Therefore, students acquire a purely theoretical understanding of the essence and benefits of CE. Still, the insufficiently in-depth connection between these skills and the actual use of knowledge causes uncertainty among students. As a result, they are rather unable to link their professional development with the principles of CE. However, 43.81% of URAK participants and 38.38% of UACS participants are willing to fully apply their knowledge and creativity for the transition from linear to CE. It is crucial that the education system, and universities, in particular, improve this preparation by providing concrete opportunities for development. This can only be achieved through direct cooperation with companies that already apply or are preparing to apply green economy principles in their operations (Pavlov & Ruskova, 2023). Concerns arise about the percentage of students who did not provide a definite opinion in relation to the overall results. For all four statements, neutral responses ranged from 19% to 42%. This result among students probably stems from a lack of knowledge of the principles of CE, which calls for higher education institutions to scrutinise these findings. To some extent, the answer “*I have no opinion*” is comparable to “*I do not know*”, and if this is indeed the case, a lack of basic understanding of the CE model will hamper efforts to implement it as a viable alternative to linear economics. Hence, schools should make a dedicated effort to enhance the abilities and expertise of their students.

5.1 Limitations of the Study

The anonymity of the questionnaires does not allow a discussion of the answers with each of the students and the understanding of the reasons for their answers. That is especially important in the context of those who disagree and strongly disagree with the statements and respectively express reluctance to become part of the CE. Knowing their likely concerns and fears would be an appropriate starting point for creating an educational approach that would enhance students' confidence and readiness to participate in the CE.

The study covered a small and geographically concentrated sample of 204 students from only two universities, one in Bulgaria and one in North Macedonia. At the same time, the focus on business-oriented majors may also distort the results, as students from other disciplines may have different levels of awareness and attitudes towards the CE. This does not allow generalisations about the attitudes of students as a whole in the two institutions and countries studied, but provides

a good starting point for expanding research in the field based on the interim results of the current study. The main goal of the LGE project, within which the research was carried out, is to improve training in disciplines directly related to the study of CE principles. In the two universities presented, these disciplines are developed and studied as a priority in business-oriented specialities.

In addition, as stated earlier, the current study did not look for a relationship between student attitudes and various demographic characteristics such as gender and age. Such correlations are the subject of additional analyses to be presented to the scientific community.

5.2 Applicability and Future Research

The results of the study will allow educational institutions to improve their programmes in the direction of greener, more sustainable, and more circular thinking. In this sense, the research enriches the existing practices and theoretical knowledge in the field of training in corporate social responsibility, economics, and management. That will make the graduates much more prepared for the active inclusion in the labour market and much more adequate to the growing demands for production and consumption in line with the principles of the CE.

6. Conclusions

The survey conducted among students from Bulgaria and North Macedonia shows a desire among young people to contribute their professional skills, entrepreneurial spirit, and creativity to the effective process of transformation towards a circular economy. The optimistic results are somewhat overshadowed by the apparent uncertainty of a significant proportion of the respondents. This uncertainty is probably a consequence of the lack of practical experience and examples from the real business processes of organisations local to the students.

The percentage of respondents who did not take a firm position on any of the formulated statements is also a source of concern. Their share remains relatively the same for all four formulated statements. This shows that many students most likely do not have the necessary theoretical foundation to form an informed opinion about the advantages or challenges associated with the transition from a linear to a circular economy.

The research seeks to show and succeed in proving that the educational process plays a vital role in making young people aware of the complex relationships between the environment and the economy. Understanding these connections is critical to the concept of CE, and only by recognising and comprehending them can significant strides be made towards a more environmentally friendly and sustainable global future.

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**Towards a Robust Assessment Framework
for the EU Open Data Maturity Index**

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Abstract

Strengthening Open Data policies is a priority for the Public Administrations of European countries because, firstly, they leverage their development momentum through economic, social, and environmental impacts and, secondly, they enhance transparency and accountability. In this context, the EU Commission publishes every year a report ranking a set of countries with respect to their maturity to Open Data. The methodology followed by the EU has given different results from year to year in terms of the ranking of a country, and the question that has been raised is the reliability of the method applied. The aim is to explore different decision methods to test their consistency and stability in relation to the existing method. In this study, a qualitative and quantitative research was conducted using a questionnaire and the AHP method was applied to modify the weights of the criteria that constitute the Open Data Maturity Index. Several countries show high volatility in their performance on sub-indices that are quite difficult to determine objectively. The AHP application showed that these sub-indices should have a fairly low weighting, having little impact on countries' performance. Based on the revised weights, the study arrives at a different ranking of the countries under evaluation and, combined with the use of the k-means method, a different clustering. A more structured and robust evaluation framework is proposed using ranking algorithms such as TOPSIS and PROMETHEE II.

Keywords: Open Data Maturity Index (ODMI), Multicriteria Decision Support Systems, Analytical Hierarchy Process, Data clustering, Public Administration.

JEL Classification: Z12.

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1. Introduction

According to the official open data portal (Open Data Portal, n.d.): “The term *Open (government) data* refers to information collected, produced, or acquired for a fee by public bodies (another name is *Public Sector Information*) and made available free of charge for further use for any purpose”. As stated by Carsaniga et al. (2022), open data is a factor for social well-being because it enhances inclusiveness, financial transparency and accountability, as well as economic development. Characteristic cases are as follows: A) Austria, where an open data-based application has been developed that enables people with disabilities to know in real-time which lifts are operating in the Vienna metro. B) Bulgaria, which through the SEBRA system enables citizens to monitor in real-time public expenditure. C) Lithuania where an artificial intelligence application based on open data was developed, to address the problem of unemployment, by analysing the labour market, predicting local employment needs and proposing solutions.

Every year since 2015, the European Commission (2018-2022) has published a report, which initially aims to rank the countries of the European Union, some countries of the European Economic Area and some countries in pre-accession negotiations according to their maturity in Open Data. The Commission, from year to year, modifies the indicators to some extent. However, there are four general categories that, in principle, remain stable.

2. Problem Statement

The Commission's methodological framework relies on a simple averaging system that leaves countries exposed to fluctuations in their performance due to unweighted sub-indicators. Some sub-indicators are difficult to measure objectively and exhibit extremely high volatility both from year to year and between countries in the same-year reports. To address this issue, this paper proposes three main innovations in the way countries are scored and clustered. First, a multi-criteria scoring mode is adopted to assess not only overall performance, but also individual performance. Countries with high performance on highly weighted sub-indices compensate for any negative performance on low-weighted sub-indices, and bilateral comparisons of countries across all criteria shape the final ranking. Second, the weights of each sub-index are determined using the Analytic Hierarchy Process (AHP) method. The opinions of open data specialists and experts are incorporated into the weight of each index, reflecting a more realistic, mathematically based framework, like those found in the international literature, where indicators do not have equal weights. Third, the country clustering is performed using the k-means algorithm, which is widely used in machine learning. This method provides a more robust and reliable clustering framework that can accurately classify countries based on their open data maturity level.

AHP (Saaty, 1996) is based on the idea of hierarchy. Mishra et al. (2018) applied the AHP to evaluate factors that influence open data initiatives and actions in the Indian public administration. Schmid and Pape (2019) used the AHP to compare the security levels of information systems of different companies and to rank them in terms of their maturity. Arief et al. (2019) used the AHP to determine the importance of the business functions of the ICT department of the government in North Maluku. Kubler et al. (2018) used AHP to compare the quality of the metadata in 250 Open Data portals in 43 different countries.

The PROMETHEE algorithm (Brans & Mareschal, 1984) is used for finding the optimal solution to problems with many alternatives and many criteria. Panayiotou and Stavrou (2019) used the PROMETHEE II method to propose an evaluation framework for the maturity of e-services of the Greek Local Government. Balkan and Akyüz (2023) used the PROMETHEE method to assess the technological maturity of the countries belonging to the OECD. The advantage of PROMETHEE II is that it provides the possibility of a full comparison and ranking between alternatives, unlike PROMETHEE I.

TOPSIS (Hwang & Yoon, 1981) is a multi-criteria decision analysis method (MCDM). TOPSIS presents a trade-off principle for multi-criteria decision-making processes. That is, there should be the smallest distance between the selected solution and the positive ideal solution and the largest distance between the selected solution and the negative ideal solution. Ardielli (2019) used TOPSIS to assess good governance in European Union countries. Sheoran et al. (2023) used the TOPSIS method to evaluate the usefulness and accessibility of open data portals, globally.

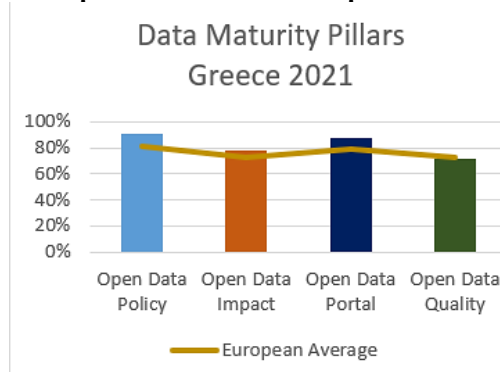
Pramanik et al. (2020) used the k-means algorithm, Haraty et al. (2015), to analyse data related to corruption in the public sector in Bangladesh. To the best of our knowledge, this is the first time that an integrated MCDM model combined with a clustering algorithm is used to modify the methodological framework of the EU Commission for the ODMI.

3. Research Questions / Aims of the Research

Qualitative research was conducted via Webex and in-person meetings with academics, experts in Decision Science, and government officials. The consultation and discussions lasted from 20th to 30th of June 2023 and took place in a total of four meetings. Based on the experts' suggestions, the Analytic Hierarchy Process (AHP) method was considered the most appropriate for determining the weights. For the quantitative research, a targeted sample of 60 people was selected based on eligibility criteria, including expertise and training on the subject of Open Data, previous experience, and the position held by the respondent. Although over 200 people were eligible to participate, the sample size was determined based on the eligibility criteria to ensure the quality of the responses. The questionnaire was compiled using Google Forms and sent to the selected respondents from July 5th to September 30th 2023 (responding rate 100%). The lion's share of the answers belongs to civil servants,

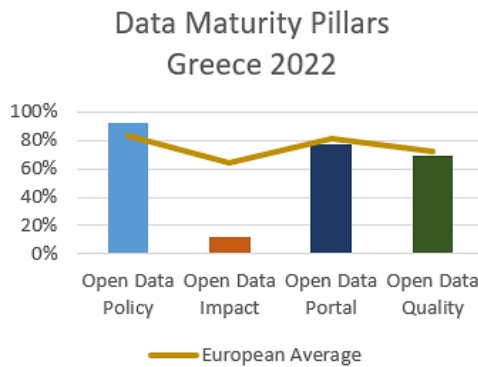
because their involvement in consultations with the EU Commission and the PSI Group makes them perhaps the most appropriate to formulate the actual weight.

Figure 1. The performance of Greece per sub-indicator, 2021



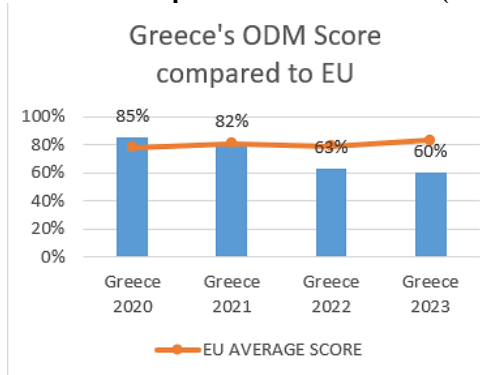
Source: processed by the authors, Excel.

Figure 2. The performance of Greece per sub-indicator, 2022



Source: processed by the authors, Excel.

Figure 3. The overall performance of Greece (2020-2023)



Source: processed by the authors, Excel.

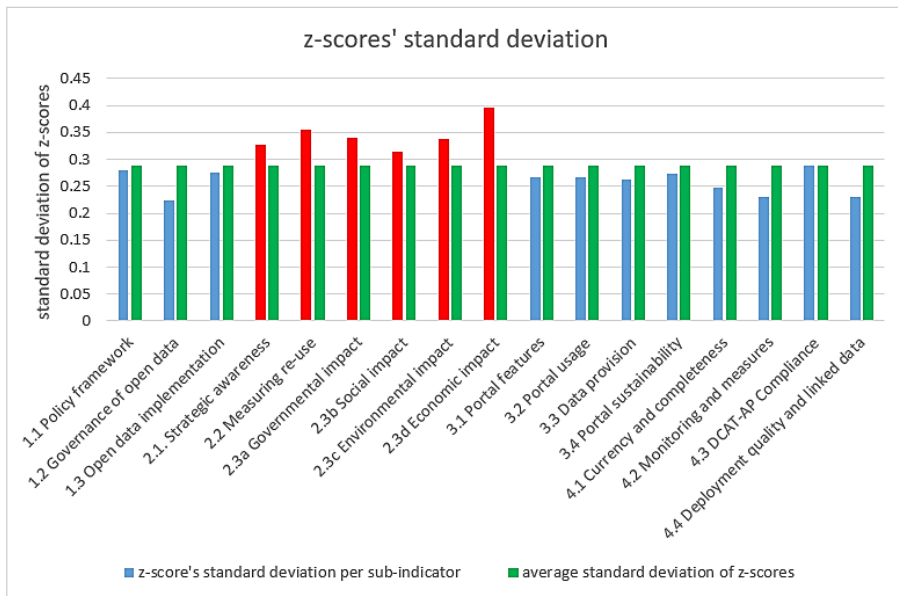
The questionnaire consists of a total of 114 sections. Greece's performance in three of the four indicators is stable (Figure 1 and Figure 2). However, from 2021 to 2022 there is a rapid deterioration in its performance in terms of “IMPACT”. Its inadequacy in this indicator is the cause of its overall score decline and its ranking in the lowest digital maturity tier. The overall score decreases from 82% in 2021 to 63% in 2022. A drop of 20% thanks to a single sub-indicator is unjustified in the context of an evaluation system that should be robust. The impact sub-index, as mentioned in the Open data Barometer 4th edition (World Wide Web Foundation, 2017), is difficult to measure and is prone to non-objective factors. The AHP method, gives high weight to the Policy sub-indicators and quite low weight to Created Impact. Greece's overall performance for 2019-2021 is equal to or above the EU average.

The Z-score, for normalisation Vafaei et al. (2016), in this study is defined as follows (in contrast to the mainstream z-score used in statistics):

$$Z_{ij} = \frac{score_{ij} - \min_i\{score_{ij}\}}{\max_i\{score_{ij}\} - \min_i\{score_{ij}\}}, \quad i - \text{country}, j - \text{criterion} \quad (1)$$

For 2022 it is observed that in 6 of the 17 sub-indices the variability of the z-score is higher than the average variability. The problem is found in the sub-indicator (impact) with the Economic impact sub-dimension showing the highest volatility.

Figure 4. Z-scores volatility per indicator (2022)



Source: processed by the authors, Excel.

Table 1. The distribution of questionnaires

Academic Institutions	Public Sector	Private Sector
National Technical University of Athens, International University, National Kapodistrian University of Athens, The Higher School of Pedagogical and Technological Education	Ministry of: a) Digital Governance, b) Development and Investments, c) The Interior, d) Tourism, e) Education, Religious Affairs and Sports, f) National Economy and Finance, Greek Parliament	Deloitte, Ernst & Young, MRC Energy Consultants, PFK Hellas

Source: authors' contribution.

4. Research Methods

Initially, the decision-makers express their view on the relative importance of the criteria, making bilateral comparisons. Their verbal response is converted into a whole number using the Likert scale, (1 = equally important, 2 = slightly more important, 3 = moderately more important, 4 = much more important, 5 = extremely more important). A matrix A is then formed, where each cell contains a number a_{ij} indicating the relative importance of the i criterion with respect to j . For example, if we use a 5-point Likert scale and the i criterion relative to j is considered much more important, then we would have $a_{ij} = 4$ and respectively $a_{ji} = \frac{1}{a_{ij}} = \frac{1}{4} = 0.25$. On the diagonal of the matrix the elements will be $a_{ii} = 1$, because the criterion i relative to itself is considered of equal importance. The weights of the criteria are obtained as the coordinates of the normalised eigenvector corresponding to the maximum eigenvalue:

$$Aw = \lambda_{max}w, \lambda_{max} \text{ (maximum eigenvalue), } w \text{ (eigenvector)} \quad (2)$$

The Consistency Index is calculated as follows where n is the matrix A dimension:

$$CI = \frac{\lambda_{max} - n}{n - 1} \quad (3)$$

The Consistency Ratio is defined as:

$$CR = \frac{CI}{RI} \quad (4)$$

where RI stands for Random Index and is a number given in official tables in the literature depending on the dimension of matrix A . If $CR < 10\%$ the results are accepted, otherwise the decision makers should repeat the procedure. For the TOPSIS method, the decision matrix is the table given by the EU Commission with the countries' scores in each sub-indicator, *Open Data Maturity Report (2022)* https://data.europa.eu/sites/default/files/country_scores_2022_0.xlsx, normalised with the Euclidean norm:

$$r_{ij} = \frac{y_{ij}}{\sqrt{\sum_{i=1}^n y_{ij}^2}}, \quad i = 1, 2, \dots, n \text{ (countries)}, \quad j = 1, 2, \dots, m \text{ (criteria)} \quad (5)$$

Calculation of the weighted normalised matrix:

$$w_{ij} = v_j r_{ij} \quad (6)$$

where v_j is the weight of criterion j . From the normalised weighted matrix W , the ideally optimal $H = (H_1, H_2, \dots, H_m)$ and the worst solution $D = (D_1, D_2, \dots, D_m)$ are calculated as follows:

$$H_j = \max_i(w_{ij}), \quad i = 1, 2, \dots, n, \quad j = 1, 2, \dots, m \tag{7}$$

$$D_j = \min_i(w_{ij}), \quad i = 1, 2, \dots, n, \quad j = 1, 2, \dots, m \tag{8}$$

The distance of each alternative from the ideally optimal and the worst-case solution is calculated:

$$d_i^+ = \sqrt{\sum_{j=1}^k (w_{ij} - H_j)^2} \quad d_i^- = \sqrt{\sum_{j=1}^k (w_{ij} - D_j)^2} \tag{9}$$

Calculate the relative distance of each alternative from the worst possible solution:

$$c_i = \frac{d_i^-}{d_i^- + d_i^+}, \quad i = 1, 2, \dots, n \tag{10}$$

5. Findings

Table 2. The Consistency Ratio is below 10% for each of the six AHP implementations

AHP	Consistency Ratio (%)
Dimension Policy	5.2
Dimension Impact	<0.1
Dimension Portals	6.4
Sub-dimension Created Impact	4.3
Dimension Quality	7.1
Comparison of 4 main indicators	1.7

Source: data processed by the authors in Excel.

Table 3. The weights calculated by the AHP method for each indicator and sub-indices

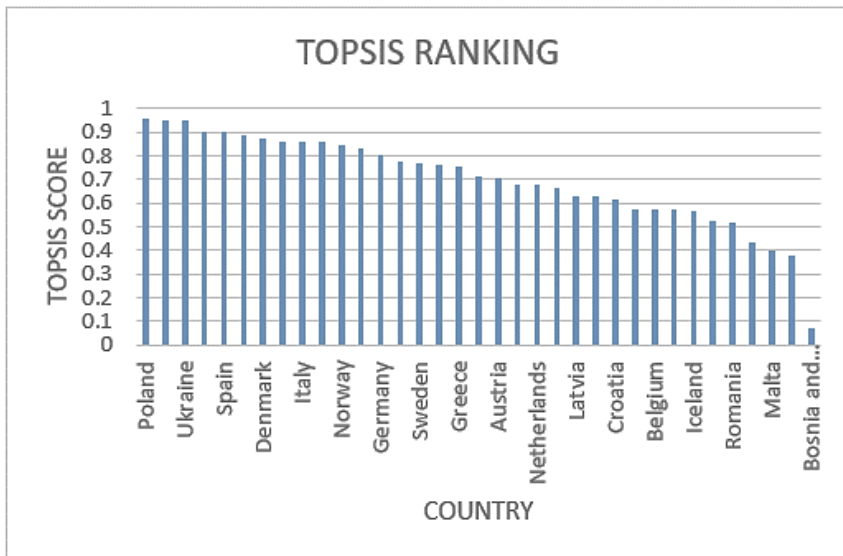
Policy 45.12%	Policy Framework	58.41%	
	Governance of open data	27.65%	
	Open data implementation	13.93%	
Impact 10.15%	Strategic awareness	42.71%	
	Measuring re-use	17.78%	
	Created impact 39.51%	Governmental impact	14.89%
		Social impact	47.77%
		Environmental impact	10.32%
Economic impact		27.02%	
Portals 21.09%	Portal features	16.53%	
	Portal usage	46.2%	
	Data provision	26.86%	
	Portal sustainability	10.41%	
Quality 23.64%	Currency and Completeness	46.46%	
	Monitoring and measures	27.89%	
	DCAT-AP Compliance	15.85%	
	Deployment quality and linked data	9.8%	

Source: data processed by the authors in Excel.

For the implementation of PROMETHEE II we used the open-access software Visual PROMETHEE (Mareschal, 1988) <https://bertrand.mareschal.web.ulb.be/promethee.html>. Based on net flows ($\Phi(x_i) = \Phi^+(x_i) - \Phi^-(x_i)$, $\Phi^+(x_i)$: the sum of the advantages of one alternative over the others, $\Phi^-(x_i)$: the sum of the benefits of all other alternatives over the alternative under consideration), Greece is ranked 19th. It is worth noting that the first and last positions do not differ from the Commission's report for 2022. This is because the top countries have high scores on almost all indicators, so any differences in weighting leave them unaffected. The same is the case for the countries that are ranked last, such as Albania, Serbia, and Bosnia and Herzegovina, because they are still at an early pre-accession stage and, therefore, the necessary convergence has not yet taken place. The impact indicator, in which Greece lags behind, has a very low weighting. In contrast, the indicator Policy and Governance, in which Greece has scored above the European average, has an increased weighting.

The Commission's methodology with a ranking resulting from the weighted total score of each country, with AHP revised weights, ranks Greece 21st, contrary to the Commission's report of 2022 (28th). The one-dimensional version of the k-means method was applied, but the same results are obtained if we apply the multidimensional k-means where each vector will have 17 coordinates, i.e. the score of each country in each sub-index.

Figure 5. TOPSIS results (2022)



Source: data processed by the authors in Excel.

Table 4. The results of k-means clustering

Trend-Setters (AHP weights)	Fast-trackers (AHP weights)	Followers (AHP weights)	Beginners (AHP weights)
Ukraine, France, Poland, Ireland, Cyprus, Spain, Estonia, Italy, Slovenia, Denmark, Norway	Lithuania, Czech Republic, Germany, Finland, Sweden, Austria, Bulgaria, Hungary, Netherlands, Greece	Portugal, Croatia, Switzerland, Belgium, Latvia, Slovakia, Republic of Serbia, Romania, Luxembourg, Iceland	Montenegro, Malta, Albania, Bosnia and Herzegovina
Trend-Setters (equal weights)	Fast-trackers (equal weights)	Followers (equal weights)	Beginners (equal weights)
Ukraine, France, Poland, Ireland, Cyprus, Spain, Estonia, Italy, Slovenia, Denmark	Norway, Lithuania, Czech Republic, Germany	Finland, Sweden, Austria, Bulgaria, Hungary, Netherlands, Greece, Portugal, Croatia, Switzerland, Belgium	Latvia, Slovakia, Republic of Serbia, Romania, Luxembourg, Iceland, Montenegro, Malta, Albania, Bosnia and Herzegovina

Source: XLSTAT (software tool for k-means clustering) <https://www.xlstat.com/en/>.

6. Conclusions

The AHP results on the weight of the indicators are in perfect agreement with the variability of the z scores of each sub-indicator. Sub-indices with high variability receive less weight than sub-indices with lower variability of z score. Based on the new weights, the Policy indicator seems to be the most important, followed by the Portals and the Quality indicator, which are of approximately equal importance, and finally the Impact indicator. However, even with the equal-weights approach using the k-means algorithm, the ranking is different from that given by the EU Commission. The proposed methodological framework enhances long-term policy making. The three different approaches: PROMETHEE, TOPSIS, weighted average with adjusted weights indicate that Greece is ranked 19th-21st instead of 28th and place it among the Fast-trackers instead of the Beginners.

The study outlined above is subject to certain limitations that present opportunities for future research. The audience interview was limited to the Greek Public Administration. It is recommended that a pan-European survey be conducted with executives from all public administrations of the countries under evaluation. However, the results obtained seem to be in line with similar studies in the international literature, particularly when assessing the weights. Additionally, restructuring the clustering methodology using machine learning algorithms, setting up a special task force to assess the impact dimension, and implementing different multicriteria evaluation systems and sensitivity analysis will help achieve maximum robustness of the results.

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**Digitalisation Risks and their Impact
on Business Sustainability**

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Alexandra-Andreea MIRONESCU⁴, Samar KAIS⁵

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Abstract

This study endeavours to explore the multifaceted risks associated with digitalisation, with a particular focus on their impact on the sustainability of businesses and strategies for reducing the negative effects. In their long-term journey to obtain sustainability, organisations are urged to remain flexible and embrace the digital innovations to ensure their relevance in the market, by responding to their client's needs. Organisations should analyse all parts of digitalisation, not only the benefits, to ensure they know what type of risks they will face, in order to be able to control them. Such risks as cybersecurity threats, digital skills gap, data privacy issues among others can have a potential impact on business sustainability. For this study a mixed research method was used, starting with reviewing the relevant literature of digitalisation risks and impact of digitalisation risks on sustainability. Afterwards, secondary data from Eurostat database was analysed using quantitative methods. The selection of this topic was done due to the growing significance of the two terms digitalisation and sustainability in both the research literature and the operational reality of organisations worldwide. Therefore, we consider the paper relevant for other researchers, students, practitioners and organisations stakeholders. The paper demonstrates originality by offering novel perspectives into the intersection of sustainability and digitalisation, through analysing the risks and their impact.

Keywords: digitalisation risks, business sustainability, risk impact on sustainability, cybersecurity threats, psychosocial stressors.

JEL Classification: Q56, D81, M21, O32.

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1. Introduction

This study investigates the impact of digitalisation risk on business sustainability. The concepts of digitalisation and sustainability have popularity among researchers and practitioners, due to their current growing significance worldwide. The present paper wants to answer the following questions: What are the risks of digitalisation? What are the dimensions of risk? What is the impact of digitalisation risk on sustainability of enterprises? It includes both quantitative and qualitative methods, analysing data from Eurostat database and recent relevant literature review.

Within the framework of the digitalisation of the economy, there are several opportunities as well as challenges (Golaido et al., 2020). Organisations are increasingly embracing digitalisation in response to the COVID-19 pandemic, positioning themselves to become more agile and adaptable in an environment marked by unpredictability (Palumbo & Cavallone, 2022). It is certain that the digital economy is expanding quickly over the years. In previous studies, the three stages of digital transformation are categorised as digitisation, digitalisation, and digital transformation (Ates & Acur, 2022). The consequences of digitalisation and its implications on corporate operations and individuals should be evaluated in accordance with the changing circumstances. Cybersecurity should be carefully evaluated within risk management practices, because as Uddin et al. (2023) says it may lead to extensive damage or even complete disruption of operations. In this study, we will analyse different perspectives of the relationship between digitalisation and sustainability, focusing on the risks related with digital innovation. The sections of the paper include the literature review which provides a summary of the latest relevant literature from the field, research methodology presenting the objectives, datasets and methods used, continuing with the part of results and discussion and finalising with the conclusions.

2. Problem Statement

Digital technologies undergo continuous evolution, there are new tools developed yearly while others fade away quickly (Kallmuenzer et al., 2024), but the company's capacity for innovation predominantly hinges on the digital skills and competencies of its workforce. Instead of being limited to particular economic sectors (Stacho et al., 2023), digitalisation affects every aspect of the economy as a whole (Blanka et al., 2022). Risk management should be integrated into the organisational environment of all enterprises (Prioteasa & Ciocoiu, 2017). Digitalisation should be approached strategically focusing on the integration of the three pillars: technology, financial support and human resources (Yang et al., 2023) to fully benefit of the opportunities. Digital technologies have a profound impact on organisational structures (Palumbo et al., 2022), changing both the physical and intangible areas of work in order to improve the flexibility, agility, and adaptation of organisations. Digitalisation can be viewed as a two-sided phenomenon (Palumbo & Cavallone, 2022), with both positive and negative effects on business. Digitalisation represents a multifaceted and long-term process, requiring financial investments and the

establishment of support infrastructures (Yang et al., 2023), as a consequence many businesses confront substantial obstacles. The use of digital technology presents a number of obstacles, including the requirement for large upfront expenditures, concerns regarding data protection (Kallmuenzer et al., 2024), and the imperative to enhance the work competencies. Risk taking rises with digitalisation (Lee et al., 2024) and the impact of risk broadens as digitalisation is susceptible and vulnerable to failure (Uddin et al., 2023), resulting from human errors, internal process deficiencies or unforeseen causes. The governments and existing legislation should take on the regulatory role (Molchan et al., 2019) and implement adjusting protection measures in case of hazards to economic security. Digitalisation's desire of centralising knowledge to be available to all stakeholders, carries the danger of decontextualising the data (Ruggeri et al., 2023) from its initial informational environment as well as ignoring the distinctive features of local organisational circumstances.

Digital innovation (Ko et al., 2022) enables business volume, which determines increasing operational risks at the level of the business (Uddin et al., 2023), in addition to digitalisation risks such as security issues, system breakdown, among others. Digital technology adoption can take many different forms (Kallmuenzer et al., 2024), with each company implementing a unique digitalisation plan. Bajpai et al. (2023) identified numerous risk factors associated with digitalisation, including inadequate systems for data integration and stakeholders' communication, maintenance and operations procedures, electronic assets, digitalisation budget, cost-benefit analysis, digital infrastructure, standards for digitalisation, security system, organisational culture, and stakeholders experience, among others. Cybercrime has emerged as a prominent concern in today's society (Uddin et al., 2023), prompting ongoing development of the legislation related with data protection, privacy, cybercrime prevention, consumer protection and electronic transactions (Kuczevska et al., 2023). This legislative evolution aims to address current societal needs effectively. Prior research has highlighted the potential negative effects of digitalisation on employees, leading to increased effort and intensity in their work, raising the pressures associated with working and job unpredictability, hiding the worker's contribution to organisation excellence, and making workers easier disposable by machines (Palumbo et al., 2022). They are frequently the most vulnerable to risks (Kahouli et al., 2023) arising from rapid technological advancements. The impact of digitalisation on small and medium enterprises is significant (Zeiringer et al., 2022), exacerbating resource limitations and cybersecurity vulnerabilities. This highlights how important it is to raise awareness and put preventative measures in place in order to deal with the potential risks. Small and medium-sized enterprises (SMEs) are particularly vulnerable to the adverse repercussions stemming from workplace digitalisation because usually they depend on digital transformation to boost their competitiveness (Palumbo et al., 2022). The unpredictability of the organisational environment is exacerbated by the trial and error system of digital innovation (Kallmuenzer et al., 2024), which may result in losses. Palumbo and Cavallone (2022) affirm that even if the downsides of

digitalisation may be exchanged by enhanced work flexibility, on the long run it can cause concerns related with disengagement and health of employees.

Digitalisation and automation are widely used (Molchan et al., 2019) and generate a substantial shift in the global economic structure. Studies show that companies who are among the first to use new digital technologies devote a significant amount of their finances to incorporating these tools, unlike companies that embrace digitalisation reactively (Kallmuenzer et al., 2024). Palumbo et al. (2022) has identified additional risks associated with digitalisation with focus on human resources, including time constraints, role ambiguity, irregular hours of work and negative work-life balance, technology aversion due to perception of machines – human being interchangeable, social relationships compromise, degradation of quality of the work environment, among others. All of the mentioned factors contributing to psychosocial stress among employees, potentially have a long-term effect on business sustainability (Palumbo et al., 2022). The fact that digitalisation creates new opportunities for business development (Lee et al., 2024), should not be forgotten when assessing the risks. Lepistö et al. (2022) state that since digitalisation is in a constant state of innovation, control functions are going to expand in the future for safety purposes.

Digitalisation plays a crucial role for social and economic advancement (Cappelli et al., 2024), influencing the economical, administrative, and social dimensions of sustainability. The convergence of sustainability and digitalisation is viewed as a synergistic partnership (Irajifar et al., 2023), as digitalisation can stimulate sustainability (Broccardo et al., 2023). The terms sustainable digitalisation and sustainable digital transformation (Lok et al., 2023) denote the process of digitalising the economy in a manner that is enduring, environmentally friendly, and naturally integrated. Brenner and Hartl (2021) concluded that the extent of digitalisation can impact the ecological and economic sustainability dimensions, while social sustainability does not show a similar correlation. The intersection of digitalisation and sustainability (Girrbach, 2018) presents compelling opportunities to tackle global challenges and pave the way for realising the Sustainable Development Goals (Irajifar et al., 2023). Business opportunities (Broccardo et al., 2023), may arise from the interaction between sustainability and digital innovation (Santarius & Wagner, 2023). The sustainability of social, economic, and administrative systems is shaped by the continuous process of digitalisation (Cappelli et al., 2024), taking into consideration all risk dimensions.

3. Research Questions / Aims of the Research

Considering the state of knowledge regarding the specific risks of digitalisation and its impact on the sustainability of businesses through the conducted research, we set out to answer the following questions:

- What type of risks specific to digitisation are relevant from the perspective of business sustainability in European countries?

- What are the risks of digitalisation that have a positive and strong relationship with representative elements regarding business sustainability in European countries?
- To what extent is the relationship between digitisation risks and business sustainability circumscribed by previous results obtained in the specialised literature?

Starting from some results obtained in previous studies published in the specialised literature and from existing secondary data, the research presented in this paper had the following objectives:

- Analysis of the state of knowledge regarding the risks specific to digitisation and business sustainability;
- The study of the relationship between digitalisation risks and a series of representative elements regarding business sustainability in European countries;
- Contextualising the results obtained in the research with those of other studies published in the literature on the same topic.

4. Research Methods

Based on the main elements resulting from the literature review, a series of representative variables for digitalisation risks and business sustainability were identified to carry out the research. For this, secondary data from the EUROSTAT databases for 30 European countries were used (related to 2019, the last one for which they were available for the structure of the analysed variables). The main variables taken into account as digitalisation risks were:

- Activities via internet not done because of security concerns;
- Fraudulent credit or debit card use;
- Online identity theft (somebody stealing individuals' personal data and impersonating individuals e.g. shopping under an individual's name);
- Getting redirected to fake websites asking for personal information (“pharming”);
- Misuse of personal information available on the Internet resulting in e.g. discrimination, harassment, bullying;
- The social network or e-mail account being hacked and content being posted or sent without individuals' knowledge;
- Experienced financial loss resulting from identity theft, receiving fraudulent messages, or being redirected to fake websites.

For the sustainability of businesses in the 30 European countries, secondary data from the EUROSTAT databases were taken into account regarding:

- Enterprises – number;
- Gross value added in the environmental goods and services sector;
- Air emission intensity from industry;
- Production in industry.

In order to highlight the existing relationships between digitalisation risks and specific indicators of business sustainability and to determine how strong they are, the analysis of correlations between the two sets of variables presented earlier in the article was used.

5. Findings

The correlations are illustrated in the below two tables for the analysed variables.

Table 1. Correlations between four specific digitalisation risks and sustainability indicators

		Activities via Internet not done because of security	Fraudulent credit or debit card use	Online identity theft	Getting redirected to fake websites	Enterprises - number	Gross value added in environmental goods and services sector	Air emission intensity from industry	Production in industry
Activities via Internet not done because of security concerns	Pearson Correlation	1	.457*	.302	.567**	.143	.353	-.090	.109
	Sig. (2-tailed)		.011	.105	.001	.450	.056	.636	.566
	N	30	30	30	30	30	30	30	30
Fraudulent credit or debit card use	Pearson Correlation	.457*	1	.614**	.758**	-.008	.219	-.206	.061
	Sig. (2-tailed)	.011		.000	.000	.967	.244	.275	.750
	N	30	30	30	30	30	30	30	30
Online identity theft	Pearson Correlation	.302	.614**	1	.725**	-.148	.116	-.245	-.412*
	Sig. (2-tailed)	.105	.000		.000	.436	.541	.191	.024
	N	30	30	30	30	30	30	30	30
Getting redirected to fake websites	Pearson Correlation	.567**	.758**	.725**	1	.013	.235	-.109	.002
	Sig. (2-tailed)	.001	.000	.000		.945	.212	.566	.991
	N	30	30	30	30	30	30	30	30
Enterprises - number	Pearson Correlation	.143	-.008	-.148	.013	1	.829**	-.129	.243
	Sig. (2-tailed)	.450	.967	.436	.945		.000	.497	.195
	N	30	30	30	30	30	30	30	30
Gross value added in environmental goods and services sector	Pearson Correlation	.353	.219	.116	.235	.829**	1	-.293	.115
	Sig. (2-tailed)	.056	.244	.541	.212	.000		.116	.544
	N	30	30	30	30	30	30	30	30
Air emission intensity from industry	Pearson Correlation	-.090	-.206	-.245	-.109	-.129	-.293	1	.241
	Sig. (2-tailed)	.636	.275	.191	.566	.497	.116		.199
	N	30	30	30	30	30	30	30	30
Production in industry	Pearson Correlation	.109	.061	-.412*	.002	.243	.115	.241	1
	Sig. (2-tailed)	.566	.750	.024	.991	.195	.544	.199	
	N	30	30	30	30	30	30	30	30

Source: own calculations using EUROSTAT data and SPSS software.

Table 2. Correlations between three digitalisation risks and business sustainability indicators

		Misuse of personal information available on the Internet	Social network or e-mail account being hacked	Experienced financial loss resulting from identity theft	Enterprises - number	Gross value added in environmental goods and services sector	Air emission intensity from industry	Production in industry
Misuse of personal information available on the Internet	Pearson Correlation	1	.262	.427*	.029	.293	-.279	-.331
	Sig. (2-tailed)		.161	.019	.877	.116	.135	.074
	N	30	30	30	30	30	30	30
Social network or e-mail account being hacked	Pearson Correlation	.262	1	.224	-.159	.018	-.344	-.426*
	Sig. (2-tailed)	.161		.234	.402	.924	.063	.019
	N	30	30	30	30	30	30	30
Experienced financial loss resulting from identity theft	Pearson Correlation	.427*	.224	1	.028	.283	-.243	-.182
	Sig. (2-tailed)	.019	.234		.882	.130	.195	.336
	N	30	30	30	30	30	30	30
Enterprises - number	Pearson Correlation	.029	-.159	.028	1	.829**	-.129	.243
	Sig. (2-tailed)	.877	.402	.882		.000	.497	.195
	N	30	30	30	30	30	30	30
Gross value added in environmental goods and services sector	Pearson Correlation	.293	.018	.283	.829**	1	-.293	.115
	Sig. (2-tailed)	.116	.924	.130	.000		.116	.544
	N	30	30	30	30	30	30	30
Air emission intensity from industry	Pearson Correlation	-.279	-.344	-.243	-.129	-.293	1	.241
	Sig. (2-tailed)	.135	.063	.195	.497	.116		.199
	N	30	30	30	30	30	30	30
Production in industry	Pearson Correlation	-.331	-.426*	-.182	.243	.115	.241	1
	Sig. (2-tailed)	.074	.019	.336	.195	.544	.199	
	N	30	30	30	30	30	30	30

Source: own calculations using EUROSTAT data and SPSS software.

The variable *Enterprises – number* has a positive weak correlation with Activities via Internet not done because of security concerns (0.143), a negative weak correlation with Online identity theft (-0.148) and Social network or e-mail account being hacked (-0.159), but no correlation with Fraudulent credit or debit card use and Experienced financial loss resulting from identity theft. Activities via Internet not done because of security concerns and Enterprises - number has the value of 0.143, which indicates a positive weak correlation between them. The correlation coefficient between Fraudulent credit or debit card use and Enterprises – number has a negative value of -0.008 which indicates there is no correlation between them. The correlation between Online identity theft and Enterprises – number has a negative value of -0.148, which indicates a negative weak correlation. Next the correlation coefficient of 0.029 indicates that there is no correlation between the variables

Misuse of personal information available on the Internet and Enterprises – number. The Pearson coefficient of -0.159 indicates a weak negative correlation between the variables Social network or e-mail account being hacked and Enterprises – number. Experienced financial loss resulting from identity theft and Enterprises – number variables doesn't have any correlation, as the correlation coefficient is 0.028. Next will be analysed the variable of *Gross value added in environmental goods and services sector* in relation with digitalisation risk variables. There exists a medium positive correlation with Activities via Internet not done because of security concerns (p-value = 0.353), a weak positive correlation with variables Fraudulent credit or debit card use (0.219), Online identity theft (0.116), Getting redirected to fake websites (0.235), Misuse of personal information available on the Internet (0.293), Experienced financial loss resulting from identity theft (0.283) and no correlation with Social network or e-mail account being hacked variable (0.018). *Air emission intensity from industry* business sustainability variable will be analysed in relation with the digitalisation risk variables. There is a negative weak correlation with all independent variables, except for Social network or e-mail account being hacked which has a negative medium correlation and Activities via Internet not done because of security concerns which doesn't have any correlation. The *Production in industry* has a medium negative correlation with Online identity theft (-0.412), Misuse of personal information available on the Internet (-0.331), Social network or e-mail account being hacked (-0.426) and a positive weak correlation with Activities via Internet not done because of security concerns (0.109) and a negative weak correlation with Experienced financial loss resulting from identity theft (-0.182), but no correlation with Fraudulent credit or debit card use (0.061).

6. Conclusions

The study Digitalisation Risks and their Impact on Business Sustainability analysed diverse variables of digitalisation risk and business sustainability. Even if there exist numerous correlation relationships between the variables, not all of them have a significant P-value. It can be seen that the significance values for the majority of correlations between variables are bigger than the standard threshold of 0.05, which indicates that there exists the probability that the correlations are determined by a random fluctuation. There are two exceptions between the Production in industry and two independent variables, respectively, Online identity theft and Social network or e-mail account being hacked which have 0.024 and 0.019 P-value, which indicates a low probability that this correlation is due to random fluctuation. Consequently, the correlation between the two variables is significant at the 0.01 level, implying a statistically meaningful relationship between them, therefore when variables Online identity theft and Social network or e-mail account being hacked are increasing, then the variable Production in industry is decreasing, and vice versa, having a negative medium correlation.

The study did not find any strong and positive relationship between the representative elements of risks of digitalisation and the representative elements of business sustainability in European countries. The limitations associated with the

paper include the fact that the findings cannot be generalised, taking into consideration that 30 countries participated with data for the selected variables. The applicability of this study can draw attention on this subject of other researchers, students, and practitioners, in order to extend the analysis to more variable elements, employing also longitudinal statistical analysis to further investigate the relationship between business sustainability and risks of digitalisation.

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**Particularities of the Public Procurement Contracts
Concluded by Public Hospitals in Romania
in the Pandemic Year 2021**

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Abstract

The article aims to analyse the public procurements in Romanian public sector hospitals in the pandemic year 2021, with the aim of identifying and analysing their particularities compared to the contracts concluded under normal conditions. The information used was extracted from the open data portal data.gov.ro and was processed with SPSS to identify the particularities that appeared in the case of public procurements carried out during the health crisis generated by the COVID-19 pandemic in the Romanian public sector, in order to identify possible solutions to be considered in the future, in the event of similar crises occurring in the future. Also, the article aims to analyse the possible correlations between various variables that were the basis for the awarding of public procurement contracts made by public hospitals in 2021.

Keywords: COVID-19, public procurements, public hospitals, contracts, sanitary crisis.

JEL Classification: H83, I15, M48.

1. Introduction

The efficient management of public resources allocated for public procurement falls to the contracting authorities, i.e. public institutions/authorities in Romania,

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which have the obligation to use them in compliance with the principles of economy, efficiency, and effectiveness.

The COVID-19 pandemic has brought with it a series of particularities regarding public procurement, especially regarding the health field. In this context, carrying out an objective analysis regarding the public procurements made by public hospitals in 2021 may highlight some phenomena that manifested themselves in crisis conditions and that had a series of effects on the public procurement process and, implicitly, on the use of public funds.

The crisis situation generated by the COVID-19 pandemic has led to a strong reaction in the supply chain of medicines, medical equipment and, above all, sanitary materials, which has resulted in enormous costs in terms of their acquisition, due to the huge demand, which led to the allocation and use of enormous sums from the state budget for this purpose. Another consequence of the shortage of sanitary materials was the entry into the market of some noncompliant products, the crisis situation being, in some cases, the perfect opportunity for fraud and corruption phenomena in this area.

In Romania, in the field of public procurement, given the crisis situation generated by the COVID-19 pandemic that led to the need to purchase medicines, medical equipment and sanitary materials, the legislative framework has undergone numerous changes, being necessary to adopt normative acts with the purpose of reducing the terms of public procurement procedures, but also to simplify the way of awarding public procurement contracts, especially in the sanitary field.

Given the fact that the legislation on public procurement provides the obligation of contracting authorities to use competitive public procurement procedures for those procurements whose estimated value exceeds a certain threshold, a series of normative acts were adopted during the pandemic, especially in the state of emergency decreed by the President of Romania, as follows: 39 primary-level normative acts, 12 secondary-level normative acts, 75 tertiary-level normative acts, i.e. a total of 126 amendments.

The changes made in the field of public procurement were aimed both at reducing the terms related to the procurement procedure (from its initiation to the signing of the contract), as well as the possibility for some contracting authorities to directly purchase products and services necessary for the prevention and combating of the COVID-19 pandemic, without being obliged to take into account the value thresholds imposed by the legislation in force in the field of public procurement, according to the American model applied as a result of the disaster caused by Hurricane Katrina in 2005.

2. Problem Statement

The COVID-19 pandemic brought with it a crisis situation, we can say a “*black swan*” type (Taleb, 2016), that is a very rare and unpredictable event, but which had a significant impact on all humanity. Some authors even consider that this crisis falls under a new concept, derived from the concept of black swan, called “*green swan*” (Lim, 2021), that is a serious and complex event, with a certain risk

of occurring in the future in a certain form, given the fact that the World Health Organisation (WHO) has already launched the PRET initiative, with the objective of enhancing global readiness for a potential future pandemic, the goal is to improve the level of preparation in all nations (WHO, 2023).

Regarding the reaction of the world's states to the COVID-19 pandemic, the way to prevent and fight infections with the SARSCov2 virus depended a lot on their level of development, the degree of development of medical services and the health system in general, the existence of policies and procedures for reacting to natural disasters, as well as the degree of their digitisation. However, the COVID-19 pandemic affected all of humanity, without exception, the situation being catastrophic for some underdeveloped states that did not have quick access to medical equipment, medicines, and sanitary materials.

Although there is some research (Arrowsmith, 2010; Ayhan and Üstüner, 2015; Wren, 2023) mentioning that, in order to be effective, the public procurement system must contain simple and clear rules and that the existence of a large number of rules in this field can suffocate the administrative apparatus and can also create opportunities for fraud and corruption phenomena (Søreide, 2002; Thomann et al., 2023; Sommersguter-Reichmann and Reichmann, 2024), however, the legislation on public procurement in Romania is extremely dense and has undergone numerous changes during the COVID-19 pandemic, as we previously mentioned.

Public procurement in the healthcare system being characterised by a series of particularities, such as the fact that the market is divided between several competitors, being practically a limited competition (Spieske et al., 2022, García-Altés et al., 2023), it is necessary to analyse the method of awarding public procurement contracts during the pandemic period, especially that, as regards the health system, the public procurements made during this period were carried out chaotically (Sadiq and Kessa, 2020; Harland et al., 2021; Njanji and Zhou, 2021), resulting in the use of huge sums from public funds (Dube et al., 2022).

The research carried out by some authors in this field has identified a series of correlations between various variables associated with public procurement processes during the pandemic period. For example, some studies have revealed that there is a strong positive correlation between the use of export restrictions that targeted medical products and the average time required to complete a competitive procurement procedure (Mathiba, 2020; Hoekman et al., 2022).

In the framework of this research, we propose to observe other correlations that intervened between different variables related to the public procurement process in the health field during the COVID-19 pandemic.

3. Aims of the Research

The article aims to analyse the public procurements in Romanian public sector hospitals in the pandemic year 2021, with the purpose of identifying and analysing their particularities compared to the contracts concluded under normal conditions.

4. Research Methods

In order to identify some phenomena that manifested in the field of public procurement during the COVID-19 pandemic in Romania in sanitary field, we extracted a database in Excel format regarding the public procurement contracts concluded by public hospitals in Romania in 2021 from the portal of open data data.gov.ro, a database that is containing 32,344 records. For the data analysis, the database in Excel format was imported in SPSS software version 29.0.1.0 (developed by IBM), generating a SAV type database.

Regarding public procurement contracts, some authors (Onur et al., 2012) have identified correlations between the number of offers and the value of the contract. Thus, following the analysis on a public procurement database in Turkey (a sample of 90,089 public procurement procedures), it was found that the number of bids received influences the price of the contract. Practically, based on the analyses carried out on the Turkish database, the authors of the analysis concluded that the size of the estimated value of the public procurement contract has a direct proportional impact on the number of offers received.

Furthermore, the research analyses whether this correlation is also identified with regard to public procurement contracts awarded by hospitals in the Romanian public health system in the pandemic year 2021.

5. Findings

In order to obtain an overview of the contracts concluded by public hospitals in Romania in 2021, we carried out a descriptive analysis with SPSS software on the database selected from the open data portal data.gov.ro (<https://data.gov.ro/dataset/achizitii-publice-sanatate/resource/5479f2bd-d8bf-4905-a00a-d458db619365>, accessed in 2023), the results being presented below:

Table 1. Distribution of relative frequencies and absolute frequencies regarding contracts concluded by lots

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	YES	31854	98.5	98.5	98.5
	NO	490	1.5	1.5	100.0
	Total	32344	100.0	100.0	

Source: data generated by SPSS.

From the analysis of the data presented in Table 1, it can be observed that most of the contracts concluded in 2021 by public hospitals in Romania were concluded in batches, respectively, 98.5% of them.

Regarding the type of contract concluded, the data presented in Table 2 show us that most of the contracts concluded were supply type contracts (96.7%),

the proportion of works and services contracts being insignificant in relation to the first (0.2% and 3.1%, respectively). This fact is easily explained by the fact that the reduction of activity in all sectors as a result of preventing and combating infections with the SARS Cov 2 virus, as well as the introduction of movement restrictions, implicitly led to a reduction in the number of contracts for works and services in the sanitary field.

Table 2. Distribution of relative frequencies and absolute frequencies regarding the concluded contracts

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Supply	31277	96.7	96.7	96.7
	Works	57	.2	.2	96.9
	Services	1010	3.1	3.1	100.0
	Total	32344	100.0	100.0	

Source: data generated by SPSS.

Regarding the type of the award notice published by the contracting authorities, the data presented in Table 3 indicate that the most notices were award notices for open tenders/accelerated open tenders (relative distribution=83.3%), compared to a weight of 16.7% in terms of award announcements for simplified procedures carried out during this period.

Table 3. Distribution of relative frequencies and absolute frequencies regarding the type of award notice published

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Award Notice	26936	83.3	83.3	83.3
	Award notice to simplified call for tenders	5408	16.7	16.7	100.0
	Total	32344	100.0	100.0	

Source: data generated by SPSS.

Also, the data presented in Table 3 show us that in 2021, public hospitals carried out a smaller number of simplified procedures compared to the other award procedures, a possible explanation being that the estimated value of the public procurement contracts that were to be assigned by the contracting authorities (public hospitals) exceeded the value thresholds provided by the legislation on public procurement, which is also confirmed by the data presented in Table 4 below:

Table 4. Distribution of relative frequencies and absolute frequencies regarding the type of public procurement procedure

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Open tender	26549	82.1	82.1	82.1
	Accelerated open tender	387	1.2	1.2	83.3
	Simplified procedure	5408	16.7	16.7	100.0
	Total	32344	100.0	100.0	

Source: data generated by SPSS.

Also, the descriptive analysis revealed the fact that the vast majority of public hospitals in Romania concluded framework agreements (81.4%), in favour of concluding public procurement contracts (18.6%), most of which were completed without e-tender as the final stage, as it can be seen from the data presented in Table 5 and Table 6 below. A possible explanation for the large number of framework agreements may be that this special way of awarding public procurement contracts can be concluded with one or more economic operators and has as its object the establishment of the terms and conditions governing the public procurement contracts to be assigned in a certain period, in particular as regards the price and, where appropriate, the quantities envisaged.

Table 5. Distribution of relative frequencies and absolute frequencies regarding the type of contract concluded (contract/framework agreement)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Concluding a framework agreement	26317	81.4	81.4	81.4
	Concluding a public procurement contract	6027	18.6	18.6	100.0
	Total	32344	100.0	100.0	

Source: data generated by SPSS.

Table 6. Distribution of relative frequencies and absolute frequencies regarding the completion of the contract by electronic tender

		Frequency	Percent	Valid Percent	Cumulative Percent
	YES	1707	5.3	5.3	5.3
Valid	NO	30637	94.7	94.7	100.0
	Total	32344	100.0	100.0	

Source: data generated by SPSS.

Next, in a bivariate analysis, the Correlate-Bivariate function was used in SPSS, to identify the existence of causal relationships between the analysed items, by calculating the *Pearson Correlation Coefficient*, whose significance from a statistical point of view was verified through the *Sig coefficient*.

After importing the Excel database, a data analysis was carried out, which took into account several variables, as follows: the number of offers, the value of the contract concluded, the date of publication of the tender notice, the minimum value of the contract, the maximum value of the contract and the estimated value, the results being presented in Table 7:

Table 7. Correlations between the main variables related to public procurement contracts concluded by Romanian public hospitals in 2021

		Number of offers	Contract value	Participation announcement date	Minimum contract value	Maximum contract value	Estimated value participation
Number of offers	Pearson Correlation	1	-.003	.099**	.079**	.080**	-.141**
	Sig. (2-tailed)		.629	<.001	<.001	<.001	<.001
	N	32344	20099	32344	12574	12575	32344
Contract value	Pearson Correlation	-.003	1	-.010	1.000**	1.000**	.421**
	Sig. (2-tailed)	.629		.144	<.001	<.001	<.001
	N	20099	20099	20099	329	330	20099
Participation announcement date	Pearson Correlation	.099**	-.010	1	-.005	-.004	-.152**
	Sig. (2-tailed)	<.001	.144		.610	.652	<.001
	N	32344	20099	32344	12574	12575	32344
Minimum contract value	Pearson Correlation	.079**	1.000**	-.005	1	1.000**	.196**
	Sig. (2-tailed)	<.001	<.001	.610		<.001	<.001
	N	12574	329	12574	12574	12574	12574
	Pearson Correlation	.080**	1.000**	-.004	1.000**	1	.196**

		Number of offers	Contract value	Participation announcement date	Minimum contract value	Maximum contract value	Estimated value participation
Maximum contract value	Sig. (2-tailed)	<.001	<.001	.652	<.001		<.001
	N	12575	330	12575	12574	12575	12575
Estimated value participation	Pearson Correlation	-.141**	.421**	-.152**	.196**	.196**	1
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	<.001	
	N	32344	20099	32344	12574	12575	32344

Note: **. Correlation is significant at the 0.01 level (2-tailed).

Source: data generated by SPSS.

Analysing the values of the Pearson correlation coefficient, presented in Table 7 above, the following conclusions can be drawn regarding the public procurement contracts concluded by the public health units in Romania in 2021: with regard to the number of offers within the analysed award procedures, it can be observed that, in the case of the analysed *public procurement contracts*, there is a positive, significant relationship between the number of submitted offers and the publication date of the tender notice ($R=0.099$, Sig. <0.001), which may suggest that the number of offers was influenced by the time period from the date of publication to the date of their evaluation. Practically, the longer the period between the date of publication of the tender notice and the date of bid evaluation, the greater the number of bids submitted by economic operators.

Paradoxically, in the case of the analysed contracts, regarding the correlation between the number of offers and the estimated value, the value of the Pearson correlation coefficient indicates that there is a negative but statistically significant relationship ($R = -0.141$, Sig. <0.001). Practically, the higher is the estimated value of the contracts, the lower is the number of offers, a possible explanation being that in the pandemic year 2021 in the sanitary field there was a shortage in terms of sanitary materials and medical equipment and it makes sense that, when the estimated value was high, there would be a lower number of offers, if we take into account the fact that a high estimated value can be based on a large amount of goods, which could only be made available by those economic operators who had the capacity to honour the respective contracts.

Thus, considering what was presented previously, we can state that during the COVID-19 pandemic, the use of export restrictions in the case of medical equipment, medicines and sanitary materials had a significant impact in terms of competition in public procurement in the sanitary field, a fact that influenced both the estimated value of the public procurement contract and its final value. Here, the use of these restrictions regarding the sanitary field had other consequences than those presented by the researchers in Turkey (Morales-Contreras et al., 2021; Hoekman et al., 2022).

In the case of *framework agreements* from the analysed database, the value of the Pearson correlation coefficient indicates that the number of offers was influenced by the minimum value and the maximum value of the public procurement contract

($R_1=0.079$, $R_2 = 0.080$, Sig. <0.001). Practically, between the analysed variables there is a positive relationship from a statistical point of view, which indicates that, in the case of framework agreements in the field of health concluded in the pandemic year 2021 by public hospitals in Romania, there was a greater number of offers when the minimum and maximum values of a framework agreement were high, meaning that there was more competition between large economic operators in the area of framework agreements with higher minimum and maximum values.

The situation presented above also has an explanation: the framework agreement is based on the conclusion of subsequent contracts for a certain period, and unlike the situation of contracts presented above, the conclusion of framework agreements allows economic operators to have time to stock up, in order to honour the contracts. It can be stated that the framework agreements were concluded with those economic operators who had the technical capacity to supply themselves with the medical equipment, sanitary materials, and medicines requested by the contracting authorities analysed, respectively, by the public hospitals in Romania.

6. Conclusions

The main effects on the value of public procurement contracts concluded by Romanian public hospitals in 2021 were generated by their estimated value, as well as the publication date of the tender notice/simplified tender notice. The least effects on the final value of public procurement contracts in the analysed period were related to the possibility of awarding contracts in batches, as well as the possibility of finalising purchases by choosing the electronic tender.

In the conditions of the COVID-19 pandemic, the conclusion of framework agreements also represented a safety measure for the contracting authorities, respectively public hospitals, by the fact that the conclusion of such framework agreements made possible that, in the event that one of the economic operators could not make available the medicines/medical materials requested by the contracting authority on the basis of the concluded framework agreement, the latter being able to purchase from another economic operator participating in the framework agreement, and in the event that none of the economic operators party to the framework agreement can make available to the contracting authority the products that are the subject of the framework agreement, the contracting authority can turn to another economic operator for their supply, in accordance with the Romanian law.

Also, based on the conclusion of researchers from Turkey and not only (Gereffi, 2020; Hoekman et al., 2022; Hanspach, 2023), regarding the fact that there is a strong positive correlation between the use of export restrictions that targeted medical products and the average time required to complete a competitive procurement procedure, we can conclude based on the results generated by SPSS that there is a positive correlation between import restrictions, the average time required to carry out a public procurement procedure and the number of bids submitted, a fact that practically influences the number of economic operators participating in public procurement procedures in the sanitary field, thus limiting competition between

them, with an impact both on the price of the public procurement contract as well as on the amounts used from public funds.

Summarising the above, the main conclusion is that, in crisis situations, the behaviour of economic operators participating in the awarding procedures carried out by contracting authorities in the health field is different in periods of crisis compared to periods of normality, in the sense that there is a series of factors that can affect their ability to honour public procurement contracts. In the case of public authorities, they must create risk indicators and performance indicators based on the careful analysis of these behaviours, both from the perspective of periods of crisis and from the perspective of periods of normality.

Also, decision-makers at the governmental level must take into account the current regulatory framework in the field of public procurement and develop special procedures for emergency situations, taking into account the fact that some of these cannot be foreseen and can have a devastating impact on both society as was the case with the COVID-19 pandemic, as well as on the use of public funds in conditions of efficiency, effectiveness, and economy.

At the same time, for periods of crisis, the public authorities must be prepared, first of all, from the perspective of securing the necessary funds, but also from the perspective of using performance indicators and risk indicators adapted to these periods, in order to make spending from public funds more efficient, but and in order to combat and eliminate the risks that may arise in times of crisis regarding the good running of public procurement contracts.

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Institutional Capacity – Provisional Results of Member States during 2014-2020 Programming Period

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Abstract

Institutional capacity building and enhancement are the main focus for projects under thematic objective 11 for the programming period 2014-2020 supported by financial instruments under the Cohesion Policy, thus contributing to the objectives of economic, social and territorial cohesion of Member States. According to studies, there is a growing importance of education and, as such, of investment in education, but also a need for strengthening the efficiency of public administration and need to invest in the latter as well so that, in cooperation with social partners, be able to face the increasingly challenging societal overcoming needs and barriers. Considering the disrupting factors present in the socioeconomic and territorial contexts determined by the armed conflicts, by the recent pandemic effects which all have a negative mark on all aspects of life, to which the constraints on the national public funding add, there is a growing need of intervention and of investment for institutional capacity building. In line with the aforementioned, the aim of the research team was to investigate the achievements of the interventions funded under thematic objective 11 for all the Member States that selected it and highlight both the progress and the opportunities available for Romanian context. As the results show, Romania has much to gain in the following years in terms of activities to be supported, but also in the magnitude of the interventions. Yet, results should also be put in the light of driving forces or factors that contributed to the achievements and also to what each Member State envisaged.

Keywords: institutional capacity, Cohesion Policy, provisional results, opportunities for Romania.

JEL Classification: Y Miscellaneous Categories.

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1. Introduction

In the context of an ever changing economic, social, geopolitic environment, the need for a flexible, more adaptive, and capable governance at both local, regional, and national level is all the more felt, as it contributes to the design of robust strategies, to efficient allocation of resources, as well as to the efficient funding administration and a better financial compliance (Bachtler et al., 2023).

On the other hand, what matters more is not the type of administrative or governance system, but its capacity to generate good and effective outcomes. This is why a broader perspective is needed on the stakeholders involved, their individual capacities and impact on institutional and organisational capacity, as well as on other factors that contribute to the efficient use of resources. The focus is, as already mentioned, on outcomes, on achievements each administration succeeds in attaining thus determining growth, but there is also the need for a better understanding of internal and external forces that impact it. Sometimes economic factors – such as the recent recession experienced by Member States, or factors dependant on organisational culture, factors arisen out of technological development or the new geopolitical context, or even local or regional autonomy factors or a mix of aforementioned are accountable for the results and ask for further insight.

Considering the financial instruments available at the European Union level under the umbrella of the Cohesion Policy, institutional capacity – as it is covered by the 11th thematic objective of the 2014-2020 programmatic period – refers both to the administrative capacity of public authorities, and also to the institutional capacity of other stakeholders and roughly on efficient public administration.

The increasing interest in the development of institutional and administrative capacity and to thus investing in it is strongly related to policy performance – in this case, Cohesion Policy performance – as this proved to be one of the explanatory factors for which some regions with better quality institutions receive more funding and have a higher level of absorption and, as such, achieve faster economic growth. (Bachtler et al., 2023)

Irrespective of the operational programme that covered the 11th thematic objective for each of the Member States that selected it (i.e. Efficient Human Resources / Croatia; Growth and Employment / Latvia; Administrative Capacity / Romania; etc.) and irrespective of the way each state decided to manage it (i.e. under one national programme and/or regional programmes), the objective included investments directed to the same areas of action and, as such, reported achievements are corelated to the same indicators.

In this context, the aim of present study was to investigate the achievements of the interventions funded under thematic objective 11 during the 2014-2020 programmatic period for all the Member States that selected it and to highlight both the progress and the opportunities available for Romanian context.

2. Problem Statement

The institutional capacity, the administrative capacity or the capacity of public administration have been under the scrutiny of scholars who tackled different facets of the problem – determining factors of institutional capacity, influence of institutional capacity over growth and funds absorption, arguments for investing in certain areas that would have a greater impact on the improvement of institutional capacity etc.

Regarding the factors that could contribute to a better, more successful institutional capacity there have been pointed out drivers like the economic, social and territorial context; the historical context; the resources available and their quality (human resources, material resources, technological resources or instruments etc.). As studies show, the capacity of local management authorities is affected by operational dimensions like management stability, equipment and capabilities, staff and staff skills etc. (Cunico et al., 2023).

Studies also show that “there is a consensus on the need to tailor projects according to context” (Kacou et al., 2022). As researchers indicate, there is a need for “best fit” to issue and context, rather than an a historical, universal “best practice”. They plead for “tailored projects and associated techniques and tools designed to suit specific needs in specific contexts”.

Besides this, the allocation of funds is strongly dependent on the economic growth, as it is “based on the ratio of regional GDP per capita (in PPS) and the EU-wide GDP” (Mohl & Hagen, 2010). This could of course favor relatively rich regions, but it is also a matter of how economies may “absorb macroeconomic effects generated by the supplementary expenses”. (Incaltarau et al., 2020).

In a highly internationalised system, there is a huge pressure to take over transformations on the international arena, but “innovations in democratic and managerial practice” (Kaygısız, 2019) also need to match the context in which they are implemented, because sometimes they can lead to negative effects due to failures. Countries need to make choices in order to improve service delivery, but these choices are “based on capacity, history and politics” (Samaratunge & Alam, 2021).

As for areas over which the institutional capacity might show its *influence or impact*, these are various and generally related to all the stakeholders along the processes found under the responsibility of public administration – from the responsibility and relation to general public/citizens (or representatives of different groups of beneficiaries of public services) to the peer-to-peer relation in the case of different institutions involved in the same process. To only refer to the capacity of public institutions to absorb and manage funds, there could be mentioned the capacity to conduct needs analyses rooted in local realities, the capacity to develop long term strategies, the capacity to allocate resources targeted to the real needs and problems encountered, the capacity to develop or select adequate and mature projects, the capacity to develop and maintain partnerships with important stakeholders etc.

As far as the EU Cohesion Policy is concerned, capacity is defined as the ability “to design regional development programmes to meet EU objectives and in accordance with local needs; to allocate funding to eligible projects in line with EU rules; and to account for the funding spent in financial terms (audit) and physical outcomes (evaluation)” (Bachtler et al., 2023).

Considering the abovementioned, the important *areas of investment* necessary to improve institutional capacity are generally related to human resources (such as education and training of personnel and other categories of participants like representatives of NGOs and citizens), soft skills (i.e. assistance granted to SMEs, transfer of knowhow, training on techniques and methods etc.), equipment/hardware (see IT&C – instruments, platforms etc.).

In the 2014-2020 programming period, the “focus on innovation and smart growth specialisation” was highly related to the importance of education and innovation for economic development. The capacity to attract funds and spend them in a framework of regulatory compliance, while also achieving the envisaged results, has significant importance in the context of various constraints on national public funding (Pinho et al., 2015).

Indicating the importance and the impact of a better, successful institutional capacity has the role to raise the awareness on what can be lost in case of inaction, but, on the other hand, it is also important to analyse the achievements according to the areas of intervention, so that to further be able to take action depending on the level registered as compared to the desired one.

Also, it would be equally important for the policymakers to consider “not only the direct impact of the actions, but also the complex dynamics that they trigger and the effects that they can generate” (Cunico et al., 2023), because not only one policy, but a complex of timely coordinated actions can drive to the expected results.

In this broader context, the aim of the analysis undertaken by the authors of the present article was to investigate the achievements registered by Member States that have chosen thematic objective 11 (TO11) in order to identify the amplitude of activities, and also how well Romania performed as compared to other Member States – considering the number of participants to the programme and benefits reported for them regarding qualifications attained or change in their labour market status. In other words, the attempt of the authors is limited to the field of education and training and focuses on the results reported by the Member States until 2022 inclusive.

3. Research Questions / Aims of the Research

As already mentioned above, the aim of the research was to have an overview on how Romania performed as compared to the other Member States (MS) and to identify the opportunities available for the Romanian context regarding TO11 – *Enhancing institutional capacity of public authorities and stakeholders and an efficient public administration.*

The analysis conducted considers the achievements reported by Member States for the 2014-2020 programmatic period that ended in December 2023 (according to the rule $n+3$ years), for which preliminary data are available, namely for 2022 included, which means that achievements for 2023 were not included in the analysis. Data subjected to analysis were consulted on the Cohesion Open Data Platform (EC - Cohesion Open Data Platform, 2024).

Important to mention is that, according to the open data available, 18 MS reported results until 2022, out of which two countries will not be represented in the results here included – one being the United Kingdom, which left the EU in 2020 and the other one Cyprus whose values for the common indicators are weakly represented.

Another important aspect for analysis was the exclusion of results reported for INTERREG. This was due to the fact that the programme includes 36 countries, out of which nine countries are not EU member states.

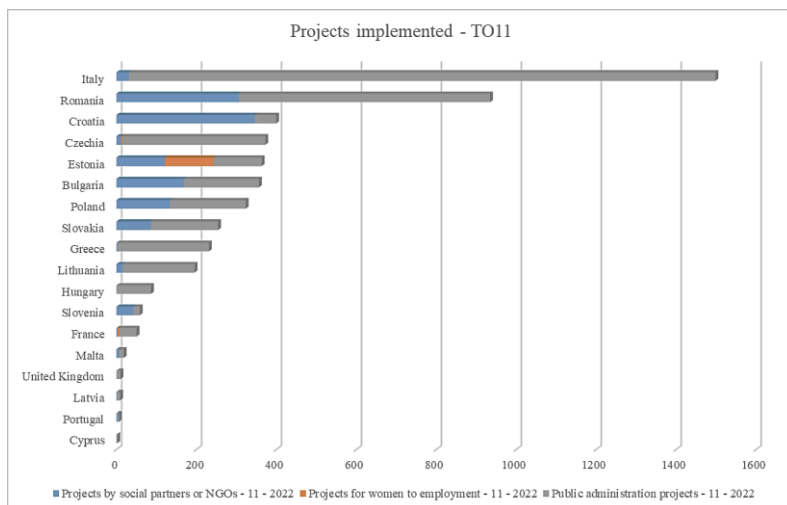
It should also be pointed out that the thematic objective was managed in a different way by different MS – some of them covered it (its indicators) in one or two national programmes – such as Bulgaria, Croatia, Cyprus, Czechia, Estonia, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia, UK, while other covered it by regional programs (coupled or not with national programmes) – such as France, Italy, and Portugal.

4. Research Methods

In order to perform the analysis, the authors first searched for the indicators associated to TO11 and classified them into categories, namely: (a) participants to the programme(s) – as per age groups, per educational status and per employment status, and also disadvantaged categories; (b) benefits of participants upon leaving the programme and (c) benefits of participants six months after leaving the programme. Data related to indicators was extracted in January 2024 and quantitative analysis was conducted according to the three sets of indicators mentioned.

The below given is Figure 1 – a representation of the number of projects implemented per category of beneficiary (social partners versus public authorities), along with projects implemented for women to employment. This was rather considered an indication on the administrative procedure (most probably more projects, shorter implementation periods, smaller budgets allocated, *or either* more projects managed at the level of different regions of the MS) than an indication on the amplitude of the programme. Data will be further compared with the number of participants to the programme(s) and other influencing factors will also be taken into consideration.

Figure 1. Representation of the number of projects implemented per category of beneficiary



Source: authors' own research.

More and more in the past years, there has been an increasing pressure for large programmes to achieve better results (at least in what means countable, quantitative indicators), reason for which programme managers are tempted to set very ambitious targets which are then very difficult to achieve (Mendez & Bachtler, 2022). This is why the authors of the present article will indicate potential factors that might have influenced the results presented, as not only the figures matter, but also the reasons why these reached certain levels. Influencing factors sometimes fall into the category of demographic indicators or economic development or are related to other contextual factors which are complex, challenging effects of the pandemic period, armed conflicts, and other long-term effects of historic and cultural nature.

5. Findings

The first set of indicators subjected to analysis was related to the number of participants to the programme. Data were analysed as per age groups, per educational status, and per employment status, and disadvantaged categories were also separately considered.

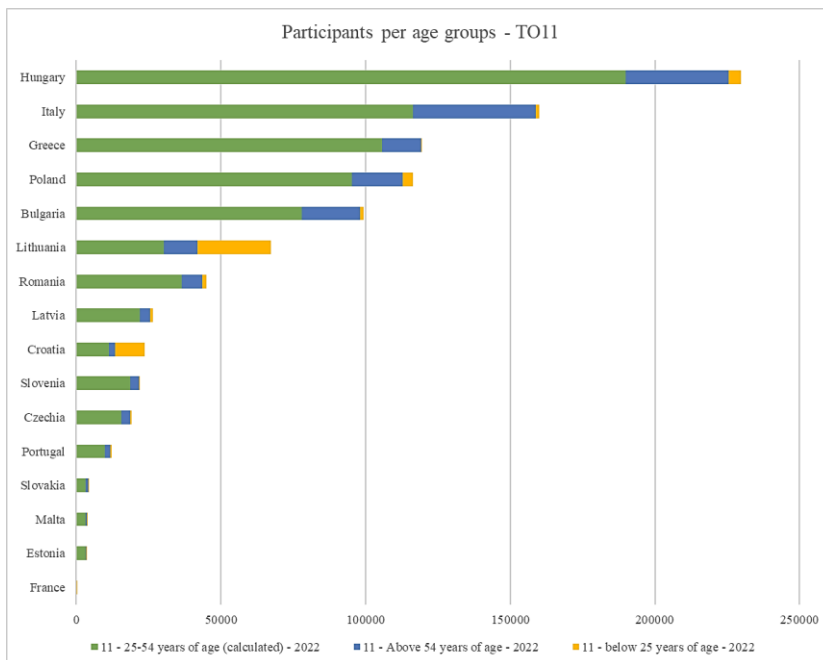
The total number of participants reported does not seem to be related with either larger populations of the states or greater experience in running projects (as would be expected in the case of older MS) and not even with territorial, geographical localisation. If considered, for example, the top three MS in terms of participants reported – Hungary, Italy, and Greece – these are located in different parts of Europe, joined the EU at different times (Italy is one of the first six MS – joined EU in 1958, Greece joined the EU in 1981 and Hungary in 2004) (European Union, 2024). On the other hand, if Greece and Hungary have similar populations in size

(10 394 055 / Greece and 9 597 085 / Hungary – 2023 census), they addressed TO11 under two national programmes, namely: Competitiveness Entrepreneurship and Innovation *and* Reform of the Public Sector – Greece *versus* Competitive Central-Hungary *and* Public Administration and Civil Service Development – Hungary. Italy, which has 5 times the population of the former two (58 850 717 / 2023 census), addressed TO11 under two national programmes (Governance and Institutional Capacity *and* Systems for Active Employment Policies) and 23 regional programmes. This proves on one side a high interest for the improvement of institutional capacity (in the case of Italy the more so for the local authorities) and, on the other side, the need to distribute the effort according to population size and administrative system.

As far as Romania is concerned, except the fact that it started reporting achievements one year later as compared to the aforementioned MS (started reporting in 2016), it managed the TO11 under a single national programme, namely *Administrative Capacity*.

Regarding the analysis per age groups, the larger group is the 25-54 age group in the case of all countries, which was expected as lifelong learning is needed more in the case of this age group and also the need for a permanent adaptation to the new requirements on the job (i.e. digital competence; use of new applications, techniques; implementation of new administrative systems / platforms etc.) – see Figure 2.

Figure 2. Number of participants per age groups - Thematic Objective 11

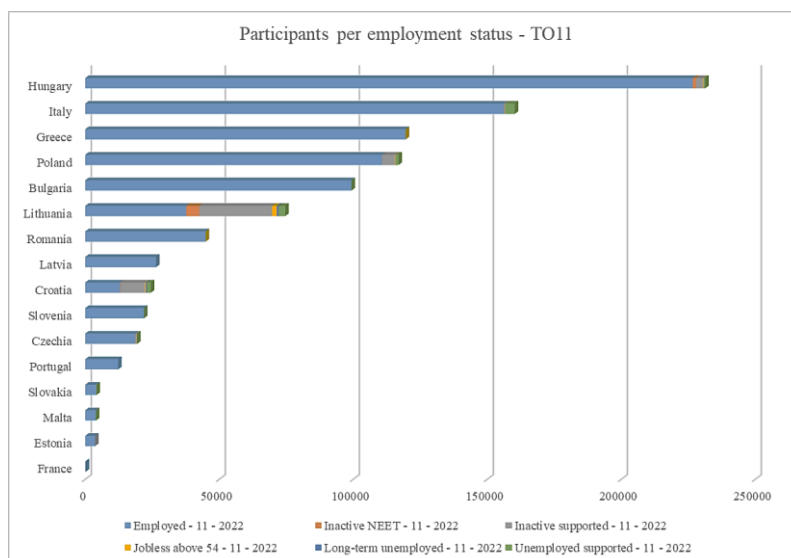


Source: authors' own research.

As per employment status (see Figure 3), the largest category represented is the *Employed* category. Considering that the programmes addressing institutional capacity target groups in public institutions and/or social partners/NGOs (in other words, employees) and to a lesser extent citizens (beneficiaries of the services provided by public institutions), this is self-explanatory.

Nevertheless, significant representations of *Inactive supported* (among which Inactive NEET – not employed nor in education or training) and *Unemployed supported* are encountered in MS like Lithuania, Croatia, Poland, and Italy, which means more citizens were included in the target group (ex. giving feedback for the procedures dedicated to these categories / being involved for input for the improvement of services provided to them).

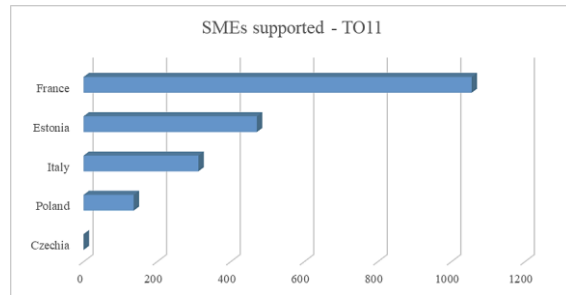
Figure 3. Number of participants per employment status - Thematic Objective 11



Source: authors' own research.

One significant indicator is reported by a few MS (see Figure 4) regarding the support granted to SMEs. This is not to be neglected, because on one hand, SMEs are drivers of growth in rural areas and, on the other hand, because mainly social enterprises (but not only) are practically partners with public administration in relation to disadvantaged categories like disabled or homeless (involving them in activities, offering support for employment etc.). This is good practice that could be taken over by Romania in the future programmes.

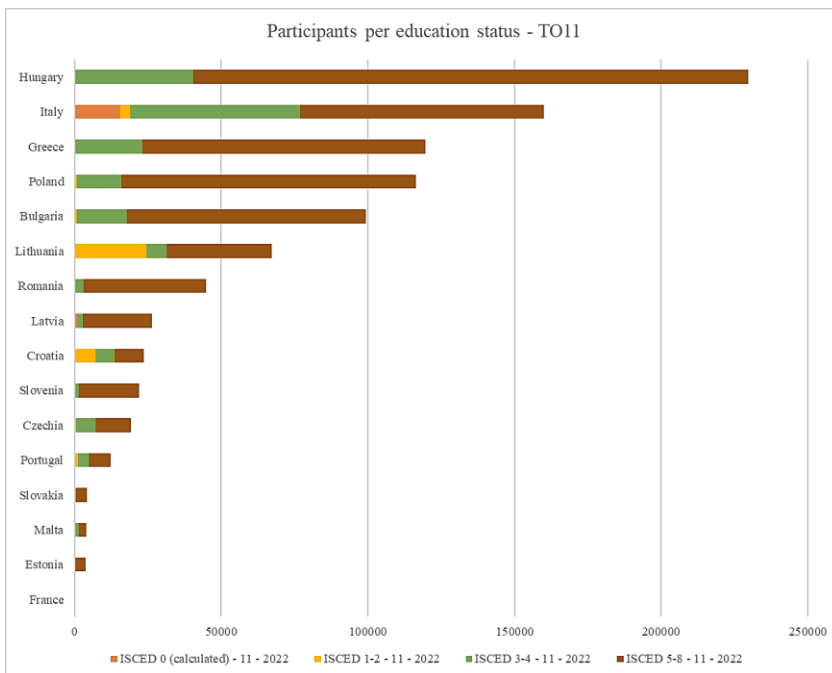
Figure 4. Number of Small and Medium Sized Enterprises supported – Thematic Objective 11



Source: authors' own research.

Participants per education status are again – as expected – highly represented by tertiary education or more (Bachelor/Master/Doctoral degree), on the second place being the secondary education participants (see Figure 5 – ISCED levels / International Standard Classification of Education). This is due to the targeted groups – employees in public administration or representatives of NGOs. Similarly to the employment status analysis, there are MS with a better representation of ISCED 0 and ISCED 1-2 categories.

Figure 5. Participants per education status according to ISCED levels – Thematic objective 11

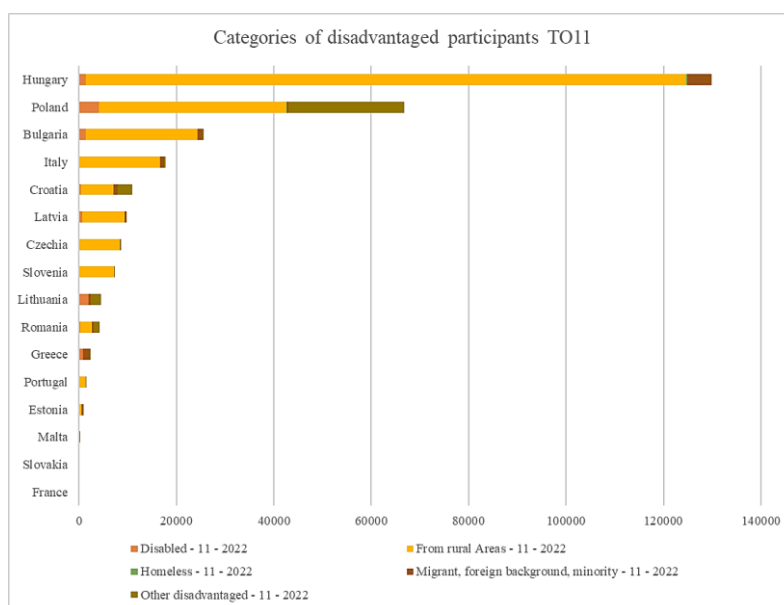


Source: authors' own research.

Here, included (see Figure 6) are the categories of disadvantaged participants as reported by the end of 2022. There were included the participants from rural areas on one hand considered disadvantaged because they come from the so called less developed regions and, on the other hand, because they do not have access to the same facilities as the ones in urban areas – at least in the East European countries. Another reason is also the fact that targeting people from rural areas means targeting local authorities – development, improvement of institutional capacity at local level. Important to mention is yet the fact that this indicator (participants from rural areas) was reported only in 2017.

Regarding the total number of participants falling in disadvantaged categories, the ranking is different in the sense that the first three places are taken by Hungary, Poland, and Bulgaria.

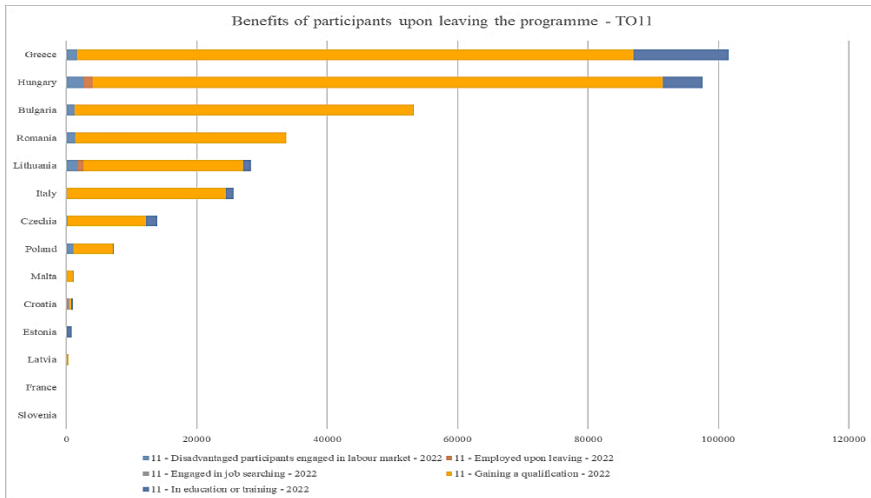
Figure 6. Disadvantaged participants – participants from rural areas included – Thematic objective 11



Source: authors' own research.

Among the benefits of participants upon leaving the programme, the greater representation is noted for *Gaining a qualification* (see Figure 7). This is probably due to the fact that most participants benefited from training programmes related to their current activity. The second place is taken by the category *In education or training*, which means that some of the participants continued the training courses upon leaving the programme.

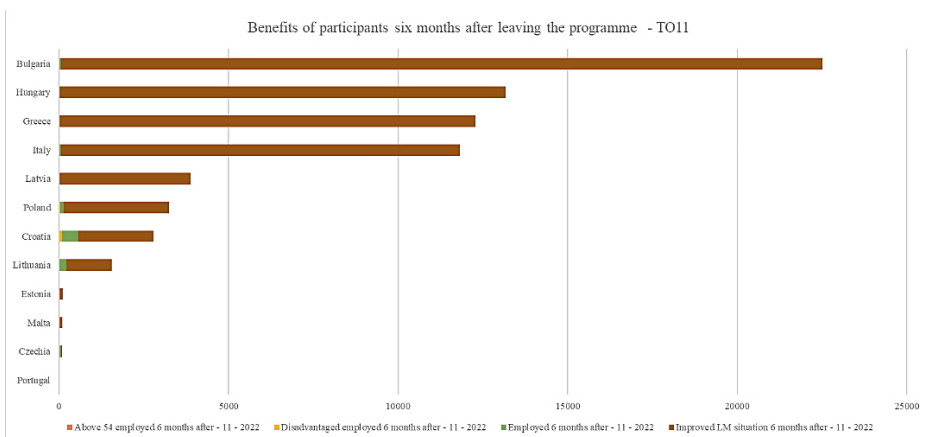
Figure 7. Benefits of participants upon leaving the programme – Thematic Objective 11



Source: authors' own research.

As for the benefits of participants six months after leaving the programme, it should be mentioned from the beginning that this might register bigger changes than the other indicators, considering that the programmes implementation has just ended in December 2023. In any case, because the aim was to have better trained employees in various aspects of their activity, *improved labour market situation* is the outcome expected for all the MS as represented in Figure 8 below. On top three, the same MS appear – similar to the case of benefits of participant upon leaving the programme.

Figure 8. Benefits of participants six months after leaving the programme – Thematic Objective 11



Source: authors' own research.

According to the results presented, Romania has much to gain in the following years in terms of activities to be supported, but also in the magnitude of the interventions. Yet, results should be also put in the light of the driving forces or factors that contributed to the achievements. Considering that neighbouring countries like Bulgaria and Poland (keeping the proportions in terms of population) that both faced more or less the same problems determined by the Russia – Ukraine war with its many facets of social and economic life but also have similar historic background as countries located in Eastern Europe, Romania should take over good practice as it is equally interested in more successful institutions / public authorities able to absorb funds and able to provide better public services.

The results should of course be considered in the light of funds allocation which is determined by economic performance of each country and also correlated to what each country envisaged for the programme proposed and implemented.

6. Conclusions

The analysis conducted revealed an overall weak performance for Romania, but this must be further analysed as compared to results foreseen, but also funds allocated / budget executed. On the other hand, it should be noted that data subjected to analysis are preliminary for the 2014-2020 financial cycle, which means that important data may add for the last implementation year (2023) and also data reported for benefits of participants at 6 months after leaving the programme.

Making a comparison between the number of projects implemented and the number of participants to the programme, Romania ranks the second for the number of projects (with 934 projects, out of which 628 are implemented by public administrations and 306 by social partners and NGOs), but the 7th in terms of the number of participants to the programme. This could have various explanations, among them there might be a focus on other resources and not the human resource – with citizens less targeted than other MS and a better orientation to public servants. There could be also interpreted as a fragmentation of resources, which might have not been the right choice to reach the results of interest. On the other hand, if local authorities / institutions are targeted, then the large number of projects might be self-explanatory like in the case of Italy that addressed the thematic objective under national, but also regional programmes. This is why further analyses might shed a better light on the achievements reported.

Good opportunities for Romania could also be to investigate the need and the possibilities of implementation for activities targeted at different actors / stakeholders maybe less addressed in the past – like the case of SMEs illustrated in the present article.

It would be of high importance as well to correlate the performance of other programmes implemented in the same financial cycle with the performance of programme dedicated to enhancing the institutional capacity and also extract areas of interest for investment in the next financial cycles that would increase the overall performance with the final aim of economic, social, and territorial cohesion.

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**Understanding the Emergence of Populist Parties: A Review
of the Interconnected Factors Involving Individual
Resilience, Educational Levels, and Party Support –
A Case Study of Romania**

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Abstract

Populism is seen as a significant phenomenon in politics nowadays. Populist parties are gaining the backing of citizens in various countries. What are the individual key factors that contribute to the rise of populism? This article aims to provide a comprehensive answer starting from three key factors such as individual resilience, educational level, and party support. Therefore, we conducted research among 241 participants (civil servants from public administration) who agree to respond to an online questionnaire. Data were gathered via the Google Form platform. The questionnaire was structured following main objectives, such as: identifying the individual resilience level, respondents' level of trust, party affiliation and support, the perception of populism and populist promises perception, the importance of truth in politics, the voting intention and socio-demographic data. The research reveals that most of the respondents (93,4%) have a high individual resilience while 90% appreciated that in interpersonal relations the best attitude is to be cautious. Furthermore, even if the general belief is that populist promises expressed during electoral campaigns cannot be achieved, an average of 37,7% of the respondents indicated that populist parties could win the elections. As regards the honesty of political actors, 55,6% of the respondents indicated that political actors cannot be honest. For 65.1% of the respondents, political advisors are responsible for the lack of honesty and trust. The rise of populist parties is due to some aspects such as: lack of trust in the current political class, social economic context (poverty), and the level of education (lack of political culture). Additionally, this research highlights the role of educational levels in shaping populist party support. Individuals with lower levels of education tend to be more susceptible to populist messages due to limited access to critical thinking skills and political knowledge. Furthermore, individuals with higher levels of resilience tend to be more skeptical or critical regarding the truth of political parties or politicians. Likewise, individuals with higher levels of resilience tend to perceive populist

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promises as less achievable. This article contributes to the existing literature by providing a comprehensive understanding of the factors that could enlighten the increase of populist parties, often promoted as having a sovereigntist doctrine. By examining individual resilience, educational levels, and party affiliation, the study offers valuable insights into the dynamics of populism in this context.

Key words: political marketing, politics, populism, resilience, consumers behaviour

JEL classification: M38

1. Introduction

Populism became a trendy concept not only for public discourse, but also for academics. The attention given to it is in the context of the emergence of political entities promoting a certain type of discourse focused on frustrations and less on solutions. Through specific tools of political marketing and mass communication, populist parties spread their content towards citizens and society. Populist political entities do not offer solutions to problems, but only amplify the degree of citizens' dissatisfaction.

As Guriev and Papaioannou (2022, p. 754) citing Dornbusch and Edwards (1991) populism was a movement belonging to Latin American area. But nowadays it became a global phenomenon, rising in different countries. Some authors (Guriev & Papaioannou, 2022, p. 754) consider that populism rise is linked to the global economic crisis, pointing to some moments such as Tea Party movement in the US (2010), the paradigm of illiberal democracy in Hungary (2010), the elections for the European Parliament (2014), SYRIZA and independent Greeks (2015), Law and Justice Party in Poland (2015), Brexit (2016), Donald Trump election in the US (2017), Alternative for Germany – AfD (2017), Lega Nord and Movimento 5 Stelle (2018). In Romania, even if populist parties (AUR or PRM) failed to take over, they gained a significant popular support.

Several researchers (Bang & Marsh, 2018; Kriesi, 2014; Mudde & Kaltwasser, 2012) characterised populism as a political force expressing the lack of trust in democratic practices. BREXIT meant not only losing an EU member and increasing European citizens' scepticism upon union values and future, but also the rise of support for populist parties. Populists spread the belief in the sovereignty of the people and uniformly lament the perceived dysfunction of democracy, attributing this to the erosion of popular sovereignty and expressing concern about it term of an ongoing threat.

Based on their political rhetoric, populists might be perceived as true protectors of the constitutional framework that supports democracy. By asserting themselves as the authentic so-called vox populi, populists invoke the core principles upon which modern democracy is founded (Espejo, 2017). Urbinati (2013, p. 140) quoted Kazin (1995) as considering populism as a democratic expression of political life that is needed from time to time to rebalance the distribution of political power for the benefit of the majority. In this context, Urbinati (2013) interpret populism as having a certain periodicity.

Although an universally accepted definition of populism proves to be elusive, it is frequently construed as an ideological framework that dichotomises society into antagonistic factions, *the people* and *the elites*, as Mudde (2004, p. 543) stated that populism “is a thin-centred ideology that considers society to be ultimately separated into two homogeneous and antagonistic groups «the pure people» versus «the corrupt elite» and which argues that politics should be an expression of the *volonté générale* (general will) of the people”.

Therefore, as an ideology, populism reveals the key role of the people in politics, stating that they – the people – have been betrayed by the so-called elites. And it is imperative that the sovereignty of the people to be restored (Meny & Surel, 2002, p. 11). Furthermore, the betrayal outcome is the lack of trust of the people in the elites. Since there is no trust, the elites are perceived as the evil, while people are the good ones.

Populism was also seen as a political strategy (Weyland, 2001) or as a project of political renewal (Urbinati, 2013). For Weyland (2001, p. 14), the most accurate definition of populism is as a political strategy to express power. Therefore, it is a political strategy through which a leader exercises government power based on the support of large numbers of citizens. Based on this definition, the populist leader is a new entry, a charismatic individual that does not belong to the elites, and, the most important, he claims to be the representant of the *vox populi*. Urbinati (2013) stated that populism as an ideology is not enough to reveal the concept. In Urbinati’s (2013) approach, populism as a phenomenon needs two elements: a polarising ideology and a leader capable of gathering masses to govern in the name and for the people. Therefore, Urbinati (2013, p. 151) pointed out that those elements represent a project of political renewal back to the natural roots of democracy.

Populism has risen in accordance with socioeconomic developments brought by globalisation and economic disfunctions (Dorn et al., 2016). The establishment's political reaction has failed to mitigate the impacts of such processes and amplified them. Fetzer (2019) indicates that economic crisis outcomes (austerity, decreases in welfare) increased support for populist parties in the UK.

According to Grossman & Helpman (2021), the populist rhetoric relies on the mechanisms of social comparisons and indicating the guilt, wherein the dichotomy people vs. elite represents the strategic purpose of indicating the so-called enemy. In this regard, individuals who perceive themselves as oppressed by the elites are supporting populist parties (Altomonte et al., 2019). Populist messages may find greater acceptance among individuals with limited exposure to diverse perspectives due to a lower educational level. The absence of critical thinking skills in such contexts can contribute to the spread of populist narratives.

Populist parties frequently attract individuals who identify strongly with these movements, finding a sense of identity and belonging within.

These populist approaches were possible and validated by votes, due to the existence of a vast electoral pool with the ability to believe such messages. A specificity of this electoral pool could be corroborated with the theory according

to which, following the occurrence of some adversities, the level of individual resilience should be very low.

Based on the opinions presented, the emergence and development of populism and populist parties can be explained as an outcome of the socio-economic context (citizens having a high level of distrust in ruling elites, high level of polarisation, frustrations). As EconPol Forum (2024) summarises, populist groups share concerns about: economic insecurity, perceived political inequality, limited opportunities, and a cautious attitude towards multinational corporations. Populism thrives on mistrust of established institutions, ideas, and ideologies (Chang, 2024, pp. 3-4 in EconPol Forum, 2024).

Within the last century, the world's political context has witnessed a continuous cycle of political doctrines (Modelski, 1978), reflecting the social, economic, and technological changes of the age. In a time when major events (world wars, the cold war, and globalisation) marked the evolution of societies, political ideologies were constantly changing and evolving.

1.1 Romanian Political Context

Nowadays, the Romanian political scene can be highlighted with a similarity regarding the theory of political cyclicity and ideologies (the 20th century Marxism theory, the 21st century globalism theory, the Spanish flu, Sars-Cov-2).

Each historical period contained debates about the role of the state in providing public services and protecting citizens from major risks, prompting a reconsideration of economic, social, and health policy, with a focus on ensuring better preparedness for future health threats. Both the pandemic of 1920 and the pandemic of 2020 had the effect of diminishing the current of globalism, followed by a reasoned growth of political currents of the sovereignist, nationalist, and even populist type.

As regards Romanian political context, there are five parliamentary parties: PSD (social democratic doctrine), PNL (liberal doctrine), Forța Dreptei (neoliberal doctrine), UDMR (representative of Hungarians in Romania), and AUR (conservative doctrine).

Among all five parliamentary parties, the new entry party is AUR (five years old). At the same time, the AUR party reshaped the political scene in Romania, earning its reputation as a party with unionist visions, deeply anti-EU. Subsidiarily, without having a traditional political organisation or leaders with a certain political reputation, in the parliamentary elections of 2020 (elections organised during the pandemic generated by the SARS-Cov-2 virus) relying on an electoral campaign with populist accents and anti-vaxxers managed to get 9.08% of the votes. Based on that, it became a parliamentary party.

Why did the voters choose to produce this change, in the sense of giving a mandate to a party that has populist communication to the detriment of traditional parties? While there is much research explaining why voters vote for populists, there is less research on why citizens choose to keep them in their preferences in terms of voting intention and how social media reinforces their anti-establishment message. In this context, the use of social media platforms seems to be a modern tool for

boosting populist messages, which, as noted by Meny & Surel (2002), has historically been a key factor in populist movements.

The success of AUR offers a new perspective on the political landscape, highlighting the ability of a new party to align with widespread populist sentiments. AUR not only revived traditional populist themes, but did so with a more radical approach, positioning itself as a key player. The party maintains a steadfast antielitist stance, coupled with a robust anticorruption campaign, employing a flamboyant political style characterised by continual confrontation, verbal assaults, and extensive accusations.

Based on researchers' considerations (Meny & Surel, 2002; Mudde, 2004; Urbinati, 2013; Weyland, 2001), the AUR party and its leader can be perceived as populism one.

1.2 Romanian Electors' Landscape

The previous elections for the European Parliament took place on May 26, 2019. According to ROAEP (2019), the total number of Romanian voters registered on permanent electoral lists (people who have their domicile or residence in Romania) was, in 2019, 18.267.732 people.

On May 26th, at the elections for the European Parliament 49,02% from the total number of people with the right to vote equivalent to 8.954.959 persons voted. As for the Romanians living abroad, a number of 375,219 people voted.

Of the 13 political parties registered in the elections and the three independent candidates, only six political parties managed to exceed the electoral threshold of 5%: National Liberal Party (PNL) 27% (2,449,068 votes), Social Democratic Party (PSD) - 22.5% (2,040,765 votes), Alliance 2020 USR-PLUS (USR PLUS) - 22.36% (2,028,236 votes), Pro Romania Party - 6.44% (583,916 votes), Popular Movement Party (PMP) - 5.76% (522,104 votes), Hungarian Democratic Union of Romania (UDMR) 5.26% (476777 votes) (Rezultate Vot, 2019).

The upcoming elections for the European Parliament will take place on June 9, 2024. There will be 12 political parties and four independents running for 33 seats. In a survey carried out by INSCOP in May 2024, the voting intentions in the European Parliament elections were as follows: PSD-PNL - 43.7%, AUR-17.5%, United Right Alliance - 14.1 % (INSCOP, 2024). Of course, the INSCOP survey represents the intention, but it clearly shows the popular support for populist parties.

According to the Standard Eurobarometer 101 (European Commission, 2024), trust in the national government has declined three points to 33%. In Romania, 29% *tend to trust*, while 62% *tend not to trust* government. As regards citizen perception of seeing themselves as *national only*, there is a percentage of 37%, while 48% are *nationality and European*. As we can see, in Romania there is a significant percentage of citizens who are not fully satisfied.

2. Problem Statement

Some studies (Balibar et al., 1991) regarding extremist movements have found that fears of downward economic mobility and loss of social status created a significant mass support for populists. The global financial crisis has impacted the income of many Western countries. Therefore, a large part of society has faced a degree of poverty. At the same time, citizens have lost trust in the political system and how democracy works.

These adversities (frustration in relation to politicians, economic dissatisfaction, anxiety due to unexpected shifts in society) have contributed to political turmoil. As an outcome, anti-establishment leaders, parties, and movements have arisen, questioning fundamental values and institutions of democracies (Wike et al., 2019).

Based on the opinion by which populist parties exploit the social dissatisfaction of individuals, not having the ability to offer concrete solutions to existing problems, in this research we chose to analyse the perception and influence of some variables (individual resilience, trust in people and in the political parties, populist messages perception) in increasing the support of populist parties.

The variables used in this study were:

Individual resilience refers to the ability of a person to adapt and bounce back in the face of adversity, trauma, or stress. It involves the capacity to cope effectively with difficult situations, challenges, or setbacks, and to maintain mental and emotional well-being despite experiencing adversity.

Trust in people refers to the belief or confidence that individuals have in the reliability, honesty, and integrity of others. It involves the willingness to depend on others, to believe that they will act in a trustworthy manner, and to be vulnerable in interpersonal relationships.

Trust in political parties refers to the level of confidence individuals have in the integrity, truthfulness, and ethical conduct of political parties.

Perception of populist messages appeal to feelings of dissatisfaction, disillusionment, or marginalisation among segments of the population, offering a sense of empowerment and belonging to those who feel disaffected by mainstream politics or societal trends. However, they can also be divisive and polarising, exacerbating social tensions and undermining democratic norms and institutions.

Educational level refers to different educational opportunities and pathways available to individuals. These typically correspond to the number of years that a person spends in formal schooling.

2.1 Individual Resilience

For individuals, stressful situations are not only challenging, but also involve a variety of levels of trauma or anxiety. For instance, unemployment can be perceived as a significant trauma. In psychology, surmounting a trauma is related to a high level of individual resilience, meaning the process of adapting well in the context of an adversity (American Psychological Association, 2014, para. 4).

As Folke (2016) stated, communities are using resilience theory to debate the current *status quo* and construct and build possibilities for the future. Therefore, resilience is a multifaceted capacity to deal with adversities and bounce back, learning from negative experience, facilitating the fundamental process of evolving to well-being, an opportunity to adapt and overcome.

Populist parties tend to resonate with individuals experiencing insecurity, vulnerability, economic uncertainties, cultural anxieties, or perceptions of marginalisation. As Hooghe and Marks (2017) stated, those who feel left behind support populist parties. Therefore, individual resilience emerges as a key factor in shaping political affiliations and support.

Economic hardship and a decline in social status are key sociopsychological factors that drive support for emerging populist parties. These parties craft their messages, channelling dissatisfaction and resentment away from individuals and towards the political system. Those who have experienced any form of poverty are particularly prone to developing resentment towards social changes. As Enke (2018) stated, compared to conventional politicians, populist leaders set a greater value on emotionally and morally (belonging, trust, and tradition) compared to fundamental principles (equality, equity, and individual rights).

Resilience is essential in relation to political and social challenges. According to Brown (2021) research, people with high levels of resilience are less susceptible to political manipulation and more likely to form their own opinions.

2.2 Trust in People and Political Parties

As regards the concept of trust, it should be noted that there are two approaches: trust as a belief and trust as an attitude (Reiersen, 2017). So, based on that, trust is a key element in establishing a relationship or setting up an action.

Trust is described as a complex construct and an internalised value that dictates how an individual should perceive and behave toward others (Uslaner, 2002). It is a belief or expectation shaped by personal experiences and dependent on the trustworthiness of others (Paxton & Glanville, 2015). Various factors influence trust, including life experiences (Flanagan & Stout, 2010), cultural transmission (Dinesen, 2010), and individual psychological aspects.

Trust and distrust are two concepts that are very common to political discourses, especially as regards the populist parties. In this case, the political attribute of trust is when the direction is from citizens to political entities. Therefore, citizens are the subjects, while parties are the objects of political trust. Based on the observation that the future political party behaviour (after winning elections) is always characterised by a certain degree of uncertainty, political trust also includes citizens' vulnerability. In the political context, trust is the value of exchange between political promises and the vote.

2.3 Educational Level

Education is a fundamental driver of individual and societal development. The level of education attained by individuals significantly influences various aspects of their lives (economic prosperity, health, and social mobility). The educational level represents the educational opportunities and pathways accessible to individuals. These levels usually correspond to the amount of time a person spends in formal schooling.

Masten (2001) highlighted that education contributes to the development of the individual's internal resources, including the ability to adapt and manage stress. Thus, education can be considered a catalyst for resilience, providing a conducive framework for acquiring the necessary skills in the face of challenges. Relevant research shows that the level of resilience can influence an individual's political behaviour (Sousa et al., 2013). People with a high level of resilience are less likely to seek simplified messages, preferring a more balanced and analytical approach to political decision making.

Furthermore, Pausch et al. (2021) research explores how education level and individual resilience can influence susceptibility to populist party messages. The results indicate that individuals with higher education and higher levels of resilience are less likely to subscribe to populist discourses, being able to critically analyse and evaluate political information. Educational levels exert a further influence on the dynamics of populist support. Empirical evidence suggests that individuals with lower educational are more susceptible to populist appeals.

In summary, the twisted web of factors contributing to the rise of populist parties is highlighted in the Romanian context, emphasising the interplay between individual resilience, educational levels, and party membership. By reviewing these connections, we can gain insights into the sociopsychological dynamics for fuelling the attractiveness of populist movements.

Voters are conceptualised as consumer segments, categorized as loyal, regular, or potential, within the realm of political marketing. Concurrently, political actors are perceived as suppliers of political goods and/or services. The central objective of this inquiry is to elucidate the way political products ethically meet the demands of citizens, transcending mere manipulative marketing strategies geared toward short-term objectives.

3. Research Questions

Through this study we aimed to obtain some possible responses for the rise of populist parties based on the following variables: individual resilience, level of trust, and educational level, such as:

- a. Perception of trusting in political parties and individual resilience level
- b. Background environment and trusting in political parties
- c. The belief of populist promises are achievable and individual resilience level

4. Research Methods

This study uses a quantitative approach to examine a particular population. The instrument used is an online questionnaire distributed via *GoogleForms*, regarding the following aspects:

- The ego-resilience scale (ER89) which contains 14 items and is constructed in the form of a short personality inventory, each item being evaluated on a Likert scale (4 levels) (Block and Kremen, 1996);
- Auto-evaluation of trusting people;
- Perception of traumatic experiences (Covid-19 pandemic, economic situation, social context, political context) – Likert 5 points scale;
- Political participation and intention to express the political option;
- Evaluation of the political and consultants' truth perception;
- Factor contributing to the rise of populist parties (lack of trust, economic conditions, lack of political culture);
- Sociodemographic data (age, gender, level of education, political party affiliation or support for a political party)

The respondents were randomly selected from several public institutions. The data population in this study consisted of 241 respondents. The responses were interpreted using IBM SPSS Statistics v.23.

5. Findings

There were 268 respondents in total who filled out the online questionnaire, but there were only 241 valid responses. Therefore, the results of the sample in this study were 241 respondents. The survey consisted of 36 items and the value of Cronbach's Alpha for the survey was $\alpha = .763$.

5.1 Characteristics of the Respondents

Among the 241 respondents, the age distribution is from 19 to 72 (St.D = 9,666), the median being 48 and the mean 46,70. From the total of 241 respondents 57,3% are female and 42,7% male. As regards the level of education, the data population is represented as following: high school (27,4%), post-high school (7,9%), university degree (44,8%), master's degree (14,1%), PhD. (5,8%).

21,2% come from rural areas, while 78,8% come from urban areas. As regards employee status, we note that 74,3% are employees. The respondents indicated various levels of income, 83,8% mentioned that they have a medium level, while 12,4% a low level.

As regards the individual resilience level, 93,4% of the respondents indicated a high level. Furthermore, 90% mentioned that the best way to act in relation to others is to keep a prudent approach.

Of the total of respondents, 49.8% indicated that they do not hold the membership of any political party, while 44.0% stated that they are members of a political party, 6.2% preferring not to express their answer. Also, 50.6% indicated that they were sympathisers of a political party, while 43.2% said that they were not sympathisers.

From the perspective of the theory of individual resilience, 61.8% of the respondents mentioned the fact that there were discrepancies between the option expressed by voting in the previous elections and the result of the vote. In other words, the political party or the political person they voted for did not win the election. Therefore, it is assumed that they experienced a sense of frustration.

Regarding the trust in political parties, the recorded results demonstrate that, at the level of the respondents' perception, 60.5% are of the opinion that political parties or political persons do not tell the truth and therefore cannot be trusted. However, 72.6% of the respondents believe that honesty is very important regarding election promises.

Moreover, at the level of the perception, 55.6% of the respondents indicated that political parties and people cannot be honest. In other words, sincerity or honesty did not seem to be a quality of the political environment, an opinion expressed by 79.3%.

Based on the data obtained, we noticed that the respondents having a high level of individual resilience expressed their belief that populist promises cannot be fulfilled (Table 1).

Table 1. Crosstab Individual Resilience level and fulfilment of populist promises

		Count		
		Populist promises are achievable		Total
		No	Yes	
Individual resilience level	Medium	12	4	16
	High	165	60	225
Total		177	64	241

Source: output generated by IBM SPSS Win v.23.

A percentage of 73.4% of respondents indicate that populist-type promises are not able to be achieved. In other words, they are aware that populist messages are misleading. And yet, elections to the European Parliament can be won by populist parties (43.2% of respondents), local elections (40.7% of respondents), parliamentary elections (39.8%), presidential elections (30.7%).

From the perspective of the respondents, the main reasons populist messages are accepted by the population are:

- Lack of trust in the current political class – 127 elections
- Poverty – 63 choices
- Lack of political culture – 57 elections

In other words, according to the respondents, the main causes that amplify the spread of populist messages and, implicitly, the increase in the popularity of populist parties find their answer in elements related to the economic context, education, and level of trust.

At the same time, 65.1% of the respondents identify this lack of honesty at the level of political consultant teams. In other words, from the desire to sell the political product and to obtain the maximum profit (a percentage of votes as high as possible), the teams of consultants use the so-called fabrication of the product to mislead the

consumers. In other words, citizens believe that, to achieve political goals, consultants distort the truth so that the "political product" they offer to consumers creates the impression that it meets the level of expectations.

But, despite all this, the real person responsible for the *purchase of a product* that does not meet the level of expectation is identified in the person of the consultants and by no means in the *political product*. However, the responsibility of keeping the electoral promises, translated into the key characteristics of the *product*, belongs to the political entity and not to the political consultants' team.

The existence of a high level of confidence in obtaining a high electoral score in the next elections correlated with the state of facts expressed previously, demonstrates the fact that society is not ready to purchase authentic products that satisfy the real needs of the consumer, there is a vicious circle, respectively, I purchase the product (meaning I vote for a political candidate) even though I am convinced that it does not satisfy my need and I do not even disagree with its quality.

5.2 Perception of Trusting in Political Parties and Individual Resilience Level

The correlation between individual resilience level and political parties (Table 2) are saying the truth is -0.624^{**} , which is highly significant (Sig.=,000, $p < 0.01$).

Table 2. Correlation between Individual Resilience level and Political parties are saying the truth

		Individual resilience level	Political parties are saying the truth
Individual resilience level	Pearson Correlation	1	-,624**
	Sig. (2-tailed)		,000
	N	241	241
Political parties are saying the truth	Pearson Correlation	-,624**	1
	Sig. (2-tailed)	,000	
	N	241	241

** . Correlation is significant at the 0.01 level (2-tailed).

Source: output generated by IBM SPSS Win v.23.

There is a strong negative correlation (-0.624^{**}) between believing in the truth of political entities and the level of individual resilience. This suggests that individuals with higher levels of resilience tend to be more skeptical or critical in regard with the truth of political parties or politicians. It could indicate that individuals who possess greater coping mechanisms or psychological strength are more discerning about political messaging and less likely to take claims at face value.

5.3 Background Environment and Trusting in Political Parties

Based on the data collected, we noticed that respondents indicated the place of origin as being urban, there is the belief that political parties are not saying the truth (Table 3). Therefore, are not to be trusted.

Table 3. Crosstab place of origin and Political parties are saying the truth

Count				
		Place of origin		Total
		Rural	Urban	
Political parties are saying the truth	Yes	19	31	50
	No	32	159	191
Total		51	190	241

Source: output generated by IBM SPSS Win v.23.

As regard the educational level, we noticed that a higher level of education (expressed by the last school graduated) indicates a low level of trust in political parties as saying the truth (Table 4).

Table 4. Crosstab educational level and Political parties are saying the truth

Count							
		Educational level					Total
		High-school	Professional	B.A.	Master	PhD.	
Political parties are saying the truth	Yes	55	5	24	6	4	94
	No	11	14	84	28	10	147
Total		66	19	108	34	14	241

Source: output generated by IBM SPSS Win v.23.

The correlation between the background environment and trusting in political parties is -0.585^{**} (Table 5) also highly significant (Sig.=,000, $p < 0.01$). There is a strong negative correlation (-0.585^{**}) between the two variables. This suggests that individuals of certain backgrounds (urban environment) are less likely to believe in trusting in political parties. Environmental factors, such as socioeconomic status or cultural context, may play a role in shaping perceptions of political honesty.

Table 5. Correlation between background environment and trusting in political parties

		Individual resilience level	Political parties are saying the truth
Individual resilience level	Pearson Correlation	1	$-.585^{**}$
	Sig. (2-tailed)		,000
	N	241	241
Political parties are saying the truth	Pearson Correlation	$-.585^{**}$	1
	Sig. (2-tailed)	,000	
	N	241	241

Note: **, correlation is significant at the 0.01 level (2-tailed).

Source: output generated by IBM SPSS Win v.23.

This could be explained by the fact that, in rural areas, access to various sources of information and, implicitly, to the associated threats (disinformation) is less likely

to occur. Moreover, in the context of the lack of information sources, the assessment related to the level of correctness is made following direct experience or reference to previous experience (analysis between the promises and what was delivered).

5.4 The Belief of Populist Promises are Achievable and Individual Resilience Level

The correlation coefficient between the individual resilience level and the perceived achievability of populist promises is -0.574^{**} (Sig.=,000, $p < 0.01$) (Table 6). This indicates a moderately strong negative correlation between these two variables. This means that the observed correlations are unlikely to have occurred by chance. The negative correlation coefficient suggests that as individual resilience level increases, the perceived achievability of populist promises decreases, and vice versa. In other words, individuals with higher levels of resilience tend to perceive populist promises as less achievable, while those with lower resilience levels tend to perceive them as more achievable.

Table 6. Correlation between populist promises are achievable and individual resilience level

		Individual resilience level	Political parties are saying the truth
Individual resilience level	Pearson Correlation	1	-,574**
	Sig. (2-tailed)		,000
	N	241	241
Populist promises are achievable	Pearson Correlation	-,574**	1
	Sig. (2-tailed)	,000	
	N	241	241

Note: **, correlation is significant at the 0.01 level (2-tailed).

Source: output generated by IBM SPSS Win v.23.

Higher levels of individual resilience can lead individuals to be more critical and discerning of political promises, including populist ones. Individuals with greater resilience might possess stronger coping mechanisms and problem-solving skills, enabling them to assess the feasibility of political promises more effectively.

This correlation implies that individuals with lower resilience levels may be more susceptible to believing in populist promises, potentially due to a greater tendency to seek simple solutions or a lower ability to critically evaluate political messages. Policymakers and political actors should consider the psychological characteristics of the electorate, such as resilience, when crafting and communicating policies and promises.

The negative correlation between individual resilience level and the perceived achievability of populist promises suggests that psychological factors play a significant role in shaping individuals' perceptions of political messages. Individuals with higher resilience levels tend to be more skeptical of populist promises, while

those with lower resilience levels may be more inclined to believe in their achievability. Understanding these dynamics can help inform political communication strategies and policy-making processes to foster more informed and resilient societies.

6. Conclusions

There is a strong negative correlation between the belief in trusting in political parties and individual resilience level. Individuals with higher resilience levels tend to be more skeptical or critical of political parties saying the truth, potentially due to their ability to cope with challenges and setbacks more effectively.

The correlation between belief in political parties as saying the truth and the background environment indicates that individuals from certain backgrounds, particularly rural areas, are more likely to believe in political entities. This could be attributed to limited access to various sources of information and a reliance on direct experiences.

There is a moderately strong negative correlation between individual resilience level and the perceived achievability of populist promises. Individuals with higher resilience levels tend to perceive populist promises as less achievable, while those with lower resilience levels tend to perceive them as more achievable. This suggests that psychological factors, such as resilience, play a significant role in shaping perceptions of political messages.

Overall, these findings underscore the importance of considering psychological characteristics, such as resilience and political marketing procedures when analysing attitudes toward political messages and policy proposals. Policy makers and political actors should consider the complex interplay between individual traits and political perceptions to develop more effective communication strategies and political marketing policies.

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**Transformative EU 27 Labour Markets: Assessing
Opportunities, Risks and Trends**

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Abstract

The labour markets are in a transformative period due to increased uncertainty and overall volatility. Moreover, they show a socially biased fingerprint affecting the social and economic policies at the EU 27 level. The unemployment rate by 6.0% in the spring of 2024 (Eurostat) indicates that the dynamics become more complex on the background of skill shortages increase. All member states display a mixed image regarding the digital economy potential, and several issues have to be addressed for avoiding employment traps, and social discontent in times of the cost-of-living crisis. The paper uses a mixed methods approach to capture relevant quantitative and qualitative data on the transformative EU 27 labour market, with emphasis on countries of Central and Eastern Europe. A rough DEMATEL Z-score method is used to characterize the main interactions and relevant impact factors. The findings show that policy makers and stakeholders need to (re)focus on education to ensure research development and innovation competitiveness, as 'blue collar' jobs are increasing. A new emergent "triptych" government-business sector-society is required for reducing persistent polarization and inequalities.

Keywords: labour market, polarisation, inequality, education.

JEL Classification: C1, D81, E24, E26, E61, I24, I25.

1. Introduction

Over the past decades, global and European markets were faced with numerous challenges determined by a complex mixture of accelerated technological advancement, geoeconomic, and geopolitical shifts. One of the core sources might be identified in the evolution of labour markets, as polarisation increased. The current

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labour market changes are unprecedented and show clear and distinctive characteristics differentiating them from traditional labour markets. In this context, the Covid-19 pandemic, the accelerated implementation of more digital solutions, the emergence of AI and the war in Ukraine have affected the EU 27 labour market less than expected, as they have shown resilience confronted with “cost-of-living” discontent, high inflation and higher energy prices, supply chain disruptions, and a general silent economic slowdown. This is proven by the fact that unemployment reached an all-time low of 6.0% in spring 2024 (Eurostat). Challenges continue to persist from a diversity of viewpoints starting with reducing gender employment gaps to dealing with increasing skills’ shortages as skill needs change, contributing to the transformation of work, or more briefly to the emergence of transformative labour markets that need to be analysed in-depth considering the variety of types and attributes embedded in them. While an unanimously accepted definition of transformative labour markets is still lacking, they should be defined by delineating their main characteristics and attributes, and the various levels where they impact the most important resource: human capital (European Commission, DG Employment, Social Affairs and Inclusion, 2023). One (at least) tentative definition of transformative labour markets would provide a starting point in understanding the multiple facets of the challenges and opportunities they present for individuals, businesses, and societies, including potential risks. The first main root driver is technological advancement in most workplace changes (McKinsey Global Institute, 2017). It facilitated, among others, the emergence and swift spread of the gig economy, which has multiple implications for the functioning of labour markets from the perspective of regulations, social protection, and how work will be performed in the future (De Stefano, 2016). These examples of how labour markets change today in a context dominated by a complex mix of abstract and practical knowledge are currently at the core of social and economic interactions. This is confirmed by a recent survey (Ipsos, Flash Eurobarometer 537, 2023), at the request of the European Commission, that analysed the supply and demand for skilled workforce in the EU 27 SME sector, which is the engine of the European economy and the main source for ensuring economic growth, competitiveness, and innovative capacities for the transition to net zero and the digitalised economy. Applied to companies from microcompanies to large companies, it showed that the lack of workers/employees with the right skills is a first-order concern for 53% of microcompanies, 65% of the SMEs with 10 to 49 employees, 68% for medium-sized companies, and for 72% of large companies with over 250 employees. The next major concerns were the regulatory obstacles or administrative burdens, however, at much lower shares. In this respect, 34% of the microcompanies expressed concerns, followed by 30% of SMEs (10-49 employees), 29% of medium-sized companies (50-249 employees) and 26% of large companies (250 and more employees). These findings are consistent with another important topic: skills’ shortages at the EU 27 level. Skill shortage brings to light the necessity of improved cooperation between the educational system and the business world, based on support policies that require the involvement of EU 27 countries’ governments for developing mechanisms and tools for mitigating the pressure effects of the current structural

changes, and of the transformative nature of work. One question is whether education and training, which are both key to addressing labour polarisation and social exclusion, can identify new innovative ways of cooperating with business stakeholders. A second relevant question is whether the institutional quality of labour market institutions provides or might provide in the future incentives and solutions for enhanced collaboration. In this context, a new “triptych” government-business sector society is required to reduce polarisation and inequalities, and counter perceptions such as those stating that unemployment diminished because people began accepting jobs for smaller wages. At the same time, new (emerging) types of unemployment might be defined based on this “triptych” as they relate to the most concerning and persistent one: long-term unemployment. The final level of investigation is the one of labour market institutions for the current and foreseeable future, based on analysing 6 of the most relevant components related to the “triptych” (Vlados & Chatzinikolaou, 2024).

2. Theoretical Framework

A definition for transformative labour markets should focus first on the main driver, respectively, technological advancement, which accelerated progressively and is, simultaneously, a major opportunity and risk for the workforce. The concept is not new, but has gained new meanings, as it is correlated with the demand and supply of skills development, contributing to emerging and increasing shortages. The most noticeable is that a complex mix between abstract and practical knowledge becomes the daily tool for all economically active groups. This increases economic and social pressures, indicating the need to review and adjust economic and social institutions to the new realities of transformative labour markets.

2.1 Definitions and Characteristics of Transformative Labour Markets

A possible definition of transformative labour markets starts from the premise that these markets undergo complex transformations differentiating their evolution from the traditional labour market changes. Hence, transformative labour markets are both a driver and a target of significant structural changes based on how and to what extent technologies are used, as globalisation/deglobalisation processes, migration, demographic ageing, and other societal and cultural changes act as mediators for the dominating characteristics of the technologically triggered transformation (Acemoglu & Restrepo, 2018). The impact is most visible for the workforce as it leads to changes in workforce dynamics, employment patterns, and job opportunities. While “transformative” might be sometimes used as substitute for a “dynamic” labour market, it is not exactly the same, as it requires more than the simple capacity to adjust in a given timeframe to implement the solutions delivered by technological innovation. It means new (improved) ways of production, evolving consumer demands (West, 2019), and superior expectations of employers and employees. In brief, the transformative labour market is the expression of current shifts in employment structure, practices, and conditions based on abstract and practical knowledge, and impacting on what types of jobs are available based on required skills, on how the

work is organised, and performed. The transformative labour market expresses and generates the need of creating an improved economic-social framework for dealing with current work realities, by taking on features of “traditional” labour markets, for instance in career advancement and skills development, but by adding new components borrowed from other social sciences: quality of life, and of workplace, thus ensuring higher correlation between governmental and societal objectives. Moreover, by making use of extended ways of cooperation with education and training, facilitated by the technological advancement, it should act towards ensuring inclusiveness and chances for everyone to participate in, and benefit from economic activities fostering social cohesion next to economic resilience. Another relevant aspect is how it impacts existing labour market institutions, and how it might improve, or even generate new ones corresponding to the emerging needs in a period dominated by geoeconomic and geopolitical volatilities. Thus, the key issue dominating the existing and transformative labour markets is the gap between required abstract and practical knowledge, and the structure of the skills, on the premise that within the EU 27 there is a certain network of skills characterising countries, and their structural differences (Gennaioli et al., 2013). The emerging pattern is one of the north-south divide regarding convergence and cohesion (Fulvimari et al., 2016), and some of the causes could be identified in the shared skill shortage issue. One key factor that might assist in identifying the reasons is the specialisation and/or overspecialisation that become persistent in some EU 27 countries, particularly in the central- and eastern European area.

2.2 Current Skill-Shortages EU 27

Skill shortages emerge when the demand for workers with qualifications exceeds the supply of workers, and these instances might have a cyclical but also a structural nature. The premises of the twin transition, associated with factors, such as demographic ageing, have resulted in increasing skill shortages in important fields of economic activity: healthcare, STEM jobs, and occupations, in the services’ industry, from low-skilled to high-skilled workers, while the trend of the ‘vanishing middle’ continues. In this context, the transformative labour market gains considerable social connotations, as skill shortages become also associated with ‘quality of work’. Here some difficulties might be noticed for employment, as lack of workforce supply persists for some jobs that still maintain significant work-intensive characteristics from the physical, and psychological perspective (health- and residence care, transport, HORECA, etc.). Emerging and increasing labour shortages were already noticed in 2012, and they continued to increase, even during the pandemic. By NACE 2 subsectors, most member states (19) record significant labour shortages in specialised construction activities, computer programming, consultancy and related activities (17), construction of buildings (17), repair and installation of machinery and equipment (16), while around 12 countries are faced with challenges at the lower end, respectively, in architectural and engineering activities, technical testing and analysis, manufacture of other transport equipment (Employment and Social Developments in Europe, 2023). A more in-depth analysis of these data shows that the “blue-collar”

becomes a necessity in the changing work landscape and the new trend in the demand for skills. This implies that extended cooperation between the education and training system and the business environment, as stakeholders, needs to be fostered in facilitating rapid adjustment between the supply and demand for skilled workforce, and to improve the qualitative side of work. At the same time, in concerted action, both stakeholders should act towards encouraging attitudes that pinpoint “blue collar” as the best option for present, and future opportunities in a quality of personal- and work-life framework, adjusted to the new socioeconomic life. Finally, government involvement is required as the main policy decision factor and agent influencing the institutional quality of the labour market.

2.3 Quality of Labour Market Institutions – Role in Shaping Government-Business-Society Relationships

Economic and social institutions represent the sets of law, regulations, incentives, and sanctions in Northian understanding, determinants for economic growth (Acemoglu & Robinson, 2013). One important component is the institutional setting of the labour market to ensure the sustainability and resilience of the EU 27 and global societies. At EU 27 level, we suggest that we are currently in the stage of building and strengthening the mechanisms contributing to the further consolidation of economic-social institutions, and the generation of “new” ones corresponding to the current work developments. One such tool is the NextGenerationEU, aimed initially at repairing immediate damages from the pandemic. Its future success depends precisely on the quality of institutions and the administrative capacity of the member states. Hence, institutional factors, such as university-business cooperation, and the regulatory capacity of the public administration, become relevant for mitigating potential risks, ensuring performance, and acting towards reducing increasing divergence between EU 27 member states in the context of the emergent transformative labour markets.

3. Methodology

The transformation of the labour market within the EU shows differing intensities, consistent with the various development stages of the member states. An indicator of the change processes is the long-term unemployment rate. It is assumed that as result of implementing new technologies, especially ICT-related ones, and by gradual adjustment of the population to the new requirements of the economic environment, this indicator tends to diminish. The period 2012-2023 seems to confirm this, as the long-term unemployment rate decreased from 4.9% to 2.1%. During the same period, the weight of specialists in ICT-technologies among the employed population increased from 3.2% to 4.8%, while the share of internet users in the total population grew from 73.53% to 92.36%. A series of differences can be observed at the level of the three indicators among member states. If we consider the founding member states (Belgium, Germany, France, Italy, Luxemburg, the Netherlands) on one hand, and some Central and Eastern European countries on the other hand, former CMEA (Council for Mutual Economic Assistance) members (Bulgaria, Czechia, Poland,

Romania, Hungary, Slovakia), the differentiated evolutions can be highlighted (Table 1). The tested hypothesis, based on an econometric fixed panel model, is the existence of a negative correlation between the long-term unemployment rate and the expansion of ICT uses in the context of persistent, presupposed differences.

Table 1. Indicators of labour market functioning and ITC-technologies expansion in some EU 27 member states, 2012-2023

Indicator, year	Long-term unemployment rate		Weight of ITC specialists in the total employed population		Internet use degree among total population	
	2012	2023	2012	2023	2012	2023
Founding member-states						
Belgium	3.1	2.2	4.3	5.4	81.8	95.3
Germany	2.4	1.0	3.5	5.9	84.0	93.4
France	2.6	1.8	2.7	4.7	83.1	93.8
Italy	6.0	4.2	3.1	4.1	58.0	87.7
Luxemburg	1.6	1.7	5.0	8.0	92.3	99.4
The Netherlands	1.7	0.5	4.5	6.9	93.5	99.3
New Member-States						
Bulgaria	7.2	2.3	2.5	4.3	55.1	84.0
Czechia	3.0	0.8	3.4	4.3	75.8	92.7
Poland	4.2	0.8	2.5	4.3	65.1	88.1
Romania	3.7	2.2	1.6	2.6	49.8	91.6
Slovakia	10.9	3.8	2.5	4.2	79.8	89.1
Hungary	4.8	1.4	3.2	4.2	72.1	91.8

Source: authors' own calculations based on Eurostat database.

The following panel with fixed effects model was estimated, and applied separately for the two groups of member states:

$$LTUR = a + b \cdot WICT + c \cdot IUUSE + \sum \text{Dummy}_k \quad (1)$$

where: LTUR = long-term unemployment rate; WICT = weight of ITC-specialists; IUUSE = internet use degree among the total population; a, b, c, Dummy_k = variables to be estimated.

Next, we used a DEMATEL-z score analysis to identify the impact and relationship of economic-social institutional factors on long-term unemployment, and overall, on the EU labour market. First, a linguistic interpretation was made, by reinterpreting a comparable analysis (Zhu & Hu, 2021) for the transformation on the Gabus and Fontel scale. This rough-DEMATEL z-score analysis shows which of the economic-social indicators are most relevant for the transformative labour market in relationship to the perspective of trust shown by business environment, education-vocational training systems, and governance, for the same member states used in the econometric model (Table 2).

Table 2. Linguistic variables for z-scores attribution on Gabus-Fontel scale

Linguistic variable	z-scores	Gabus-Fontel scale
Very Low	0	0 = no influence
Low Influence	0.1-0.3	1 = Low influence
Medium influence	0.4-0.6	2 = medium influence
High	0.6-0.9	3 = high influence
Very high	0.9 – 1.0+ and over	4 = high impact

Source: authors’ own concept.

The institutional variables selected were: university-industry cooperation, state of cluster development, government ensuring policy stability, active labour market policies, government responsiveness to change, and government long-term vision. Z-scores were computed in SPSS 26. Thereafter, a matrix of direct relationships was constructed (Table 3) according to the above linguistic variable attributions.

Table 3. Direct relationships matrix

	UnivIndCol	Stateclusdev	GovPoSt	ALMP	GovRCh	GovLTVs
Univindcol	0	1	3	2	4	3
Stateclusdev	2	0	4	1	3	2
Govpost	4	2	0	1	3	2
ALMP	2	3	4	0	3	4
GovRCh	1	2	3	4	0	1
GOVLTVIS	4	2	1	2	2	0

Source: authors’ own calculations based on WEF Global Competitiveness Index 4.0.

The second step, was normalising this matrix based on the following equation:

$$X' = \lambda * T \tag{2}$$

Where: $\lambda = 1/\text{divided by the highest value of summing up each row } X$; X – Matrix of direct relationships; X' = normalised matrix of direct relationships for each country group of old member states and for the New Member States used in the econometric model. The results were transformed to build the final total influence matrix relevant for all selected countries, and to determine which of the institutional factors are most relevant for all countries included in the analysis.

The matrix of total influence was calculated as follows:

$$T = X' * (I - X')^{-1} \tag{3}$$

where: T – total influence/impact matrix (direct or indirect); X' – standardised matrix of direct relationships; I – unitary matrix. The element x_{ij} of the matrix T indicates the direct and indirect influence/impact of the indicator I on indicator j .

The final step was to calculate the significance and relationship indicators:

a) Significance indicator:

$$S_i = \sum_{j=1}^n t_{ij} + \sum_{j=1}^n t_{ji} \tag{4}$$

b) Relationship indicator:

$$R_i = \sum_{j=1}^n t_{ij} - \sum_{j=1}^n t_{ji} \tag{5}$$

The results, included into a cause-effect map of significance and relationship, deliver information about how the institutional factors relate, and interact with each other.

4. Results and Discussion

Estimated parameters and statistical tests of the econometric model in the case of EU-founding member states and new EU member states, ex-members of the former CMEA (Table 4).

$$RLTU = a_2 + b \cdot RICT + c \cdot IUSE + \sum \text{Dammy}_k; \text{ in the case of EU-founding member states} \tag{6}$$

Table 4. Summary of the results of the econometric model

Indicator Name	Indicator size	Student Test Statistics	Indicator Name	Indicator size	Student Test Statistics
Group of founding Members of EU			Group of ex-members of CMAE		
a	10.4199	9.1121	a	114293	8.8854
b	-0.2937	-3.0525	b	-2.56310	-5.5677
c	-0.0841	-5.9393	c	-0.0189	-0.7120
Dummy Belgium	1.4239	6.5443	Dummy	2.4132	4.4812
Dummy Italy	3.0574	10.4127	Dummy	1.7531	3.3211
Dummy France	0.7046	3.4713	Dummy	-1.8364	-3.1896
Dummy Luxemburg	1.1601	4.6386	Dummy	5.3509	11.1633
Dummy Netherlands	0.7382	3.1420	Dummy	1.8296	3.6448
R ²		0.9325	R ²		0.8129
R ² adj		0.9251	R ² adj		0.7924
D-U		1.0382	D-U		0.5454

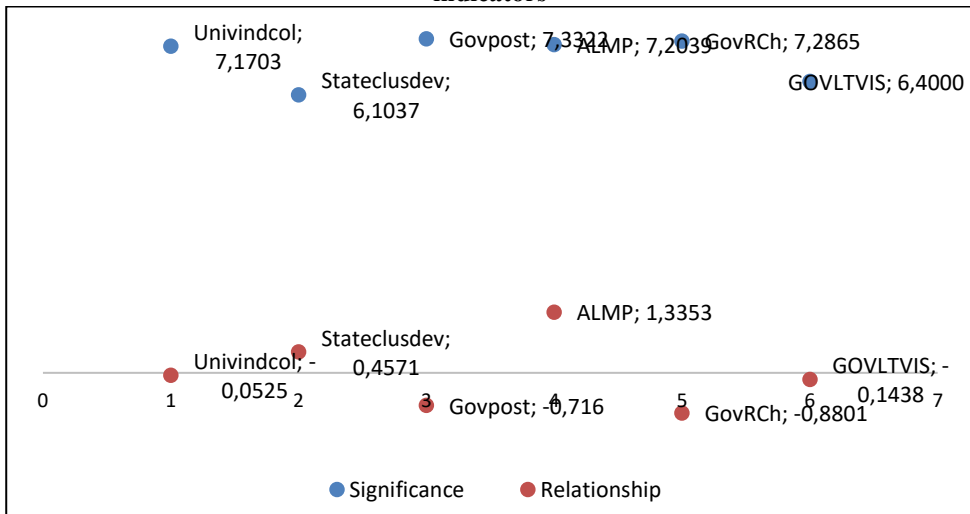
Source: authors' own calculations based on Eurostat database.

The estimated models have high coefficients of determination, over 0.80. The Student-test shows that all coefficients corresponding to the dummy variables are significant. The estimates for the founding member-states are better from qualitative viewpoint, compared with the ones for the new central and eastern European member states, if we consider the size of the calculated values for the statistical tests. The negative relationship between the long-term unemployment rate and the expansion of ICT use is confirmed. Moreover, all coefficients corresponding to the dummy variables for the founding countries of the EU are positive, indicating that the long-term unemployment rate was, in all other countries, superior to the one in the

country of reference. For the selected CEE member states, only in the case of Romania the estimated value of the dummy variable is negative.

The rough-Z-score DEMATEL method indicates that all selected economic-social institutional indicators have a high level of significance, and can be used in analysing best interventions for decreasing long-term unemployment, and avoiding increases in other types of unemployment. Also, they can be used for assessing transitions affecting incomes. Active labour market policies have high significance and positive relationship with all other indicators. In the case of the other institutional indicators, despite their high significance, their relationships would require a more refined analysis, according to the significance and relationship diagram in the last step of the DEMATEL analysis (Figure 1).

Figure 1. Significance and relationship matrix of economic-social institutional indicators



Source: authors' own elaboration.

Moreover, the state of cluster development, which has a positive value in the relationship with the other economic-social indicators seems to signal that “clusters” defined as a complex nexus of abstract and practical knowledge might contribute significantly to simultaneously addressing long-term unemployment (structural in nature), and skill shortages that send a contradictory message, at least at the level of the population.

5. Conclusions

Long-term unemployment had different dynamics if analysed from the perspective of the EU 27 founding member states, against the New Member States included in the present analysis. While structural long-term unemployment will remain a constant also in the foreseeable future, the underlying data of long-term unemployment analysis, associated with the economic-institutional analysis, suggest that the helix government

– business – education, should be developed into a “tritych” allowing for an in-depth analysis of the determinant macroeconomic factors in association with other factors of institutional nature. By further developing this framework, based on MCDM/MCDA methods, new tools might be created for reducing long-term unemployment, but also other types of unemployment related to labour market transitions which are still not enough investigated for preventing their risks and negative impacts at the level of national EU 27 economies and societies. A consistent argument in this respect is the strong relationship identified based on the rough Z- score DEMATEL method between active labour market policies and all the other economic-social institutional factors.

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**What Factors Affect Households' Decision to Be a New
“International Migrant Household” in Rural Bangladesh?
Evidence from a Unique Panel Data**

Mahtab UDDIN¹

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Abstract

We explore the role of households' economic status and migration network on the probability of becoming a new international migrant household while controlling for other conventional parameters. We use the Bangladesh Integrated Household Survey data, a nationally representative panel for rural Bangladesh covering three periods – 2012, 2015, and 2018. Based on a dynamic panel probit model, we find that being from the top four income deciles in the base year (2012) leads to a statistically significant higher probability of being a migrant household in a later period. We also observe a strong impact of the migration network. Having a family member abroad in the baseline increases the probability of having a new migrant in the later periods significantly. In addition, being in the migrant-prone area increases the probability of sending a new member abroad. However, the village migration network is a weaker predictor of future migration than the family network.

Keywords: migration, migration decisions, new migrants, migration and household's economic status.

JEL Classification: F22, O15.

1. Introduction

International migration has long been a strategy for diversifying household income and earning sources. From here on, by migration we refer to international migration, and by remittance, we refer to international remittances, unless mentioned otherwise. More formally, remittance refers to the non-commercial transmission of funds carried out by an expatriate labourer, an individual from a diaspora group, or a citizen connected to relatives residing abroad. Bangladesh has experienced a substantial increase in international migrants over the years. Between 1976 and 2023,

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Bangladesh sent over 15 million workers abroad, per BMET (n.d.), data updated until August 2023. This figure only includes migrations through formal official channels. A sizeable proportion of international migrants migrate using informal channels, which is not captured in the official figures. Particularly in rural areas, where more than two-thirds of the population resides, migration has emerged as a significant livelihood strategy, offering opportunities for economic and social advancement. However, not every household becomes an international migrant. Jones (1998), Stark and Bloom (1985) argue that who gets to migrate overseas depends on the stages of migration. In the earlier stages of migration, richer households have the social network and abilities to migrate, which eases over time for households from lower income quantiles. We test this hypothesis in the Bangladesh context based on the BIHS database, a panel data covering 6500 households in each 2012, 2015 and 2018 round.

This paper examines the relationship between a household's economic status and the probability of becoming a new international migrant household. We show that households located in migrant-prone regions and households from upper-income deciles are more likely to become new migrants.

We analyse Bangladesh's existing foreign migration procedure, develop a theoretical framework for foreign migration, and estimate a model to show the likelihood of becoming a new migrant household depending on several individual, household, and social factors. Our results show that the economic condition of a household is one of the strongest predictors of migration decisions. We establish that the households from the lowest income quantiles have the least probability of migrating abroad. In other words, it is the richer households who migrate more in the initial period. However, the process disseminates more within the region once a stronger migration network develops within the region, which is strongly visible in the time dummy we introduce in the model.

Our paper is different from the earlier literature in several aspects. This is the first study in the Bangladesh context that uses nationally representative panel data to understand the impact of household characteristics, a pre-existing migration network, and the household conditions from the previous rounds on becoming a new international migrant household. The panel data allow us to explore the dynamic nature of the data and utilise a more robust estimate than a conventional approach.

2. Literature Review

International migration is a broad theme, and the research questions could link to anything from peace and conflict, and forced migration, to human capital accumulation, and economic migrations. Given the objective of this paper, we only confine to the economic theories of international migration.

In one of the first neoclassical theories of international migrations, Sjaastad (1962) formalised that a worker decides whether to migrate abroad or not depending on the net present value of lifetime earnings abroad and the net present value of the lifetime cost of living abroad in addition to the migration cost. Later models also considered migration as a human capital investment (Becker, 1964), arguing that

migration happens when people are willing to add skills and training to attain higher human capital.

Compared to the classical models of international migration, the New Economics of Labour Migration (NELM) differs significantly. One of the stark differences between NELM and classical models is that NELM considers migration a household decision rather than an individual utility maximisation problem. Stark (1978, 1991) pioneered the concept that the decision-making unit is the household, and the household not only maximises income, but also minimises and diversifies risks (Stark & Levhari, 1982; Stark & Bloom, 1985). Such a risk minimisation strategy helps explain cases where migration occurs without wage differentials. The NELM also assumes an imperfect credit market that is often only accessible to elites in society. Migration is considered to break the credit constraints of households. Another difference between the neo-classical migration model and the NELM is that the former does not consider remittances in the migration decision. In contrast, the latter perceive it as an essential catalyst (De Haas, 2010).

Moreover, it is also argued that there is selection bias in who migrates and who does not. In other words, migration decisions are not random (Arouri & Nguyen, 2018). For example, households with better networking and higher income opportunities may have higher migration tendencies than those with lower education or income profiles. As such, the migrant families might have had a better outcome even in the absence of migration. Arouri and Nguyen (2018) argue that this issue can be adequately controlled with an appropriate IV. Fixed effects can also contain such biases in the absence of an IV by removing the time-invariant variables.

Chort and Senne (2015) frame a theoretical model accounting for household-based migration decisions and their implications on selecting migrants and their destinations at the household level. Based on an extension of the Roy-Dahl model of mobility and earnings, the paper shows that expected remittances, earnings differentials between home and host countries etc., are essential factors for intra-household migration decisions. After controlling for the earning differentials between home and migration destination country, the paper finds that the households select migrant workers with the highest remittance potentials. In addition, they considered variables such as two “eldest dummies” to capture the socioeconomic context of Senegal, where the eldest son is expected to assume responsibility.

In the context of Bangladesh, Kikkawa and Otsuka (2016) investigate the relationship between migration networks, social capital, and the likelihood of international migration, emphasising how the significance of these forms of capital evolves over time. The research uses a panel data collected from households in three time periods: 2000, 2008, and 2014. However, one of the short-comings of the paper is that it does not control for the initial value problem. As Woolridge (2000) and Woolridge (2005) show, with a short T and large N, pooled probits, or probit fixed effects, can lead to potentially biased estimates because of unobserved time-invariant individual effect being correlated with lagged explanatory variables. Moreover, the study data is not nationally representative, and it primarily focuses on the migration network as the key explanatory variable for international migration.

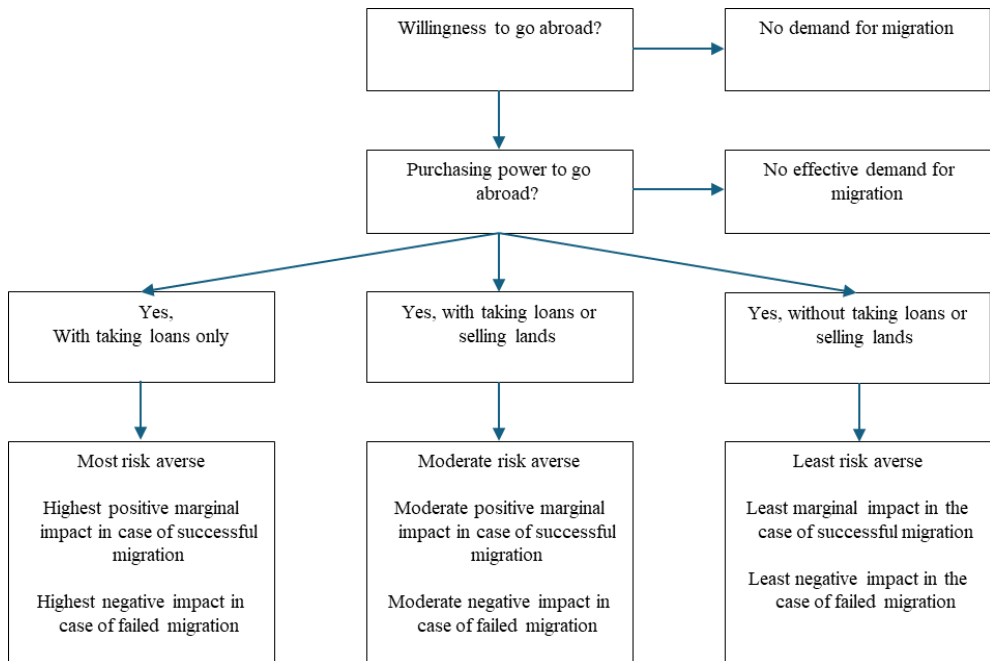
Our paper is different from the earlier literature in several aspects. First, this is the first study in the Bangladesh context that uses nationally representative panel data to understand the impact of household characteristics, a pre-existing migration network, and household conditions from the previous rounds on the international migration dynamics. This paper is also the first one to attempt a theoretical understanding of why the poor are less involved in the migration process than others in the context of Bangladesh. Moreover, empirically, we apply a dynamic panel probit estimator – which provides us with a more robust estimate of the migration dynamics in the Bangladesh context.

3. Conceptual Framework: Migration Procedure in Bangladesh

An aspirant migrant household does not make the decision in isolation, nor does it make the decision abruptly. Economic migration is a rational decision that the household makes after considering risks, relative risks, and costs, including forgone/opportunity costs. One of our underlying assumptions is that households make migration decisions in steps.

The first step to deciding whether to migrate depends on the first basic problem: whether the household has enough resources to pass through the borrowing constraint. In other words, whether the household has an effective demand for migration (Figure 1).

Figure 1. Household decision-making in steps

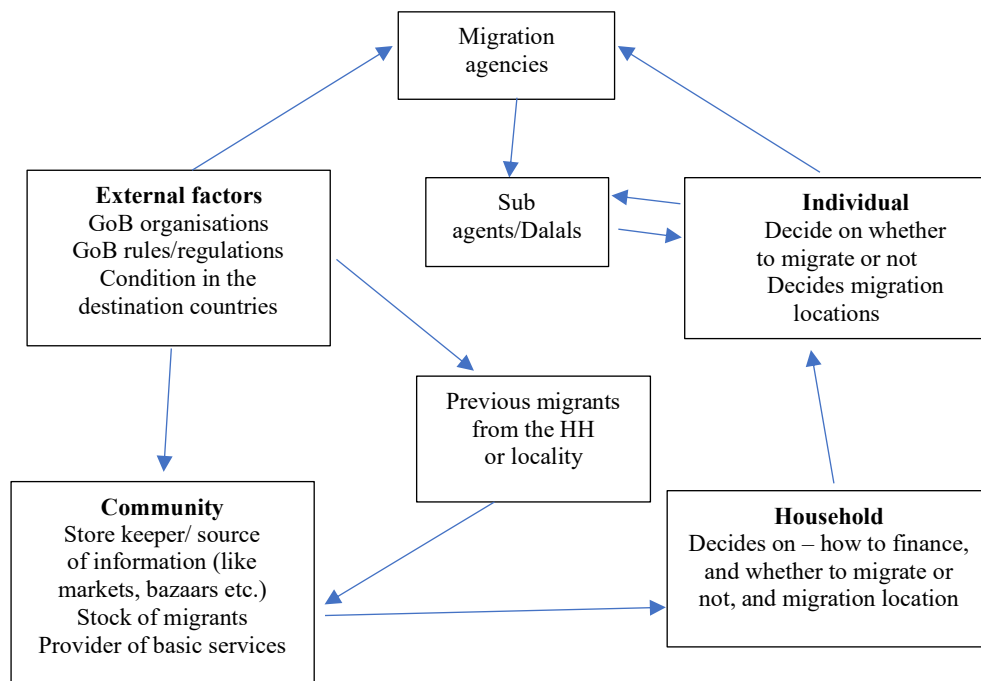


Source: author's conceptualisation.

It must be noted that the impact of foreign migration would largely depend on the pre-existing household conditions controlling for individual attributes. For instance, one of these determinants would be how the household meets the borrowing constraints for overseas migration. As per the Knowledge Network on Migration and Development (KNOMAD) of the World Bank, the cost of international migration is the highest in Bangladesh (The World Bank, 2017). Such a higher cost of migration makes overseas migration more difficult and also creates problems such as debt bondage and exploitation at the destination country that the workers find difficult to overcome (Razzaque et al., 2018).

Once the household is sure about the credit constraints and other factors, it reaches the second step of its decision-making. The second stage of the migration process involves getting into the migration network, making choices regarding destinations, weighing risks, and completing the migration procedure (Figure 2).

Figure 2. Second stage of migration: migration network and how does it work in Bangladesh



Source: author’s conceptualisation is based on a secondary literature review.
For more details on the process of overseas migration in Bangladesh, see Razzaque et al. (2018, pp. 45-52), Barkat et al. (2014).

This second stage of migration, or the migration process, takes place through one of the three channels, (i) migration through labour recruiters, (ii) migration through intermediaries, social network or family, and (iii) migration through government

agencies (Razzaque et al., 2018). Among the three, the last has the least share in sending overseas workers. Migration through overseas recruiters involves recruitment agencies in Bangladesh which are registered with the government. However, most of these recruiting agencies are located in the capital and do not have branches across the country. Therefore, aspirant migrants often do not have the opportunity to engage with the recruiting agencies directly. Rather, in most of the cases, they are contacted by a middleman or intermediaries (often referred to as ‘Dalals’ in Bengali) (ibid.). The intermediaries work as deal breakers among the recruiting agencies and the aspirant migrants. IOM (2010) notes that almost 45 percent of overseas migrant workers relied on intermediaries for overseas migration. To what extent a potential migrant would depend on the intermediaries depends on the level of education, migrant network in the village, etc. IOM (2021) points out the lack of information on the aspirant migrants as one of the major obstacles.

Where the potential migrants are illiterate or come from households with lower education or lower social migrant networks, the information asymmetry between the migrant worker and the intermediary increases, leading to a potential moral hazard problem. It increases the cost of migration and risks for migration fraud, as noted by Barkat et al. (2014) and Ahmed et al. (2015). The type of migration fraud includes sending the migrant worker abroad with a nonworker visa (such as a tourist), creating false overseas employment contracts, involving workers in illegal occupation (such as forced sex) etc. (Razzaque et al., 2018). According to a survey on the returning migrants workers by the ILO in 2015, only 17 percent of the sampled workers had a valid work permit when they migrated abroad (Ahmed et al., 2015).

This leads to our hypothesis that poorer aspirant migrant workers are more prone to risky migration process than richer quartile aspirant migrant workers. This is because aspirant migrants with higher education, or where their family members are highly educated, would have more access to better information, either through better access to a safer migration network, the ability to verify information online or read and understand the contract papers, etc.

Unlike migration through intermediaries, migration through friends or families is much safer. According to IOM (2010), around 35 percent of migrant workers collected information on overseas migration through friends or families.

Based on the above discussion, we presume that, in the second stage, a household in Bangladesh decides on migration depending on multiple factors, including (i) the individual, (ii) the households, (iii) the community, and (iv) external factors.

Individual factors include the age, education level, gender, marital status, etc., of the potential migrant. Household factors include the age, sex, and education of the household head, household’s income status, household asset (such as total land holding), number of dependents in the household, number of working age population within the household, previous migrants (current or returnee) within the household etc. Community factors include migration network at the community level (such as the proportion of households with a migrant worker), local economic condition (such as mean per capita income/consumption expenditure), environmental

condition (such as propensity to flooding or any other natural disasters) etc. The external factors would include government policies (at home and abroad), conditions and opportunities at the destination countries etc. It also includes recruiting agencies and intermediaries (such as ‘Dalals’).

It must be noted that the internal migration mechanism is entirely different than how the external migration would work, at least in the context of Bangladesh (Table 1).

Table 1. Two major differences between internal and international migrations

Area	Internal migration	International migration
Cost of migration	As low as \$1 to a maximum \$5 to travel to any part of the country in Bangladesh	Depends on the destination. However, the most popular destinations, such as Malaysia or Saudi Arabia, would cost around \$3000 to \$5000 (Blanchet & Bishwas, 2021). A larger amount is paid to the recruitment agent. The accrued cost is often 300-500% higher than government-set fees (ibid.). There is a huge political economy of the recruitment agency in Bangladesh.
Barriers to migration	There is no barrier to migrating internally except three CHT (Chittagong Hill Tracts Area) – Bandarban, Rangamati, and Khagrachari – where you would need separate permission to settle. No permission is needed to work.	Needs the appropriate visa to migrate to the country. Many Bangladeshi workers are still working as undocumented migrants as they do not have proper visa. In many cases, there are language and cultural barriers. Bangladesh has one of the lowest ranking passport acceptability globally. According to the Henley passport index 2022, it ranks 104 among 110 countries.

Source: author’s analysis based on literature.

4. Theoretical Model

One of the cornerstones of migration theory, more precisely the human capital model of migration, has been first coined by Sjaastad (1962), who argues that migration is nothing but acts of positioning one’s skills in the market that pays the highest. In his model, Sjaastad (1962) considers the differential in wages for the source and destination countries, the cost of living differential in the source and destination countries, the present value of net gain to migration, the distance between origin and destination, as well as a vector of determinants of migration costs. He argues that, a potential migrant worker only moves abroad if the net return is positive.

However, the model has several limitations (Bodvarsson, 2015). As such, the model only considers migration as a single-period decision and does not consider the migrant worker’s age, the career point at which the migrant worker is at, how

much the migrant worker values leisure over income, etc. Moreover, the model also considers migration as a problem of individual decision making. However, as the NELM literature suggests, the migration decision is taken at the household level. For example, whether there is already a migrant member in the family, where the migrant lives, how much the family earns, sex composition in the family (such as whether there are no boys in the family, the age of the eldest son in the family etc.) can have a significant influence on the household migration decision.

The model also assumes no asymmetry of information for the migrant workers. The uncertainty and asymmetry of information could be higher for migrants travelling cross-border. Also, risks and uncertainty could be higher for persons with pay in piece than persons with permanent tenure employment opportunities. Nonetheless, the costs of migration, in terms of risks and uncertainty would lower down as there are increasing past migrations in the destination country.

Later models on international migration extend on Sjastad and show that kinship networks and migrant networks would reduce employment search costs, increase security, lower risks, lower language barrier, and lower costs of accommodation, amongst others (Massey & Garcia, 1987; Taylor, 1986, etc.). However, as the later literature shows, beginning with Stark and Levhari (1982), Stark (1984, 1991), and Katz and Stark (1986), the migration decision is not made by the individual but rather by the household.

In our model, we argue that, even though the household is the decision maker on migration, it does not decide in isolation. Rather, the migration decision is taken jointly by the migrant worker and the household. At the individual level, the aspirant migrant compares the option available, like the destinations, the difference in earnings at the source and destination countries, as well as the opportunity cost of migrating abroad. However, when it comes to the cost, the role of the household comes in. This is because the cost, as we argue in the context of Bangladesh, can be a borrowing constraint at the household level, which is resolved at the household level.

In our model, we assume that a migrant worker maximises his expected revenue from migrating abroad rather than absolute revenue. This is because there are always some uncertainties related to international migration, at least in the context of rural Bangladesh. We assume that there is a probability p that his migration will be successful; that is, there is $(1-p)$ probability that it may fail.

At the individual level, the individual would be willing to migrate abroad if the expected revenue from cumulative migration within a span of t years exceeds the expected costs within the same period of time. In our context, the expected revenue is:

$$\text{Expected revenue} = p \left(\text{wage}_1 + \frac{\text{wage}_2}{(1+\delta)} + \frac{\text{wage}_3}{(1+\delta)^2} + \dots + \frac{\text{wage}_{t+1}}{(1+\delta)^t} \right) - (1-p)\text{mig_cost} \quad (1)$$

where,

wage_i = wage in period i , $i = 1, 2, \dots, t$

δ = discounting factor (including inflation and social adjustment costs)

p = the probability that it would be a successful migration. Therefore, $(1-p)$ stands for the probability of an unsuccessful migration.

mig_cost = the total cost of migration. It does not include living expenses during the migration years. In the case of a failed migration, the migrant will have zero cumulative wages, and still, he will have to bear the costs (such as the payments made to the intermediaries, fees or travel costs paid, etc). In this particular case, the expected revenue would be negative.

Now, the expected cost from the migration, where it is successful, would be $= p(mig_cost)$.

Where mig_cost is the cost of migration incurred initially. However, it must be kept in mind that individuals can consider this migration cost and divide it into periods. For example, if the total migration cost is C , he may divide it into periods.

Let's assume he would gain a return of interest (i) for each period of this money had he invested in some banks or bought some assets. Alternatively, had he taken the cost C as a borrowing, it can be considered as the interest rates paid off each period.

However, the migrant will not consider this amount as a one of payment. Rather than a split payment over a period of T (his total length of migration).

Therefore, the true cost incurred, which is split across time would be:

$$mig_cost = \sum_{t=1}^{t=T} \frac{C(1+i)^{t-1}}{T} * \frac{1}{(1+\delta)^{t-1}} = \sum_{t=1}^{t=T} \frac{C}{T} \frac{(1+i)^{t-1}}{(1+\delta)} \quad (2)$$

For simplicity, let's assume, the interest rate, i is equal to the social discounting rate/inflation rate (δ). Therefore, equation (2) would become:

$$mig_cost = \sum_{t=1}^{t=T} \frac{C}{T} = C$$

However, for this basic model, we assume that, along with this migration cost, there will be the cost of living in the destination country. Let's assume, living cost in each period of time is L_t . We also assume that the inflation rate at the home and the destination country are the same. Therefore, a migrant would assume that his cost of living in the destination would increase exactly at the same rate as his discounting factor $(1 + \delta)$. We also assume that there is a fixed exchange rate between the home country and the destination. This assumption of a fixed exchange rate is particularly valid in the context of Bangladesh. The central bank of Bangladesh manages the exchange rate and follows a dirty float to keep it fixed.

Therefore, his total living cost would be:

$$= L_1 + L_2(1 + \delta) + L_3(1 + \delta)^2 + \dots + L_t(1 + \delta)^{t-1}$$

Therefore, his expected profit (Π) from going abroad would be:

$$\begin{aligned} \Pi = & p \left(wage_1 + \frac{wage_2}{(1+\delta)} + \frac{wage_3}{(1+\delta)^2} + \dots + \frac{wage_{t+1}}{(1+\delta)^t} \right) - (1-p) \left(\sum_{t=1}^{t=T} \frac{C(1+i)^{t-1}}{T} * \right. \\ & \left. \frac{1}{(1+\delta)^{t-1}} - p \left(\sum_{t=1}^{t=T} \frac{C(1+i)^{t-1}}{T} * \frac{1}{(1+\delta)^{t-1}} + L_1 + L_2(1 + \delta) + L_3(1 + \delta)^2 + \dots + \right. \right. \\ & \left. \left. L_t(1 + \delta)^{t-1} \right) \right) \end{aligned} \quad (3)$$

Equation (3) can be written in simple terms as:

$$\Pi = pW - (1 - p)C - p(C + L) \quad (4)$$

where,

Π = net return from overseas migration

W = total wage accrued between period 1 and t in present value

C = total migration cost in present value, which only occurs in the current period

L = total living cost (between period 1 and t) abroad in present value

Some basic rearrangements of equation (4) would give us:

$$\Pi = pW - C - pL \quad (5)$$

A person, at the individual level, would decide on migrating abroad if:

$$\Pi = pW - C - pL \geq \theta \quad (6)$$

where, θ is some reservation wage, or the minimum wage that a person would earn even at her village without migrating abroad (between period 1 and t).

Setting it to equality gives us the following:

$$\Pi = pW - C - pL = \theta + \kappa \quad (7)$$

$$\Rightarrow pW = C + pL + \theta + \kappa \quad (8)$$

where, κ = Non-negative premiums are earned by the migrant member overseas.

Equation 7 tells us that an individual will be willing to migrate abroad only if he profits as much as he would have been had he been engaged in the rural labour market.

A person will only be willing to migrate if his expected wage abroad is as high as the total migration cost, total living expenses, and reservation wage (equation 8). It must be noted here that C is a binding borrowing constraint. A higher value of C would mean a more stringent borrowing constraint for the individual and the household.

And it is through C and Π that the individual decision to migrate influences the household's decision whether to send the migrant member abroad or keep him in the region, where he can earn a wage of θ with certainty. Given that the rural unemployment rate in Bangladesh is less than 1 percent, we assume that the individual has certainty about earning from the village a value of θ . However, it can take any value. During the lean season, it can be 0. However, as in all cases here, we assume all our values at the annual average level summing for a period of t.

Now, at the household level, the household knows about equation 7. They know about the cost of migration and the potential returns.

We hypothesise that the cost of migration puts a borrowing constraint on the household. Here, the cost of migration, C is defined as:

$$C = f(T_c, L_c, w(I)) \tag{9}$$

where, T_c is the transport cost for the aspirant migrant. It could be bus fares, airfares, or any mode of transport that the worker takes. We assume that the mode of transport is homogeneous, and the cost for all migrants for a given destination is the same for a given year.

L_c = Legal costs of migrations. It would include any costs, such as documentation in the source country, visa costs, etc. We assume this would be homogeneous for all migrants for the same destinations for a given year.

ω = Premium paid to the intermediaries, which is a function of I , the degree of asymmetry of information.

We assume that the higher the proportions of migrant households from a region, the lower the asymmetry of information in a particular region. The higher the migration network, the lower the degree of asymmetry in information. [Here, N = Migrant network in the community. One measure could be the proportion of households in the community with at least one international migrant]. We also assume that the level of education of the migrant and the aspirant migrants is important as it would enable them to read what is written on the visa application and other documents and help them to make more informed decisions. In other words, the higher the level of education or parental education, the lower the degrees of asymmetric information. In other words, we assume:

$$I \propto \frac{1}{N}, \frac{1}{E}, \frac{1}{PE} \tag{10}$$

where I is the degree of asymmetric information. Equation 10 says that the degrees of asymmetric information are inversely proportional to the migrant network in a particular community, the aspirant migrant's education, and the parental education of the aspirant migrant.

However, the level of kinship or relationship among the villagers/ residents of a particular community can vary from region to region. For instance, for some regions, this kinship could be more potent than for some other regions. This is also true for the quality of education in a locality. Some regions may have better education qualities than others. Therefore, the degree of information asymmetry is related to the region-specific qualities like strength of kinship, quality of education, etc., in the specific locality. In other words, equation (10) will equate as follows:

$$I = k * \left[\frac{1}{N} + \frac{1}{E} + \frac{1}{PE} \right] \tag{11}$$

where k is an idiosyncratic variable for each region or a region-specific fixed effect.

Given the relationship between I and N, the premium charged by an intermediary would be:

$$\begin{aligned} \omega &= I + \epsilon \\ \Leftrightarrow \omega &= k * \left[\frac{1}{N} + \frac{1}{E} + \frac{1}{PE} \right] + \epsilon \end{aligned} \quad (12)$$

where, ϵ is the fee that he would charge anyone regardless of the asymmetry of information. That is, in the case that the migrant worker has perfect information, the value of I would be 0, and the only premium that he would be paying is ϵ or the fees of the intermediary. According to 11 and 12, the least cost of information would be incurred by a household that has a very strong migration network, higher years of education as well as higher parental education.

Therefore, for a typical migrant worker, the total cost of migration would be:

$$C = T_c + L_c + \omega \quad (13)$$

Equation 13 says that the total migration cost has a direct relationship with travel costs, legal costs, and the cost of intermediaries. Following equation 12, equation 13 can be rewritten as:

$$C = T_c + L_c + k * \left[\frac{1}{N} + \frac{1}{E} + \frac{1}{PE} \right] + \epsilon \quad (14)$$

Here, C is a borrowing constraint for a household if

$$C > L_f + A + S + cY \quad (15)$$

In other words, if the cost of migration is greater than the total amount the household can borrow (L_f) from informal (friends, relatives, etc.) or formal (banks, NGOs, etc.) channels, total asset holdings (A) (such as total land values), total savings (S), and proportion of income after consumption expenditure (cY). Here, c is the marginal propensity to consume for a typical household.

For migrant or aspirant migrant households, equation 15 must be:

$$C \leq L_f + A + S + cY \quad (16)$$

At the corner solution, equation 16 would solve with equality:

$$C = L_f + A + S + cY \quad (17)$$

Given this, a household's decision to have an international migrant would be a function of:

$$I_M = f(L_f, A, S, cI, T_c, L_c, N, E, PE, k).$$

Where, $I_M = 1$ if the household has a new international migrant, and 0 otherwise. Whether to migrate or not, i.e. the value I_M takes would depend on household's utility.

From equation (7) we get,

$$\Pi = pW - C - pL - \theta = \kappa \quad (18)$$

Π enters the utility of the household utility function. The households optimise their utility. The utility depends on household consumption expenditure (Y), as well as the earning from international migration (Π). If there is no migration, the migration benefit would be 0, and therefore, the utility would be entirely dependent on the amount of consumption expenditure. We also assume that, for the households who want to be a migrant, their risk aversion depends on their total wealth or total asset (A). The richer the households, the less risk-averse the households when it comes to the migration net benefits. A wealthy household would be more risk taker for a given value of Π compared to a less wealthy household.

Therefore, the household maximises its utility function:

$$U = f(Y, A, \Pi) \quad (19)$$

where, Y is the level of consumption of the household.

To capture the degree of risk aversion of the household, let us introduce a parameter γ which is a function of A . Therefore, our utility function becomes:

$$U = f(Y, A, \gamma, \Pi) \quad (20)$$

Now, assuming a decreasing relative risk aversion (DARA), that is, the degree of risk aversion decreases as the household's wealth or asset level increases with regard to the net benefits of foreign migration, our utility function becomes:

$$U = Y^\alpha + \frac{\Pi}{\gamma(A)} \quad (21)$$

where, α is the elasticity of consumption (Y)

In the case that the household does not decide to migrate, the value of Π is 0. In other cases, the higher the net benefits from migration (Π), the higher the utility of the household. However, the utility also depends on household wealth (A) that follows a function $\gamma(A)$. $\gamma(A)$ decreases as wealth increases. In other words, households become less risk-averse as their wealth or asset level increases. Therefore, utility (U) from migration is higher for higher-income households. Richer households are less risk-averse for a given level of net benefit from migration than poorer households.

The functional form of $\gamma(A)$ is as follows:

$$\gamma(A) = \frac{\eta}{A^\rho} = \eta A^{-\rho} \quad (22)$$

Here, η and ρ determines the shape of the DARA function. η represents the overall level of risk aversion. It determines the degree of risk aversion for the household with respect to net benefits of migration, with a higher value indicating higher risk aversion. The reciprocal of η , $1/\eta$, can be interpreted as the coefficient of absolute risk aversion (CARA), which measures the sensitivity of the household's utility to changes in risk. A higher value of η indicates a higher degree of risk aversion, meaning the household is more sensitive to changes in risk and tends to be more conservative in their decision making and vice versa. In the case of ρ , it determines the rate at which risk aversion decreases with increasing wealth. A higher value of ρ would mean faster decrease in risk aversion as the household becomes wealthier and vice versa.

Substituting $\gamma(A)$ in 21 and after some manipulations we get:

$$U(Y, A, \Pi) = Y^\alpha + \frac{\Pi A^\rho}{\eta} \quad (23)$$

$$\Rightarrow U(Y, A, \Pi) = Y^\alpha + \frac{\kappa \cdot A^\rho}{\eta} \quad (24)$$

$$\Rightarrow U(Y, A, \Pi) = Y^\alpha + [pW - C - pL - \theta] \frac{A^\rho}{\eta} \quad (25)$$

Replacing the value of C in equation 25 we get:

$$U(Y, A, \Pi) = Y^\alpha + [pW - (T_c + L_c + k * [\frac{1}{N} + \frac{1}{E} + \frac{1}{PE}] + \epsilon) - pL - \theta] \frac{A^\rho}{\eta}$$

$$\Rightarrow U(Y, A, \Pi) = Y^\alpha + (pW - T_c - L_c - k * [\frac{1}{N} + \frac{1}{E} + \frac{1}{PE}] - \epsilon - pL - \theta) \frac{A^\rho}{\eta} \quad (26)$$

Equation 26 states that the utility of the household increases with increasing consumption, however, at a decreasing rate. Moreover, whether to migrate or not, the household decides that based on the latter part of the equation in 24. As long as $\kappa > 0$ (in equation 24), households' utility from migrating abroad would be greater than the decision on non-migration. From equation (26), it can be asserted that, for a given value of ρ , η , p , and A , the utility of a household will increase:

- with an increase in overseas lifetime income (W) or an increase in the rates of successful migration (p) or both (pW);
- decrease in transport cost (T_c);
- decrease in legal costs to migrate abroad (L_c);
- increase with higher social network, individual education, or parental education – as these will reduce the asymmetry of information between the aspirant migrant and the intermediary (N , E , or PE);
- decrease in the premium charged by the intermediary (ϵ);
- decrease in the lifetime cost of living abroad (pL);
- and, decrease in the local wage (θ).

In a nutshell, our theoretical model underpins three important dynamics influencing migration decisions at the household level.

First, one of the primary determinants for household migration decision is whether the household has adequate resources to migrate abroad. In other words, whether the household can meet the binding resource constraint. Our theoretical model shows that it is the richer households who are more likely to migrate than others as they can meet this binding resource constraint.

Second, the relationship between household assets and the migration decision is not linear. Households with higher resources would be less risk averse and, therefore, with the same level of migration benefits would be willing to migrate more.

And lastly, a decrease in information asymmetry would enable a higher level of migrations.

5. Hypotheses:

We hypothesise that households from the lower income quantiles have least probability to migrate. We also hypothesise that households with better migration networks would have higher probability to migrate compared to others.

6. Data and Methodology

6.1 Data

We use Bangladesh Integrated Household Survey (BIHS) data. It is the only nationally representative panel survey for rural Bangladesh covering detailed data on agriculture production, dietary intake of household members, anthropometric measurements of all household members (including heights and weights), data on measuring women's empowerment, information on household income and expenditures, as well as detailed information on shocks (economic or natural disasters), migration, and remittances of the household members etc. The survey data cover 6,500 households from 325 primary sampling units (PSUs). The surveys are conducted in 2011-12, 2015-16, and 2018-19.

A trade-off for using these data is that they only cover rural Bangladesh. However, since this is nationally representative of rural Bangladesh for all administrative districts of the country, it enables a deeper analysis of the rural Bangladesh context. Moreover, more than two-thirds of the total population still lives in rural areas, and most of the employment comes from the rural farm and nonfarm sectors. Moreover, international migration is more of a rural phenomenon than urban in Bangladesh. Moreover, the panel dimension of the dataset enables us to explore the impact of migration and remittances using more robust econometric models than otherwise.

All the prices and income in the data are in constant 2012 prices (such as monthly household expenditure etc.) based on a constructed regional consumer price index (See Annex 1 for further details).

6.2 Empirical Models

Dynamic Panel Probit Model

Based on the conceptual and theoretical underpinning, and the panel dimension of our data, a naïve regression model would look as follows:

$$m_{it} = \alpha_0 + x_{it}'\alpha + z_{it-1}'\gamma + m_{i0}\beta + c_i + \mu_{it} \quad (27)$$

where,

$m_{it} = 1$ if the household has any new international migrant member in period t ,
0 otherwise

$m_{i0} = 1$ if the household had any international migrant in the baseline period,
0 otherwise

x_{it} is a vector of variables such as the education of the household head, and education squared, age of the household head, and z_{it-1} is a vector of variables showing migrant members in one period lag: internal migrant network in one period lag at the district level (measured as the proportion of households with at least one internal migrant); international migrant network in one period lag at the district level (measured as the proportion of households with at least one international migrant); household income decile in one period lag; proportions of working age male population in the household etc.; the proportion of adult males in the household in lag 1; the amount of loan or savings in the households in one period lag (in log); etc. μ_{it} is the error term.

More specifically, we can denote our pooled probit model as follows:

$$m_{it}^* = \alpha_0 + x_{it}'\alpha + z_{it-1}'\gamma + c_i + \mu_{it} \quad (28)$$

where,

$$m_{it} = \begin{cases} 1, & \forall m_{it}^* > 0 \\ 0, & \text{Otherwise} \end{cases} \quad (29)$$

We observe whether household i has a new migrant member in period t or not. If household i has a new migrant member in period t , it takes 1, and 0 otherwise. In essence, m_{it}^* shows the ability of a household to have a new migrant worker in a particular period.

However, running a pooled probit estimate would lead us to a biased estimate as the assumption that c_i is independent of z_{it-1} is impossible (Wooldridge, 2005). One approach is to control for c_i as a parameter estimate for each i . This is often referred to as controlling for household fixed effects. However, with fixed T and $N \rightarrow \infty$, this would result in inconsistent estimators (Wooldridge, 2000), precisely our case.

Wooldridge (2000) suggests, first, to model the distribution of $c|z_t, x_t$ and then to construct the density of explanatory variables given (z_t, m_0) . Furthermore, Wooldridge (2005) provides a simple solution to the initial conditions problems as is in our case.

Moreover, in the presence of attrition, following Wooldridge (2005) has several advantages. Wooldridge (2005) approach allows attrition to arbitrarily depend on m_{i0} , the initial condition. In the present case, m_{i0} , shows the household's migrant status in the initial period. An MLE estimation following Wooldridge (2005) would allow attrition probabilities to differ across the initial condition. In contrast to this approach, traditionally, it would have required us to explicitly model attrition as a function of the initial condition following appropriate Heckman analysis (Wooldridge, 2005).

Whether the household has a new migrant in period t , could depend on whether the household had a migrant in period $t-1$, or in the initial year. Also, one of our key hypotheses is that households from the poorest income quantiles are the least likely to migrate given the higher borrowing constraint. Therefore, we are interested in observing the impact of the household's income status from the previous round affects the new migrant status in the current round. Wooldridge (2005) shows that, if not properly controlled for, such initial value problems can lead to potential biased estimates. In other words, unobserved individual heterogeneity affecting m_{1it} can be correlated with unobserved individual heterogeneity affecting m_{2it} . Moreover, idiosyncratic shocks that affect m_{1it} can be strongly correlated with idiosyncratic shocks affecting m_{2it} . Therefore, Wooldridge (2005) suggests a simple solution by applying dynamic panel probit model.

Following Wooldridge (2005), we have two key underlying assumptions on the conditional distribution. First, the dynamics in our model is correctly specified. "This means that at most one lag of m_{it} appears in the distribution given outcomes back to the initial time period" (*ibid.*) which can be written as:

$$D(m_{it}|z_{it}, m_{i,t-1}, c_i) = D(m_{it}|z_{it}, m_{i,t-1}, \dots, m_{i0}, c_i) \quad (30)$$

We assume that our this 'structural density function' is correctly specified.

Our second assumption is $z_i = \{z_{i1}, \dots, z_{it}\}$ is appropriately strictly exogenous, conditional on c_i .

Here, z_i is the row vector of all explanatory variables from all time periods and it can take lag or leads of any exogenous variables.

Let us assume our dynamic probit model with unobserved effect as follows:

$$P(m_{it} = 1|m_{i,t-1}, \dots, m_{i0}, z_i, c_i) = \Phi(z_{it}\gamma + \rho m_{i,t-1} + c_i) \quad (31)$$

In addition to equation 31, we also assume that c_i is distributed as follows,

$$c_i|m_{i0}, z_i \sim N(\alpha_0 + \alpha_1 m_{i0} + z_i \alpha_2, \sigma_a^2) \quad (32)$$

Given equation (31) we can write:

$$f(m_1, m_2, m_3, \dots, m_T | z, c, \beta) = \prod_{t=1}^T \{\Phi(z_t \gamma + \rho m_{t-1} + c)\}^{m_t} \times [1 - \Phi(z_t \gamma + \rho m_{t-1} + c)]^{1-m_t} \quad (33)$$

where,

$\beta = (\gamma', \rho)'$. Integrating (33) with respect to the normal distribution in (32) will give us the density function $D(m_{i1}, \dots, m_{iT} | m_{i0}, z_i)$.

Now, from (32), we can write

$$c_i = \alpha_0 + \alpha_1 m_{i0} + z_i \alpha_2 + a_i \quad (34)$$

Here, a_i follows a normal distribution with mean 0 and variance σ_a^2 . That is,

$$a_i | (m_{i0}, z_i) \sim N(0, \sigma_a^2)$$

It follows that $(m_{it} | z_{it}, m_{i,t-1}, \dots, m_{i0}, c_i)$ would follow a probit model with response probability

$$\Phi(z_{it}\gamma + \rho m_{i,t-1} + c_i) \quad (35)$$

Substituting the value of c_i from (34) to (35) we get:

$$\Phi(z_{it}\gamma + \rho m_{i,t-1} + \alpha_0 + \alpha_1 m_{i0} + z_i \alpha_2 + a_i) \quad (36)$$

From (36), we can finally write the latent variable version of our model as:

$$m_{it}^* = z_{it}\gamma + \rho m_{i,t-1} + \alpha_0 + \alpha_1 m_{i0} + z_i \alpha_2 + a_i + u_{it} \quad (37)$$

$$\text{where, } u_{it} | Z(z_{it}, m_{i,t-1}, \dots, m_{i0}, a_i) \sim N(0, 1) \quad (38)$$

Now, the density function stated in (33) becomes:

$$\prod_{t=1}^T \{ \phi(z_t\gamma + \rho m_{t-1} + \alpha_1 m_0 + z\alpha_2 + a)^{m_t} \times [1 - \phi(z_t\gamma + \rho m_{t-1} + \alpha_1 m_0 + z\alpha_2 + a)]^{1-m_t} \} \quad (39)$$

After Integrating (38) for the normal density function ($N(0, \sigma_a^2)$), one would obtain the same structure as the standard random effects probit model (for further details, see Woolridge (2005)). However, the only difference from the random effect probit (as written in equation 28) is that the explanatory variables in the time period t would include the lag of the dependent variable ($m_{i,t-1}$), and the initial values (m_{i0}). Here, we add m_{i0} and z_i in each time period as additional explanatory variables and use of standard random effect probit software would give us unbiased estimates of the parameters.

Therefore, our modified empirical migration model from equation 28 can be written as follows:

$$m_{it}^* = \alpha_0 + \alpha_1 m_{i0} + z_i \alpha_2 + x_{it} \alpha_3 + z_{it-1} \delta + \rho m_{i,t-1} + a_i + u_{it} \quad (40)$$

where,

$m_{it} = 1$ if the household has any new international migrant member in period t ,
0 otherwise

$m_{it-1} = 1$ if the household has any new migrant member in period $t-1$, 0 otherwise

$m_{i0} = 1$ if the household has any new migrant member in the initial period,
0 otherwise

x_{it} are the other covariates such as, education of the household head, age of the household head, regions, depends in the households, proportion of adult males in the household, mean years of schooling of the household members, proportion of working age adults in the households etc.

z_i is the row vector of all explanatory variables from all time periods and it can take lag or leads of any exogenous variables.

w_{it-1} are the variables such as household income quantile in period $t-1$, domestic migration network in one period lag, international migration network in one period lag etc.

6.3 Summary Statistics of the Selected Variables

Among all households, only 5% of the households have a new international migrant worker (Annex Table 1). 66% of the new households of international migrant workers had at least one international migrant in the initial period (2012). In contrast, for households without any new migrant workers, this rate was only 7%. It shows the strong role of the family network in new international migration.

The mean years of education for the head of the new migrant households is slightly higher (4.1 years) than the nonmigrant households (3.5 years). What is more interesting is, in the one period lag, the highest years of schooling is much higher for the new migrant households (7 years) compared to non-migrant households (4.75 years). Moreover, the proportion of working-age male members in the new migrant households in one period lag is 1.35 times higher than the nonmigrant households.

The descriptive statistics also show that the new migrant households come from stronger migrant-prone areas. As such, the new migrant households are coming from areas where on average 25% of the households have at least one international migrant. In the case of nonmigrant households, the proportion of households with at least one international migrant at the village level is only 11%.

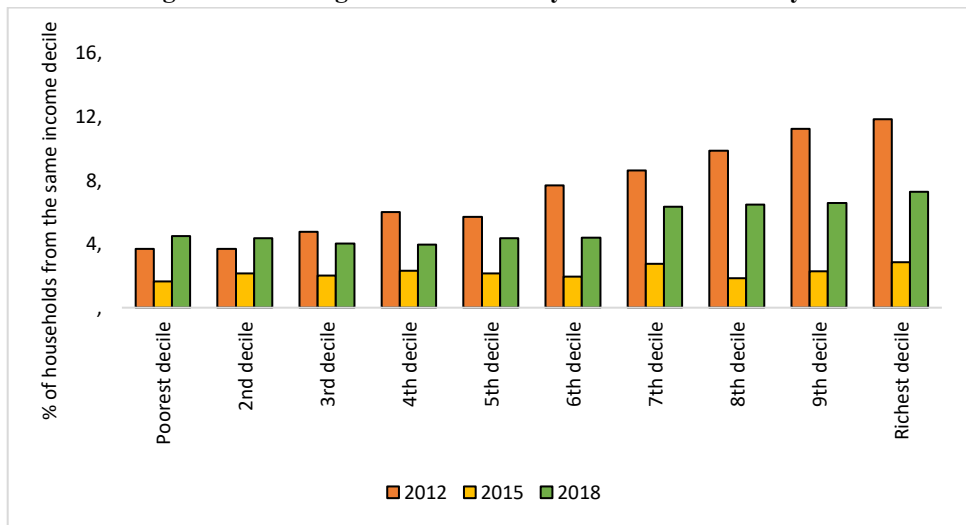
Moreover, we note that the internal migration network is slightly stronger in the regions of nonmigrant households. For non-migrant households, the mean value of the “proportion of households with at least one internal migrant member at the village level” is 23% compared to 20.7% in the case of new international migrant households.

We do not see much difference between the new international migrant households and the nonmigrant households with regard to other variables such as the under 15 dummy, elderly dummy, log of total loan in one period lag, or the log of total savings in one period lag etc.

6.4 Descriptive Statistics

The proportion of households with at least one new international migrant is higher in the higher-income deciles. For instance, in 2012, only 3.7 per cent of the poorest-income households had at least one international migrant member (Figure 3). In 2018, this rate has increased to 4.3%. In contrast, in 2012, among the households in the richest income decile, 11.8% of the households had at least one new international migrant member. However, we notice that the proportion of new international migrant workers is almost flat across all income deciles. One possible explanation for this could be that international migration is costly. We observe the same set of households across three periods. Therefore, a time lag could influence the lower proportion of new migrants in 2015.

Figure 3. New migrant households by income deciles and year



Source: author’s estimation.

The same trend is observed in the migrant workers by income deciles. For example, among all the new migrants in 2012, 56.8% of them belonged to the top four income deciles. The bottom four deciles, the share of new international migrants in 2012 was 24.8%. In 2018, the share of new international migrants among the bottom four deciles increased to 34.8%. However, 49% of the all new international migrants still come from the top four income deciles.

Therefore, it can be argued that the proportion of new migrant households in the poorer income decibels has increased significantly over the years. As such, in 2012, the richest 40% of the households had a 2.29 times higher propensity to have new international migrant households than the bottom 40% of the households (Table 2). This propensity decreased to 1.43 in 2018, meaning that the top 40% of the households had at least 1.43 times more new international migrants than the bottom 40% of the households.

Table 2. Migrant share index

Indicator	2012	2015	2018	Total
Share of the bottom 40% of households in total new migrations (%)	24.8	38.6	34.1	29.9
Share of top 40% of households in total new migrations (%)	56.8	42.9	49.	52.2
The ratio of the top and bottom 40%	2.29	1.11	1.43	1.74

Source: author's estimation.

7. Regression Results

Following the empirical model discussed above, we estimate our model by following different model specifications as a robustness check. In all the model specifications, our main objective variables, such as whether the household has any new migrant in one period lag, whether the household had any migrant at the baseline, household head education, household's income deciles, migration networks (both internal and international) etc. are kept the same. In alternative specifications, we add variables such as whether the household had any under-15 dependents at home (in lag), whether there were any elderly in the family (in lag), the proportion of the working age males in the household (in lag), log of total loan in the household (in lag), log of total savings in the household (in lag) etc. The results of the marginal effects are presented in Annex Table 2. For the brevity of the paper, we do not incorporate the results from the main probit regression. However, this is available from the author upon request.

The results of the regressions show that having a new migrant in the immediate past lag lowers the probability that the household sends another migrant member in the present period. As such, households with new migrant members in the immediate past lag would have a 34 per cent lower probability of sending another member abroad. However, we observe a strong relationship between the migration status of a household in the initial period and the probability of sending a new migrant member. Households with international migrant members in the initial period have a 33 percentage points more probability to have an international migrant member in the following periods compared to nonmigrant households. We also observe a strong role of migration networks at the village level. A 10 per cent increase in the proportion of international migrants at the village level can increase the probability of having a new international migrant household in the locality by more than two percentage points. However, we did not observe any significant relationship between the internal migration network and the probability of new international migration at the household level.

In all the specifications, we observe a strong relationship between household expenditure deciles and the probability of new migration in the following period for the households from the upper income deciles. As such, for households belonging to the bottom five deciles, no relationship can be observed between the decile status and the new international migration status compared to the base category (poorest expenditure decile). However, households from the sixth income

decile have 51 percentage points higher probability of having a new migrant member in the following period compared to the poorest decile households. This relationship becomes more prominent as we move up in the expenditure decile. As such, the richest income decile households have an 81 percentage points higher probability of becoming a new migrant household in the next period compared to the poorest income decile households.

We observe a weak relationship between the years of education of the household head and the probability of having a new migrant member. However, this relationship is quadratic in nature and it increases at a decreasing rate. One reason behind this result could be that households educated beyond certain threshold points might have more high-yielding local opportunities than other households. We also observe a positive and significant relationship with the highest years of male education in the household: higher educated households, higher probability to have a new migrant in the following period. However, we do not see any significant relationship between the female highest education in the household and the probability of new migration.

8. Conclusion

Bangladesh is one of the main migrant host countries in the world. Migration and remittances have played important roles in the development dynamics of Bangladesh. However, as the stages of migration theory suggest, due to the cost and risks associated with international migration, not all households have opportunities to become international migrant households. In this paper, we explore the international migration process in Bangladesh, devise a theoretical framework, and test our key hypothesis using the Bangladesh Integrated Household Survey data from 2012, 2015 and 2018.

Our theoretical model predicts that households with higher education, better migration networks, and higher wealth endowments will have higher tendencies to international migration. Our empirical findings support this hypothesis. Based on a dynamic panel probit model, we see that households with international migrant members in the initial period have a higher probability of sending another new migrant member in the later periods. In other words, the family migration network is highly significant in household migration decisions. We also observe a significant relationship between the migration network at the village level and the probability of new migration. However, the magnitude of this network is much lower than that of the family network. Our result also suggests that households from the richer income deciles have a significantly higher probability of being new migrants compared to the households from the poorer income deciles. We also observe that the education of the household members plays an important role. As explained in the theoretical model, higher education can reduce the risk of international migration and, thereby, can reduce the expected cost of international migration. Our evidence supports this hypothesis.

Several conclusions can be drawn from the results. First, unequal access to international migration can have a further inequality abating impact on the source

community. Therefore, the migration process needs to be much easier and less costly so that poorer households can participate. Furthermore, as found in the paper, education can play an important role in this process. Therefore, extra attention should be provided to the regions where international migration is low and explore whether lower education in those regions explains such outcomes. As we show in this paper, increasing a household's education endowment will increase the chances of international migration by lowering the risk associated with it.

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Appendix

Table 1. Summary of the key variables

Variable	New migrant households						Non-migrant households						All households						Ratio of mean (migrant/non-migrant)
	Obs	Mean	Std. Dev.	Min	Max		Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max			
New international migrant household dummy	905	1.00	0.00	1.00	1.00		17639	0.00	0.00	0.00	0.00	18544	0.05	0.22	0.00	1.00			
New international migrant dummy in the initial period	872	0.64	0.48	0.00	1.00		16562	0.05	0.21	0.00	1.00	17235	0.08	0.26	0.00	1.00		14.07	
Household head years of education	905	4.09	4.02	0.00	18.00		17639	3.55	4.15	0.00	18.00	18544	3.57	4.15	0.00	18.00		1.15	
Household head years of education square	905	32.87	46.59	0.00	324.00		17639	29.81	52.72	0.00	324.00	18544	29.96	52.44	0.00	324.00		1.10	
Highest years of education of females in the HH	409	5.96	3.75	0.00	18.00		10630	5.17	3.83	0.00	18.00	11040	5.20	3.83	0.00	18.00		1.15	
Highest years of education of males in the HH	409	7.02	3.81	0.00	18.00		10630	4.75	4.40	0.00	18.00	11040	4.84	4.40	0.00	18.00		1.48	
Proportion of working age members in the HH in L1	409	67.74	20.77	20.00	100.00		10631	60.60	22.21	0.00	100.00	11041	60.86	22.20	0.00	100.00		1.12	
Proportion of working age males in the HH in L1	409	35.09	16.66	0.00	80.00		10631	25.98	17.45	0.00	100.00	11041	26.32	17.50	0.00	100.00		1.35	
U15 dummy in L1	409	0.75	0.43	0.00	1.00		10628	0.78	0.41	0.00	1.00	11038	0.78	0.41	0.00	1.00		0.96	
Number of U15 in L1	409	1.42	1.18	0.00	6.00		10625	1.51	1.15	0.00	7.00	11035	1.50	1.16	0.00	7.00		0.95	
Elderly dummy in L1	409	0.23	0.42	0.00	1.00		10628	0.20	0.40	0.00	1.00	11038	0.20	0.40	0.00	1.00		1.15	
Number of elderly in L1	409	0.26	0.50	0.00	2.00		10628	0.22	0.47	0.00	3.00	11038	0.22	0.47	0.00	3.00		1.15	
Number of members with disability in the HH	409	0.67	0.90	0.00	6.00		10631	0.52	0.77	0.00	6.00	11041	0.53	0.78	0.00	6.00		1.27	
ln(total loan, cons 2012 prices)	409	7.13	5.17	0.00	13.87		10630	6.66	4.83	0.00	15.88	11040	6.67	4.84	0.00	15.88		1.07	
ln(savings, cons 2012 prices)	409	5.85	4.62	0.00	13.65		10629	5.14	4.45	0.00	14.03	11039	5.17	4.45	0.00	14.03		1.14	
Proportion of households with at least one international migrant member	409	24.90	21.03	0.00	90.00		10631	11.23	15.21	0.00	100.00	11041	11.73	15.67	0.00	100.00		2.22	
Proportion of households with at least one internal migrant member	409	20.71	14.07	0.00	65.00		10631	23.29	15.54	0.00	100.00	11041	23.20	15.49	0.00	100.00		0.89	
HH income decile (monthly exp at lag1, cons 2012 prices)	409	6.54	2.65	1.00	10.00		10631	5.36	2.85	1.00	10.00	11041	5.40	2.85	1.00	10.00		1.22	

Source: author's estimation based on BIHS datasets (2012, 2015, 2018).

Table 2. Dynamic Probit model: Who becomes a new migrant? Marginal Effects

(Dependent variable: New migrant dummy at the household level)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
New migrant dummy in lag 1	-0.3404**	-0.3736**	-0.3736**	-0.3786**	-0.3824**	-0.3603**	-0.3795**
	(0.1712)	(0.1747)	(0.1747)	(0.1768)	(0.1759)	(0.1754)	(0.1729)
Whether the household had any migrants in 2012, the base year	0.3345***	0.3878***	0.3878***	0.4129***	0.3886***	0.3888***	0.3882***
	(0.1261)	(0.1295)	(0.1295)	(0.1317)	(0.1299)	(0.1296)	(0.1301)
HH years in education	0.0334*	0.0356*	0.0356*	0.0364*	0.0359*	0.0333	0.0351*
	(0.0202)	(0.0207)	(0.0207)	(0.0207)	(0.0209)	(0.0204)	(0.0208)
Square of HH education	-0.0085***	-0.0078***	-0.0078***	-0.0077***	-0.0078***	-0.0077***	-0.0078***
	(0.0017)	(0.0018)	(0.0018)	(0.0017)	(0.0018)	(0.0017)	(0.0018)
Female highest education in lag 1	-0.0093	0.0053	0.0053	0.0086	0.0047	0.0050	0.0048
	(0.0095)	(0.0097)	(0.0097)	(0.0101)	(0.0098)	(0.0097)	(0.0098)
Male highest education in lag 1	0.0893***	0.0619***	0.0619***	0.0540***	0.0615***	0.0625***	0.0621***
	(0.0103)	(0.0109)	(0.0109)	(0.0111)	(0.0110)	(0.0110)	(0.0110)
Total international migrant proportion in lag 1 at village	0.0213***	0.0219***	0.0219***	0.0222***	0.0219***	0.0220***	0.0220***
	(0.0020)	(0.0021)	(0.0021)	(0.0022)	(0.0021)	(0.0021)	(0.0021)
Total internal migrant proportion in lag 1 at village level	-0.0040*	-0.0032	-0.0032	-0.0031	-0.0032	-0.0034	-0.0032
	(0.0022)	(0.0022)	(0.0022)	(0.0023)	(0.0022)	(0.0022)	(0.0022)
2 nd Decile (monthly exp) at lag1 at the village	-0.1139	-0.1595	-0.1595	-0.1737	-0.1600	-0.1645	-0.1714
	(0.2618)	(0.2724)	(0.2724)	(0.2769)	(0.2727)	(0.2719)	(0.2741)
3 rd Decile (monthly exp) at lag1 at the village	0.1775	0.1558	0.1558	0.1456	0.1582	0.1607	0.1533
	(0.2825)	(0.2908)	(0.2908)	(0.2929)	(0.2910)	(0.2886)	(0.2919)
4 th Decile (monthly exp) at lag1 at the village	0.3237	0.2998	0.2998	0.2739	0.3029	0.3062	0.2854
	(0.2600)	(0.2694)	(0.2694)	(0.2729)	(0.2695)	(0.2700)	(0.2703)
5 th Decile (monthly exp) at lag1 at the village	0.4306	0.4143	0.4143	0.3926	0.4171	0.4192	0.4015
	(0.2782)	(0.2903)	(0.2903)	(0.2941)	(0.2896)	(0.2908)	(0.2916)
6 th Decile (monthly exp) at lag1 at the village	0.5184*	0.4888*	0.4888*	0.4657*	0.4943*	0.4991*	0.4801*
	(0.2664)	(0.2755)	(0.2755)	(0.2789)	(0.2754)	(0.2770)	(0.2765)
7 th Decile (monthly exp) at lag1 at the village	0.5151*	0.4933*	0.4933*	0.4615	0.4981*	0.5076*	0.4842*
	(0.2683)	(0.2815)	(0.2815)	(0.2850)	(0.2813)	(0.2811)	(0.2828)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
8 th Decile (monthly exp) at lag1 at the village	0.7402***	0.7242***	0.7242***	0.7001**	0.7356***	0.7295***	0.7135**
	(0.2693)	(0.2801)	(0.2801)	(0.2833)	(0.2799)	(0.2804)	(0.2812)
9 th Decile (monthly exp) at lag1 at the village	0.6914**	0.6639**	0.6639**	0.6363**	0.6650**	0.6946**	0.6509**
	(0.2740)	(0.2839)	(0.2839)	(0.2864)	(0.2840)	(0.2863)	(0.2854)
10 th Decile (monthly exp) at lag1 at the village	0.8143***	0.7915***	0.7915***	0.7601**	0.7947***	0.8098***	0.7768***
	(0.2875)	(0.2997)	(0.2997)	(0.3020)	(0.2996)	(0.3003)	(0.3010)
year_18	0.4906***	0.4856***	0.4856***	0.4871***	0.4867***	0.5052***	0.4789***
	(0.0732)	(0.0745)	(0.0745)	(0.0755)	(0.0747)	(0.0768)	(0.0748)
The proportion of working-age males in the HH lag 1		0.0120***	0.0120***	0.0171***	0.0121***	0.0118***	0.0121***
		(0.0021)	(0.0021)	(0.0028)	(0.0021)	(0.0021)	(0.0021)
Under 15 dummy in lag 1				0.2321**			
				(0.0952)			
Elderly dummy in lag 1				0.2681***			
				(0.0881)			
Number of members with a disability					0.0449		
					(0.0375)		
Ln(total loan in lag 1 in constant 2012 prices)						-0.0203*	
						(0.0122)	
Ln(total savings in lag 1 constant 2012 prices)							0.0155
							(0.0124)
Observations (N)	9208	9208	9208	9206	9208	9208	9202

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: the table does not include the dependent variables for each year due to brevity.

Source: author's estimation based on BIHS datasets.

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**Resilience of Higher Education Students
during the COVID-19 Pandemic**

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Abstract

The coronavirus pandemic has caused unprecedented disruption to various sectors of the social systems around the world. The young population has faced important challenges not only in education, but also in their economic situation. The transition to online education, as well as the reduction of the workforce, changed the lives of young people in an unprecedented way. The current paper analyses micro-data collected from higher education students through a global survey during the coronavirus pandemic. Our results show that many young people have adapted well to the new teaching and learning experiences. On the other hand, a high number of higher education students experienced permanent or temporary job loss or salary cuts. The resilience of students has been fostered by the possession of digital skills. Moreover, negative experiences during the pandemic were associated with greater worries with respect to their future education and career. Our results highlight the importance of developing digital skills and providing support services in order to increase the resilience of young people facing crisis.

Keywords: higher education, COVID, pandemic, resilience, students.

JEL Classification: P46, O15.

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1. Introduction

The coronavirus pandemic has caused unprecedented disruption in various domains. Among the most significantly impacted by this crisis was the young population, who faced important challenges not only in education, but also in its economic situation. The rapid shift to online learning due to extensive school closure has generated considerable challenges for students, spanning from technological obstacles, given that they had to adapt to new platforms and technologies (often without access to necessary resources or adequate support) to the absence of face-to-face interactions with classmates and teachers. At the same time, the economic downturn triggered by the pandemic has resulted in extensive layoffs, leaving numerous young individuals uncertain about their job opportunities and financial security. The dual challenge of managing remote education and facing economic instability has reshaped the lives of young people, highlighting the necessity for comprehensive support to meet the challenges.

In this context, the objective of the paper is to assess the impacts of the COVID-19 pandemic on students' educational and professional life and to identify resilience factors that acted as protective mechanisms in front of such impacts.

This paper follows the structure: Section 1 introduces the topic and outlines the aim of the research. Section 2 presents literature review, providing findings from various studies that investigated the impact of the pandemic on young individuals with respect to education and labour market participation. Section 3 presents the research questions, while section 4 provides the data and the statistical methods that are used in this paper. Section 5 presents the empirical results of the analysis, while the concluding section summarises the most important findings of the study.

2. Problem Statement

The COVID-19 pandemic, a global health crisis of unprecedented scale, has impacted numerous countries, influencing various components of social systems. The younger population has faced the higher repercussions, encountering challenges in multiple domains. Unprecedented disruption of education systems, as well as job losses, income reduction, and a decline in the quality of employment, were the main ways through which this crisis impacted young individuals (Lee et al., 2020).

The COVID-19 pandemic has caused unprecedented disruption to education systems, impacting nearly 1.6 billion learners across over 190 countries, school closure and other learning spaces shutdown affecting 94% of the global student population, rising to 99% in low and lower middle-income countries (United Nations, 2020). Millions of students have been forced to study from home, but the shift to online education caused significant disruptions in academic activities due to several factors, such as unequal access to technology, network issues, inadequate facilities, digital divide, poor digital skills, and lack of training (Onyema et al., 2020). These challenges can be categorised into two main groups: technical issues, such as limited internet access, affecting less than 15% of students in western Europe and America, but up to approximately 80% in Africa, and skill-related problems,

including insufficient digital skills for both students and teachers (Buda & Czékman, 2021). These issues favoured significant learning setbacks, exacerbating both intergenerational and intragenerational inequalities, while also worsening gender disparities in the labour market (ILO, 2022). Moreover, findings from a study investigating the career decision-making process revealed a lack of support from teachers or other school staff in terms of guidance and advice regarding career, during online education (Jemini-Gashi & Kadriu, 2022). A further consequence of the new way of learning has been discovered by another study which has shown that, during remote learning, young adults exhibited either increased independence or indifference, as the reduction or partial elimination of school structures and coordinated actions led to a lack of commitment (Egger & Huber, 2022).

On the other hand, the transition from school to work has been challenged during this period, as the pandemic impacted vulnerable groups such as students and graduates seeking employment. Early career workers have encountered difficulties in securing employment due to the scarcity of job opportunities amidst the pandemic (Konle-Seidl & Picarella, 2021). According to ILO (2021), entering the job market during a recession can have long-lasting effects on young people's employment prospects, that can lead to significant long-term earnings losses, but also to increase competition for fewer jobs in the years ahead. Moreover, a study conducted on this matter revealed that the transition from school to work in Italy has been significantly prolonged due to the COVID-19 pandemic (Fiaschi & Tealdi, 2022).

Likewise, young people who were employed at the onset of the COVID-19 pandemic also experienced greater hardships compared to other age groups due to the fact that they are predominantly employed in sectors that have been severely affected, notably accommodation, food services and personal care services (Wilson & Papoutsaki, 2021). In the EU-27 member states, job losses affected 1.1 million individuals aged 15-24 and 1.02 million aged 25-29 between the fourth quarter of 2019 and the first quarter of 2021, with youth employment declining by 2.2 percentage points compared to a 1.4 percentage point decrease in the overall employment rate for the age group 20-64 (Konle-Seidl & Picarella, 2021). Nevertheless, significant disparities emerged between individuals with different levels of education, primarily attributed to the capacity of educated individuals to work remotely, given that individuals with a college degree fared considerably better during the pandemic compared to those with no university education, largely due to their ability to work remotely (Goldin, 2022). Some studies suggest that increased participation in education has contributed to maintaining a stable number of young people outside education or work overall (Wilson & Papoutsaki, 2021; Williams et al., 2021). For example, youth participation in full-time education has risen in the UK to its highest rate on record (48%, compared with 43% before the crisis began), while the youth employment rate has fallen (53%, compared with 55% before the crisis began), being nearly 200,000 more young people in education and not looking for work than before pandemic (Williams et al., 2021).

However, while the pandemic had notably affected young people negatively, it had also brought some opportunities for them. One example is related to online

education, which has resulted in enhanced digital and problem-solving skills (Buda & Czékmán, 2021). Furthermore, the accelerated digitalisation prompted by this crisis has also led to increased job flexibility through remote or home-based work, a trend that has persisted beyond the pandemic-imposed restrictions. On the other hand, the emerging digital economy holds significant potential for enhancing youth employment, productivity, and the quality of job prospects, but effective policy interventions are essential to ensure the transformation of this potential into tangible opportunities for decent work, thereby addressing existing inequalities (ILO, 2022).

In this context, the present paper aims to explore the impacts of COVID-19 pandemic on students' educational and professional life, as well as resilience factors that acted as protective mechanisms in front of such impacts.

3. Research Questions

Addressing the objective of the paper, our research questions are as follows:

- Q1: Which is the profile of students who had been more resilient to changes in the teaching and learning environment amid the COVID-19 pandemic?
- Q2: Which students had their jobs affected by the pandemic?
- Q3: Have the difficulties experienced by students been associated with an increased level of concern with respect to their future education and career?

4. Research Methods

This research relies on the data gathered in May-June 2020 via a worldwide survey focusing on the impact of the COVID-19 pandemic on the life of university students. The questionnaire included inquiries regarding transition to online education, economic situation, and how students coped with experienced challenges. The database can be found on the data.mendeley website (Aristovnik et al., 2021). The current analysis covers 10 European countries (Bosnia and Herzegovina, Croatia, Germany, Greece, Hungary, Italy, Poland, Portugal, Romania and Slovenia), including a total of 10,432 higher education students (32% males and 68% females). Most of the students (around 70%) were enrolled in bachelor's degree programmes, while 26% pursued master's degrees and 4% were Ph.D. students. The average age of the participants was of 23 years.

After descriptive statistical analysis, we perform ordinal regression to identify predictors for well-adaptation of students to new teaching and learning experience. Independent variables are the characteristics of the students and their proficiency with respect to digital skills. No multicollinearity issues have been identified. Also, we apply multinomial logistic regression to reveal the profile of students affected by job loss or salary cuts. In addition, we conduct correspondence analysis to investigate the relation between well-adaptation in education and negative emotions with respect to future education or career.

5. Findings

Students were asked to rate their agreement with the following statement: "I have adapted well to the new teaching and learning experience". More than half of the participants stated that they succeeded to adapt well to the new teaching and learning experience. Conversely, one in five respondents disagrees with this assertion (including those who responded with disagreement and full disagreement).

Table 1. Well adaptation to the new teaching and learning experience

Levels of agreement	Percent
Strongly disagree	5.2%
Disagree	14.7%
Neutral	23.7%
Agree	39.6%
Strongly agree	16.9%
Total	100%

Source: authors' own research results.

The results of the ordinal regression show that the older students have been more resilient in front of challenges of the new teaching and learning experience amid pandemic. On the other hand, no significant variation has been found in relation to the student status or the level of study. Concerning the field of education, we found that social sciences students adapted better to the new education reality than natural and life sciences students. Also, female students have been more well adapted in this matter than male students. In addition, our result shows that the lack of digital skills reduced the resilience of students in relation to the new teaching and learning experience. Of significance has been the proficiency in using online teaching platforms, using online collaboration platforms, using software and programmes, and applying advanced settings to some software and programmes.

Table 2. Ordinal regression on “Well adaptation to the new teaching and learning experience” (1= Strongly disagree...5= Strongly agree)

	Estimate	Std. Error	Wald	df	Sig.	95% Conf. Int.	
						LB	UB
Age	0.015	0.006	7.113	1	0.008	0.004	0.027
Citizen of the country in which you study (ref.=No)							
Yes	0.185	0.099	3.501	1	0.061	-0.009	0.38
Status (ref.=Part-time)							
Full-time	-0.054	0.105	0.267	1	0.605	-0.259	0.151
Level of study (ref.=PhD)							
Bachelor	-0.079	0.181	0.192	1	0.662	-0.434	0.276
Master	0.044	0.181	0.058	1	0.810	-0.312	0.399

	Estimate	Std. Error	Wald	df	Sig.	95% Conf. Int.	
						LB	UB
Field of study (ref.=Natural and life)							
Arts and humanities	-0.032	0.104	0.097	1	0.755	-0.235	0.171
Social sciences	0.216	0.071	9.366	1	0.002	0.078	0.355
Applied sciences	0.084	0.082	1.038	1	0.308	-0.077	0.245
Gender (ref.=Female)							
Male	-0.125	0.059	4.38	1	0.036	-0.241	-0.008
Skilled in browsing online information (ref.=Agree)							
Disagree	-0.388	0.21	3.417	1	0.065	-0.800	0.023
Neutral	-0.102	0.105	0.947	1	0.331	-0.307	0.103
Skilled in sharing digital content (ref.=Agree)							
Disagree	-0.283	0.15	3.572	1	0.059	-0.577	0.010
Neutral	-0.238	0.086	7.587	1	0.006	-0.408	-0.069
Skilled in using online teaching platforms (ref.=Agree)							
Disagree	-0.482	0.097	24.852	1	0.000	-0.671	-0.292
Neutral	-0.176	0.071	6.175	1	0.013	-0.314	-0.037
Skilled in using online collaboration platforms (ref.=Agree)							
Disagree	-0.421	0.145	8.435	1	0.004	-0.704	-0.137
Neutral	-0.200	0.09	4.978	1	0.026	-0.376	-0.024
Skilled in using online communication (ref.=Agree)							
Disagree	-0.365	0.231	2.495	1	0.114	-0.817	0.088
Neutral	-0.412	0.127	10.575	1	0.001	-0.661	-0.164
Skilled in using software and programs (ref.=Agree)							
Disagree	-0.672	0.133	25.358	1	0.000	-0.934	-0.410
Neutral	-0.317	0.082	14.864	1	0.000	-0.479	-0.156
Skilled in advanced settings to software and programs (ref.=Agree)							
Disagree	-0.455	0.088	26.626	1	0.000	-0.628	-0.282
Neutral	-0.140	0.068	4.21	1	0.040	-0.273	-0.006

Note: Model Fitting Information Chi-Square Sig.0.000; Goodness-of-Fit Pearson Sig. 0.310, Deviance Sig. 1.000; Pseudo R-Square Cox and Snell 0.107, Nagelkerke 0.114.

Source: authors' own research results.

The impacts on employment have been investigated through the following question: “If you have been working or plan to work, has this paid job been affected by the COVID-19 pandemic?”. On the one hand, 11.9% and 10.4% of the students reported being permanently laid off or experiencing a reduction in their wage. 30.8% of the students have been affected by temporary job loss and 30.6% of students remained unaffected and continued to work.

Table 3. Have you been affected by the pandemic at work?

	Percent
Yes, I have lost the job permanently	11.9%
Yes, I have lost the job temporarily	30.8%
Yes, I have had a salary cut	10.4%
No, the job ended before the COVID-19 crisis	16.3%
No, I am still working	30.6%
Total	100%

Source: authors' own research results.

The results of the multinomial logit regression suggest that older students have been less affected by job loss, while full-time students had higher chances to lose their job (permanently or temporarily) than part-time students. Also, bachelor and master students had much higher chances to be affected by job loss than PhD students. Concerning the field of education, we found that arts and humanities students have lost more their jobs than natural and life sciences students. No significant differences have been found between male and female students. On the other hand, students who were not proficient in using online communication and in applying advanced settings to some software and programmes registered higher chances of losing their jobs than skilled students. Conversely, students who were skilled in using software and programmes were more affected by job loss than non-skilled students. With respect to the chances of being affected by salary cuts, we found that full-time students were less vulnerable, while arts and humanities students were more exposed to this negative impact. Digital skills register a lower power of prediction in this case. However, we found that students skilled in sharing digital content were more exposed to salary cuts than non-skilled students.

Table 4. Multinomial logit regression on “Have you been affected by the pandemic at work?” (reference category = no change)

	Job loss (permanently or temporarily)		Salary cut	
	Sig.	Exp(B)	Sig.	Exp(B)
Age	0.000	0.936	0.822	1.002
Citizen of the country in which you study (ref.=No)				
Yes	0.730	0.944	0.725	1.097
Student status (ref.=Part-time)				
Full-time	0.009	1.492	0.010	0.628

	Job loss (permanently or temporarily)		Salary cut	
	Sig.	Exp(B)	Sig.	Exp(B)
Level of study (ref.=PhD)				
Bachelor	0.000	4.815	0.313	1.45
Master	0.000	4.452	0.225	1.567
Field of study (ref.=Natural and life)				
Arts and humanities	0.001	1.770	0.043	1.724
Social sciences	0.115	1.198	0.124	1.336
Applied sciences	0.946	0.991	0.508	1.157
Gender (ref.=Female)				
Male	0.063	0.836	0.953	1.009
Skilled in browsing online information (ref.=Agree)				
Disagree	0.825	1.076	0.123	2.089
Neutral	0.454	1.142	0.080	1.557
Skilled in sharing digital content (ref.=Agree)				
Disagree	0.864	1.042	0.048	0.435
Neutral	0.609	0.928	0.638	0.903
Skilled in using online teaching platforms (ref.=Agree)				
Disagree	0.384	0.868	0.548	1.154
Neutral	0.559	0.934	0.751	1.058
Skilled in using online collaboration platforms (ref.=Agree)				
Disagree	0.805	1.058	0.880	1.049
Neutral	0.023	1.395	0.896	0.971
Skilled in using online communication (ref.=Agree)				
Disagree	0.050	2.073	0.478	1.461
Neutral	0.176	0.756	0.236	0.692
Skilled in using software and programs (ref.=Agree)				
Disagree	0.022	0.608	0.126	1.618
Neutral	0.077	0.785	0.014	1.643
Skilled in advanced settings to software and programs (ref.=Agree)				
Disagree	0.000	1.845	0.945	0.983
Neutral	0.003	1.382	0.301	1.197

Note: Model Fitting Information Chi-Square Sig.0.000; Pseudo R-Square Cox and Snell 0.098, Nagelkerke 0.115.

Source: authors' own research results.

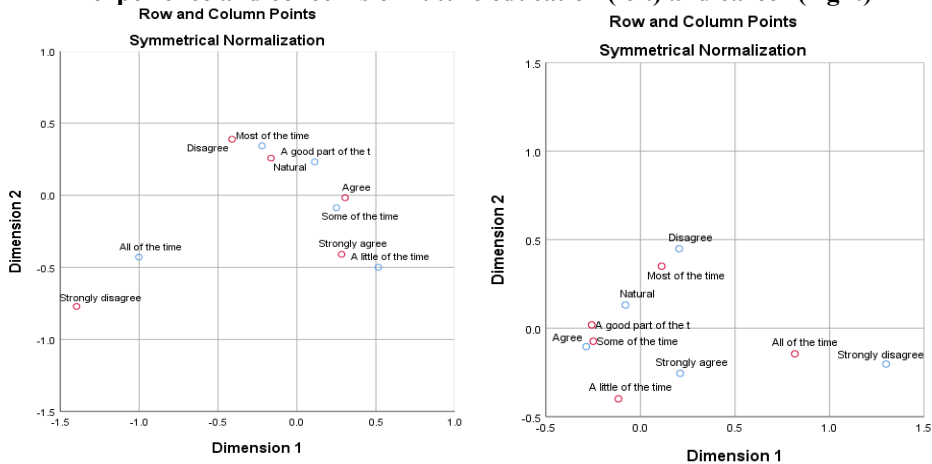
The emotional well-being of students has been investigated through the following question: "How often do you have worries about the following personal circumstances?" Data indicate that there were similar levels of concern for either future education or professional career. Most students worried "a good part of the time", followed by "some of the time" and "most of the time". Overall, the students were quite concerned about their future education and professional career. In fact, results of correspondence analysis suggest that the poor resilience to new learning experience is associated with a higher level of worries on future education and professional career.

Table 5. How often do you worry about your future education, respectively your future professional career?

	Future education (%)	Future career (%)
A little of the time	13.6%	11.7%
Some of the time	25.8%	22.4%
A good part of the time	27.2%	27.9%
Most of the time	21.9%	23.2%
All of the time	11.5%	14.7%
Total	100%	100%

Source: authors' own research results.

Figure 1. Correspondence analysis between well adjustment to new educational experience and concerns on future education (left) and career (right)



Source: authors' own research results.

6. Conclusions

Our results show that most higher education students have adapted well to the new teaching and learning experiences amid the pandemic. On the other hand, a high number of students experienced permanent or temporary job loss or salary cuts. The

resilience of students has been fostered by the possession of digital skills. Our results highlight the importance of developing digital skills and providing support services in order to enhance resilience and emotional well-being of young people facing crisis.

Based on our findings, several policy recommendations for educational institutions and governments can be formulated. First, the objectives of developing basic digital skills need to be embedded in primary and secondary educational programmes. Second, optional courses for skills of using online teaching platforms, online collaboration platforms, and applying advanced settings to specialised software and programs can be provided to higher education students or adult learners. Thus, the development of digital skills has to be targeted by higher education programmes across all study fields. Third, support and counselling services for students facing difficulties and anxiety during challenging periods are essential for enhancing resilience and coping mechanisms that are needed in increasingly changing environments.

The limitations of the study are related to the cross-sectional design of our data and to the fact the sample was based on the availability and willingness of the students to participate in the survey. Therefore, our results must be understood as an association relation between digital skills and the resilience of students. Future work will employ a multilevel model, exploring supportive factors at national or institutional level.

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**Sustainable Development through Green Innovations:
Economic Strategies of China and the EU Compared**

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Abstract

The paper examines the economic strategies of China and the European Union in promoting sustainable development through green innovations. Sustainable development, essential for economic growth, environmental protection, and social equity, necessitates the adoption of environmentally friendly technologies and practices. Numerous studies have explored these concepts separately, but only some have compared the economic strategies of major players like China and the EU, which account for about 1/3 of global GDP. The comparative analysis methodology was used to investigate the economic strategies of China and the EU, including insights from government policies and key sectors targeted for green innovation. Research questions concern the effectiveness of these strategies in promoting sustainable development and the differences in approaches between China and the EU. The results reveal significant disparities in their approaches and impact on the way to the development of green economies. China leans towards top-down government interventions and investments, while the EU emphasises regulatory frameworks and collaborative efforts focusing on bottom-up initiatives. Both global actors grapple with balancing economic growth and environmental sustainability. Statistical data underscores the burgeoning growth of industries embracing green innovations, with the global market for green technology reaching \$13.7 billion in 2022. While the development of Industry 4.0 is a common feature of both economies, their specialisations differ, so the need for further cooperation and exchange of goods remains. The paper also explores the impact of green innovations on industry competitiveness, showing that companies investing in environmentally friendly technologies gain market share. These findings underscore the importance of the country's strategies and international cooperation to tackle global environmental challenges. The paper offers a benchmarking of China and the EU's economic strategies for promoting sustainable development through green innovations. By synthesising the existing literature and providing insights into their differing approaches, it contributes to a better understanding of the effective strategies for global sustainable development.

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JEL Classification: Q55, Q56, Q58, O57.

1. Introduction

China has become a world-fast growing leader in green technology, dominating sectors such as wind, solar, hydropower, lithium batteries, and electric vehicles. Chinese companies, often state-backed, are major players in these industries or the supply chains that support them. On the other hand, the EU has been putting forward ambitious strategies to sustain global leadership through innovations, especially green innovations. It is trying to combine high value-added investments within the EU and relatively lower technology transfer to less developed countries.

These two regions are key for the global economy from ecological and economic points of view even though they have rather different models and strategies of development. Both are moving towards Industry 4.0 and support principles of sustainable development. This calls for an important task to compare them to define the fields where they could cooperate and where to compete.

The participation in international sustainable frameworks (Task Force on Climate-Related Financial Disclosures, Partnership for Carbon Accounting Financials, Carbon Disclosure Project, Principles for Responsible Investment, World Business Council For Sustainable Development, IFC's Sustainability Framework and Equator Principles) and standards (Global Reporting Initiative, European Sustainability Reporting Standards, Financial Accounting Standards Board, International Financial Reporting Standards, International Accounting Standards Board, OECD Guidelines for responsible business conduct) also is quite uneven for the EU and China on their way to net zero.

Climate change conferences in Kyoto (1997), Copenhagen (2009), Paris (2015), Glasgow (2021) call for the growth of nations' inputs into reduction of CO² and other GHG emissions.

2. Problem Statement

We support the idea outlined by Kivimaa and Kern (2016) that in the times of the transition to the values of sustainable development, green and digital transformations, innovation systems act as engines of creative destruction. Incremental innovations may dramatically impact the structure of the global economy, the relationships between key players, and thus change the global economic order.

It is vital to address the actors and factors of sustainable development to solve the global ecological problem through green innovations. The EU and China are responsible for 1/3 of global greenhouse gas emissions which puts them among key polluters, so their input will impact the whole global ecosystem. Differences in national models of green innovations lead to asymmetric impact on nature,

so they should be investigated in the together with the best practices which should to be shared.

3. Aims of the Research

The purpose is to conduct a comprehensive comparative analysis of the economic strategies employed by China and the EU in promoting sustainable development through green innovations. By examining government policies, initiatives, and key sectors targeted for green innovations, as well as main results on the way in both regions, the article aims to identify differences and similarities in their strategic approaches. Through this analysis, the article seeks to assess the effectiveness of these strategies in achieving sustainable development goals and to highlight their implications for global environmental challenges.

4. Research Methods

The study uses a mixed-methods approach to analyze green innovation strategies in the EU and China. It uses a literature review, content analysis, and bibliometric analysis to understand the topic comprehensively. The literature review covers academic publications, policy documents, and reports on green innovations in the EU and China, using databases like Eurostat, OECD, WIPO, the SDG Transformation Center, the Global Green Growth Institute, SCOPUS, and SCImago. The bibliometric analysis extracts publications related to green innovation, while the content analysis identifies common themes, strategies, and outcomes. The comparative analysis compares the effectiveness of green innovation strategies in the EU and China, using key indicators like publications, patents, investments in green technologies, and outcomes related to sustainable development goals. The case studies are selected to examine the EU and Chinese initiatives' objectives, implementation strategies, challenges, and outcomes.

5. Findings

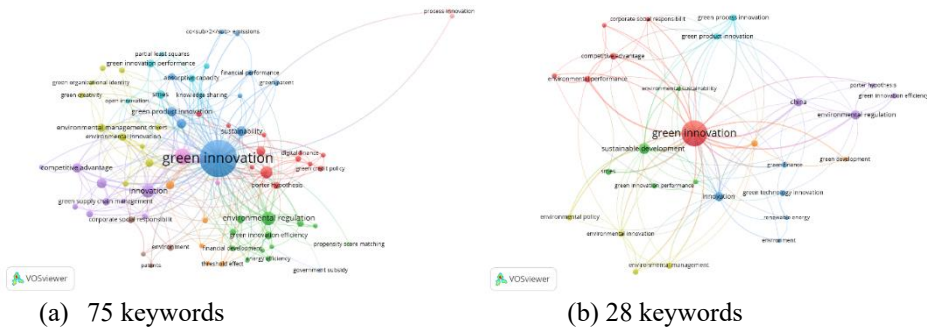
5.1 Literature Review

Strategies for green innovations in the EU and China vary in several dimensions, but the starting point is the research on the topic. Having built a word map of keywords of publications with “green innovation” we observe variety of related topics (Figure 1). Only one of the word clusters is heavily connected with China, others are more universal, while the EU is not among them at all. This is probably related to the fact that European researchers pay most of their attention to corporate level of analysis, while for China the most vital is state regulation and leadership. Although China outperforms the EU in the total number of publications with ecology problem and innovations, the key is in the field of their quality and impact.

Green and digital transformations have got different levels of maturity as factors of economic development of national economies. The study by Banelienė and Strazdas (2023) provides empirical evidence showing that green innovations have

a positive impact on economic growth in the EU unlike the absence of valid correlation between digitalisation and growth. Their key findings highlight the importance of focusing on the development of green innovation not only for reducing the impact of climate change but also as a strategic direction for increasing competitiveness and economic growth.

Figure 1. Word map of keywords of publications with “green innovation” in the Scopus database



Source: Created by the authors with VOSviewer and data from the Scopus database.

The state's steering capacity in promoting sustainability goals through green innovation programmes faces significant obstacles, including vague overall goals and a lack of emphasis on sustainability within policy networks. The research conducted by Eckerberg et al. (2023), critically examines the implementation of the EIP-AGRI programme in Sweden, highlighting challenges in promoting “green innovation” for sustainability within the agricultural sector. The study underscores the importance of enhancing evaluation processes to assess societal outcomes and long-term environmental impacts of innovation initiatives, emphasising the need for clearer policy goals and stronger collaboration with relevant expertise in the field of sustainability transition.

The role of government is crucial since it creates a formal way for sustainable development. The study conducted by Kwilinski et al. (2023) investigated the influence of greenfield investment on green economic growth in European Union countries, utilising the Malmquist-Luenberger Global Productivity Index and the Tobit model. By incorporating both desirable (GDP) and undesirable (environmental emissions) outputs in the assessment of green economic growth, the research sought to address a gap in existing methodologies. The findings highlight the importance of promoting greenfield investment through innovative projects and policy interventions to facilitate the transition towards a more sustainable and environmentally conscious economy in the EU.

Green innovations and eco-innovation efforts have led to improved resource efficiency outcomes, such as material and energy productivity, and positive

socioeconomic outcomes, including increased exports and employment in environmental sectors. According to the European Environment Agency (EEA, 2023), the European Green Deal's ambitious goals have driven a steady increase in eco-innovation in the EU, highlighting its crucial role in achieving sustainable development objectives. By examining the roles of natural gas and oil imports in EU countries amidst the backdrop of the Russia-Ukraine war, the study conducted by Zhijie et al. (2023), highlights the vital importance of transitioning to cleaner energy sources to foster sustainable growth and prevent negative climate change. The findings underscore the need for policy interventions to accelerate the energy transition and promote green innovation in response to the challenges posed by energy dependencies and geopolitical conflicts.

When it comes to large companies the valuable insights into green innovation, emphasising the need for organisations to address environmental challenges through sustainable practices are disclosed at study made by Chavira et al. (2023). The benefits of green innovations in enhancing corporate performance and competitiveness, underscoring the importance of managerial concern, and the use of digital tools in driving successful green initiatives. Markets and industries vary by the maturity of sustainability. So, green innovations in the aviation industry, exemplified by initiatives like the SAGE programme, have led to significant reductions in CO₂ emissions from commercial aircraft, contributing to sustainable development by mitigating the industry's impact on climate change. According to Smith (2016), these innovations have also spurred technological advancements, influenced regulatory changes, and emphasised the importance of strategic business approaches to support the adoption of environmentally friendly technologies in aviation.

On the other hand, the study of semiconductor industry role in the development of green innovations revealed that semiconductors contribute significantly to sustainable development through green innovations (Hsieh et al., 2023). Companies like Taiwan Semiconductor Manufacturing Company Limited (TSMC) and Intel have committed to renewable energy goals to support sustainable practices. They play a crucial role in many industries – advancing green energy, promoting health monitoring, improving environmental technologies, and addressing industrial wastewater challenges. These findings highlight the potential of the semiconductor industry to drive sustainable practices and align with the Sustainable Development Goals.

Green innovation and sustainability are constantly in the focus of the Chinese leaders, which is due to the rapid development of the manufacturing industry in the country and the environmental effect that was caused. Even in the Chinese economic model Huang et al. (2021) identified the impact mechanism of marketisation and local government competition on green innovation efficiency in China, bridging the research gap by exploring the roles of the market and the government in driving sustainable development through technological innovation. It was revealed that local government competition not only directly inhibits green innovation efficiency but also hinders the promotional effect of marketisation, shedding light on the complex

dynamics of government actions and market forces in green innovation development. Investigating the impact of green investment on sustainable development in China, with a focus on promoting sustainable consumption and production patterns Li and Wang (2023) revealed that green investment plays a crucial role in enhancing production efficiency, reducing energy consumption and environmental pollution, ultimately leading to more inclusive and sustained production patterns. It leads us to the conclusion that increasing green investment can drive technological innovation, improve pollution control and energy-saving technologies, as well as foster breakthroughs in cultivating sustainable consumption and production patterns.

Being the leader in the search for green innovations the EU faces the challenge of lack of comparative studies with key competitors leading to possible global gaps. For instance, Dima et al. (2022) investigated bioeconomy in the European countries only. While we must admit that there are some researchers in the field, like comparative study of green organisational identity and sustainability in China and Portugal (Lopes Cancela et al., 2023). Our research is one of the few attempts to make these gaps shorter.

5.2 EU's Green Innovation Efforts

The European Green Deal is the key strategy for developing green economy in the EU, which is supported by wide variety of sectoral strategies and plans. These include, universal (Strategic plan 2020-2024 for research and innovation, Horizon Europe programme for 2021-2027, Circular Economy Action Plan) and sectoral strategies (transport – Sustainable and Smart Mobility Strategy, Zero-Emission Vehicles Strategy and Fit for 55 Package till 2030; food and natural ecosystems – Farm to Fork Strategy and Biodiversity Strategy till 2030; social & regional cohesion – NextGenerationEU, Just Transition Mechanism, skills development programmes, social inclusion initiatives; energy – REPowerEU, Renovation Wave Initiative; new industrialisation – EU Industrial Strategy).

Various sectors play an important role in the realm of green innovations. Energy is one of the most valuable. That was the reason why the European Strategic Energy Technology Plan had been adopted in 2008 for the period till 2030. In 2023 the EU announced plans to make it fit the strategies of European Green Deal, REPowerEU and policy within Energy Efficiency Directive.

Many spheres remain under strategic administration by national governments. For instance, although the EU waste policy is an important part of European Green Deal, it is still within the competence and autonomy of national and regional governments.

Most of modern EU strategies stand on the results of “A Sustainable Europe for a Better World: A European Union Strategy for Sustainable Development” which had been adopted in 2001. Changes in greening strategic priorities start to bring results. That is why the findings of the European Climate Neutral Industry Scoreboard suggest that the EU creates more than half of global high-value inventions in four technologies: permanent magnets, wind rotors, biomethane, heating and cooling networks (Kuokkanen et al., 2023).

There were about 25% of European Inventor Awards winners who worked in the field of green innovations in the EU from 2006 to 2020 (Vimalnath et al., 2020). They tend to choose closed and semi-open IP, particularly non-exclusive licensing, to drive green innovations in the EU while in China the IP commercialisation market depends on governmental strategic choices. We should admit that in recent years there have been some changes in this field as China started to implement a new IP commercialisation strategy (Zhang et al., 2017). However, as we know this sector dramatic changes take decades to happen.

5.3 Chinese Green Innovation and Sustainable Development Policy

In 1979, the People's Republic of China passed the Environmental Protection Law (SCNPC, 1979) and the first steps towards environmental protection were taken at the legislative level. In 2008, the Circular Economy Promotion Law of the People's Republic of China (SCNPC, 2008) was adopted, entering into force on January 1, 2009. The purpose of this law is to promote the efficient use of resources, environmental protection, and sustainable development. According to the legislation, the new industrial policy must meet the criteria of the circular economy. With the law, the government encourages research and development, as well as international scientific cooperation on closed-loop economy issues. The 12th Five-Year of the People's Republic of China for 2011-2015 encompassed several green energy development tasks. These included reducing energy consumption, promoting the extraction of alternative energy, and gradually establishing a carbon market. The initiative fostered the growth of a low-carbon economy. In 2013, the Circular Economy Development Strategy and Short-Term Action Plan (SC PRC, 2013) was adopted, which defined three levels of the circular economy: within the enterprise, industrial park, city, and province. According to the Action Plan, the coal industry should be improved in five aspects: "green" mining, comprehensive exploitation and utilisation of coal, energy conservation and reduction of consumption, environmental protection, and construction of industrial networks. In the 13th Five-Year Plan of the People's Republic of China 2016-2020, the circular economy was one of the key areas focused on ecosystem development and environmental protection. During this five-year period, the plan aimed to achieve several objectives: the implementation of the cyclical development management plan, the promotion of the implementation of closed-loop processes at industrial enterprises, and the creation of waste disposal demonstration areas (Khomeiko (Drobotiuk), 2018). It is important to note that a key difference between the European and Chinese concepts of circular economy lies in their focus. The European approach concentrates on business opportunities to minimise waste and transform it into a resource. In contrast, the Chinese approach is broader, encompassing pollution, industrial eco-parks, ecological civilisation, and waste and resource management challenges (Kemp et al., 2019).

In 2015, the strategy "Made in China 2025" was adopted. Its implementation is aimed at advancing manufacturing industries towards smart, green, and service-oriented development. The focus lies on strengthening potential for innovation

and basic competitiveness in key sectors such as next-generation information technology, modern equipment, new materials, and biomedicine (SC PRC, 2017).

In 2016, according to the UN Global Sustainable Development Goals, the Chinese government adopted China's National Plan for Implementation of the 2030 Agenda for Sustainable Development. The plan emphasises compliance with the main national policy of resource conservation and environmental protection, following a civilised path of development that ensures a higher level of production and quality of life. The goal is “green” development based on a low-carbon economy, as well as solving the problem of climate change and protecting the ecological system through a system of “green” technological innovations.

The green development and innovation are among the key priorities for the medium-term perspective in the 14th Five-Year Plan (2021-2025) for National Economic and Social Development and the Vision 2035 of the People’s Republic of China (14thFYP, 2021). Prioritising the ecology and pursuing green development, the Chinese government promotes “overall resource management, scientific allocation, comprehensive conservation, and recycling, and coordinates efforts to drive high-quality economic development and high-level ecological environment protection” (14thFYP, 2021).

5.4 Comparison of Effectiveness in Promoting Sustainable Development Through Green Innovations

The European Green Deal and Horizon Europe programmes prioritise sustainability and innovation, these policy frameworks target for reducing greenhouse gas emissions, promoting renewable energy, and fostering sustainable consumption and production. China has implemented several policies aimed at promoting green innovation, including its 13th and 14th Five-Year Plans and the Made in China 2025 strategy, which emphasise technological upgrading and environmental protection. In the implementation of sustainable development policies, the European Union employs a combination of regulatory measures, economic incentives, and public-private partnership mechanisms to promote green innovations. Notably, the Chinese policy features state intervention (top-down directives) and state initiatives that include subsidies and incentives for the development of green innovations.

The success of the efforts by the European Union and China in ensuring sustainable development through green innovations is demonstrated by the Sustainable Development Goals Index (SDGI). According to the SDGI (Sachs et al., 2023), European Union countries hold leading positions in achieving sustainable development goals (SDG). China has also made significant progress in implementing policies aimed at achieving sustainable development goals, especially before the Covid-19 pandemic. In 2019, China ranked 39th and improved its scores by 14.1 points compared to 2016. However, post-pandemic, China has not yet fully recovered its positions, while EU countries continue to lead (see Table 1). The major challenges for both EU countries and China remain in achieving the following Sustainable Development Goals: SDG2: No Hunger; SDG12: Responsible

Consumption and Production; SDG13: Climate Action. Success has been achieved by the majority of EU countries and China in implementing the goal of SDG1: No Poverty.

Table 1. Changes in the Sustainable Development Goals Index in the EU and China

Country	2016		2019		2023	
	Score	Rank	Score	Rank	Score	Rank
Finland	81.0	4	82.8	3	86.8	1
Sweden	84.5	1	85.0	2	86.0	2
Denmark	83.9	2	85.2	1	85.7	3
Germany	80.5	6	81.1	6	83.4	4
Austria	79.1	7	81.1	5	82.3	5
France	77.9	11	81.5	4	82.0	6
Czech Rep.	76.7	15	80.7	7	81.9	8
Poland	69.8	38	75.9	29	81.8	9
Estonia	74.5	21	80.2	10	81.7	10
Croatia	70.7	36	77.8	22	81.5	12
Slovenia	76.6	17	79.4	12	81.0	13
Latvia	72.5	28	77.1	24	80.7	14
Spain	72.2	30	77.8	21	80.4	16
Ireland	76.7	14	78.2	19	80.1	17
Portugal	71.5	34	76.4	26	80.0	18
Belgium	77.4	12	78.9	16	79.5	19
Netherlands	78.9	8	80.4	9	79.4	20
Hungary	73.4	24	76.9	25	79.4	22
Slovak Rep.	72.7	26	76.2	27	79.1	23
Italy	70.9	35	75.8	30	78.8	24
Greece	69.9	37	71.4	50	78.4	28
Luxembourg	76.7	16	74.8	34	77.6	33
Romania	67.5	41	72.7	42	77.5	35
Lithuania	72.1	31	75.1	32	76.8	37
Malta	72.0	32	76.1	28	75.5	41
Bulgaria	71.8	33	74.5	36	74.6	44
Cyprus	66.5	45	70.1	61	72.5	59
China	59.1	76	73.2	39	72.0	63

Source: compiled by the authors based on Sachs et al. (2016, 2019), Sachs et al. (2023).

The EU is one of the global leaders in investing in renewable energy sources and clean technologies. In 2022, the EU’s environmental protection expenditures accounted for 0.8% of GDP (€130 billion) (Eurostat, 2022). The EU directs its investments toward research and development in areas such as renewable energy, energy efficiency, and circular economy solutions (as indicated in Table 3). This commitment is reflected in the number of patents (Table 2) and publications (Table 3) in these fields.

China increases investments in green technologies, including public expenditures on energy conservation and environmental protection that accounted for 0.45% of GDP (541.3 billion yuan) in 2022 (Statista, 2024). Additionally, China subsidises industries such as solar and wind energy, and invests in electric vehicles and battery technologies. By the end of 2022, China became the largest producer of solar energy

with an installed capacity of 393 GW, surpassing the EU’s capacity of 205 GW (Venditti, 2024).

Table 2. Input into global sustainable technology patents

Green technologies	Number of patents, units		Grand total	Global share, %		EU-China gap, times
	EU	China		EU	China	
transportation	8229	1899	25542	32.2%	7.4%	4.3
energy	15228	3754	56650	26.9%	6.6%	4.1
water	698	249	3329	21.0%	7.5%	2.8
farming & forestry	3265	998	13171	24.8%	7.6%	3.3
pollution & waste	5515	1093	17906	30.8%	6.1%	5.0
product, materials & processes	2957	685	11503	25.7%	6.0%	4.3
building & construction	4326	1563	13537	32.0%	11.5%	2.8
All types	36752	9566	129677	28.3%	7.4%	3.8

Source: authors calculations based on WIPO GREEN Database of Innovative Technologies and Needs as of May 1st, 2024.

Analysing the indicators of sustainable development policy implementation through green innovations in the EU and China, we can conclude that Northern European countries have a relatively high share of employment in green production and patent publications related to environmental technologies, indicating a strong emphasis on green innovations. Germany and Austria also demonstrate ecological sustainability, with a high proportion of employment in green production and significant funding allocated to green technologies. The indicators for the Czech Republic and Poland suggest the involvement in innovations in the field of environmental technologies, as evidenced by their high share of patent publications in this area. However, there is a significant gap among EU countries, with Greece and Malta showing relatively lower indicators compared to others. China leads in the highest number of publications in Environmental Science. The indicators for China suggest a minor lag in the share of employment in green manufacturing and the allocation of funding for green technologies.

Table 3. Performance indicators of Promoting Sustainable Development through Green Innovations

Country	Share of green manufacturing employment in total manufacturing employment (%)	Share of patent publications in environmental technology to total patent (%)	Share of export of environmental goods to total export (%)	Total amount of funding to promote environmentally sound technologies per GDP, (%)	Number of publications in Environmental Science, units
Finland	0.112	12.99	7.37	0.04	2301
Sweden	0.075	12.21	6.80	0.04	4090
Denmark	0.127	21.95	7.96	0.06	2911

Country	Share of green manufacturing in total manufacturing employment (%)	Share of patent publications in environmental technology to total patent (%)	Share of export of environmental goods to total export (%)	Total amount of funding to promote environmentally sound technologies per GDP, (%)	Number of publications in Environmental Science, units
Germany	0.134	13.32	12.34	0.06	12146
Austria	0.097	13.96	9.34	0.06	2168
France	0.074	12.54	5.80	0.03	7905
Czech Rep.	0.133	11.59	10.12	0.12	2323
Poland	0.092	9.03	6.10	0.07	5102
Estonia	0.076	3.30	6.91	0.09	472
Croatia	0.079	2.73	3.75	0.05	829
Slovenia	0.099	9.18	6.44	0.10	634
Latvia	0.068	11.90	3.58	0.04	407
Spain	0.087	10.94	3.89	0.02	10092
Ireland	0.018	6.29	1.73	0.01	1251
Portugal	0.070	6.71	7.37	0.04	3832
Belgium	0.069	8.43	4.45	0.06	3019
Netherlands	0.081	9.52	4.96	n.a.	5217
Hungary	0.092	6.95	8.40	0.15	1197
Slovak Rep.	0.102	11.75	7.72	n.a.	769
Italy	0.096	9.63	9.12	n.a.	10245
Greece	0.053	7.10	3.08	0.02	2360
Luxembourg	0.020	10.21	6.81	0.03	174
Romania	0.076	7.22	11.73	0.05	1469
Lithuania	0.058	6.91	6.21	0.07	601
Malta	0.012	7.57	3.81	0.02	116
Bulgaria	0.074	12.41	4.37	0.05	607
Cyprus	0.046	16.59	1.80	0.01	440
China	0.074	8.73	6.07	0.02	105988

Source: compiled by the authors based on the Green Growth Index (2022) and SJR (2023).

6. Conclusions

Our comparative analysis of the economic strategies employed by China and the EU in the field of green innovations has recovered that both global players have put systematic efforts to support sustainable development. Researchers from these two regions make considerable input into international knowledge base by research papers and patents. While making this research authors had permanent feeling that countries concentrate on their competitiveness in policies, initiatives, and key sectors targeted for green innovations more than sustainable development goals.

Benchmarking of EU and Chinese strategies has demonstrated differences in approaches and levels of effectiveness in promoting sustainable development through green innovation. The leading role of government in China gives little space for manoeuvre for local bodies, while in the EU strategies serve as guiding star to national governments which are responsible within national borders for the input into reaching SDGs with uneven successfulness. The EU's approach is focused on public-private partnerships, while in China, the role of the state is of leading importance.

Although the EU takes the lead in green patents in transportation, energy, water, farming & forestry, pollution & waste, product, materials & processes, building & construction pushing them into Industry 4.0, for both global actors the weak side is international cooperation and transfer of technologies.

Both the EU and China have made significant progress in promoting green innovation and sustainable development. This is evidenced by the leading positions of the EU and China in the development of alternative energy, the introduction of green innovations in production, and the development of the circular economy. However, challenges remain for both the EU and China in achieving sustainable development goals, particularly in areas such as climate change and responsible consumption and production.

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The Worldwide Progress of SDGs.

Depicting the Yearly Hot Topics, using Language Processing

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Abstract

The Sustainable Development Goals have become indispensable for the international agenda since their official launch in 2015. Corroborated, the publication of the yearly SDG reports represents a candid focal point for the gained progress, as long as a clear depiction of the global challenges, resources, and knowledge. Thus, in the 2016-2023 period, eight annual reports have been published, containing more than 500 content pages. Starting from those, we aim to design an explorative analysis framework, through the computation of several language processing techniques from the family of text mining, and sentiment analysis. Our objective will be to identify the top-level hot topics of every year, while also pinpointing certain temporal dynamics in terms of new or recurrent subjects, international threats, or social-economic discourse elements. Deep-diving into the methodological instruments, the analysis will be based on a mix of techniques, starting from the illustration of the most common terms and collocations. Afterward, we will apply the Term Frequency-Inverse Document Frequency algorithm to highlight the importance of several words relative to the entire collection of documents, with a focus on the evolutive dimension. Going forward, we will evaluate the sentiment scores for each report, to assess whether in certain moments the general tone of the conversation has switched to a more negative or positive valence. Throughout the applicative section, we will present the results through several graphical visualisations meant to better profile the connections between concepts. Finally, we consider the current approach to be valuable for understanding the general evolutions in terms of sustainable development, creating a summative and computational-based exploration of the progress generated worldwide in the last decade.

Keywords: Sustainable Development Goals, Language Processing, Text Mining, Sentiment Analysis, TF-IDF.

JEL Classification: Q01, Q56, F53.

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1. Introduction

The Sustainable Development Goals (SDGs) could be described as a constant hot topic on the international agenda, ever since their official launch in 2015. Designed as a fundamental instrument of the Sustainable Development Pillar, the goals have become the centrepiece for understanding the global context, with a critical focus on the multiple shortages and risks that have appeared throughout the last decade. However, assessing the international status quo is not an easy task, so along with the 17 official SDGs, a great deal of data, research, and expertise has been put forward by individual experts, representatives of the related literature, and linked institutions. To get a glimpse of the volumes, as of May 2024, according to the official SDGs website³, there were 169 targets, almost 4.000 events, and over 1.300 publications on the subject, with the numbers increasing daily.

As part of those publications, one of the most important will be the *SDG Progress Report*, presented every year by the UN Secretary-General. The goal behind it is simple: highlight in a concise and documented way the evolution towards the targets, while also raising awareness on the urgency needed to reach a more sustainable future. However, even though these publications will be as brief as possible, when studying the entire period, the volume of information is undoubtedly increasing, making it more difficult to identify certain temporal dynamics and more subtle insights. Thus, our approach is coming as an extension of the individually done research, completing the perspective with a language processing computation, meant to extract the most relevant conclusions in terms of word patterns, overall perceived sentiment, and the potential network, and interconnections found under the *development* umbrella.

2. Problem Statement

Going forward to the research framework, as mentioned in the introduction, our main source of data will be represented by the SDG progress reports from the last eight years, more specifically the period 2016-2023. Thus, in the applicative section, we will study these publications as both individual components, as well as in conjunction, merged together to form a new text entry. However, before proceeding to the computational part, it can be useful to get a glimpse of their structure.

Each of the SDG reports will start by presenting a foreword section, aimed at summarising certain trends and dynamics in the current international state of affairs. In the more recent reports, an emphasis on several crucial and urgent pillars will also be present, as well as an acknowledgment of the severe risks faced by humanity. Nevertheless, each report will focus on a summary of all 17 goals, based on the army of indicators behind them, ending with a closing statement, strengthening the main actions that need to be taken. Finally, each publication will be completed with visual summaries, valuable for a rapid skimming of the document.

Going back to our application, the first step we endeavoured was to extract the main idea from each report, an initial milestone in the process. The result can be

³ Retrieved from: <https://sdgs.un.org/goals>.

observed in Table 1, where we can find the reports' references, number of pages, and yearly simplified key points. As a methodological mention, the main ideas have been generated empirically, through observation.

Table 1. Description of the reports

Reference	Pag	Main Ideas
(UN DESA, 2016)	56	A starting point, with a focus on presenting each goal and the need for key milestones and frequent evaluation going forward.
(UN DESA, 2017)	64	Progress is visible, however not equitable, being uneven among different demographics. A bolder vision is needed to meet the SDG targets.
(UN DESA, 2018)	40	Emphasising the need for immediate and accelerated action, with a reflection on the global challenges. A focus on the disadvantaged groups.
(UN DESA, 2019)	64	Climate change is defined as the most urgent area for action, along with inequality, poverty hunger, and diseases. The exploration of the interlinkages across goals and the opportunities to accelerate progress.
(UN DESA, 2020)	68	The effects of the COVID-19 pandemic, which could generate transformative pathways in turbulent times. A need for data innovations.
(UN DESA, 2021)	68	The continuation of the pandemic and its toll on the society and economy. A focus on vaccines, global solidarity, and a commitment to a multidimensional, inclusive recovery.
(UN DESA, 2022)	68	Interlinked global crises: the pandemic, a fragile economic recovery, the war in Ukraine, and climate change. A focus on a sustainable and urgent rescue effort.
(UN DESA, 2023)	80	The age of poly-crisis. A special edition that presents a vision of hope, highlighting the progress and the potential for further advancements.

Source: authors' own processing, based on the mentioned references.

After a quick understanding of the general message of each report, the next step was to turn to the related literature, in the effort of finding similar papers that employed language processing tools. Thus, we have found several articles that used text-mining methods to analyse specific goals or processes, for example, climate change (Hwang et al., 2021) or the global sustainable development concept (Roy et al., 2022). Regarding sentiment analysis, an interesting approach has been designed by Shen et al. (2021) in the exploration of social media for SDGs, however, the comparability with our approach will be limited.

Therefore, we can consider the current paper as a valuable contribution to the related field, adding an element of novelty through the methodology and the correlation with the SDG reports. At the same time, it can be seen as a continuation of previous authors' work (Pernici et al., 2023).

3. Research Methods

Relating to the research methodology, we will split our analysis into two sections. The first one will be text mining, through the use of several instruments, such as identifying the most common words, collocations, and measuring the TF-IDF frequencies. The second one will focus on sentiment analysis, through the computation of the sentiment scores and exploring certain word valences. Both of the sections will be described theoretically going forward.

Before proceeding, there is one last step that needs to be described, namely the preprocessing stage. Therefore, we will first ensure the curation of our datasets, through the removal of the numbers, punctuations, special characters, and stopwords from each of the eight individual texts. Next, the data frames will be tokenised, or in other words, reduced to an easy-to-process format made out of singular elements. With this new format, we will go forward with the application of the language processing methods, using a Python environment.

3.1 Text Mining

For the first family of methods, we will start with the illustration of *the most common words*. In this stage, we will also focus on graphical representations, especially through the form of *word clouds*, for each of the eight SDG reports. Afterward, we will continue with the exploration of the *collocations*, or the combinations of words that are frequently found together throughout the text. In this step, we will design a network graph meant to better highlight the conceptual connections. To complete the picture, we will also employ a frequently used measure in language processing, the TF-IDF, explained in detail below.

Term Frequency-Inverse Document Frequency (TF-IDF)

The *TF – IDF* is a popular technique used to determine the relative contribution of one word in correlation with an entire corpus of documents. Thus, there will be three main elements that together compose the *TF – IDF* scores. The first one will be the *term frequency (TF)*, or the number of instances of a given word *t*, in a document *d*, while the second one will be the *document frequency (DF)*, which will count the number of occurrences of the word *t* in the document set *N* (1). Going forward, the third element will be the *inverse document frequency (IDF)*, which will assess the number of documents in the corpus separated by the frequency of the text. Regarding this last element, it is important to mention that the *IDF* scores will be processed with a base 2 logarithm to reach the final values (2).

$$TF(t, d) = \frac{\text{count of } t \text{ in } d}{\text{number of words in } d}, \quad DF(t) = \text{occurrence of } t \text{ in } N = N(t) \quad (1)$$

$$IDF(t) = \frac{N}{DF(t)} \Rightarrow IDF(t) = \log\left(\frac{N}{DF(t)}\right) \quad (2)$$

Thus, the method will ultimately be a weighting system that assigns a weight to each word based on its term frequency (*t*) and the reciprocal document frequency. As a last step in the computation, the *TF – IDF* scores will be calculated (3).

$$TF - IDF(t, d) = TF(t, d) * IDF(t) \quad (3)$$

3.2 Sentiment Analysis

Reaching our second part of the paper, the sentiment analysis, here the focus will be on extracting the sentiment scores, at both a document and word level. Therefore,

using the *VADER* lexicon in Python, we will be able to identify the general tone of voice in each SDG report, assess whether in time these publications have become more positive or negative, and extract the most significant results at an individual term level. In terms of methodology, the application will start from the tokenised format, search, and find each token in the specific lexicon and their adjacent sentiment value, and finally aggregate the total sentiment scores.

4. Findings

4.1 Text Mining

Most common words

Discussing now the first results, namely the illustration of the most common words in each year, it is important to mention that before arriving at a conclusive illustration, we have eliminated plenty of words from the tokenised dataset. This decision was made considering their significance, many of them being usual words that do not bring extra value (for example *percent, dollars, many*), or terms that are evident for the subject at hand (for example *sustainable, development, action*).

Therefore, the first method in which we chose to illustrate the most common words is shown in Table 2, where we can find the top 25 frequent terms for the period 2016-2019 (after the curation step), along with the absolute and relative frequencies. What is important to mention here is the fact that we have kept the geographical terms as well, considering them valuable for understanding several dynamics.

Table 2. Most common words – absolute and relative frequency – 2016-2019

2016		2017		2018		2019	
Asia	219 - 1.6%	Asia	242 - 1.1%	Water	91 - 0.7%	Asia	167 - 0.9%
Africa	116 - 0.9%	Africa	210 - 1%	Asia	77 - 0.6%	Africa	151 - 0.8%
Children	61 - 0.5%	America	158 - 0.7%	Africa	70 - 0.6%	America	94 - 0.5%
Subsaharan	57 - 0.4%	Subsaharan	129 - 0.6%	Access	62 - 0.5%	Subsaharan	93 - 0.5%
Women	52 - 0.4%	Women	104 - 0.5%	Energy	50 - 0.4%	Water	81 - 0.4%
Water	51 - 0.4%	Children	92 - 0.4%	America	44 - 0.3%	Women	75 - 0.4%
America	51 - 0.4%	Europe	90 - 0.4%	Subsaharan	43 - 0.3%	Children	72 - 0.4%
Growth	48 - 0.4%	Latin	76 - 0.4%	Sanitation	38 - 0.3%	Access	67 - 0.4%
Caribbean	48 - 0.4%	Caribbean	74 - 0.3%	ODA	37 - 0.3%	Health	60 - 0.3%
Latin	47 - 0.2%	Zealand	71 - 0.3%	Women	34 - 0.3%	Poverty	55 - 0.3%
Access	43 - 0.3%	Water	70 - 0.3%	Use	33 - 0.3%	Climate	55 - 0.3%
Oceania	43 - 0.3%	Growth	70 - 0.3%	Urban	32 - 0.3%	Growth	50 - 0.3%
Urban	41 - 0.3%	Australia	70 - 0.3%	Forest	32 - 0.3%	Resources	50 - 0.3%
Energy	40 - 0.3%	Oceania	70 - 0.3%	Consumption	29 - 0.2%	Australia	49 - 0.3%
GDP	33 - 0.2%	Access	65 - 0.3%	Growth	29 - 0.2%	Zealand	49 - 0.3%
Caucasus	33 - 0.2%	Poverty	61 - 0.3%	Implementation	28 - 0.2%	Energy	47 - 0.3%
Health	30 - 0.2%	Health	59 - 0.3%	Management	28 - 0.2%	Latin	46 - 0.3%
Risk	29 - 0.2%	Urban	56 - 0.3%	Agenda	27 - 0.2%	Europe	45 - 0.2%
Deaths	29 - 0.2%	Deaths	53 - 0.2%	Policies	27 - 0.2%	Caribbean	42 - 0.2%
Marine	29 - 0.2%	Energy	43 - 0.2%	Resources	27 - 0.2%	Oceania	39 - 0.2%
Poorest	28 - 0.2%	Marine	42 - 0.2%	Living	25 - 0.2%	Use	37 - 0.2%
LDCS	28 - 0.2%	Climate	40 - 0.2%	Health	25 - 0.2%	Income	35 - 0.2%
Resources	27 - 0.2%	Education	38 - 0.2%	Material	25 - 0.2%	Public	34 - 0.2%
Education	26 - 0.2%	Girls	38 - 0.2%	LDCS	24 - 0.2%	Policies	33 - 0.2%
Food	26 - 0.2%	Risk	37 - 0.2%	Support	24 - 0.2%	GDP	33 - 0.2%

Source: authors' own processing.

Thus, a first insight that prevails is the high volume of *Asia* and *Africa* occurrences, a fact, however, that is due to the way the UN is mapping the regional groupings, with a higher segmentation in these two continents. Regarding the conceptual words, we can observe that in the first years, the focus was put on *children*, *women*, and *water access*, while some important other concepts also make an appearance: *sanitation*, *ODA*, *energy*, *marine*, and *education*.

When reaching the 2020-2023 period (Table 3), we can determine that *COVID* and the *pandemic* terms have naturally become one of the most used notions. Corroborated, we can see the *health* dimension as being prevalent, along with the *crisis* term. Interestingly, in 2023, the most used concept has become *climate*, while *energy* has also climbed some steps, a fact that could be interpreted as a new priority at the global level. Last but not least, *Ukraine* has been identified as entering the top 25 most common words in 2022, due to the aggression happening on its territory.

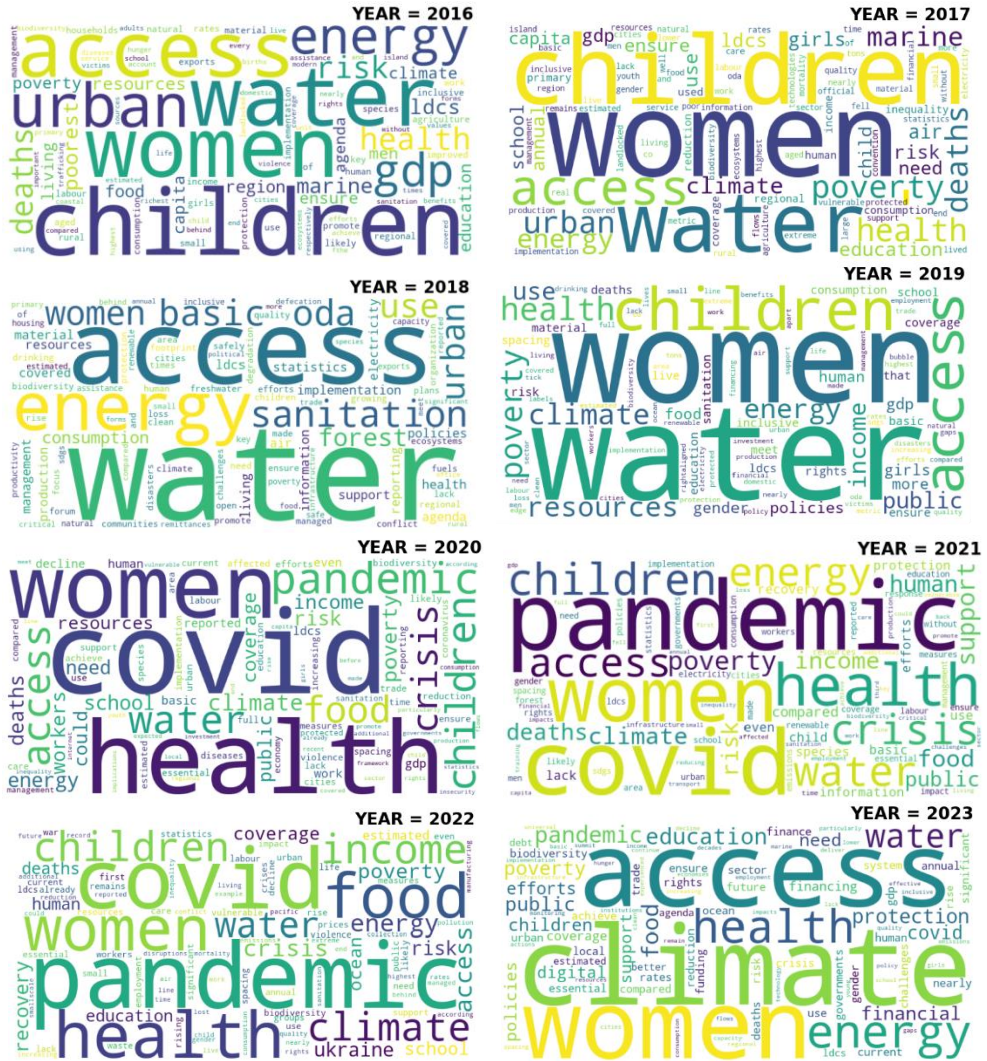
Table 3. Most common words – absolute and relative frequency – 2020-2023

2020		2021		2022		2023	
COVID	158 – 0.7%	Pandemic	168 – 0.8%	Pandemic	140 – 0.6%	Asia	158 - 0.6%
Asia	149 – 0.7%	COVID	152 – 0.7%	Asia	139 – 0.6%	Africa	131 - 0.5%
Africa	139 – 0.6%	Asia	143 – 0.7%	COVID	118 – 0.5%	Climate	110 - 0.4%
Health	117 – 0.5%	Africa	120 – 0.6%	Africa	104 – 0.5%	Access	102 - 0.4%
Women	92 – 0.4%	Women	103 – 0.5%	America	95 – 0.4%	America	99 - 0.4%
Pandemic	91 – 0.4%	Health	98 – 0.5%	Health	93 – 0.4%	Women	91 - 0.3%
America	88 – 0.4%	America	97 – 0.5%	Women	86 – 0.4%	Energy	87 - 0.3%
Subsaharan	79 – 0.4%	Children	72 – 0.3%	Food	83 – 0.4%	Health	81 - 0.3%
Children	78 – 0.4%	Water	66 – 0.3%	Children	77 – 0.4%	Water	76 - 0.3%
Water	73 – 0.3%	Crisis	66 – 0.3%	Income	77 – 0.4%	Growth	71 - 0.3%
Access	73 – 0.3%	Subsaharan	63 – 0.3%	Climate	71 – 0.3%	Pandemic	70 - 0.2%
Food	65 – 0.3%	Energy	60 – 0.3%	Water	59 – 0.3%	Food	69 - 0.2%
Crisis	61 – 0.3%	Access	60 – 0.3%	Energy	55 – 0.3%	Subsaharan	69 - 0.2%
Growth	60 – 0.3%	Zealand	51 – 0.2%	Access	53 – 0.2%	Education	67 - 0.2%
Climate	57 – 0.3%	Poverty	50 – 0.2%	Crisis	51 – 0.2%	Protection	67 - 0.2%
Poverty	48 – 0.2%	Europe	50 – 0.2%	Growth	51 – 0.2%	Public	62 - 0.2%
Latin	48 – 0.2%	Australia	49 – 0.2%	Latin	50 – 0.2%	Poverty	61 - 0.2%
Australia	47 – 0.2%	Support	46 – 0.2%	Europe	48 – 0.2%	Financial	57 - 0.2%
Zealand	46 – 0.2%	Latin	46 – 0.2%	Caribbean	48 – 0.2%	Europe	57 - 0.2%
Energy	45 – 0.2%	Caribbean	44 – 0.2%	Subsaharan	46 – 0.2%	COVID	55 - 0.2%
Risk	44 – 0.2%	Climate	42 – 0.2%	Poverty	44 – 0.2%	Children	53 - 0.2%
School	43 – 0.2%	Income	41 – 0.2%	Zealand	41 – 0.2%	Efforts	50 - 0.2%
Deaths	43 – 0.2%	Food	41 – 0.2%	Australia	40 – 0.2%	Caribbean	49 - 0.2%
Europe	43 – 0.2%	Human	39 – 0.2%	Ukraine	38 – 0.2%	Latin	48 - 0.2%
Caribbean	42 – 0.2%	Risk	37 – 0.2%	Risk	38 – 0.2%	Policies	47 - 0.2%

Source: authors’ own processing.

Next, in order to better illustrate the most frequent sustainability topics, we have chosen to design several word clouds, one for each year of analysis. However, this time we chose to eliminate the geographical terms, so the representation could better profile the status quo. Thus, throughout Figure 1, we can see the confirmation of the insights generated before, namely the clear focus on *children*, *women*, and *water* elements in the period 2016-2019, followed by the appearance of *COVID*, *pandemic*, *health*, *energy*, and *climate* dimensions starting in 2020.

Figure 1. Wordcloud 2016 (left) – 2017 (right)



Source: authors' own processing.

Term Frequency-Inverse Document Frequency (TF-IDF)

Going forward, to study more in-depth the evolution of certain concepts throughout the years, we will proceed with the computation of the TF-IDF scores. Therefore, in Table 4 we can find the final scores for a selection of concepts related to sustainability. From an interpretation point of view, the words that show a higher value will be the more frequent ones in that year's report, however, rare across the entire corpus. The colored cells will show the peaks for each concept. Therefore, we can note that more recently, words such as *food*, *climate*, *education*, *digital*, *technology*, *crisis*, *recovery*, or *war* have increased their values, gaining more significance in the overall context.

Table 4. TF-IDF Scores – selection of words - 2016-2023

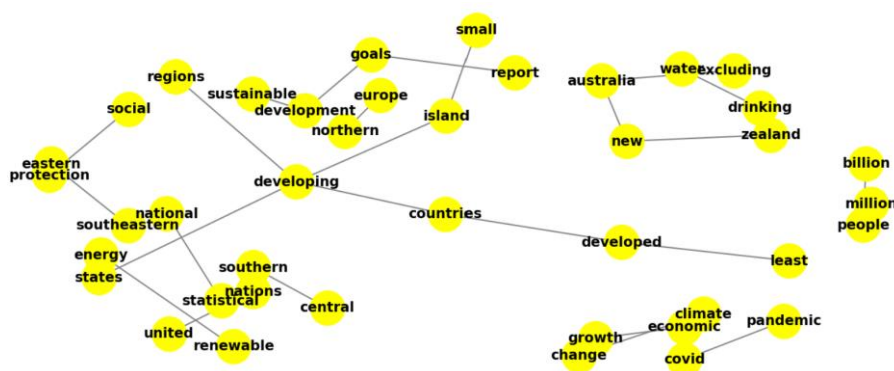
Term/Year	2016	2017	2018	2019	2020	2021	2022	2023
Children	0.14	0.15	0.06	0.14	0.12	0.11	0.12	0.07
Women	0.12	0.17	0.10	0.15	0.15	0.16	0.14	0.13
Water	0.12	0.11	0.28	0.16	0.12	0.10	0.09	0.11
Energy	0.09	0.07	0.15	0.09	0.07	0.09	0.09	0.12
Health	0.07	0.09	0.08	0.12	0.19	0.15	0.15	0.11
Deaths	0.07	0.09	0.02	0.05	0.07	0.06	0.06	0.05
Marine	0.07	0.07	0.03	0.03	0.03	0.02	0.03	0.04
Food	0.06	0.03	0.04	0.06	0.10	0.06	0.13	0.10
Pandemic	0.00	0.00	0.00	0.00	0.23	0.41	0.36	0.16
Climate	0.06	0.06	0.05	0.11	0.09	0.06	0.11	0.16
Education	0.06	0.06	0.03	0.05	0.04	0.04	0.06	0.09
Poverty	0.06	0.10	0.04	0.11	0.08	0.08	0.07	0.09
Digital	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.07
Technology	0.01	0.02	0.01	0.01	0.00	0.01	0.02	0.04
Ukraine	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.04
Income	0.04	0.04	0.03	0.07	0.06	0.06	0.12	0.04
Crisis	0.01	0.00	0.00	0.01	0.11	0.11	0.09	0.06
Recovery	0.00	0.00	0.00	0.00	0.03	0.06	0.07	0.04
War	0.00	0.00	0.00	0.00	0.01	0.00	0.06	0.02
Economy	0.01	0.00	0.01	0.01	0.04	0.03	0.01	0.01

Source: authors’ own processing.

Collocations

Regarding the collocations, we decided to illustrate a Bigrams network graph, aimed at highlighting the most common linkages of words. Therefore, the computation has been done using the entire corpus of documents, since the yearly differences did not vary considerably. The result is visible in Figure 2.

Figure 2. Collocation Network Graph, the entire corpus



Source: authors’ own processing.

In terms of interpretation, one can observe several clusters of words, for example, the geographical one, the one that links the development adjectives to certain spatial units (*states, countries, regions*), as well as several individual collocations (*covid-pandemic, renewable-energy, drinking-water, united-nations*).

4.2 Sentiment Analysis

Finally, regarding the computation of the sentiment analysis application, we have used the *VADER* lexicon in Python to identify the overall scores for each progress report. Thus, in Table 5 we can see sentiment scores for each year, along with a classification into positive, negative, and neutral words.

Table 5. Sentiment Scores and distribution of words

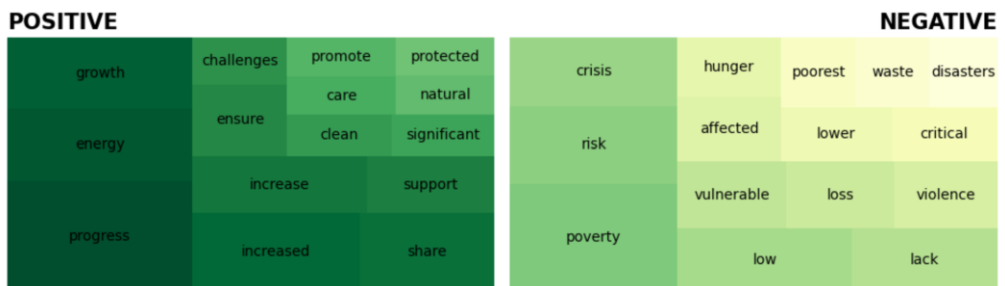
Year	Sentiment Scores	Number of positive words	Number of negative words	Number of neutral words
2023	314.5	2.161	1.096	23.415
2022	-23.2	1.319	1.156	18.031
2021	96.3	1.376	937	18.013
2020	61.5	1.421	1.063	17.716
2019	175.9	1.342	686	15.271
2018	176	939	377	10.580
2017	194.6	1.424	773	17.785
2016	138.7	915	442	11.227

Source: authors' own processing.

Therefore, what we can note is that most of the documents will have a generally positive tone of voice, with the exception of 2022, which will register the only negative value. This is explained by a variety of factors, correlated with the leitmotiv of the report, namely, the *road map out of crisis*. Thus, multiple factors have played a role in the overall negative valence, such as the pandemic, natural disasters, pollution, climate change, or the war context. What is interesting, however, is the fact that the number of negative words will be lower than the positive ones, so the explanation is coming from the intensity of the gloomy sentiment, with words such as *apocalyptic*, *catastrophe*, or *devastating* being between the most frequent terms. Nevertheless, the good news is coming from the 2023 publication, where we can observe the most positive sentiment score, a fact that is confirmed by the general objective of the report, namely the focus on the progress gained until now, and a hopeful plan for the future. To complete this insight, *success*, *rescue*, or *recovery* will be between the more positive words prevalent throughout the document.

Lastly, the sentiment exploration could be concluded by highlighting the most frequent positive and negative words in the collection of documents (Figure 3).

Figure 3. The most frequent positive and negative words in the entire corpus



Source: authors' own processing.

As a result, in Figure 3 we can see the top 15 positive and negative words, where the dimension of the figure represents the absolute frequency. Thus, in the positive category, we can see words such as *progress*, *increase*, *support*, or *care*, while in the negative group, we have found terms such as *poverty*, *risk*, *crisis*, and *vulnerable*.

5. Conclusions

In conclusion, we can consider the current approach as a starting point in understanding the dynamics shown in the SDG progress reports, one of the most conclusive publications for the international scene and the centrepiece of the sustainable development UN agenda. Through the use of both text mining and sentiment analysis, we have been able to explore some of the most important concepts of each year, starting from the children and women focus, and reaching towards climate, economic recovery, and building a more inclusive global community. At the same time, the urgency of action remains prevalent, with a general negative sentiment, however, recently sweetened by the progress registered at the half of the path towards 2030.

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Social and Environmental Commitment Across the Early and Established Stages of Entrepreneurial Activity

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Abstract

This study aims to explore the sustainable development awareness, priority, and commitment of adults engaged in early and established entrepreneurial activity. The study is based on the GEM dataset collected during 2023 through an adult population survey on a representative sample in Croatia. The results of the study indicate that the role of social and environmental commitments varies across different motivational orientations of entrepreneurially active adults. It confirms the evolution of motivational orientations and sustainability commitment along the different stages of entrepreneurial activity. Among established businesses whose motivation is either to make a difference in the world or to build great wealth there are more of those who always consider social implications while regarding steps toward the minimisation of environmental impact or the maximisation of social impact there are no differences. Also, more established businesses have taken actions towards SDGs. When we compare factors that influence the motivation to make a difference in the world, in early-stage businesses, important factors are the easiness and proactivity to start a business, the importance of high level of status of entrepreneurs and the steps to maximise the social impact of the business while in established businesses considering social implications and awareness of SDGs are the most important factors. This study contributes to a better understanding of the differences between new or established entrepreneurial activity and their commitment to sustainability which may be essential to the more successful promotion, adoption, or consolidation of sustainable entrepreneurship.

Keywords: SDGs, Social and Environmental Commitment, Early-stage entrepreneurial activity, Established businesses, Global Entrepreneurship Monitor.

JEL Classification: L26, Q56.

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1. Introduction

Sustainable entrepreneurship is considered as a new approach to developing entrepreneurial activities and is increasingly recognised as a solution for urging issues such as poverty, inequality, climate change, carbon emissions, global warming, and pollution. Sustainable entrepreneurs have been expected to be catalysts (Filser et al. 2019) or game changers (Vuorio, 2017) in the transition to sustainable development. Although the growing number of entrepreneurs are increasingly aware of the need to adopt sustainable goals, those who effectively influence sustainable development are still insufficient (Roomi et al., 2021). Several recent studies indicated the significant interaction between sustainable development and opportunity-driven entrepreneurial activity (Cervelló-Royo et al., 2020; Hudek & Bradač Hojnik, 2020). Not surprisingly, researchers (Muñoz & Dimov, 2015) attempting to explain sustainable entrepreneurial behaviour are explicitly emphasising the role of the motivations (such as the aspiration to make a change in the world) and values (i.e. prioritisation of the environmental or social goals) in starting or running sustainability-oriented ventures.

Sustainable entrepreneurship starts with the individuals who consider the social and environmental implications of their activities and are motivated to make a difference. Since indicators of sustainable entrepreneurship are still debated, there is only a sparse empirical evidence regarding the persistence of the sustainability commitment over specific motivational triggers for entrepreneurial engagement or over time (Fischer et al., 2018). In addition, it is still unclear what individual factors induce entrepreneurs to aspire to make a difference in the world. As a response to these gaps in the literature, this study aims to analyse the magnitude and manifestation of entrepreneurs' commitment to sustainability across different motivational orientations and along different stages of the entrepreneurial process. A better understanding of what drives sustainable development and how to enhance or sustain it is essential for more effective transition to the sustainable development agenda (UN, 2016).

2. Problem Statement

Sustainable entrepreneurship is focused on discovering, creating, and exploiting entrepreneurial opportunities that generate economic, social, and environmental values (Shepherd & Patzelt, 2011; Roomi et al., 2021, p. 4). Among studies attempting to explain sustainable entrepreneurial behaviour, the role of motivations is explicitly acknowledged in a number of studies (Fischer et al., 2018; Kummitha & Kummitha, 2021; Reuther et al., 2023;). Motivational orientation seems to be influenced among others, by personal factors such as gender, age, education, prior knowledge and experience, values, and goals (Fischer et al. 2018). Younger or more educated adults are more likely to have a sustainable entrepreneurial goal, whereas ageing or having lower education diminishes the odds of having a sustainable goal (Vuorio, 2017). Females are more likely to hold higher social goals than males (Hechavarría et al., 2017). Regarding psychological predictors, sustainability-oriented behaviour has been associated with sustainability commitment (Spence et

al. 2011), prior knowledge, desire to create value, or help others (Muñoz & Dimov, 2015), and lower aspirations to achieve high profits (Kirkwood & Walton, 2010). Individuals who prioritise freedom, self-expression and quality of life, are more likely to start sustainability-oriented ventures than those who prioritise material and economic security (Hechavarría et al., 2017). Fischer et al. (2018) investigated how motivation evolves along different stages of the sustainable entrepreneurship lifecycle. Sustainable entrepreneurs initially pursue the SDGs and start their ventures driven by a desire to solve social or environmental challenges. Later, as the venture matures, entrepreneurs recognise that they need to achieve financial stability to impact sustainable development (Harte et al., 2020). The higher sustainable commitment of the entrepreneurs appears to be inductive to higher innovativeness, growth expectations and exports, consequently leading to a higher national welfare (Neumann, 2023). However, sustainable entrepreneurship research acknowledges the insufficiency of the number of organisations or entrepreneurs that effectively balance economic, social, and environmental goals (Reuther et al., 2023). Therefore, exploring entrepreneurs' commitment to sustainability or finding which individual drivers contribute to the entrepreneurs' aspiration to make a difference in the world, appears to be a worthy avenue of research.

3. Aims of the Research

The main aim of this study is to offer new insights into the magnitude and persistence of entrepreneurs' commitment to sustainability across their motivational orientation and over time.

The GEM observatory (GEM, 2023) explores various types, stages, and motivational orientations of entrepreneurially active individuals. For example, Total Early-Stage Activity (TEA) indicates the engagement of adults (18-64 years old) in entrepreneurial activities not older than 3,5 years, whereas established business ownership (EBO) reflects those individuals who are engaged in owning or managing businesses more than 3,5 years old. In addition, GEM acknowledges heterogeneous motivational goals and aspirations related to engaging in entrepreneurial activity. Motivational orientations mapped through GEM research are: 1) to make a difference in the world; 2) to build great wealth or a very high income; 3) to continue a family tradition; and 4) to earn a living.

The GEM observatory (GEM, 2023) introduced a relatively new synthetic construct to measure sustainability commitment in 2021. This construct is composed of the seven items that capture consideration of social, and environmental implications, prioritisation of the social and environmental goals over profit, actions taken to minimise environmental damage or steps taken to maximise social gains of entrepreneurial actions, and SDGs awareness and actions toward these goals. Roomi et al. (2021) validated the importance of such a construct and pointed out that collecting empirical evidence from countries that are less represented in entrepreneurial research, and the addition of individual drivers of sustainable entrepreneurship, create valuable future research proposals for investigating sustainable entrepreneurship. As a response, this study uses Croatia as the case study for testing the available instrument to gain new insights in the magnitude and

alignment of the commitment to sustainability among new and established entrepreneurs.

Since motivational orientations and sustainable commitments may have strong mutual interactions that are relatively under-represented in the previous research, this study contributes to the existing literature by offering preliminary empirical evidence and insights on the differences in commitment across different motivational drives.

4. Research Methods

GEM uses an Adult Population Survey (APS) to annually collect data from a representative sample of adults (18-64 years) in each participating country. In 2023, a representative sample of 2000 adults in Croatia comprised 256 individuals who were engaged in owning or managing early-stage entrepreneurial activity (TEA), and 98 in established businesses ownership (EBO). Those sub-samples were used in this research. The variables analysed in this study, taken from the APS Croatia 2023 dataset, are described in Table 1.

Table 1. Description of the variables used in the research

Variable name	Variable description
GENDER	Gender of the respondents
AGE	Age of the respondents
EDUC	Education of the respondents (secondary, post-secondary, graduate)
OPPORT*	In the next six months, there will be good opportunities for starting a business in the area where you live
SUSKILL*	You personally have the knowledge, skill, and experience required to start a new business
FEARFAIL*	You would not start a business for fear it might fail.
EASY*	In your country, it is easy to start a business
OPPISM*	You rarely see business opportunities, even if you are very knowledgeable in the area
PROACT*	Even when you spot a profitable opportunity, you rarely act on it
CREAT*	Other people think you are highly innovative
VISION*	Every decision you make is part of your long-term career plan
EQUAL*	In my country, most people would prefer that everyone had a similar standard of living
NBGOOD*	In my country, most people consider starting a new business a desirable career choice
NBSTATUS*	In my country, those successful at starting a new business have a high level of status and respect
NBMEDIA*	In my country, you will often see stories in the public media and/or internet about successful new businesses
JOBS	Expected job growth (persons) in 5 years
SOC_HI	When making decisions about the future of your business, you always consider social implications (yes / no)
SOC_ENV	When making decisions about the future of your business, you always consider environmental implications (yes / no)
SOC_PRI	You prioritise the social and/or environmental impact of your business above profitability or growth (yes / no)
SDG_STEPS1	Have you taken any steps to minimise the environmental impact of your business over the past year? (yes / no)
SDG_STEPS2	Have you taken any steps to maximise the social impact of your business over the past year? (yes / no)
SDG_AWARE1	Are you aware of the 17 United Nations Sustainable Development Goals? (yes / no)
SDG_AWARE2	Have you identified any of the goals which are a priority for your business and defined a set of clear objectives, actions, and Key Performance Indicators? (yes / no)

Note: * measured by the Likert scale (1: strongly disagree to 5: strongly agree).

Source: Global Entrepreneurship Monitor, Adult Population Survey Questionnaire.

To analyse the dependence between stage of entrepreneurship (early, established) regarding the motivation for starting a business and variables related to social and environmental commitment, the chi-square test is used (Gujarati & Porter, 2009). The results are presented in tables 2 to 4. A p-value less than 5% (or 10%) indicates a statistically significant dependence between variables. Multiple linear regression is used for the purpose of identifying characteristics that have significant impact on one specific motivation for starting a business – to make a difference in the world. The additional goal was to recognise whether characteristics related to social and environmental issues have impact on entrepreneurs’ motivation for starting a business. The results are presented in Table 5. Data analysis was conducted using R.

5. Findings

5.1 Sustainability Consideration and Prioritisation

In the first phase of analysis, we investigated the difference between early-stage and established entrepreneurs regarding the motivation for starting a business and social/environmental implications or prioritisation of social and environmental goals over profit (shown in Table 2). Sustainability commitment is more frequently pronounced among established rather than early-stage entrepreneurs. Previous research indicated that consideration of sustainable development goals is higher in start-up phases than in the established phase. In contrast, the Croatian sample shows that more established entrepreneurs consider sustainable goals. In the case of Croatia, established entrepreneurs may have a better position to seize the full potential of programs and policies supporting the transition to sustainable development, which perhaps makes them more inclined to consider sustainability issues.

Table 2. Social/environmental implications and motivation for starting a business in early (TEA) and established entrepreneurs (EBO)

Motive		Social implications			Environmental implications			Social/environmental over profit		
		Yes	No	p	Yes	No	p	Yes	No	p
TEA	To make a difference in the world	90.1	9.9	.075	86	14	.280	79.8	20.2	.542
EBO		97.4	2.6		89.7	10.3		78.9	21.1	
TEA	To build great wealth or a very high income	77.9	22.1	.073	77.1	22.9	.315	61.8	38.2	.063
EBO		87.5	12.5		80.4	19.6		74	26	
TEA	To continue a family tradition	77.8	22.2	.326	85.7	14.3	.592	74.2	25.8	.489
EBO		81.4	18.6		84.1	15.9		74.4	25.6	
TEA	To earn a living	86.2	13.8	.295	82.8	17.2	.254	66.2	33.8	.134
EBO		88.9	11.1		86.4	13.6		73.8	26.2	

Source: authors’ calculations.

A significantly higher percentage of established rather than new entrepreneurs consider social implications among those individuals who aspire “to make a difference in the world”. In contrast, those individuals who are motivated “to build a great profit” have a higher percentage of respondents who are not considering

social implications when making decision about the future of their ventures. There are no significant differences between new or established entrepreneurs regarding environmental implications in neither of the motivational orientations. However, a significantly lower percentage of early-stage entrepreneurs (61.8%) prioritise social/environmental gains over profit in comparison with established entrepreneurs (74%) among those who are motivated “to build a great wealth and high income”. It seems that in Croatia, even among those who are motivated by building a great wealth, it is easier to balance sustainability and economic gains when the venture is already established than when it is in the emerging stage.

5.2 Enhancing Impact on Environment or Society

In the second phase of our analysis, we investigated the difference between early-stage and established entrepreneurs regarding motivation for starting a business and steps taken towards environmental and social impact. The results can be found in Table 3.

Table 3. Steps toward environmental/social impact and motivation for starting a business in early and established entrepreneurs

Motive		Steps to minimise environmental impact			Steps to maximise social impact		
		Yes	No	p	Yes	No	p
TEA	To make a difference in the world	74.7	25.3	.122	75.3	24.7	.579
EBO		84.2	15.8		73.5	26.5	
TEA	To build great wealth or a very high income	69.5	30.5	.57	59.5	40.5	.315
EBO		68.1	31.9		63.6	36.4	
TEA	To continue a family tradition	73.2	26.8	.606	66.1	33.9	.717
EBO		70.7	29.3		60.5	39.5	
TEA	To earn a living	67.2	32.8	.275	63.8	36.2	.519
EBO		71.4	28.6		63.5	36.5	

Source: authors’ calculations.

Table 3 shows that there is no statistically significant difference between early and established entrepreneurs in any type of motivational orientation related to steps toward improving environmental and social impact. Regarding the magnitude of the positive responses, it is encouraging that a majority of respondents undertake actions to minimise environmental impact, whereas the percentages of those who are taking steps to maximise social impact are slightly lower. These findings may indicate that entrepreneurs are perceiving environmental impact as more regulated and therefore more entrepreneurs try to avoid fines. Another explanation may be that entrepreneurs see the opportunity to seize the financial or non-financial incentives related to green transition.

5.3 Awareness of SDGs and Actions toward these Goals

Results of the third phase of our analysis can be found in Table 4. Interestingly, most of the respondents are not aware of the SDGs. The only exception is those who are motivated “to make a difference in the world”.

Table 4. Awareness of SDGs and actions toward priority goals regarding motivation for starting a business in early and established entrepreneurs

Motive		Awareness of SDGs			Actions toward priority goals		
		Yes	No	p	Yes	No	p
TEA	To make a difference in the world	71.1	28.9	.043	60.9	39.1	.027
EBO		44.7	55.3		88.2	11.8	
TEA	To build great wealth or a very high income	25	75	.420	60.9	39.1	.051
EBO		24.5	75.5		83.3	16.7	
TEA	To continue a family tradition	26.8	73.2	.478	85.7	14.3	.086
EBO		27.3	72.7		100	0	
TEA	To earn a living	23.6	76.4	.136	56.7	43.3	.005
EBO		30.8	69.2		90	10	

Source: authors' calculations.

As shown in Table 4, the percentage of those who aspire to make a difference and who are aware of SDGs is significantly higher for early-stage than established entrepreneurs. Since the SDGs Agenda includes over 100 indicators (according to the global reporting standards for sustainability development - GRI, 2021), multitude of areas and targets, that have been sparsely promoted in Croatia for only the last couple of years, new entrepreneurs are more aware of them. On the other hand, the differences between early-stage and established entrepreneurs are statistically significant for all motivational orientations regarding the actions taken toward priority goals. A higher percentage of established entrepreneurs reported they are taking these actions. This finding is confusing, since only a minority of the respondents are aware of the SDGs. However, the explanation of these actions in the questionnaire (such as the identification of the priority goals and setting clear objectives, actions, and key performance indicators) reflects the traditional “strategical planning” approach which is unavoidable in doing business irrespective of the identified goals, particularly in the established phase, which may explain the significant difference between early-stage and established entrepreneurs.

5.4 Predictors of Entrepreneurial Activity Driven by the Motivation “to Make a Difference in the World”

In the last phase of our empirical research, the goal was to find which characteristics have significant impact on motivational aspiration “to make a difference in the world” (measured on Likert scale 1- strongly disagree; 5 - strongly agree). This motivational orientation has been considered an important segment of opportunity-driven entrepreneurship, holding significant interaction with aspects of sustainable commitment. In line with the literature, the various demographical, psychographic, and sustainable commitment factors may contribute to this motivational trait. Two multiple regression models were developed separately for early-stage and established entrepreneurs. Results, emphasising only those variables that were found significant are presented in Table 5.

Table 5. Multiple regression model for early-stage entrepreneurs and established entrepreneurs

Variable	To make a difference in the world - TEA		To make a difference in the world - EB	
	B (SE)	p-value	B (SE)	p-value
EASY	-0.1144 (0.063)	.0717		
PROACT	-0.1602 (0.066)	.0160		
VISION	0.2223 (0.077)	.0045		
NBSTATUS	0.1660 (0.072)	.0221		
SOC HI (yes)			1.1581 (0.427)	.008
SDG STEPS2 (yes)	0.5587 (0.1819)	.0023		
SDG AWARE1 (yes)			0.8991 (0.331)	.008

Source: authors' calculations.

Among early-stage entrepreneurs, the aspiration to make a difference increases with a higher valuation of the long-term career plan, more favourable perception of the high status of entrepreneurs in society, and taking actions to maximise the social impact of the business. Early-stage entrepreneurs feel that the more difficult it is to start a business, the more important their motive is to make a difference in the world. In addition, a lower inclination to act on the perceived opportunity decreases an early-stage entrepreneur's aspiration to make a difference in the world.

Established entrepreneurs who consider the social impact of their future decision in business demonstrate a higher motivation to make a change in the world. Similarly, awareness of the SDGs' correlates with a higher motivation to make a positive difference. In the case of Croatia, this finding may be the consequence of the cultural norms and socialistic background, as well as the fact that social responsibility has a longer tradition than responsibility toward the environment.

6. Conclusions

This study provides empirical evidence and insight into how sustainability commitment varies across motivational drives or stages of entrepreneurial ventures. It therefore contributes to enhancing the quality of entrepreneurial activity and more effective adoption of the sustainability development goals.

Our study found encouraging evidence of the magnitude of entrepreneurs' general sustainability commitment. The majority of entrepreneurially active persons in Croatia considers sustainability impact, prioritise it over profit gains, take steps to enhance it, or take planned actions. A significantly higher percentage of those who are oriented to make a difference in the world are considering social implications in making decisions of the future of their business, are aware of the SDGs, and are setting clear objectives and key performance indicators for measuring progress to priority goals. However, entrepreneurs have heterogeneous motivational orientations which are not clearly delineated in terms of sustainability commitment. Such findings corroborate ongoing debate about the shortcomings of deconstructing entrepreneurial motivation to the opportunity or necessity driven ventures. Alignment of sustainability commitment along motivational orientations remains debatable, since our study confirmed partial support to the presumption that

sustainability commitment is more pronounced among those entrepreneurs who engage in entrepreneurial activity with the aspiration to make a difference in the world. In addition, this study suggests that the general sustainability commitment may change over time. Significant differences regarding social implications, awareness of SDGs and actions taken to define objectives and KPIs are noticeable between new and established entrepreneurs.

Analysis of the individual drivers of the motivation to make a difference in the world in our study shows that psychological and sustainability attitudes, values, and traits have a decisive role in increasing aspirations to make a difference among early-stage entrepreneurs. Neither of the demographic factors shows a significant effect on this motivational orientation. Findings indicate that emphasising proactivity through the educational system, policies promoting the easiness of starting a business, long-term career plans, and social responsibility of new entrepreneurs are inductive to making a difference in the world and enhance new entrepreneurs' willingness to fulfil their role as sustainable development catalysts.

The limitations of this study originate from choosing only one country, namely Croatia as a case of detecting nuances between motivational orientation and sustainable commitment. The additional limitation is related to the design of the GEM questionnaire and the size of the available sample, which resulted in deploying basic statistical tests and gaining only preliminary results which are not representative for other countries or cases. However, GEM annually collects a large amount of data using strict procedures and instruments and therefore allows the accumulation of data which are methodologically consistent and comparable longitudinally, at the level of one country, or across numerous countries. Either of these avenues for comparative or longitudinal studies related to sustainability and entrepreneurship creates promising opportunities for future studies with more robust methodology and larger samples.

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**Circular Economy as the Pathway to Sustainable Future:
A Case Study on ALTRNTV Shop**

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Abstract

Current societies rely primarily on increased consumption behaviour, this type of conduct being in contradiction with the finite character of resources and the planet's ability to sustain life. The transition from the linear economy to the circular economy is thus to be desired and, in this sense, ongoing commitment is required from the community and decision makers. At both the European Union level as well as worldwide, various action plans and measurement indicators have been launched to enforce circularity, which stands as a main element of the Sustainable Development Goals. Within this context, this research aims to describe how a circular economy retail business in Bucharest, Romania, aligns with the Circular Economy Monitoring Framework indicators. Moreover, it identifies additional elements of circularity and positive societal impact generated by the business. To achieve the objective, the research methodology utilises qualitative research methods, specifically a descriptive case study. The data was collected through an in-depth interview and from both internal and public information available between 2022 and 2024. To the best of authors' knowledge, this is a first research on Romanian-based startups in the circular economy, and it maps how much of the circular economy practices can be implemented in the current context in Romania. The analysis allowed us to describe how this startup is supporting the circular economy manufacturing sector and it covers all five large categories of indicators of the Circular Economy Monitoring Framework. Although the intention of this research was not specifically to highlight other significant societal impacts, the in-depth interview responses and the study of various internal and public materials revealed numerous practices with a high social impact. Future research should aim to understand how circular economy practices implemented in businesses create positive social impact.

Keywords: circular economy framework, business in the circular economy, circular manufacturing, Romanian startup, Sustainable Development Goals.

JEL Classification: Q01, Q56, O35.

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1. Introduction

In the current society, reflecting a constant requirement for enhanced products, the incremental consumption trend no longer adheres to sustainability and hence circular economy is a primary point that addresses this issue (Lakatos et al., 2018; Geissdoerfer et al., 2017; Korhonen et al., 2018). Since design holds a paramount importance in the circular economy, various tools and means are available at the moment to sustain the switch from linear to circular functioning (Rocha et al., 2023).

Steps towards circularity have been initiated by the European Union, the reduction of greenhouse gas emissions being intended to take place by 55% until 2030, while the pursuit of carbon neutrality is expected until 2050 (Sharmina et al., 2023), with asymmetrical progress of EU states (World Bank, 2022), in the switch to the circular economy, Romania scoring the lowest circular materials use at 1,3%.

Research acknowledges the concern of governments, organisations and civil society entities in addressing the attainment of the Sustainable Development Goals (SDGs) (Kleespies & Dierkes, 2022; Pedersen, 2018; Valverde & Avilés-Palacios, 2021). The United Nations formulated 11 targets and 13 indicators for SDG 12 - Responsible consumption and production (Arora & Mishra, 2023; Our World in Data, 2023). SDG 13 - Climate Action acts on the improvement of resilience against climate risks, the incorporation of measures in national action plans, and boosting awareness on the reduction of climate change effects (Campbell et al., 2018). The urgency of this change appears even more relevant as Danu and Nedeff (2015) highlight that every EU citizen produces over 4,5 tons of waste every year, this requesting a change in consumers' and companies' environmental conduct. Governments are concerned with action plans to foster the propagation of circular economy (Dragomir & Duțescu, 2022), such as the European Green Deal, the European Circular Economy Action Plan (Dumitrica et al., 2023; European Resource Efficiency Knowledge Centre, 2019; Rodino, 2023), the Sixth Environment Action Programme, the Thematic Strategy on the Sustainable Use of Natural Resources, the Roadmap to a Resource Efficient Europe (European Academies Science Advisory Council, 2015; Mazur-Wierzbička, 2021), the Ecodesign Working Plan, and the Raw Materials Scoreboard (Baldassarre & Saveyn, 2023).

The aim of this research is to illustrate how a Bucharest-based startup in the circular economy effectively employs circular economy practices to develop its operations and support the Sustainable Development Goals, aligning to the Circular Economy Monitoring Framework indicators.

2. Problem Statement

Global-wise, the preoccupation for natural resources' depletion is manifested at an increasing pace, drawing attention to the need for the shift from the take-make-consume-throw model, specific to the linear economy, to the reduce-reuse-recycle-redesign model, connected to the circular economy (Androniceanu et al., 2021; Danciu et al., 2019; Dobre-Baron et al., 2022). In addition, the need for clear circular economy policies is shaped by the fact that humanity annually uses 60% more resources than what the Earth can regenerate, with forecasts warning that until

2050 sustainability could be severely threatened by increased population and consumption behaviour (OECD, 2023).

Placing the focus on the textile and apparel industry, Staicu and Pop (2018) recognise it as being among the heavily polluting industries and underline that the reconfiguration of production and consumption are required. Engagement from consumers, hence adaptation of their conduct in line with circular economy practices, is a key matter for a functional circular economy (Karpova et al., 2020; Matová et al., 2019; Ungerman & Dědkova, 2024). Yet, consumers' role and behaviour in the circular economy are poorly researched themes (Vidal-Ayuso et al., 2023).

Circular economy is defined by resource usage optimisation, the safeguarding of sustainable development needs, and the ultimate desired creation of zero waste (Burlacu et al., 2020; Iuga, 2016) by employing closed-loop models (Osobajo et al., 2022; Vermeşan et al., 2020), mimicking the existence of natural ecosystems (Negrei & Istudor, 2018). As a regenerative system (Daño et al., 2020; Herrero-Luna et al., 2022; Sterie et al., 2022), it is an alternative for the creation of an equilibrium between growth and environmental resource constraints (Business Review, 2024; Căuţişanu et al., 2018; Consumer Insight Action Panel, 2022; Valencia et al., 2023). Social enterprises are remarkable actors within circular economy, where the European Structural Funds grants are a prerequisite for circular social economy in Romania (Barna et al., 2022), where, according to Păunescu (2018), new social innovation models arise and substitute the traditional innovation labs.

The change towards a circular economy involves barriers such as the absence of infrastructure, change opposition, poor performance indicators, and financial aspects, whereas some catalysing factors are the altered competitiveness, the creation of industry partnerships, and the presence of innovation and networks (Piciu, 2019). Also, the transition is slowed down by an absence of measurement scales and standardised metrics (Guarnieri et al., 2023), standardised assessment methods playing a great role in sustaining decisions for sustainable development (Oliveira et al., 2021).

2.1 Territorial Standing concerning Circular Economy: Romania

In Romania, the private investments in the circular economy grew from 1013.2 million euros in 2010 to 1699.6 million euros in 2019 (Zota et al., 2022). However, research (Crişan et al., 2019) claims that Romania holds the last places concerning the waste recycling rate, with a recycling rate of 11.3% in 2020, a share below the goals of the European Union (Mocanu et al., 2024). As for the total recycling rate of plastic packaging, the research of Jora et al. (2020) notes that Romania recorded a value of 46.4% in 2016, going close to the 2030 EU target of 55%, but meeting the new goals will involve difficulty.

A report by the European Topic Centre on Circular economy and resource use (2022) also conveys downgrading statistics on the standing of Romania with respect to the percentage usage rate of circular materials, that followed steady decline in the observation period 2011-2020, by opposition to the uprising trend proved by the EU states. Additionally, the computation of an aggregate waste

indicator by Steliac (2020) based on indicators of waste generation and waste recycling rates for EU countries for years 2010, 2012, 2014, and 2016 depicted that Romania was positioned in the top 14 EU states only in 2016. Following the above data, it is clear that Romania needs to heavily improve its approach toward circular economy. In this sense, Basarabă and Cojocaru (2015) propose directions for a country’s economic policy to converge with the circular economy: enhancing raw material purity to permit easier recycling; encouraging repair-remanufacture processes to generate employment opportunities; forming a multisectoral team; setting up a motivating economic context in terms of fiscal considerations; launching the Romanian ECO LABEL and an online research hub for universities and other entities in the circular economy field. Circular economy and social economy are tools utilised to correct social and environmental problems (Bellemare et al., 2022). To enhance the potential of setting up social enterprises in the circular economy sector, Danciu et al. (2019) mentions the need to develop abilities for financing, project management, business plan creation and promotion, and practices and partnerships in circular economy.

Two circular economy legislative initiatives conducted at Romanian level are the National Government Plan 2021–2024, with the aim to minimise landfill waste by minimum 75 percent of all waste types until 2025 and to create a packaging deposit-return system. The National Plan for Investments and Economic Recovery 2020-2025 gives directions for the energy, economy, agriculture, and local development areas, ultimately creating convergence with EU countries in terms of GDP per capita (World Bank, 2023). According to Vermeşan et al. (2020), an increasing concern has been shown for the circular economy in Romania in the last years, however, the successful examples in this domain are scarce (Table 1).

Table 1. Circular economy initiatives at private level conducted in Romania

Organization	Description of the initiative
Employers’ Confederation Concordia	the publication of the “Circular Economy in Romanian Business” guide that conducts a presentation of circular economy programs initiated by organisations belonging to various fields e.g. hospitality, retail, banking
Ateliere Fără Frontiere	Romanian social enterprise tackling the social exclusion of vulnerable groups and advocating for employment integration
Viitor Plus	NGO running circular economy programs: Recycling Map, Atelierul de Pânză, RECICLETA, and EcoProvocarea
Terra Mileniul III	NGO operating programs pertaining to circular economy and environmental shielding
The Danube Goes Circular	circular economy platform fostering the communication and material trade between 16 partners in the Danube countries
GreenGroup	conducts the production of synthetic polyester fibers in Romania, based on 100 % recycled PET flakes and the collection, processing and recycling of EEE
ECOTECA	maps urban areas consumption, waste production and management
LanaTerm	production of building insulation on the basis of sheep wool
ecoHORNET	production of multi-system burners based on ecological combustion processes to generate biochar, gas, and oil
bonapp.eco	connects food suppliers and consumers to minimise waste
PRECIOUSCIRCUIT	jewelry production out of electrical and electronic equipment

Source: European Topic Centre on Circular economy and resource use (2022).

2.2 Territorial Standing concerning Circular Economy: the European Union

Worldwide, the concern for carbon neutrality and zero emissions acted as a catalyst for the embracement of circular economy practices (Banjerdpaiboon & Limleamthong, 2023; Serrano-Bedia & Perez-Perez, 2022). European practitioners and scientists have also become aware of the importance of circular economy (Försterling et al., 2023; RREUSE, 2024), and several plans have been initiated at the EU level to ensure circularity and reach carbon neutrality: the *Strategy for a Sustainable Built Environment*, that was published in 2020 and *A Clean Planet for all. A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy* (Marek & Krejza, 2023). In 2018, the Circular Economy Monitoring Framework was initiated by the European Commission (European Environment Agency, 2024), its pillars being detailed in Table 2.

Table 2. The composition of the Circular Economy Monitoring Framework

Production and consumption	Waste management	Secondary raw materials	Competitiveness and innovation	Global sustainability and resilience
Material footprint	The recycling rate of municipal waste	The usage rate of circular materials	Private investments	Consumption footprint
The productivity of resources	The recycling rate of waste, not including major mineral wastes	The input rates for end-of-life recycling (aluminum)	Employed individuals	GHG emissions from activities of production
Green public procurement	The recycling rate of overall packaging	Imports from countries outside the EU	Gross value added	The reliance on material import
Total production of waste	The recycling rate of plastic packaging	Exports to countries outside the EU	Patents pertaining to the management and recycling of waste	The self-sufficiency of the EU in the case of aluminum raw materials
Waste production, not including major mineral waste	The recycling rate of WEEE that are separately collected	Intra EU trade		
Production of municipal waste				
Food waste				
Production of packaging waste				
Production of plastic packaging waste				

Source: European Environment Agency (2024).

3. Research Questions / Aims of the Research

In line with the literature insights previously delineated, the paper aims to answer to the following research question: “How does a circular economy retail startup located in Romania conduct its activities in line with the Circular Economy Monitoring Framework indicators?” The research question is constructed in line with the European Environment Agency (2024), which launched the Circular Economy Monitoring Framework in 2018, as a tool intended to foster circularity. In addition, the paper’s aim is built based on Mocanu et al. (2024) and Crişan et al. (2019), who note that circular economy still exists in the inception phase in Romania.

4. Research Methods

To achieve the objective, the research methodology utilises qualitative research methods, specifically a descriptive case study (Yin, 2018) of startup ALTRNTV Shop. The following key attributes of the case study methodology are underlined in this research (Priya, 2021):

M.1. Our case study involves a detailed study of the concerned unit of analysis within its natural setting, the context for the development of circular economy businesses in Romania (Table 1).

M.2. Since an in-depth study is conducted, case study research allows the authors the leeway to use any method of data collection which suits their purpose. For a sound, unadulterated, and unbiased study of the phenomenon under investigation, several techniques of data collection were used, such as in-depth interview and the study of documents internal procedures (related to ISO 9001, ISO 45001 and ISO 14001 the company has been certified for in 2023) and brochures, and all public data, text, and video material published about the business.

The data was collected as follows: the in-depth interview addressed to one of the startup’s co-founder was performed in March 2024 (Table 3) and the internal and public information about ALTRNTV is recent (2022 to 2024) (Table 4).

Table 3. In-depth interview questions

No.	Question
1	What does the startup ALTRNTV do for customers?
2	Who is behind ALTRNTV and what studies does the team have?
3	Why is ALTRNTV a startup in the circular economy?
4	What were the obstacles of opening such a startup?
5	Who financed this business that supports the circular economy?
6	How have customers received the circular products that you propose?
7	And the interior design of the space was made using circular practices. Which are these?

No.	Question
8	Is the packaging of the products also aligned with circular economy practices?
9	What are the plans to include other circular practices in the startup's operations?
10	How do you encourage sustainable product designers to expand their product propositions?

Source: authors' own processing.

Table 4. Sources for data collection

Type of data and number	Year
ISO 9001, ISO 14001, ISO 45001 ALTRNTV internal procedures	2023
ZIARUL FINANCIAR (6 Articles) Selection: Pagina verde. Daniela Staicu și Alina Țiplea au deschis în București ALTRNTV Shop, un magazin de haine și accesorii create de designeri români din materiale sustenabile	2022-2024
REVISTA IGLOO (1 article) Se deschide ALTRNTV, un spațiu dedicat produselor de design românesc sustenabile – igloo	2022, 2024
RETAIL.RO (1 article) ALTRNTV, spațiul social dedicat designerilor români, se deschide în București (retail.ro)	2022
IMPACT HUB BUCHAREST (1 article) ALTRNTV la Black Sea ClimAccelerator: Sustenabilitate, design, artă și cafea - Impact	2023
GREEN-REPORT.ro (1 article) Despre moda sustenabilă, cu ALTRNTV: Trebuie să schimbăm metodele de producție a materialelor și comportamentele - Green Report (green-report.ro)	2022
REVISTA ATELIERUL (1 article) https://www.revista-atelierul.ro/2022/11/28/despre-altrntv-cu-alina-tiplea-si-daniela-staicu/	2023
THE WOMAN (2 articles) https://thewoman.ro/voices-of-womentrepreneurs-o-voce-puternica-pentru-antreprenoriatul-feminin-dedicat-designului-sustenabil/	2022, 2024
ROMANIAN GREEN STARTUPS (1 article) https://activize.tech/green-startups-romania-overview/	2023
BANISIAFACERI.RO (1 article) https://banisiefaceri.ro/educatie-stil-de-viata-si-wellness-antreprenoriatul-feminin-romanesc-subiect-de-studiu-la-scoala-in-saptamana-verde-si-saptamana-altfel/	2024
YOUTUBE (2 videos) https://www.youtube.com/watch?v=ubklw8Zqao&t=3s	2024
Brochure about ALTRNTV, in English language (2 articles)	2023, 2024

Source: authors' own processing.

5. Findings

The research particularly focused on describing how a circular economy retail business based in Romania aligns to the Circular Economy Monitoring Framework indicators (Table 5).

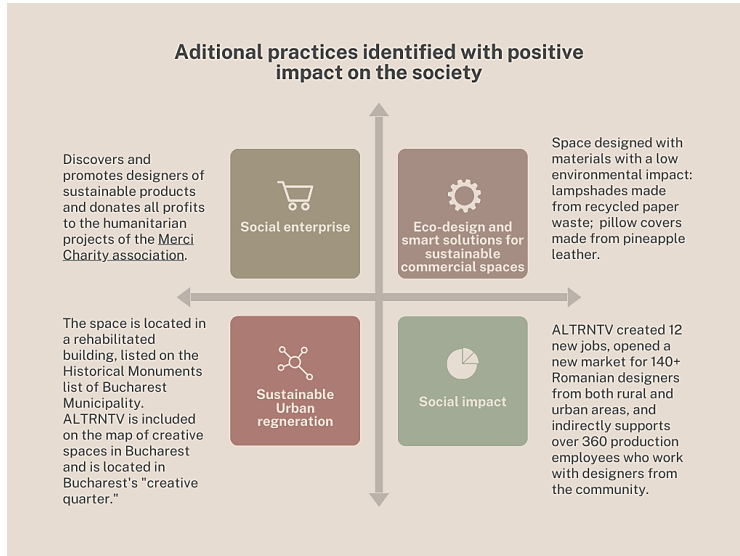
Table 5. ALTRNTV practices related to circularity

Production and consumption	Waste management	Secondary raw materials	Competitiveness and innovation	Global sustainability and resilience
<p>Material footprint At ALTRNTV, each designer is required to explain the origin of the material employed. Materials arriving from proximity to Bucharest are preferred. However, no certified scheme for material footprint monitoring is yet employed.</p>	<p>The recycling rate of waste, not including major mineral wastes 100% of the waste produced at ALTRNTV is collected selectively and distributed to a waste collector. The recycling rate of overall packaging 100% of the overall packaging is originated from recycled sources, either is manufactured at ALTRNTV/bought from EU (recycled cardboard/paper). The recycling rate of plastic packaging 100% of the plastic collected is distributed to a waste collector, recycled.</p>	<p>The usage rate of circular materials 100% of raw materials employed by the designers at ALTRNTV are either recycled, deadstocks, biodegradable, organic (Certified GOTS, OEKO-TEX for fabrics). Intra EU trade The organic fabrics certified are bought from the EU (Poland, Portugal, Germany, Romania).</p>	<p>Private investments Investments in ALTRNTV were done 100% by private investors (foundation NESsT) and companies: Banca Comerciala Romana, Philips Romania, Tarket). Employed individuals This business collaborates with 140 designers who employ 360 + people. ALTRNTV's staff is of 7 people. All designers and ALTRNTV offer decent work conditions (ISO 45001).</p>	<p>Consumption footprint By buying circular products from ALTRNTV, the customers diminish their consumption footprint because of their choice of products with less CO2 footprint. GHG emissions from activities of production ALTRNTV produces its own line of clothing with a diminished CO2 footprint and sells in the store.</p>

Source: authors' analysis based on the Circular Economy Monitoring Framework, per the European Environment Agency (2024).

Moreover, additional elements of circularity were employed, not yet integrated in the Circular Economy Monitoring Framework (Figure 1) such as the sustainable regeneration of urban space, the incorporation of eco-design and smart solutions into the shop's design, the generation of social impact, and the support of social entrepreneurship. Through this, the paper's findings confirm the previous work of Lawrence (2015) and Nasr et al. (2023), who debated on the usage of sustainable building materials. The paper's findings also reflect adherence with Barna et al. (2022), who advocate on the importance of social enterprises and the European Structural Funds grants for the Romanian circular economy. Last but not least, the findings are in line with Arora and Mishra (2023) and Campbell et al. (2018), by proving that ALTRNTV Shop operates in accordance with SDG 12, Responsible consumption and production, and with SDG 13, Climate Action.

Figure 1. Additional elements of circularity associated with positive impact



Source: authors' own processing.

The startup is concerned with exerting a minimal environmental impact by running business processes that source materials from proximity locations (preferably Romania), to lower carbon emissions during transportation (by electric car, bike). Additionally, as employees are the core of business success, ALTRNTV supplies them fair work conditions as per ISO 45001 guidelines. In addition, as it currently relies on well established circular practices, ALTRNTV can continue to enrich the local circular economy manufacturing sector by attending events for startups, for instance, Romanian Design Week.

Table 6. Circular economy principles at ALTRNTV

Circular economy principles (Basarabă & Cojocaru, 2015)	Actions done by ALTRNTV shop in line with Basarabă and Cojocaru (2015)
enhancing raw material purity to permit an easier recycling	The shop only accepts to exhibit and sell products made from mono natural certified materials and alternative bio-degradable materials.
encouraging repair-remanufacture processes to generate employment	The shop has encompassed a tailor shop which acts also as a repair workshop. It currently employs one person.
forming a multisectoral team	The shops team is formed by experts in textiles, professors from ASE – the business administration stream and the University of Arts in Bucharest – fashion stream.
setting up a motivating economic context in terms of fiscal considerations	The business model of ALTRNTV is the most motivating for the designers who exhibit, currently charging the lowest commission in the market, and offering additional PR and marketing opportunity (such as the campaign to promote young female entrepreneurs endorsed by the US Embassy in Romania: Voices of Wom(en)trepreneurs).

Source: authors' analysis based on the qualitative data collected.

To boost the awareness of the young generation on circular economy, ALTRNTV plans to develop collaboration with universities (the Faculty of Business Administration and its Master in Entrepreneurship), through internship offerings, and presentation of the startup's activities through guided visits of students, and collaborations with the business environment, recently advancing in discussions with the American Chamber of Commerce. Moreover, the operations of this startup align with the circular economy principles (Table 6) as described by Basarabă and Cojocaru (2015).

To further supply enhanced sustainable impact, a valuable direction for ALTRNTV is the formation of partnerships with other local circular economy businesses, from which it can acquire know-how and innovative practices, in line with Piciu (2019), who underlines the importance of industry networks and innovation in fostering the shift to circular economy. ALTRNTV already implements collaborative practices with sustainable product designers, however, there is room for extended business partnerships leading the way to increased social impact. To strengthen its potential, ALTRNTV should also prioritise the gathering of a certified scheme for material footprint monitoring.

6. Conclusions

This research aimed to detail how a circular economy retail business in Bucharest, Romania aligns with the Circular Economy Monitoring Framework indicators and what additional elements of circularity and positive impact on the society it produces. This is, as far as we know, a first research on Romanian based startups in the circular economy, and it maps how much of the circular economy practices can be implemented in the current context in Romania. In this case, the analysis allowed to describe how this startup is supporting the circular economy manufacturing sector and covers all five large categories of indicators of the Circular Economy Monitoring Framework (Table 5). Although the intention of this research was not specifically to highlight other significant societal impacts, the in-depth interview responses and the study of various internal and public materials revealed numerous practices by this startup that have a high social impact.

The research aims to fill an existing gap in the studies on the Romanian-based startups in the circular economy, illustrating how a Romanian circular economy startup supports the circular economy manufacturing sector, in line with the Circular Economy Monitoring Framework. The findings of the paper can be particularly useful to decision makers in the circular economy sector as well as individuals intending to become entrepreneurs in this field. A research limitation resides in the non-inclusion of other circular economy assessment indicators, which could enrich the research findings. Future research should aim to understand how circular economy practices implemented in businesses create positive social impact.

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**An Analysis of Sustainable Urbanism in Europe:
Unveiling Trends and Key Contributors**

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Abstract

Also referred to as green cities or eco-cities, sustainable urban centres have arisen from the imperative to harmonise economic, ecological, and social agendas, aimed at fostering resilient environments for the benefit of both present and future generations. This global interest in transitioning cities and communities towards sustainability is exemplified by the 11th Sustainable Development Goal, which encompasses objectives such as ensuring safe housing and infrastructure, enhancing air quality, managing waste efficiently, and bolstering disaster resilience. The main objective of this article was to identify publications investigating the issue of sustainable cities in Europe in order to observe research trends on this topic. This study conducts a bibliometric analysis encompassing all published literature within the Web of Science database pertaining to this subject. The earliest documented studies trace back to 1994, with a marked escalation in scholarly interest observed from 2016 onwards. Employing the Biblioshiny package in R, 245 articles were identified wherein both the terms “sustainable cities” and “Europe” appeared in the titles, abstracts, or keywords. Key recurring themes identified in the authors' discourse on sustainable urbanism include sustainable development, urban planning, smart cities, urban sustainability, climate change, urban development, and energy efficiency. Additionally, this analysis identifies noteworthy sources, prolific authors, and highly cited papers, thus shedding light on prevailing research trends within this domain. Among the topics researched by the most cited articles is the reduction of energy consumption, since 80% of energy consumption is generated by cities and their supply chains. Among the solutions provided by them is the integration of local stakeholders in the decision-making process regarding long-term sustainability.

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JEL Classification: O18, O30, Q01, Q20, Q55.

1. Introduction

Given the upward trend of population growth and their desire to live in the city, the agglomeration of urban areas leads, among other things, to pollution, the alteration of the natural course of the ecosystem, and the high increase in energy consumption. In addition to the environmental aspects, the sustainability of cities must also be viewed from the social point of view. Thus, according to Haughton and Hunter (2004), a sustainable city is one in which citizens and stakeholders try to improve the natural environment, culture, and architecture at the micro (local and regional) level, but with the aim of helping to achieve global sustainability.

The aim of the current study is to determine current trends in researchers' interest in sustainable cities in Europe. The objective of the study is to identify the most productive sources and authors and to discover the countries that have conducted the most intensive studies of this phenomenon. It was also intended to observe the research trends, the most common topics studied together with sustainable cities, as well as the study themes addressed by the most quoted article in this field.

The paper is divided into three large important sections, the first being dedicated to explaining the concept of sustainable cities. The second section is dedicated to the research methodology where the steps to extract the investigated dataset are explained. The results start with general information about documents such as the number of authors, the rate of collaboration between authors from different countries, continuing with information about the journals in which the articles were published, presenting Bradford's Law and H index to show the impact of the most representative sources. It also provides information about the authors, about the most productive countries and the collaborations between them, together with the presentation of the networks between the top 20 authors, as well as affiliations. Information is also presented regarding the most cited articles in the field, showing the main topics addressed by them, as well as the most used keywords.

2. Problem Statement

For several decades, the population's tendency has been to move to cities because they are considered places with great economic impact, offering significantly more jobs than in the countryside. But in order to support a rising number of individuals, increasingly significant amounts of resources are consumed, generating a greater degree of pollution. As the surface of cities remains the same and the population in these areas is growing, the issue of ensuring sustainability in such areas arises (Phillis et al., 2017). Due to the excessive pollution produced by cities and their supply chain (Harris et al., 2020), management and design policies of city infrastructure are needed, as well as the involvement of local stakeholders in

discovering long-term solutions to support sustainability (Carlsson-Kanyama et al., 2008). To evaluate the degree of sustainability of cities, methods such as hierarchical algorithms (Akande et al., 2019a), fuzzy evaluation (Phillis et al., 2017), and the INVAR method (Kaklauskas et al., 2018) were implemented.

To ensure that the urban environment is sustainable, it is necessary to cover economic, social, and ecological needs. Among the ways to achieve a sustainable city are energy efficiency, the use of renewable sources, but without aiming only at the creation of ecocities, but also at addressing social and economic problems (Hassan & Lee, 2015). The debate on sustainable cities revolves around the sphere of transport solutions, the generation of renewable energy sources, and the provision of resource-efficient buildings, without taking into account the social sphere and the ability of individuals to change their mindset regarding the sustainable approach. The most important factors that can ensure sustainability are the very people who live in the urban environment (Stieninger Hurtado, 2018). Circular economy may have an impact in attaining a sustainable city, according to Rogers (1998), that proposed an approach of a circular metabolism by which to minimise the inputs and maximise the recycling capacity.

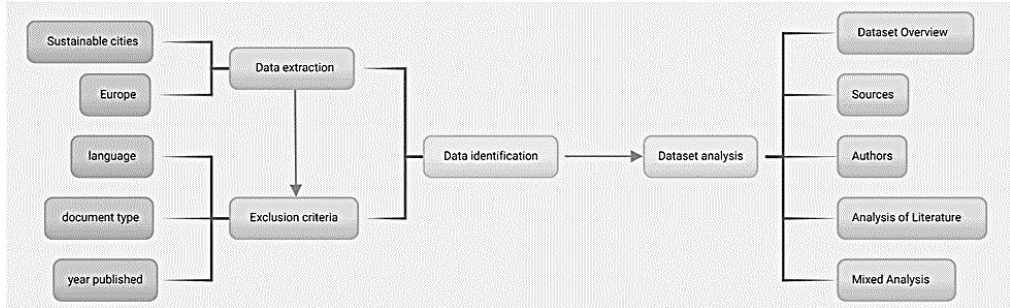
Buildings consume approximately 40% of energy and produce 21% of CO₂ globally. Thus, the identification of intelligent and sustainable building planning methods is essential. A new method of building houses refers to the use of shipping containers, which are cheaper, innovative, and easier to make compared to traditional methods (Abrasheva et al., 2013). Another way in which we can test the sustainability of a city refers to resilience in case of natural hazards, such as earthquakes, as it is necessary for the authorities to take into account the vulnerability of cities in case of risk situations (Aguilar-Meléndez et al., 2019).

Among the most intensively analysed topics are energy consumption (Azurza-Zubizarreta et al., 2021; Napoli et al., 2020; Villamor et al., 2020) and energy efficiency (García-Fuentes & De Torre, 2017; Pardo-Bosch et al., 2019), as well as the concern for climate change (Bayulken & Huisingh, 2015; Yang et al., 2020), the modification of the transport system (Marcucci et al., 2017; Ramirez-Rubio et al., 2019), urban planning (Bibri & Krogstie, 2020; Bottero et al., 2019) and greenhouse gas emissions (Andersson & Andersson, 2019; Stolfi & Alba, 2018).

3. Research Methods

The objective of this research is to identify those papers that addressed the issue of sustainable cities in Europe with the aim of illustrating the most productive sources, authors, as well as the most cited documents, but also the main research topics associated with this subject. To achieve the main objective of this study, the Biblioshiny package (Aria & Cuccurullo, 2017), available in R, was selected. It is frequently chosen by researchers for literary analyses on various subjects (Delcea et al., 2023; Domenteanu et al., 2024; Profiroiu et al., 2024; Nica et al., 2024), including those related to sustainable cities (Janik et al., 2020; Kumar et al., 2023).

Figure 1. Document search algorithm



Source: authors' own work using bubbl.us.

In order to ensure a relevant database, the documents available on the Clarivate Web of Science platform containing information on sustainable cities in Europe were extracted. The next step was to exclude documents that did not meet the language, time, and document type criteria. After the identification criteria were met, it moved on to the next step, which consists of the actual analysis of the documents, discussing general aspects, and then presenting information on the most productive authors, the most relevant sources, together with the analysis of the literature (Figure 1).

Table 1 shows that 5,263 documents on sustainable cities and 1,164,985 on Europe have been published. From the intersection of the two considered concepts, a number of 391 documents can be observed, of which 121 were eliminated by limiting them to articles. The English language criterion reduces the number of documents to 251, and by applying the time restriction (those published in 2024 are not taken into account), the number of articles becomes 245.

Table 1. Data identification steps

Exploration steps	Questions on Web of Science	Description	Query	Query number	Count
1	Title/ Abstract/ Keywords	Contains the specific keyword related sustainable cities	((TI=(sustainable_cit*)) OR AB=(sustainable_cit*)) OR AK=(sustainable_cit*)	#1	5,263
2	Title/ Abstract/ Keywords	Contains the specific keyword related to Europe	((TI=(europe*)) OR AB=(europe*)) OR AK=(europe*)	#2	1,164,985
3	Title/ Abstract/ Keywords	Contains the specific keyword related to both	#1 AND #2	#3	391
4	Document type	Limit to Article	(#3) AND DT=(Article)	#4	270

Exploration steps	Questions on Web of Science	Description	Query	Query number	Count
5	Language	Limit to English	(#4) AND LA=(English)	#5	251
6	Year publisher	Not 2024	(#5) NOT PY=(2024)	#6	245

Source: authors' own work.

4. Findings

The current section provides a complex analysis of the set of documents on sustainable cities obtained by applying the methodology presented previously. The study involves an examination from several perspectives of the articles chosen among them, but not limited to the authors, sources, or the most cited documents in the specialised literature.

4.1 Dataset Overview

General information about the 245 identified documents is presented in this subsection. It should be noted that the period in which they were published, 1994:2023, is obtained by applying the selection criteria mentioned in the methodology, respectively, limiting the documents to articles written in English, not including the year 2024.

In Table 2, the most important information about the selected articles can be found, noting a number of 878 authors who contributed to their writing, noting that 40 articles were written by single authors, while the average number of authors per document was approximately 3.7.

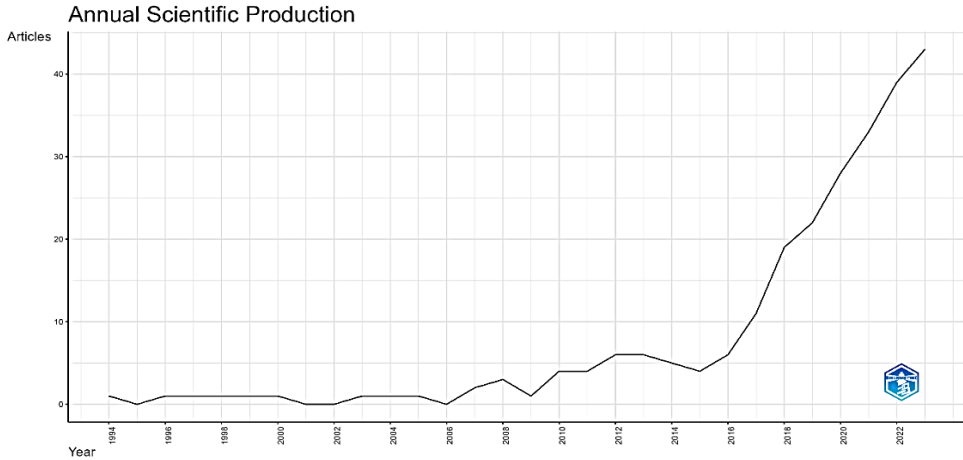
Table 2. Main information

Indicator	Value	Indicator	Value
Timespan	1994:2023	Sources	138
Authors	878	Annual Growth Rate %	13.85
Authors of single-authored docs	39	Average citations per doc	17.45
Single-authored docs	40	References	12,701
Co-Authors per Doc	3.69	Keywords Plus (ID)	579
International co-authorships %	31.84	Author's Keywords (DE)	943

Source: authors' own work.

Furthermore, the collaboration rate between authors from different countries is 31.84%, the authors' interest in this topic being explained by a 13.85% annual increase in the number of articles. The written papers were published in 138 journals, with an average number of 17.45 citations per paper and 12,701 references identified. Additionally, a number of 943 keywords and 579 keywords plus were noticed.

Figure 2. Annual scientific production evolution



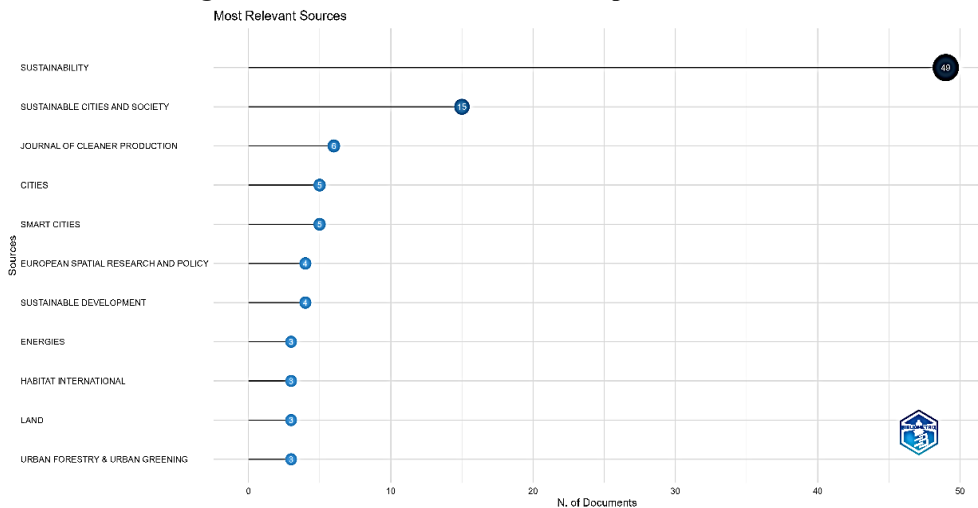
Source: authors' own work using Biblioshiny.

Although the time period analysed is a very long one, it is noteworthy that, only since 2012, more than five articles per year have been written, and in 2017 the threshold of 10 articles was exceeded, from then until the end of the analysed period there is a significant increase in the number of published articles.

4.2 Sources

In this subsection, you can find information about the main sources that chose to publish articles about sustainable cities, focusing on the most productive journals, Bradford's Law or journals' impact based on H-index.

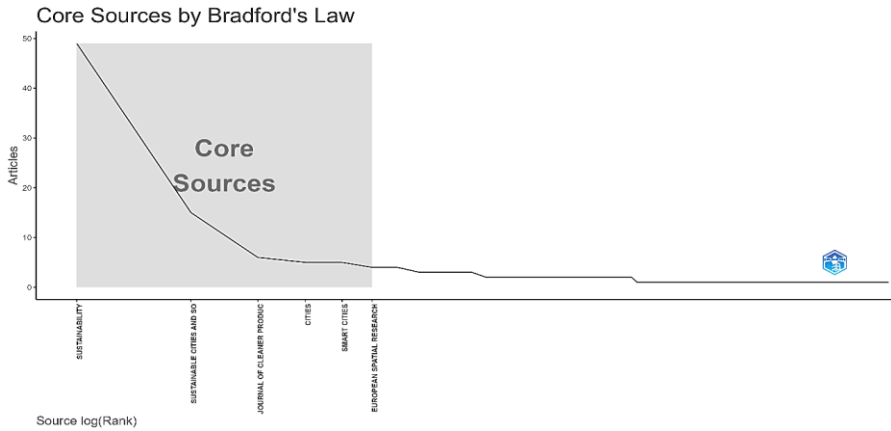
Figure 3. Journals with three or more published articles



Source: authors' own work using Biblioshiny.

Figure 3 shows the journals that have the most articles published on the topic of sustainable cities, at the top of the ranking is Sustainability with 49 articles, the next ranked journal (Sustainable Cities and Society) having three times less articles related to the analysed topic. Next, the Journal of Cleaner Production published six articles during the analysed period, followed by Cities and Smart Cities with five publications each, European Spatial Research and Policy and Sustainable Development publishing four articles each. The following four journals, respectively Energies, Habitat International, Land and Urban Forestry & Urban Greening each published three articles containing the phrase sustainable cities in the abstract, title, or keywords.

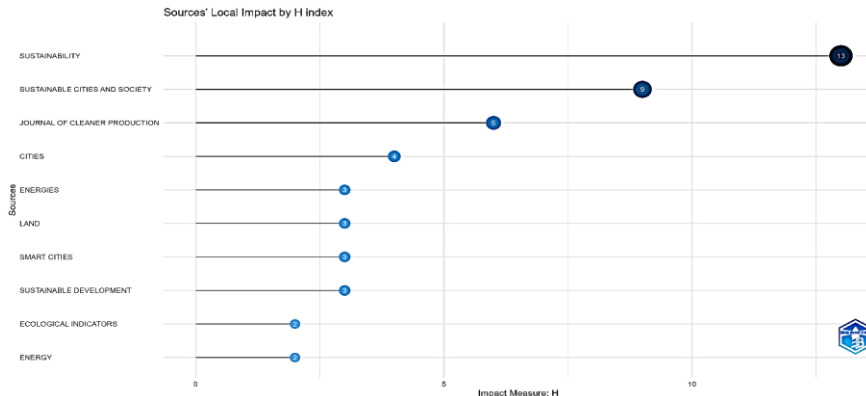
Figure 4. Bradford’s Law on source clustering



Source: authors’ own work using Biblioshiny.

Figure 4 shows the most productive and cited sources from the specialised literature. Thus, Sustainability, Sustainable Cities and Society, Journal of Cleaner Production, Cities, Smart Cities, and European Spatial Research encapsulate a third of all published articles.

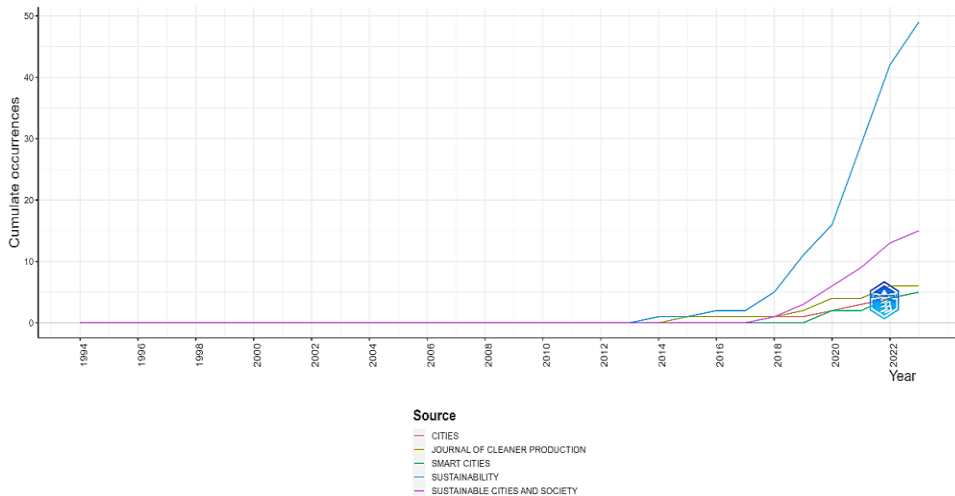
Figure 5. Journals' impact based on H-index.



Source: authors’ own work using Biblioshiny.

Additionally, to support the impact brought by these sources on the specialised literature, the H index is also presented, which shows the number of articles published in a journal and which were cited at least H times each (Hirsch, 2005). Therefore, Sustainability published 13 articles with at least 13 citations each, followed by Sustainable Cities and Society with nine articles published at least nine times, in third place is the Journal of Cleaner Production which published six articles cited, each by at least six times. Cities occupies the fourth position in the ranking with four articles cited at minimum four times each, followed by Energies, Land, Smart Cities and Sustainable Development, each with three articles published and cited at least three times, the next ranked being Ecological Indicators and Energy with two articles that have at minimum two citations each.

Figure 6. Journals' growth (cumulative) based on the number of papers Sources' Production over Time

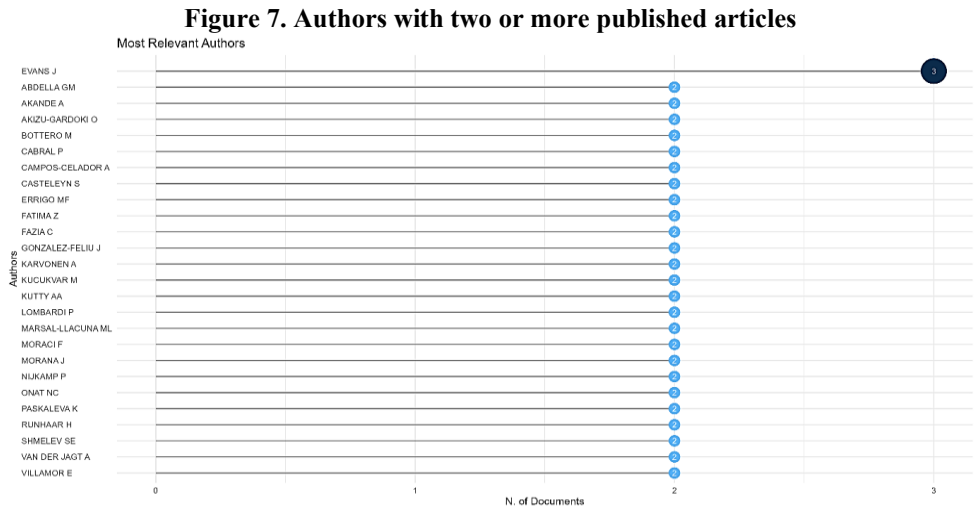


Source: authors' own work using Biblioshiny.

Regarding the production over time of the most productive journals, it can be seen, according to Figure 6, that Sustainability was the first journal that chose to publish, in 2014, articles on this topic, also having the most spectacular growth, being followed by the Journal of Cleaner Production, in 2015, no longer publishing until 2019, and then reaching third place in the list of the most articles published at the end of the period. Sustainable Cities and Society and Cities both started publishing in 2018, with the former occupying the second place in the list of the most articles published. Although Smart Cities started publishing articles about sustainable cities only in 2020, it managed to occupy the fourth place in the list of the most published articles, just like Cities.

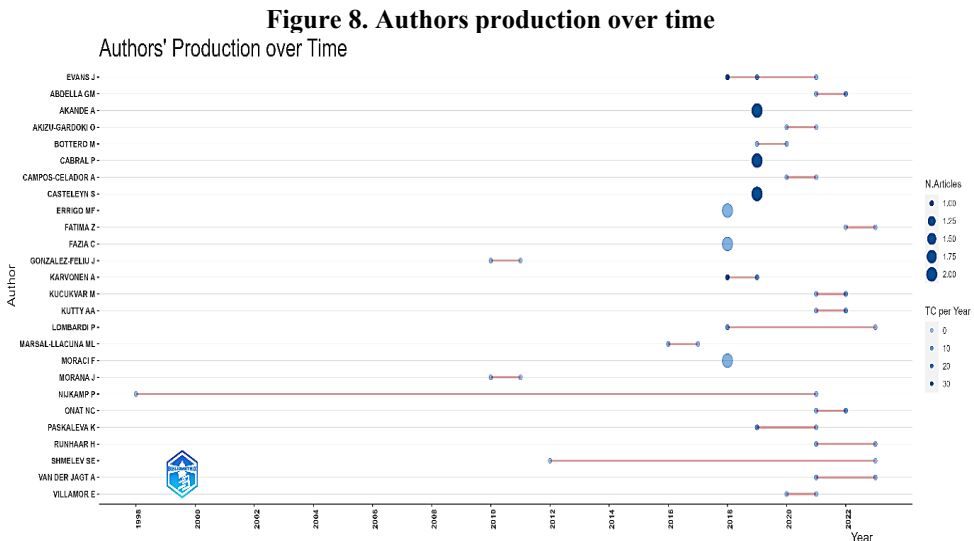
4.3 Authors

The current subsection details information about the authors of the analysed documents, also referring to the countries from which these authors research, as well as the collaborations between them.



Source: authors' own work using Biblioshiny.

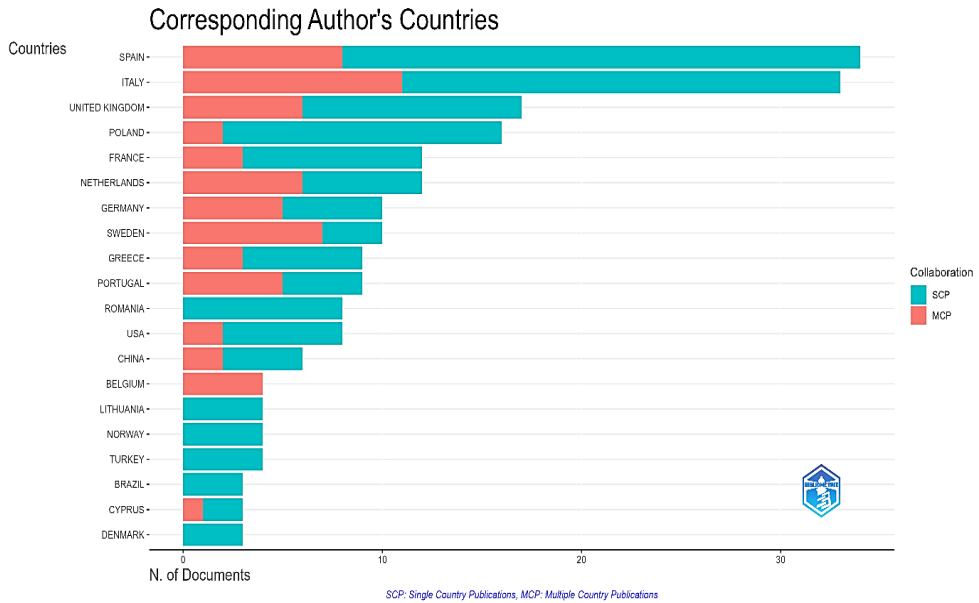
Figure 7 shows the authors with at least two articles published on the chosen topic, noting that only Evans J. wrote three articles published on the Clarivate platform.



Source: authors' own work using Biblioshiny.

Figure 20 shows that the three articles written by Evans J. were published in three distinct years between 2018 and 2021, and, as expected, being the oldest, the 2018 article is the most cited of the three. Interesting to note is the time gap between the writing of the two articles by Nijkamp P., one being published in 1994 and the other in 2021. Another author who published two articles a long time apart, but not compared to the one mentioned previously is Shmelev S.E., who chose to address this topic in 2012 and later in 2023.

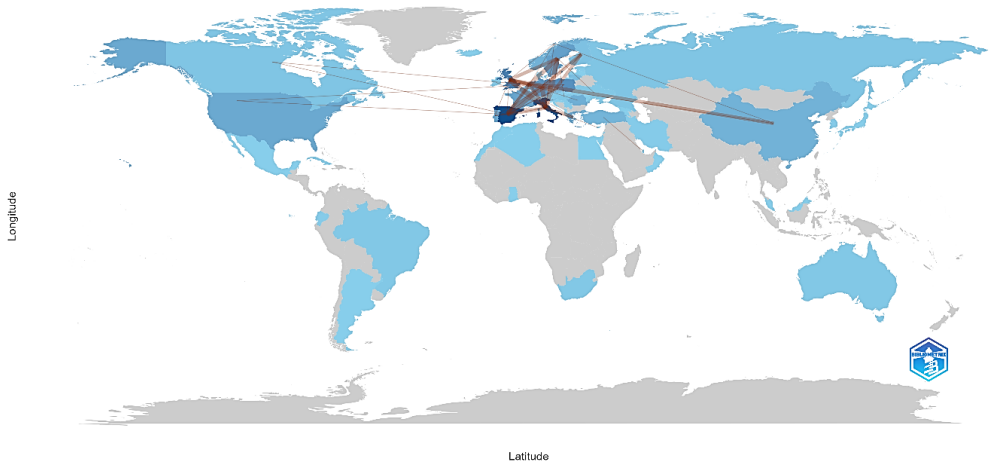
Figure 9. Top-20 most relevant corresponding author's country



Source: authors' own work using Biblioshiny.

Regarding the country of the corresponding author, the most productive are Spain and Italy, with more than 30 articles published each, about a quarter of which are written in collaboration with authors from other countries. The countries from which at least 10 papers were written are the United Kingdom, Poland, France, the Netherlands, Germany, and Sweden. At least six articles were published by countries such as Greece, Portugal, Romania, USA and China, Belgium, Lithuania, Norway and Turkey each publishing four articles, while authors from Brazil, Cyprus, and Denmark published three.

Figure 10. Country collaboration map
Country Collaboration Map



Source: authors' own work using Biblioshiny.

Figure 10 shows the countries from which the authors have published research on sustainable cities in Europe, noting that the more intense the shade of blue, the more articles were published in that country. Thus, collaborations between the United Kingdom and China, as well as between Spain and Italy, which are also the most productive countries, are recorded. Other multiple collaborations have been made between Spain and Sweden, Italy and Finland, United Kingdom and Italy, Spain and Finland etc. Since this paper analyses the European sustainable cities, it is obvious that the countries of Europe are the most productive, but it is important to note the collaboration with the other countries outside the European continent, particularly the United States and China.

Figure 11. Top 20 authors collaboration network



Source: authors' own work using Biblioshiny.

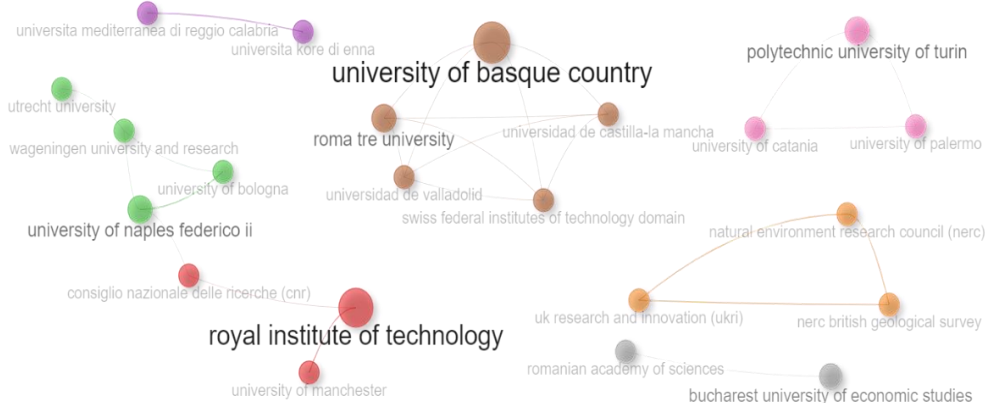
Figure 11 illustrates the collaborations between the authors with the most published articles, noting in green the partnership between Evans J., Karvonen A. and Paskaleva K., who wrote an article about smart sustainability (Martin et al., 2019). Also, Evans J. wrote two other articles in association with each of the other two authors, thus, together with Paskaleva K. studied Quadruple Helix (Paskaleva et al., 2021), while with Karvonen A. they produced a paper on smart-sustainable cities in Europe and North America (Martin et al., 2018).

The next network formed, visualised in brown, is between Errigo M.F., Fazia C., and Moraci F. who published together two articles on resilience cities (Moraci et al., 2018a; Moraci et al., 2018b). Another collaboration between three authors is highlighted in orange between Villamor E., Akizu-Gardoki O., and Campos-Celador A. who studied the energy transition (Azurza-Zubizarreta et al., 2021; Villamor et al., 2020). Moreover, Cabral P., Akande A., and Casteleyn S. joined forces to write two papers, one about ranking of 28 European cities regarding their sustainability (Akande et al., 2019a) and another one regarding the gap between technology and the environmental sustainability (Akande et al., 2019b).

The network with the most nodes consists of Kucukvar M., Kutty AA., Onat NC., Abdella GM. and Al-Nuaimi M. who authored together two articles on eco-efficiency (Onat et al., 2021) and the sustainability performance of European smart cities (Kutty et al., 2022).

There are two networks with two nodes each, the collaboration between Gonzalez-Feliu J. and Morana J. leading to the creation of a study on sustainable solution for city logistics (Gonzalez-Feliu & Morana, 2011), while Runhaar H. and van der Jagt A. published two articles on urban nature (Dorst et al., 2021; Van Der Jagt et al., 2023).

Figure 12. Top 20 affiliations collaboration network



Source: authors' own work using Biblioshiny.

Regarding the collaborations between affiliations, the collaboration between the network with the most nodes is noteworthy, which includes two distinct associations linked by the partnership between the University of Naples Federico II and the

Consiglio Nazionale delle Ricerche, which published two papers on sustainable cities in the Mediterranean Basin (Battarra et al., 2020) and sustainable city-port (Cerreta et al., 2020). Thus, in green is illustrated the partnership between Utrecht University, Wageningen University and Research, University of Bologna and University of Naples Federico II who wrote a paper on sustainable city food systems (Vittuari et al., 2021), the last two mentioned universities also publishing a paper on reducing energy consumption from buildings (Ruggiero et al., 2021). The red network is represented by the Royal Institute of Technology and the University of Manchester, whose researchers have jointly published two papers on smart-sustainable cities (Martin et al., 2019; Martin et al., 2018), the Royal Institute of Technology, writing another one paper with the Consiglio Nazionale delle Ricerche on urban metabolism and life cycle assessment (Maranghi et al., 2020).

The second largest network is represented in brown, being composed of the University of Basque, Roma Tre University, Universidad de Valladolid, Universidad de Castilla-La Mancha, and the Swiss Federal Institutes of Technology Domain that have published on greenspace management (Fischer et al., 2020). In orange is represented the partnership between the Natural environment Research Council, UK Research and Innovation, and Nerc British Geological Survey, which published a work on urban groundwater (Ó Dochartaigh et al., 2017). The following three-node network is coloured pink and is made up of Polytechnic University of Turin, University of Catania, and University of Palermo who created a paper on energy efficiency of public building (Napoli et al., 2020).

The last partnerships analysed are composed of two affiliations each, with purple representing the collaboration between Università Mediterranea di Reggio Calabria and Università Kore di Enna, which published a paper on smart tools for an energy resilient city (Moraci et al., 2018b). The partnership between the Bucharest University of Economic Studies and the Romanian Academy of Sciences, which wrote about the efficiency of urban development (Maricuț et al., 2023), is highlighted in grey.

4.4 Analysis of Literature

In this subsection, aspects such as the summarisation of the most cited articles, together with the most frequently encountered expressions, but also the grouping of the themes addressed by the authors according to the interest given to them, will be discussed.

Table 3. Brief summary of the content of top 10 most global cited documents

No.	Paper (First Author, Year, Journal, Reference)	Total citations (TC)	Title	Purpose
1	Martin CJ, 2018, Technol Forecast Soc (Martin et al., 2018)	337	Smart and sustainable? Five tensions in the visions and practices of the	It presents a review of the specialised literature on the subject of smart cities, following which differences in vision between smart cities and the SDGs are identified. It also presents ways in

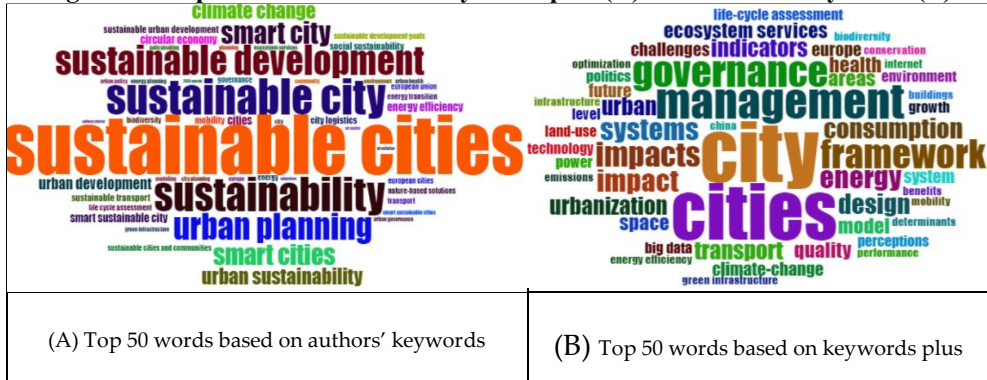
No.	Paper (First Author, Year, Journal, Reference)	Total citations (TC)	Title	Purpose
			smart-sustainable city in Europe and North America	which urban developers, together with municipalities and citizens, can address these differences with the help of digital technology specialists.
2	Akande A, 2019, Sustain Cities Soc (Akande et al., 2019a)	335	The Lisbon ranking for smart sustainable cities in Europe	The paper presents a ranking of a number of 28 European capitals using principal component analysis and hierarchical algorithms for clustering based on a number of 32 indicators regarding their sustainability.
3	Carlsson-Kanyama A, 2008, Futures (Carlsson-Kanyama et al., 2008)	147	Participative backcasting: A tool for involving stakeholders in local sustainability planning	The study involves the identification of some methods to involve local stakeholders in long-term sustainability discussions. Among their proposals were identified the need for local and organic food, an improved public transport in which to find ways of nonmotorised transport, as well as a greener environment.
4	Phillis YA, 2017, Comput Environ Urban (Phillis et al., 2017)	137	Urban sustainability assessment and ranking of cities	The research wants to evaluate a number of 106 cities based on a number of 46 socioeconomic and environmental indicators to measure urban sustainability based on a fuzzy logic.
5	Haarstad H, 2017, J Environ Pol Plan (Haarstad, 2017)	99	Constructing the sustainable city: examining the role of sustainability in the 'smart city' discourse	The article presents the role of sustainability in smart cities starting from the EU and reaching a local setting, the city of Stavanger in Norway. According to what will be illustrated in the paper, smart cities are realised through technology, innovation, and economic entrepreneurialism, without sustainability appearing to be a significant factor.
6	Harris S, 2020, J Clean Prod (Harris et al., 2020)	83	Low carbon cities in 2050? GHG emissions of European cities using production-based and consumption-based emission	The article debates the role of competent authorities in cities to reduce the amount of carbon, because, they say, cities and their supply chains produce approximately 80% of global energy consumption and more than 60% of greenhouse gas emissions. The paper presents, based on ten European cities,

No.	Paper (First Author, Year, Journal, Reference)	Total citations (TC)	Title	Purpose
			accounting methods	two scenarios for the year 2050, with 2010 as the base year.
7	Kaklauskas A, 2018, Cities (Kaklauskas et al., 2018)	70	Quality of city life multiple criteria analysis	The article involves the analysis of the quality of life in European cities comparing the results obtained by applying the INVAR method with the Quality-of-Life Index, also offering recommendations for the cities based on the analysed indicators.
8	Nilsson A, 2018, Energ Buildings (Nilsson et al., 2018)	68	Smart homes, home energy management systems and real-time feedback: Lessons for influencing household energy consumption from a Swedish field study	The research involves studying the impact of Home Energy Management Systems on energy consumption, identifying obstacles to energy consumption behavioural change, and also recommending policies. Following a study of 154 households in a district of Stockholm for a period of one year, the results showed that energy consumption varies significantly from one house to another.
9	Martin C, 2019, Sustain Cities Soc (Martin et al., 2019)	67	Smart-sustainability: A new urban fix?	The study presents the role of urban policy in creating sustainability through smart urban development. Based on the literature on sustainable and smart cities, the authors present ways to integrate environmental and digital initiatives through entrepreneurial forms of urban governance.
10	Torabi Moghadam S, 2018, Sustain Cities Soc (Torabi Moghadam et al., 2018)	64	A GIS-statistical approach for assessing built environment energy use at urban scale	The research presents a geospatial bottom-up statistical model to estimate the energy consumption of an Italian city, analysing approximately 3600 residential buildings.

Source: authors' own work.

Even if Table 10 analyses the situation of the 10 most cited articles, it is noted that the topics discussed in them are consistent with those found in Figures 13 and 14, energy consumption and its planning being the subject of discussion in several of the analysed articles. Furthermore, sustainable urban planning is debated, as well as the quality of life found in these cities, along with the role of governance and technology in the adoption of sustainable cities.

Figure 13. Top 50 words based on keywords plus (A) and authors' keywords (B)



Source: authors' own work using Biblioshiny.

As expected, the most frequent keywords are those chosen when retrieving the dataset of articles, so that sustainable cities is the most common keyword, followed by sustainable city, sustainability, sustainable development, urban planning, smart cities, and climate change. While Figure 13 (B) shows that the most frequent keywords-plus are city and cities, followed by management, governance, systems, impact, energy, etc. Regarding the most common expressions found in the abstracts, it is noted that sustainable cities and sustainable development appeared more than 100 times each, followed by phrases such as climate change, smart or sustainable city, urban development or urban planning, sustainable urban, smart cities, and European cities.

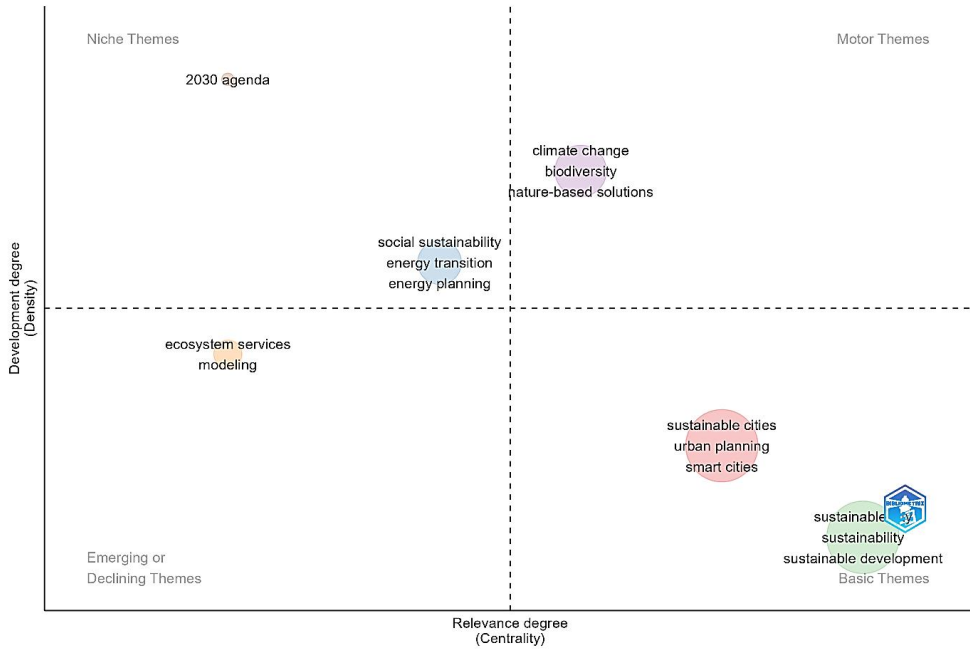
Table 4. Top 10 most frequent bigrams and trigrams in abstracts

Bigrams	Occurrences	Trigrams	Occurrences
sustainable cities	128	sustainable development goals	30
sustainable development	116	sustainable urban development	15
climate change	62	development goals sdgs	12
smart city	61	greenhouse gas emissions	12
sustainable city	60	europaean green deal	9
urban development	55	smart sustainable cities	9
europaean cities	52	nations sustainable development	8
smart cities	49	sdg sustainable cities	8
urban planning	48	smart sustainable city	8
sustainable urban	42	united nations sustainable	8

Source: authors' own work.

Table 4 also shows the most used trigrams, namely sustainable urban development, greenhouse gas emission, European green deal etc.

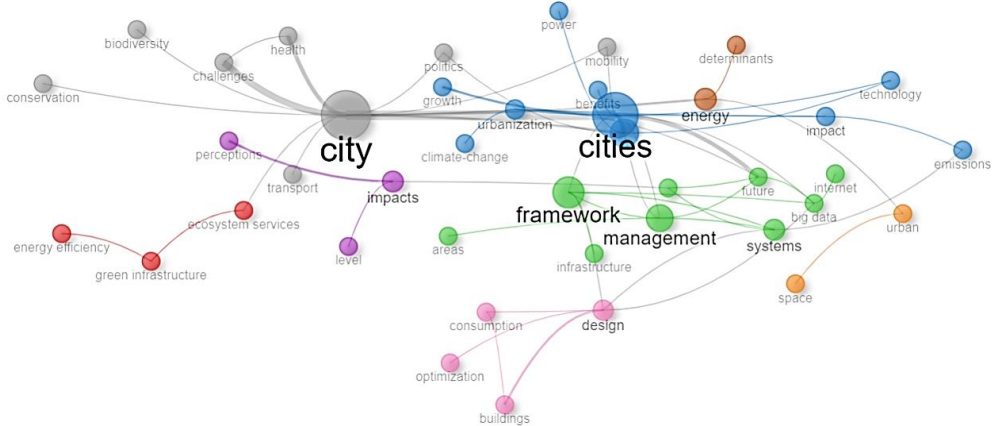
Figure 14. Thematic map – keywords



Source: authors’ own work using Biblioshiny.

Regarding the framing of the themes addressed by the authors’ keywords in the analysed articles, it is found that the basic themes are related to sustainable development and sustainable cities, while the motor themes focus on climate and environmental actions. Niche themes address topics such as Agenda 2030, social sustainability, and energy transition. As for the emerging themes, according to Figure 14, ecosystem services and modelling can be found.

Figure 15. Co-occurrence network - keywords plus



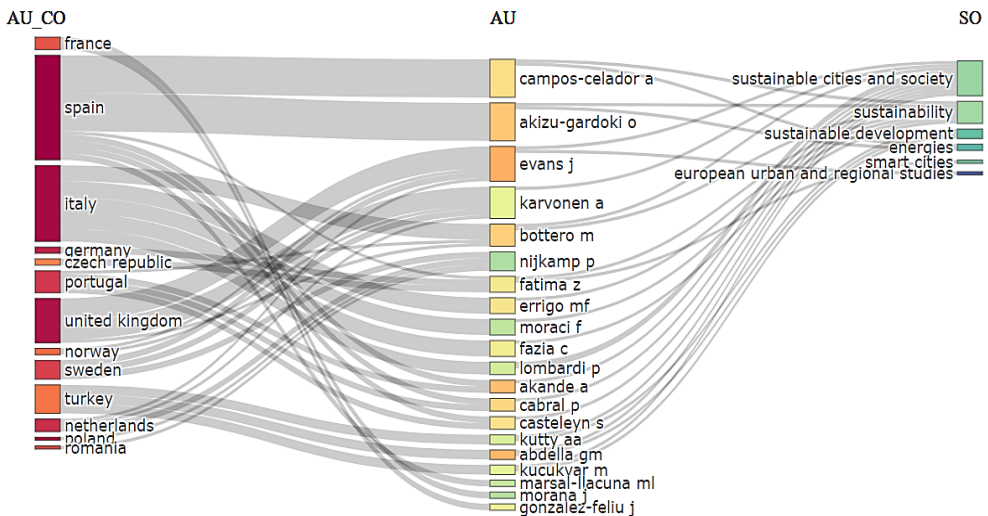
Source: authors’ own work using Biblioshiny.

Concerning the appearance of the keywords plus in the problematisation of sustainable cities, notions such as biodiversity, health, policies, transport are discussed. Another focus is on energy efficiency and green infrastructure, while the impact on the future focuses on systems, the internet, and big data. An additional approach is represented by optimising the design of buildings to limit the consumption of resources.

4.5 Mixed Analysis

The last subsection of the chapter dedicated to the results represents a cross-analysis between the 20 most productive authors and the country from which they are affiliated, together with the names of their affiliations and the main sources in which they chose to publish their papers, as well as the keywords selected by them to describe his research.

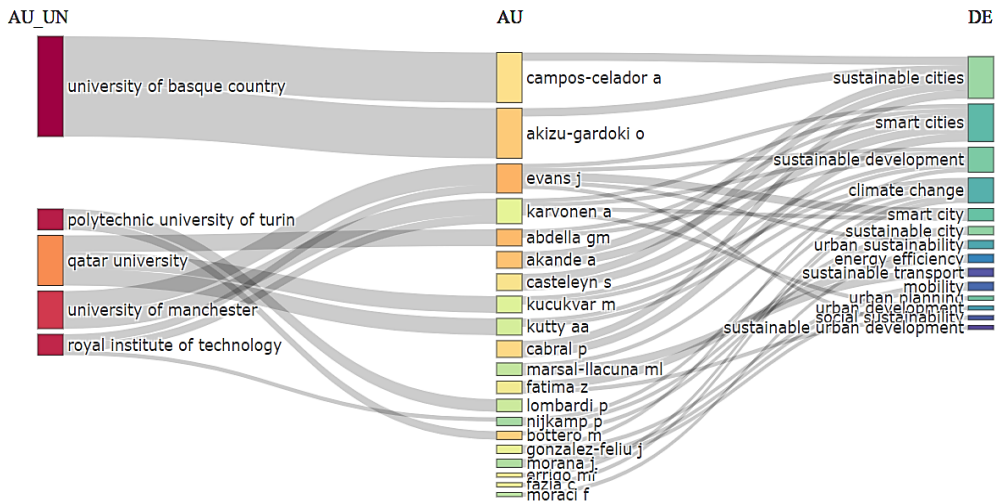
Figure 16. Three-fields plot: countries (left), authors (middle), journals (right)



Source: authors' own work using Biblioshiny.

According to Figure 16, most of the most productive authors come from countries such as Spain, Italy, United Kingdom, and Turkey. Other representative countries for these authors are France, Germany, the Czech Republic, Portugal, Norway, Sweden, the Netherlands, Poland, and Romania. The sources in which these authors have chosen to publish their work are Sustainable Cities and Society, Sustainability, Sustainable Development, Energies, Smart Cities, and European Urban and Regional Studies.

Figure 17. Three-fields plot: affiliations (left), authors (middle), keywords (right)



Source: authors' own work using Biblioshiny.

Figure 17 shows the affiliations of the 20 most productive authors, noting the University of the Basque Country, Qatar University, University of Manchester, Royal Institute of Technology, and Polytechnic University of Turin. Furthermore, among the most used keywords are sustainable cities, smart cities, sustainable development, climate change, smart and sustainable cities etc.

Throughout the current research, data has been highlighted regarding: the sources with the greatest inclination to publish such topics, the authors who have studied the phenomenon of sustainable cities in Europe, the most used keywords to describe these researches, thus noting some practical implications that should remain in the readers' minds. First of all, the tendency of the authors to introduce local stakeholders into the discussions about the sustainability of the cities they are part of was observed. Another element refers to the use of digital innovations, big data, and IoT in capitalising on solutions regarding the creation of sustainable and resilient cities. The impact of cities on the environment and their high energy consumption is also highlighted, discussing finding solutions to reduce pollution and reduce the use of resources, but also the mentality of citizens because change must start from those who live in the environments urban.

5. Conclusions

The role of the current research consisted of studying the specialised literature on the topic of sustainable cities in Europe in order to identify the sources that issued the most papers related to this topic, observing that Sustainability journal presents the leading position with 49 published articles, being followed by Sustainable Cities and Society with 15 papers. Moreover, among the countries whose researchers have studied this phenomenon most intensively are Spain, Italy, the United Kingdom, Poland etc., while the countries outside the continent that collaborated

in the writing of the most articles related to sustainable European cities are United States and China. With regard to the studies presented by the 10 most cited articles, the authors pointed out their inclination towards reducing pollution and energy consumption, as well as improving the quality of life, or integrating local stakeholders in decision-making processes to promote long-term sustainability in the urban environment. The connection between sustainable cities and climate change, greenhouse gas emissions, urban planning, and energy planning was found to facilitate the transition to a green economy, studying nature-based solutions and using technology, the Internet, and big data to preview the future of infrastructure cities. Like any other study, there are certain limitations in this case as well. For the current research, the limitations appear based on the choice of words by which the articles were searched, but also based on the exclusion criteria; thus, any changes to them would have represented a different dataset. However, we chose to study only those articles that debate the issue of sustainable cities in Europe because the number of published works on sustainable cities exceeded 5200 documents, which is a much too large amount of information to be examined in detail.

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**The Governance Profile of European Countries
and Key Banking Indicators – A Causality Analysis**

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Abstract

The study documents a significant relationship in terms of causality between country-level governance indicators (as a component of ESG) and main banking system indicators by relying on a sample of European Union countries that exhibit a temperate climate profile. Granger causality test is used to assess the link between banking system and country governance, in terms of a cause-effect framework. The findings show that the influence of country governance performance on banking activity is most pronounced in Belgium, Portugal, and Spain while in the Netherlands, France, Greece, and Italy the interplay is relatively balanced. Banking system indicators that appear to precede changes in governance ones in most countries are related to bank credit to bank deposits, bank deposits to GDP, and bank non-performing loans to gross loans. Bilateral causality is present mostly in Greece and Spain, the control of corruption and bank non-performing loans being the variables most often included in the causal link.

Keywords: ESG, governance, banking system, causality analysis.

JEL Classification: C10, G21, G38.

1. Introduction

Since the founding of the United Nations (UN) in 1945, it has sponsored and created several global initiatives related to social, economic, and environmental issues. According to Thérien (2006), the 1990s witnessed the most notable changes in UN practices related to economic and social issues. Consequently, the UN laid the basis for the first initiative to create the term ESG in 1999. After the launch of the UN Global Compact, the need for more harmonising efforts has increased, which is why the UN invited the world's leading financial institutions in 2004 to join

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the new initiative “Who Cares Wins”. Under the aegis of this initiative, a report was published using the new term ESG, in addition to substantiating several recommendations for policymakers and financial practitioners (Pollman, 2022). Later, many other initiatives aimed to provide more opportunities for asset managers and investors to increase their understanding of the concept and risks of ESG, leading to the integration of ESG with investment decisions and the implementation of ESG issues in the functioning of financial markets (IFC, 2004). But that was not sufficient; there was an increasingly greater need to raise awareness of the risks of ESG.

The official discourse around ESG focusses not only on the proper classification of ESG factors, but also on pointing out the exposure to a new category of risk, namely the ESG risks.

In this respect, the European Banking Authority is defining ESG risks as the risks that stem from any negative (current or prospective) impact of the ESG factors on the financial institutions by affecting counterparties or invested assets, which will further impact the financial performance, liquidity, or solvency of the individual financial entity. Consequently, the occurrence of ESG risks through core financial institution activities overlaps the traditional categories of financial risks; therefore, ESG risks, from a prudential perspective, represent the negative materialisation of ESG factors (EBA, 2021b).

The focus of this paper is on the governance dimension of the ESG concept, to reveal whether there is a causal relationship between good governance in a country and selected key banking indicators. When considering country-level governance indicators, we followed the acceptance provided by the European Banking Authority: Governance risks are mostly related to the financial impacts of fraud, bribery, corruption, or poor executive leadership (EBA, 2021a). This definition is complemented by the one proposed by the International Finance Corporation (Valcin et al., 2021) for the governance component of the ESG: it refers to the structure and processes of corporate governance, which guide, control, and adjust the company’s activity (e.g., risk management framework, board composition and structure, internal code of ethical conduct), including specific governance procedures for the implementation of basic social and environmental policies.

The analysis carried out in this article delineates the existing literature in several ways. First, the objective of the research is to validate the presence of a causal relationship between the main country-level institutional indicators (governance) and the key indicators of the banking system that account for bank competition, profitability, operational efficiency, liquidity, capitalisation, quality of the loan portfolio, and size of the banking sector from the standpoint of deposits collected (the deposit growth). This approach is meant to show whether the governance environment in the home country determines the development of banking activity, or vice versa. Second, we conduct a country-level granular analysis considering a selection of European countries. The sample is chosen based on the climatic profile of the countries designated by the World Bank sovereign ESG data portal. In particular, we envisaged only European countries that were included in the category of a temperate profile. Our choice is substantiated in the findings of

a European Commission (2008) report stating that climate challenges are not evenly distributed across European countries and that some particular regions appear to be more exposed to this asymmetric impact. By considering only the temperate-climate countries, we account for a homogeneous sample and increase the comparability of the results among them.

The structure of the paper is as follows: the second section overviews existing related research, the third one describes the range of variables employed, the fourth section presents the findings of the Granger causality test, and the last one concludes.

2. Literature Review

In recent years, the global interest in the ESG criteria has increased. This considerable attention was based in part on three main factors:

- the findings of recent studies / analyses / reports belonging to researchers and the financial industry suggest that investing in ESG activates suitable development conditions, being able to improve several indicators such as returns and better risk management;
- the social attention: growing awareness of the risks related to climate change, the benefits of responsible investments, the growing need for diversity in the board and workplace, assuming that social values will lead to a positive impact on company performance;
- the sustainability perspective: many financial institutions nowadays target a longer-term perspective, and move away from a short-term one in terms of envisaged returns and risk appetite, which reflect a pattern of sustainability embedded into the conduct of the business model and the associated investment performance (Boffo & Patalano, 2020).

A recent EU regulation defines ESG factors as sustainability factors and emphasises that the environmental, social and employee matters like respect of human rights, antibribery, and anticorruption, represent important sustainability factors (European Commission, 2019).

In shedding light of the importance of ESG-related risks assessment, which represents a key priority for both decision makers, central banks, and financial market players, the European Banking Authority (EBA) has set several priorities on sustainable finance and activities related to ESG risks management. For example, to estimate the potential effect of climate risks on banking activity and reliably map the banks' exposures, in 2020 EBA launched a pilot learning exercise as a valuable tool that complements the other quantitative and qualitative approaches employed by EBA to assess ESG risks (EBA, 2021c).

Although several articles and reports refer to the importance of implementation and taking into account ESG factors in all business decisions made by intermediaries in financial markets, they still remain a challenge for contemporary financial markets (Zorlu, 2018).

A review of the literature indicates two main research strands, namely the influence of a country's ESG performance on economic growth and, respectively, the effect of ESG on banking system activity. For example, Wang et al. (2023) argue

that “the economic benefits of country-level ESG performance are most pronounced in countries with bank-based financial systems”. Menicucci and Paolucci (2023) investigate the influence of environmental performance, social responsibility, and corporate governance (ESG) dimensions on banking system performance in a country-level case-study approach. They claim that the environmental dimension of ESG exerts the most significant impact on banking profitability, and reveal significant positive relationship between waste and emission reductions (as proxies for the environmental component) and ROE and ROA.

In general, empirical findings are mixed because some studies address a sample of countries, while others represent a case study for a single country. In terms of the study coverage, some employ the aggregate value of ESG, while others prefer to test the various dimensions of ESG policies at a disaggregated level.

3. Data and Sample Selection

The banking system data used in the study come from the World Bank Global Financial Development database and consist of the following key indicators: bank concentration, bank cost-to-income ratio, bank deposits to GDP, credit/deposit ratio, nonperforming loans to gross loans, regulatory capital to risk-weighted assets, ROA and ROE. The country governance indicators are summarised in Table 1. Being constrained by the country sustainability data, our sample period ranges from 1997 to 2021. The sample of countries included in the category of temperate climate profile is represented by: Belgium, France, Greece, Italy, the Netherlands, Portugal, and Spain.

Table 1. List of selected governance indicators for the G dimension of the ESG concept

Governance indicator	Description	Source of the data
Control of Corruption	the extent to which public power is exercised for private gain, including petty and corruption, as well as “capture” of the state by elites and private interests.	World Bank ESG indicators
Political Stability and Absence of Violence/Terrorism	the likelihood of political instability and/or politically-motivated violence	World Bank ESG indicators
Ratio of female to male labour force participation rate	labour force participation rate of women	World Bank ESG indicators
Regulatory Quality	government ability to formulate and implement sound policies and regulations that promote private sector development	World Bank ESG indicators
Rule of Law	the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts	World Bank ESG indicators

Source: World Bank ESG Data Portal.

The Granger causality test is employed as a statistical method to verify the causal relationship between pairs of variables to understand particular interactions between a set of time series (Shojaie and Fox, 2022). In particular, it tests “whether one variable in a linear relation can be meaningfully described as a dependent variable and the other variable as an independent variable, whether the relation is bidirectional, or whether no functional relation exists at all” (Stern, 2004). In other words, the findings reveal whether changes in a given variable precede those of the other. A complementary definition is that 'testing for Granger causality relies on estimating the capacity of dynamics in one-time series to forecast dynamics in another' (Oravec and Vandekerckhove, 2023).

4. Causality analysis on countries’ governance performance and banking indicators

We distinctly analyse the causal relationship between the governance component and key banking indicators for each country in the sample. Table 2 synthesises only the statistically significant relationships identified between pairs of variables.

Table 2. Banking system indicators and country-level governance performance

Country	Granger test relationship	Obs.	F-statistic	Prob.
Belgium	Rule of law does not Granger cause ROA	18	5,28	0,0209
	Rule of law does not Granger cause ROE	18	4,26	0,037
	Control of corruption does not Granger cause bank concentration	18	4,72	0,028
	Rule of law does not Granger cause bank concentration	18	3,93	0,046
	Bank credit to bank deposits (%) does not Granger cause control of corruption	18	2,903	0,0907
	Bank credit to bank deposits (%) does not Granger cause Political Stability and Absence of Violence/Terrorism	18	4,44	0,034
	Bank credit to bank deposits (%) does not Granger cause Regulatory Quality	18	5,07	0,023
	Rule of Law does not Granger cause bank credit to bank deposits (%)	18	3,54	0,062
	Bank non-performing loans to gross loans (%) does not Granger cause regulatory quality	17	5,35	0,021
	Rule of law does not Granger cause Bank non-performing loans to gross loans (%)	17	6,11	0,015
	Ratio of female to male labour force participation rate does not Granger	21	3,76	0,046

Country	Granger test relationship	Obs.	F-statistic	Prob.
	cause bank regulatory capital to risk-weighted assets			
	bank regulatory capital to risk-weighted assets (%) does not Granger cause regulatory quality	17	4,06	0,045
France	Bank concentration does not Granger cause control of corruption	18	4,64	0,0301
	Ratio of female to male labour force participation rate does not Granger cause bank concentration	20	3,97	0,041
	Bank credit to bank deposits (%) does not Granger cause Political Stability and Absence of Violence/Terrorism	18	3,46	0,062
	Bank deposits to GDP (%) does not Granger cause regulatory quality	17	3,34	0,071
	Rule of law does not Granger cause bank non-performing loans to gross loans (%)	16	3,74	0,057
	Regulatory quality does not Granger cause ROA	20	3,01	0,079
	ROE does not Granger cause rule of law	17	3,49	0,064
Greece	Bank concentration does not Granger cause control of corruption	16	9,71	0,0037
	Ratio of female to male labour force participation rate (%) does not Granger cause bank concentration	16	6,09	0,02
	Regulatory quality does not Granger cause bank concentration	16	5,13	0,027
	Bank concentration does not Granger cause regulatory quality	16	3,07	0,086
	Bank concentration does not Granger cause rule of law	16	4,82	0,031
	Control of corruption does not Granger cause bank cost to income ratio (%)	16	3,85	0,053
	Bank cost to income ratio (%) does not Granger cause control of corruption	16	8,23	0,006
	Ratio of female to male labour force participation rate (%) does not Granger cause bank credit to bank deposits	19	6,65	0,009
	Regulatory quality does not Granger cause bank credit to bank deposits	18	3,11	0,078

Country	Granger test relationship	Obs.	F-statistic	Prob.
	Rule of law does not Granger cause bank credit to bank deposits (%)	18	2,94	0,088
	Bank credit to bank deposits (%) does not Granger cause rule of law	18	2,97	0,086
	Control of corruption does not Granger cause bank non-performing loans to gross loans (%)	17	4,13	0,043
	Bank non-performing loans to gross loans (%) does not Granger cause control of corruption	17	4,47	0,035
	Political Stability and Absence of Violence/Terrorism does not Granger cause bank non-performing loans to gross loans	17	3,93	0,048
	Ratio of female to male labour force participation rate does not Granger cause bank non-performing loans to gross loans	21	3,27	0,064
	Regulatory quality does not Granger cause bank non-performing loans to gross loans (%)	17	9,93	0,003
	Bank deposits to GDP (%) does not Granger cause ratio of female to male labour force participation rate (%)	19	6,82	0,008
	Bank deposits to GDP does not Granger cause regulatory quality	18	4,65	0,03
	Ratio of female to male labour force participation rate does not Granger cause bank regulatory capital to risk-weighted assets	21	4,85	0,023
	Bank regulatory capital to risk-weighted assets (%) does not Granger cause ratio of female to male labour force participation rate	21	5,44	0,015
	Bank regulatory capital to risk-weighted assets (%) does not Granger cause regulatory quality	17	9,05	0,004
Italy	Political Stability and Absence of Violence/Terrorism does not Granger cause ROA	18	6,36	0,012
	Political Stability and Absence of Violence/Terrorism does not Granger cause ROE	18	3,16	0,076
	Regulatory quality does not Granger cause bank concentration	18	2,93	0,089

Country	Granger test relationship	Obs.	F-statistic	Prob.
	Bank concentration does not Granger cause rule of law	18	4,56	0,031
	Regulatory quality does not Granger cause bank cost to income ratio (%)	18	4,65	0,029
	Bank cost to income ratio does not Granger cause rule of law	18	10,06	0,002
	Bank credit to bank deposits (%) does not Granger cause control of corruption	18	7,34	0,007
	Ratio of female to male labour force participation rate (%) does not Granger cause bank credit to bank deposits (%)	19	2,81	0,093
	Regulatory quality does not Granger cause bank credit to bank deposits (%)	18	4,12	0,041
	Bank deposits to GDP does not Granger cause Political Stability and Absence of Violence/Terrorism	18	2,77	0,099
	Bank deposits to GDP does not Granger cause regulatory quality	18	4,28	0,037
	Bank non-performing loans to gross loans (%) does not Granger cause control of corruption	17	4,55	0,334
	Political Stability and Absence of Violence/Terrorism does not Granger cause bank non-performing loans to gross loans	17	4,17	0,042
	Bank non-performing loans to gross loans (%) does not Granger cause Political Stability and Absence of Violence/Terrorism	17	3,96	0,047
	Rule of law does not Granger cause bank regulatory capital to risk-weighted assets	17	8	0,006
Netherlands	Bank credit to bank deposits (%) does not Granger cause ratio of female to male labour force participation rate (%)	20	5,23	0,035
	Ratio of female to male labour force participation rate (%) does not Granger cause bank deposits to GDP (%)	20	3,6	0,075
	Bank deposits to GDP (%) does not Granger cause regulatory quality	19	5,75	0,029

Country	Granger test relationship	Obs.	F-statistic	Prob.
	Rule of law does not Granger cause bank concentration (%)	19	3,18	0,094
	Control of corruption does not Granger cause bank cost to income ratio (%)	19	18,99	0,0005
	Bank cost to income ratio (%) does not Granger cause control of corruption	19	3,11	0,097
	Regulatory quality does not Granger cause bank cost to income ratio (%)	19	7,04	0,017
	Control of corruption does not Granger cause bank non-performing loans to gross loans (%)	14	4,01	0,07
	Bank regulatory capital to risk-weighted assets (%) does not Granger cause regulatory quality	18	3,84	0,068
	Bank regulatory capital to risk-weighted assets (%) does not Granger cause rule of law	18	4,05	0,063
	Political Stability and Absence of Violence/Terrorism does not Granger cause ROA	19	5,13	0,037
	Portugal	Regulatory Quality does not Granger cause Bank cost to income ratio (%)	18	4,45
Control of Corruption does not Granger cause Bank concentration (%)		18	4,84	0,026
Ratio of female to male labour force participation rate (%) does not Granger cause Bank concentration (%)		20	3,07	0,076
Bank concentration (%) does not Granger cause rule of law		18	2,95	0,088
Control of corruption does not Granger cause Bank credit to bank deposits (%)		18	3,87	0,047
Bank credit to bank deposits (%) does not Granger cause Political Stability and Absence of Violence/Terrorism		18	3,81	0,05
Bank credit to bank deposits (%) does not Granger cause Ratio of female to male labour force participation rate (%)		19	2,82	0,093
Regulatory quality does not Granger cause Bank credit to bank deposits (%)		18	3,52	0,06

Country	Granger test relationship	Obs.	F-statistic	Prob.
	Bank non-performing loans to gross loans (%) does not Granger cause Political Stability and Absence of Violence/Terrorism	14	14,04	0,002
	Ratio of female to male labour force participation rate (%) does not Granger cause Bank regulatory capital to risk-weighted assets (%)	21	4	0,038
	Regulatory quality does not Granger cause ROE	18	8,82	0,004
Spain	Political Stability and Absence of Violence/Terrorism does not Granger cause Bank concentration (%)	18	4,64	0,03
	Ratio of female to male labour force participation rate (%) does not Granger cause Bank concentration (%)	20	5,12	0,02
	Bank cost to income ratio (%) does not Granger cause Control of Corruption	18	4,57	0,031
	Political Stability and Absence of Violence/Terrorism does not Granger cause Bank cost to income ratio (%)	18	3,38	0,065
	Ratio of female to male labour force participation rate (%) does not Granger cause Bank cost to income ratio (%)	20	6,25	0,01
	Bank cost to income ratio (%) does not Granger cause Ratio of female to male labour force participation rate (%)	20	5,57	0,015
	Regulatory quality does not Granger cause Bank cost to income ratio (%)	18	6,26	0,012
	Rule of law does not Granger cause Bank cost to income ratio	18	6,4	0,012
	Control of Corruption does not Granger cause Bank credit to bank deposits (%)	18	3,38	0,065
	Bank credit to bank deposits (%) does not Granger cause Control of Corruption	18	2,78	0,098
	Bank credit to bank deposits (%) does not Granger cause Political Stability and Absence of Violence/Terrorism	18	4,17	0,039
	Ratio of female to male labour force participation rate (%) does not	19	4,35	0,034

Country	Granger test relationship	Obs.	F-statistic	Prob.
	Granger cause Bank credit to bank deposits (%)			
	Regulatory quality does not Granger cause Bank credit to bank deposits (%)	18	5,35	0,021
	Bank deposits to GDP (%) does not Granger cause Ratio of female to male labour force participation rate (%)	19	5,07	0,022
	Bank non-performing loans to gross loans (%) does not Granger cause Political Stability and Absence of Violence/Terrorism	17	2,87	0,095
	Bank non-performing loans to gross loans does not Granger cause Ratio of female to male labour force participation rate	21	3,33	0,061
	Ratio of female to male labour force participation rate (%) does not Granger cause Bank regulatory capital to risk-weighted assets (%)	21	3,77	0,045
	Bank regulatory capital to risk-weighted assets (%) does not Granger cause Ratio of female to male labour force participation rate (%)	21	2,75	0,094
	Rule of law does not Granger cause Bank regulatory capital to risk-weighted assets (%)	17	3,5	0,063
	Political Stability and Absence of Violence/Terrorism does not Granger cause ROA	18	3,37	0,066
	Political Stability and Absence of Violence/Terrorism does not Granger cause ROE	18	3,12	0,078
	ROE does not Granger cause Political Stability and Absence of Violence/Terrorism	18	3,42	0,064

Source: authors, by using EViews software.

The findings reveal that the five indicators used as a proxy for the governance dimension exhibit a causal relationship with the banking indicators, in each of the countries considered. Most causality relationships have been identified for Spain (22) and Greece (21), followed by Italy (15), Belgium (12), Portugal, and the Netherlands (11) while France shows only seven statistically significant causal links. By having a closer look at the indicator type, we uncover that change in governance indicators seem to act as the prevailing determinant for banking indicators in

Belgium, Portugal and Spain (therefore, change in governance is the cause and banking indicators developments are the effect), while in Netherlands, France, Greece and Italy the interplay is relatively balanced between governance and banking indicators.

Bilateral causality has been identified between regulatory quality and bank concentration (in Greece), control of corruption and bank cost-to-income ratio (in Greece, the Netherlands), rule of law and bank credit to bank deposits (in Greece), control of corruption and bank nonperforming loans to gross loans (in Greece), control of corruption and bank credit to bank deposits (in Spain), political stability and absence of violence/terrorism and bank nonperforming loans to gross loans (in Italy), ratio of female to male labour force participation rate and bank cost-to-income ratio (in Spain), ratio of female to male labour force participation rate and bank regulatory capital to risk-weighted assets (in Spain).

Banking system indicators that appear to precede changes in governance ones (unilateral relationship) are related to: bank credit to bank deposits (Belgium, France, Italy, Netherlands, Portugal, Spain), bank deposits to GDP (France, Greece, Italy, Netherlands, Spain), bank non-performing loans to gross loans (Belgium, Greece, Italy, Portugal, Spain), bank regulatory capital to risk-weighted assets (Belgium, Greece, Netherlands), bank cost to income ratio (Greece, Italy, Spain), bank concentration (France, Greece, Italy, Portugal), ROE (France, Spain).

As for the opposite relationship (governance – banking), changes in banking profitability indicators (ROA and ROE) are influenced by previous governance changes in nine cases (for Belgium, France, Italy, Netherlands, Portugal, Spain), changes in bank concentration occur in 11 cases (Belgium, France, Greece, Italy, Netherlands, Portugal, Spain), changes in bank cost-to-income ratio occur in nine cases (Greece, Italy, Netherlands, Portugal), changes in bank nonperforming loans appear in 8 cases (for Belgium, France, Italy, Greece, and Netherlands), changes in bank credit to bank deposits are triggered in 11 cases (Belgium, Greece, Italy, Portugal, Spain), changes in bank regulatory capital to risk-weighted assets occur in six cases (Belgium, France, Greece, Italy, Netherlands, Portugal, Spain), while changes in bank deposits to GDP seem to be determined by governance indicators in only one case (Netherlands).

5. Conclusions

ESG issues have become one of the top priorities of the financial institutions, being primarily motivated by the demands of government bodies, banking regulators and supervisors or shareholders, which further led to changes in the business strategy and value creation in both financial and non-financial indicators because of the demand for publishing ESG and other non-financial reports (Annandale et al., 2022).

Statistical findings validate our initial assumption of the interaction between the governance dimension and several key indicators of the banking system. Each of the five governance indicators and each of the eight banking indicators appears to influence them or to be influenced. Bilateral causality is present mostly in Greece and Spain, the control of corruption and bank non-performing loans being the

variables most often included in the causal link. Except for bank deposits in GDP, all banking indicators belonging to the Italian banking system are determined by previous changes in the country's governance indicators. A similar situation exists for the Netherlands, all its banking indicators, apart from bank credit to bank deposits, are being impacted by changes in governance.

Although the direction of this relationship (positive or negative) is not one of the outcomes of the Granger causality test, there is robust evidence of the interaction between a country's compliance with the regulatory framework and the rule of law, corruption management, political stability, and gender balance (through female labour force participation rate) and key banking indicators related to competition, profitability, capital adequacy, liquidity, efficiency, credits, and deposits managed.

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**Quantitative Dimensions of Yield Curve Dynamics
in Post-Pandemic Environment – The Case of Romania**

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Abstract

The purpose of the research is to explore the characteristics in the dynamics of the Romanian government bond yield curve during the post-pandemic period and to reveal the related expectations for the development of the Romanian economy. Its results show that the Romanian government bond market begins the analysed period with clear positive expectations for the country's economic growth, but ends it with projections for short-term economic slowdown at a moderate reduction of inflation. The study also reveals that in the behaviour of the Romanian government bond market there are two distinct segments influenced by different economic factors – one in the maturity spectrum 6 months–1 year and the other in the maturity range between 2 and 10 years. The results from conducted principal component analysis show that the most important factor of the dynamics in the studied yield curve is inflation with a contribution of 88.16%, followed by economic growth and the type of the monetary policy with weights of 8.89% and 1.33% respectively. In turn, the direction of influence of these factors reveals that in the post-pandemic period, portfolios of Romanian government bonds with maturities between 2 and 10 years can be successfully hedged against interest rate risk even using duration-based techniques alone.

Keywords: Romanian government bond market, government bonds, yield curve, yield curve dynamics, principal component analysis.

JEL Classification: G10, G12, G15, H60, H74.

1. Introduction and Literature Review

The modern history of the Romanian government bond market began relatively long ago in 1994. However, it can be defined as relatively new against the background of the developed European and global debt markets. Quite in tune with

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this statement is the fact that, for its existence so far, the Romanian government bond market has gone through various different stages of development related to its creation and establishment, increasing transparency, growing investor interest, its institutional development, and its modern functioning. It is the existence of these stages that practically shows the degree of development of the Romanian government bond market and largely directs and determines the scientific interest of the academic community, mainly from Romania, in its exploration. In addition, the different dimensions in the development of this bond market also determine the depth of available studies that reveal its main characteristics. For example, the first in-depth scientific study that clarifies the characteristics, development prospects, and possible ways to transform the Romanian government bond market into a credible and liquid bond market is that of Pop et al. (2012). A descriptive analysis by Pop and Georgescu from 2013 reveals the attributes of the treasury bond market segment of Bucharest Stock Exchange for the period 2008-2012 and identifies low transparency, the lack of reliable financial information, and weak institutional flexibility as the main factors hindering positive development on the secondary government bond market in Romania (Pop & Georgescu, 2013). The conducting of these studies can be defined as belated against the background of the first significant studies of other segments of the bond market in Romania such as that of municipal bonds and corporate bonds, which were first investigated, respectively, by Pop and Dumbrava (2004) and by Corduneanu and Milos (2008). However, there is a very important reason for this delay. It is related to the lack of adequate, detailed, and reliable data on the issuance of Romanian government bonds in the reports of the Romanian Ministry of Finance until mid-2007, which does not allow effective analyses. Gradually, however, the increased interest in government bond investments since the outbreak of the global financial and economic crisis of 2008-2009, combined with the possibility for trading of Romanian government bonds on the Bucharest Stock Exchange since August 2008, surged the popularity of the Romanian government bond segment. The increased attractiveness of Romanian government bonds among the investors, together with the policy change of the Romanian Ministry of Finance, leads to feeding the scientific community with appropriate data, enabling adequate scientific research. However, to date, the government bond market has a lower popularity among the scientific community in Romania against the background of the municipal and corporate bond markets in the country. Thus, for example, in recent years, only publications of Oprea (Oprea, 2019; Oprea, 2022) have addressed various aspects related to the bonds issued by the Romanian government. Of these, only the second one analyses the possibilities of building relative value investment strategies on the Romanian government bond market by studying the behaviour of an important economic and market indicator such as its yield curve for the period between March 2019 and March 2022. However, there has been a lack of such research since the end of the COVID-19 crisis. This is what motivates the conduct of the present study. Therefore, its main purpose is to explore the characteristics of the behaviour of the Romanian government bond yield curve during the

post-pandemic period and thus to reveal the expectations that this benchmark debt market has for the future state of the Romanian economy.

2. Study period, Data and Methodology

The main factors that determine each studied period are the purpose of the study and the available data. For this reason, a clear definition of the beginning of the post-pandemic period in the functioning of social and economic processes in Romania is needed in the present study. However, due to the policy of the Romanian government, this is a very easy task, because on March 9, 2022, the Romanian authorities removed all restrictions preventing the spread of COVID-19 (Reuters, 2022). Therefore, it can be assumed that, from this date, public life, the Romanian economy, and financial market function under post-pandemic conditions. In turn, the end of the research period is fixed on February 9, 2024, thus the whole study period spans 702 calendar days. On the other hand, the database of the study is formed by data for the yield to maturity on Romanian government bonds with a daily frequency, obtained from the World Government Bonds section of the global financial platform Investing.com (Investing.com, 2024). The database contains information for yields on Romanian government bonds with residual maturities of 6 months, 1, 2, 3, 4, 5, 7 and 10 years. Here, the need to ensure the time equivalence of the data and their correct structuring requires that the missing yields for certain time periods be replaced with the last available or quoted values from a previous period.

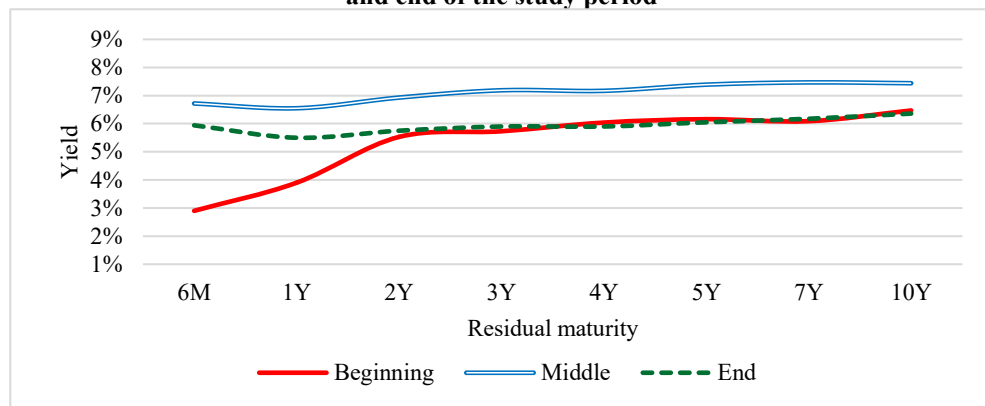
In concrete terms, the research methodology involves using of techniques for analysing the dynamics of the studied yield curve and the dynamics of the spread between the longest-term and the shortest-term yields within the studied maturity spectrum. Next, to reveal the volatility profile of the Romanian government bond yields, the analysis of their standard deviation and correlation dependences is used. The most powerful quantitative tool that the research engages in revealing the characteristics in the dynamics of the studied yield curve is principal component analysis (PCA). PCA is an econometric technique that reveals the main factors (components) in the dynamics of a studied dataset by reducing its dimensionality without losing essential information (Jolliffe, 1986, p. 1). The quantitative technique allows us to reveal the strength and direction of the influence of these factors through the so-called component values and component loadings. The calculations are usually done using as a basis a covariance or correlation matrix (Dunteman, 1989, p. 15), presenting the relation in the behaviour of the studied time series. In the present study, the correlation matrix is chosen as the basis of the computation procedures. This is due to the fact that its use has a higher information value and produces easily interpretable results.

3. Empirical Results

The general picture of the dynamics of the Romanian government bond yield curve for the period March 9, 2022–February 9, 2024 is presented in Figure 1. In order to facilitate the analysis and increase its informational value, the figure

shows the analysed yield curve only at the beginning, middle and end of the investigated period. It can be seen that the studied period begins with a clear positive slope of the analysed yield curve with a total spread between the yields of the ten-year and six-month bonds issued by the Romanian government of 3.57%. The observed slope is particularly steep between 6 months and 2 years residual maturity, where the spread has a value of 2.63%. This is 73.67% of the total yield spread between the yields of the longest-term and the shortest-term Romanian government bonds as of March 9, 2022. Therefore, Romanian debt markets enter the post-pandemic period with clear and definite positive expectations for the development of the Romanian economy, which are particularly strong in the short term. Although it is not the subject of analysis, the mentioned fact also shows that the Romanian government bond market was not concerned about positive economic growth in the country, even in the conditions of COVID-19.

Figure 1. Romanian government bond yield curve at the beginning, middle and end of the study period



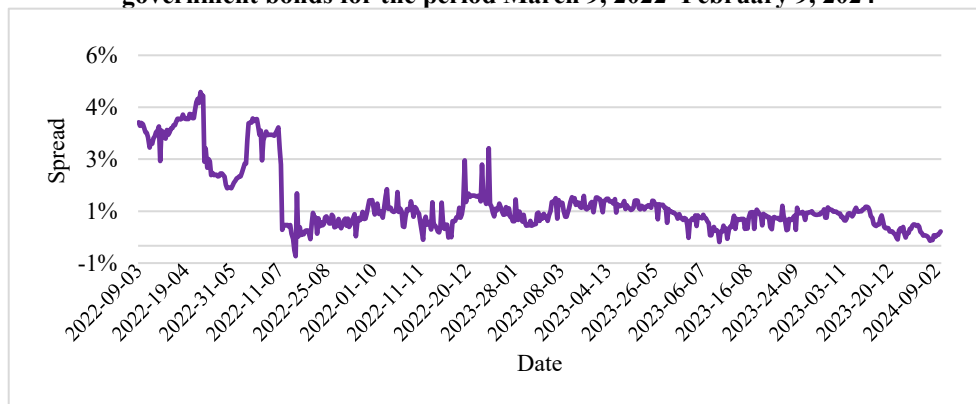
Source: own calculations based on data from Investing.com (Investing.com, 2024).

However, between the beginning and the middle of the studied period, there is a major change in the Romanian government bond yield curve. Thus, by the middle of February 2023, a general increase of all analysed yields was observed by an average of 1.76%. This positive change is particularly strong for short-term Romanian government bond yields. To a large extent, the noted upward movement of the investigated yields is due to the increasing inflation in Romania during this period, which has reached 16.76% by November 2022. On the other hand, it can be seen that towards the middle of the studied period the analysed yield curve is flatter, with the spread between the ten-year and six-month Romanian government bond yields of only 0.72%. This is a clear indicator that, at the beginning of 2023, the Romanian government bond market has already started to emit negative expectations for the economic development of the country. Moreover, at the end of the studied period, these negative expectations deteriorate further. As of February 9, 2024, the positive slope of the analysed yield curve continues to decrease, and the spread between the yields of the 10-year and 6-month bonds issued by the Romanian government falls

to 0.42%. This is also accompanied by a clear parallel shift down with an average drop in all considered yields of about 1.16%. That is, between the middle and the end of the studied period, market predictions for an economic slowdown in Romania become stronger, this time accompanied by lower inflation expectations, due to the progressively decreasing inflation rate in the country from the beginning of 2023.

Figure 2 provides more details of the observed slope oscillation process, that makes the investigated yield curve flatter. It shows the dynamics of the yield spread between the 10-year and 6-month Romanian government bonds for the period March 9, 2022–February 9, 2024. Until the beginning of 2024 the spread steadily decreases from levels of about 3.5–4.4% to 0.42%. An interesting detail here is that until mid-2022 this spread is markedly positive, but at the end of June 2022 it drops sharply and even takes negative values. That is, then the analysed yield curve even becomes inverted. After that, there is a slight recovery of the positive slope of the Romanian government bond yield curve, with the spread between the yield of 10-year and 6-month debt instruments for long periods reaching levels above 1% and sometimes even above 2%. From March 2023, the trend in its dynamics becomes downward again. Therefore, it can be confidently concluded that between the end of June 2022 and the end of March 2023, the Romanian government bond market begins to experience strong uncertainty about the direction of economic development in Romania. At the time of the finalisation of the research, the Romanian government bond market is rather beginning to calculate a slowdown in economic activity of the country with lower inflation expectations, which, however, do not indicate a serious decline in the inflation rate.

Figure 2. Dynamics of the yield spread between 10-year and 6-month Romanian government bonds for the period March 9, 2022–February 9, 2024



Source: own calculations based on data from Investing.com (Investing.com, 2024).

The information in Figure 1 shows another interesting fact regarding the dynamics of the analysed yield curve. It is about the fact that for the entire investigated period, the yield to maturity of the Romanian government bonds with a residual maturity between 6 months and 2 years varied the most. Against this background, the overall variation in bond yields with maturities between 2 and 10 years is significantly

smaller. This is also confirmed by the term structure of volatility and the correlations in the yield to maturity on Romanian government bonds for the period 9 March 2022–9 February 2024 presented in Table 1.

Table 1. Volatility profile and correlation coefficients of yields to maturity on Romanian government bonds for the period March 9, 2022–February 9, 2024

Residual maturity	6M	1Y	2Y	3Y	4Y	5Y	7Y	10Y
6M	1							
1Y	0,851*	1						
2Y	0,592*	0,814*	1					
3Y	0,639*	0,842*	0,974*	1				
4Y	0,588*	0,806*	0,965*	0,990*	1			
5Y	0,617*	0,823*	0,962*	0,992*	0,990*	1		
7Y	0,621*	0,827*	0,952*	0,985*	0,982*	0,993*	1	
10Y	0,613*	0,799*	0,922*	0,955*	0,952*	0,970*	0,976*	1
Standard deviation	1,180%	1,139%	0,906%	0,933%	0,934%	0,894%	0,874%	0,826%

* indicates significance at 99% confidence interval.

Source: Own calculations based on data from Investing.com (Investing.com, 2024).

Information on the yield volatility of fixed income securities issued by the Romanian government shows that it decreases as the maturity increases. This is completely consistent with the results from a previous empirical study on the characteristics of interest rate volatility (Bali & Neftci, 2001). What is special here, however, is that the standard deviation of the yield-to-maturity of the shortest-term Romanian government bonds – those with maturities of 6 months and 1 year – is significantly higher than the yield volatility of debt instruments from all other maturities. This indicates that in a post-pandemic environment, the behaviour of the two shortest-term segments of the Romanian government bond market is likely to be driven by specific factors different from those shaping the rest of the analysed yields. This finding is unequivocally supported by the analysis of the correlations among the yields from the studied maturity spectrum. Their value clearly indicates the presence of two main groups of yields within the post-pandemic Romanian government bond market. Government debt instruments with maturities of 6 months and 1 year fall into the first one. Their yields to maturity have weaker correlation with all other studied yields, with correlation between the yield of six-month Romanian government bonds and the all other yields being around 0.6, and relative to the yield of two- and four-year debt instruments even below this value. The second group includes bonds with maturities between 2 and 10 years, where the correlation in their yields to maturity can be defined as very strong. There, with one exception, the measured correlation coefficients exceeded a value of 0.95.

The reasons for the already revealed behaviour of the analysed yield curve can be quantitatively defined and distinguished by the analysis of the principal components in its dynamics. The first results of the application of the econometric technique are

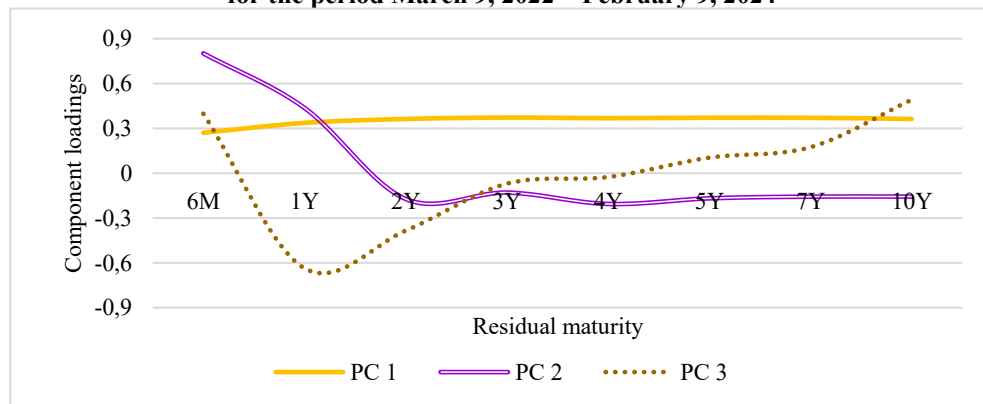
presented in Table 2. The data show that for the post-pandemic period, the most information, amounting to about 98.38%, on the dynamics of the Romanian government bond yield curve can be described by the influence of its first three principal components. The influence of the first of them is the strongest, as it has a weight of 88.16% in the overall dynamics of the studied yield curve. The second principal component has a contribution to its dynamics of 8.89%, and the third can explain only 1.33% of its variation.

Table 2. Value and influence strength of the principal components in the dynamics of the Romanian government bond yield curve for the period March 9, 2022 – February 9, 2024

Principal component	Component value	Proportion of the influence	Cumulative proportion
First	7.053	88.16%	88.16%
Second	0.711	8.89%	97.05%
Third	0.107	1.33%	98.38%
Fourth	0.073	0.92%	99.30%
Fifth	0.035	0.44%	99.73%
Sixth	0.011	0.13%	99.87%
Seventh	0.006	0.08%	99.95%
Eighth	0.004	0.05%	100%

Source: own calculations based on data from Investing.com (Investing.com, 2024).

Figure 3. Component loadings for the first three principal components in the dynamics in the Romanian government bond yield curve for the period March 9, 2022 – February 9, 2024



Source: own calculations based on data from Investing.com (Investing.com, 2024).

Figure 3, in turn, details the direction of influence of the three main factors already identified. The figure clearly shows that the first principal component has a constant influence on the analysed yield curve regardless of the maturity, that is, it is a factor of the change in its level. In the financial literature, this influence is associated with inflation and inflation expectations (Kaya, 2014). Therefore, it can be concluded that

in the post-pandemic period, inflation in Romania affected equally all analysed maturity segments. During the studied period, the second main component propelled the six-month and one-year yields upwards, and under its influence the yields of Romanian government bonds with maturities from 2 to 10 years were pushed downwards. Thus, this second main component, associated in the financial literature with the influence of economic growth (Abdymomunov, 2013), causes a rotation of the analysed yield curve with a pivot point between 1- and 2-years residual maturity.

Some quantitative studies relate the influence of the third principal component also to the influence of economic growth (Abdymomunov, 2013), while others associate it with the influence of the monetary policy of the central bank (Rudebusch & Wu, 2008). Of course, there is a direct connection between the two views because the monetary policy of the central bank has a direct impact on economic growth and prospects for economic development. In the case presented, it can be seen that the third principal component has a stronger negative impact mainly on one-year yields and a weaker but still negative impact on two-, three-, and four-year yields. For the remaining maturities, the influence of this component is moderately positive. Therefore, it can be said that it makes the short-term end of the studied yield curve concave, which is the probable reason that at the end of the studied period it is slightly inverted between residual maturities of 6 months and 4 years. That is, at the time of conducting the research, the Romanian government bond market shows clear signals that it treats the interest rate policy of the Romanian National Bank as restrictive and restricting short-term economic growth of the country. For this reason, it is very likely that it will begin to change.

4. Conclusions

The study presented an analysis of the dynamics of the Romanian government yield curve for the period March 9, 2022–February 9, 2024. It revealed that one of the most important debt markets in Romania starts the post-pandemic period with clear expectations of a positive economic development of the Romanian economy. However, these expectations change in the middle of 2022. Thus, at the end of the analysed period, the Romanian government bond yield curve becomes almost flat with a relatively weak inversion in the segment between 6 months and 4 years to maturity at a higher overall interest rate level. However, the behaviour of the research showed that in the Romanian government bonds market during the studied period, two distinct segments are observed, driven by apparently different market, financial, and economic processes. The first includes bonds with a maturity of 6 months and 1 year, and the second contains debt instruments with a residual maturity between 2 and 10 years. Against this background, the other important conclusions of the study can be formulated as follows:

First. The steeper slope of the Romanian government bond yield curve in the maturity region between 6 months and 2 years indicates that at the beginning of the post-pandemic period, the positive expectations for economic growth in the country were only short-term. Even at this point, market participants expected a slowdown in Romanian economic growth in the medium and long term.

Second. At the time of completion of the study, the Romanian government bond market is projected to show a moderate decline in both short-term and long-term inflation in the country.

Third. The slight inversion of the Romanian government bond yield curve in the range between 6 months and 4 years of residual maturity indicates that the likely deterioration or slowdown in economic growth in the country will be relatively weak and/or with a short-term horizon of a maximum of 3 to 4 years.

Fourth. The most important factor of the dynamics of the investigated yield curve with a contribution of 88.16% in it is the inflation in Romania. After it, in second place, with a weight of 8.89%, comes economic growth, which is a significant factor in the increase of short-term yields throughout the studied period. The third most important factor with a share of 1.33% is the influence of the central bank's monetary policy on Romanian economic growth.

Fifth. The empirical characteristics of the dynamics of the studied yield curve during the post-pandemic period show that bond portfolios of Romanian government bonds with maturities between 2 and 10 years and especially with maturities of 3 to 5 years can be effectively hedged against interest rate risk even using the simplest duration-based techniques. However, investments in Romanian government debt instruments with maturities of 6 months and 1 year require the use of more sophisticated techniques for this purpose. Of course, this conclusion is to some extent conditional due to the low liquidity of the short-term segment of the Romanian government bond market.

Sixth. The significant flattening of the Romanian government bond yield curve towards the end of the study period, in combination with its down-parallel shift and its weak inversion at its short-term end, shows that the probability for cutting the monetary policy rate by the Romanian central bank starts to rise. However, this can happen only if there are clear signals of a significant slowdown of inflation in Romania.

However, the above-stated conclusions are made for the entire study period. On the other hand, the empirical results show that there are practically two distinctive subperiods within the investigated period. The first of them can be defined as a stage of the positive slope of the Romanian government bond yield curve, which starts on March 9, 2022 and lasts until mid-June 2022. The second subperiod can be defined as the flattening period of the studied yield curve. Therefore, as the main direction for continuing the work on the topic of Romanian government bond yield curve can be indicated, a detailed study of the characteristics of these two subperiods can be indicated. In this way, a more detailed picture of the current state and prospects for the development of the Romanian government bond market and the Romanian economy will be revealed.

Contribution statement

The study is conducted and written by the authors as follows: assoc. prof. Alexander Ganchev, PhD – Sections 1. Introduction and Literature Review, 3. Empirical Results and 4. Conclusions; assoc. prof. Catalin Deatcu, PhD – Section 2. Study Period, Data and Methodology.

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Using Machine Learning to Model Bankruptcy Risk in Listed Companies

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Abstract

This article extensively studies the optimisation and relative performance of three classes of machine learning models (logistic regression with regularisation, Random Forest, and XGBoost) to quantify the probability of bankruptcy using financial data from a database of listed companies in Taiwan. The database covers the period from 1999 to 2009, contains 95 financial ratios from 7 categories, has 6,819 observations, and has a bankruptcy rate of approximately 3.2%. The database choice stemmed from our wish of utilising a dataset which was publicly available and that posed high quality and moderate size, traits that permitted the rapid training of machine learning models. As a result, we were able to run experiments based on multiple model configurations and to compare the attained results with the ones gathered by other researchers. For the purpose of splitting data for training and testing sets, the k-fold cross-validation methodology can be used. We investigate the validity of its use, especially in the context of XGBoost with an early stopping round based on the test fold. We also determine the sensitivity of predictive performance on the value of k and on the specific folds created. We use AUROC as a performance measure and show that Random Forest models significantly outperform logistic models with regularisation, while XGBoost models have a moderately higher performance than Random Forest. For each type of model, we study hyperparameter tuning and demonstrate that this process has a significant effect on predictive performance. For the first two types of model, we perform a full grid search. For XGBoost models, we use a guided (sequential) grid search methodology. Furthermore, we study and propose a criterion for hyperparameter tuning using average performance instead of maximum performance, highlighting the relatively large effect on predictive performance of the stochastic component employed by these machine learning algorithms during training. Our research also indicates that in the case of some hyperparameters, tuning can shape predictive performance. Last but not least, the meaningfulness of variables in forecasting the bankruptcy likelihood is assessed, as it was indicated by the three classes of models.

Keywords: bankruptcy risk, probability of bankruptcy, machine learning, xgboost, random forest.

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JEL Classification: C53, C55, D81, G2, G32.

1. Introduction

In the last years, artificial intelligence displayed a significant development level, altogether with the emergence of deep learning and GPT models. The drawback resides however in the fact that this type of models need large amounts of data (hundreds of millions or even billions of observations). As a result, machine learning models (such as random forests or boosted trees) remain relevant for the comparatively small datasets used for bankruptcy prediction.

Although there are a number of studies that use and compare various machine learning algorithms for bankruptcy prediction, very few aim to find the best possible model by studying various architectures and hyperparameter tuning.

In this paper, we search for the best model we can find and, in the process, make recommendations and present findings relevant in guiding such a search: from splitting the data into training and test sets to hyperparameter tuning strategies based on model type.

In the whole process, we trained 1,062 logistic regression models, 17.646 Random Forest models, and 881 XGBoost models.

2. Problem Statement

Lending institutions and investors are exposed on a daily basis to challenges resulting from the risk of adverse events such as default or bankruptcy. A resolution point could be artificial intelligence (AI), which, through the employment of large data and machine learning, boosts risk evaluation. In addition, it contributes to more informed financing decisions based on the analysis of borrowers' financial data, that can ultimately diminish default and bankruptcy rates and increases capital flow in the financial industry. Liang et al. (2016) examine the effectiveness of integrating financial ratios (FRs) and corporate governance indicators (CGIs) for bankruptcy prediction with real-world data from Taiwan, using machine learning methods. They found that FRs and CGIs together improve prediction accuracy. In the realisation of a precise projection, elements such as profitability and solvency FR categories are key points, apart from board and ownership structure CGIs.

Lately, many researchers have forecast loan defaults using machine learning methods. In a recent study, Lin (2024) used four machine learning algorithms, including Logistic Regression, Random Forest, XGBoost and AdaBoost, underscoring the efficacy of the Gradient Boosting framework, particularly the XGBoost model, in predicting loan defaults. Although it may have some limitations, this research revealed that while maximising loan profitability is paramount in default prediction, the analysis did not extend to calculating final payoffs predicted by different algorithms. Moreover, the author suggests considering factors like loan interest rates to more accurately assess final payoffs. In addition to that, Hernes et al. (2023) stated that XGBoost is an intriguing possible substitute for the conventional process of making a score card. The authors suggested that the implementation of sophisticated algorithms in credit decision-making procedures will necessitate modifications to the IT infrastructure of numerous institutions, perhaps resulting in extra financial outlays, but these algorithms may actually have a significant effect on how well decisions are made.

Per Moscatelli et al. (2019), in their effort of assessing potential borrowers, lenders or credit analysts can find it advantageous to employ statistical and machine learning models in a combined approach. Additionally, Sifrain (2023) emphasises that recovery, debt-to-income ratio, annual income and loan amount, as independent variables, reflected to be correlated in

the most significant manner with the response variable, especially when it comes to the logistic regression and random forest classifiers.

In their research in which they employed a Random Forest and Decision Trees method to establish a model for loan forecasting and credit risk evaluation, Madaan et al. (2021) revealed that a higher degree of precision was provided by the first model. In addition, Alonso and Carbó (2021) note that machine learning models operate better compared to the conventional Logit model, in the classification and calibration tasks. Additionally, the authors acknowledge these facts through sensitivity analysis in a different setting. Last but not least, Hyeongjun et al. (2020) notes that it is important to understand the manner in which every approach should be used when establishing the proper technique which may generate relevant data for the prediction goal.

3. Research Questions / Aims of the Research

Our main objective is to discover a methodology for searching the best-performing model given a dataset. In the process, we answer several questions: (1) Can the k-fold cross-validation methodology be safely used with XGBoost? (2) What is the optimal number for k and how to find it? (3) How sensitive are the model performances to the specific (random) split of data in the k folds? (4) What is the relative performance of various machine learning models (logistic regression with regularisation, Random Forest, XGBoost)? (5) What is the optimal methodology for hyperparameter tuning depending on model type? (6) How sensitive are the model performances to the randomness induced by the training algorithm? In other words, using the same hyperparameters and data splits, how much does performance vary due to different random seeds used by the algorithm? The answer to this question will guide the choice of optimal hyperparameter values: should we base our choice on the best model or on average performance? (7) What are the most important predictors of bankruptcy? (8) Do the most important predictors differ for different model types?

4. Research Methods

For comparability, we opted to use a publicly available dataset. We investigated several options and settled for the dataset compiled by Liang et al. (2016). We chose this dataset due to (1) the large number of predictors (95), some correlated, suitable for investigating various machine learning algorithms, (2) its relatively small size for machine learning models (6,819 observations), which allowed us to efficiently test alternative methodologies, and (3) its quality (having little noise and no missing data). The data set is comprised of Taiwanese listed companies, has 95 financial ratios as explanatory variables, and a bankruptcy rate of 3.22%, defined according to the Taiwan Stock Exchange rules for bankruptcy. The data covers the period 1999-2009 and consists of non-financial companies that had at least three years of available data.

For testing, we used **the k-fold cross-validation** approach, which involves randomly partitioning the data into k equally sized folds and then iteratively setting aside one fold for out-of-sample testing and training a model on the remaining $k-1$ folds. In total, for each model, k component models will be trained. When using the model with new data for prediction, the average of all k component models' predictions will be considered. As a result, the whole dataset will be used for training and out of sample predictions will be obtained for the entire training dataset.

In creating the k folds, we used stratified sampling based on the target variable, hence ensuring equal bankruptcy rate across all folds.

We studied three model types: **logistic regression with regularisation, Random Forests, and XGBoost**. We trained 19,589 individual models to identify the best-performing model type and also to tune its hyperparameters.

Logistic regression with regularization has a loss function with an additional term compared to standard logistic regression:

$$\hat{\beta} = \arg \min_{\beta} \left\{ \frac{1}{2n} \sum_{i=1}^n (y_i - \beta_0 - x_i^T \beta)^2 + \lambda \left(\alpha \sum_{j=1}^p |\beta_j| + \frac{1-\alpha}{2} \sum_{j=1}^p \beta_j^2 \right) \right\} \quad (1)$$

The first part of the formula corresponds to the OLS method. The effect of the regularisation term is to minimise the coefficients β , which controls the risk of overfitting. There are three types of regression with a regularisation term: Lasso – for $\alpha=1$, Ridge – for $\alpha=0$ and Elastic net – for α between 0 and 1.

The hyperparameter λ controls the effect of the magnitude of the regularisation term’s effect.

Random forests (RF) imply the training of multiple decision trees and taking the average of their prediction. Each decision tree is trained on a subset of data, and at each node, a subset of features is selected. As a result, each decision tree is suboptimal and captures one aspect of the solution. However, averaging across multiple decision trees will improve performance beyond what the best single tree could do.

XGBoost (eXtreme Gradient Boosting) is an algorithm that, like Random Forest (RF), is based on decision trees. Unlike RF, which builds independent trees unconnected to each other, XGBoost iteratively constructs trees, each one attempting to correct previous errors. With each iteration, the newly constructed tree is trained on the residuals of the previous ones and not on the original Y variable. In this way, the predictions are improved with each iteration. If training is not stopped, the algorithm will overfit the training data to a high degree. As a result, it is customary to use a test set to stop the training once out-of-sample performance does not improve for several iterations, typically in the order of hundreds.

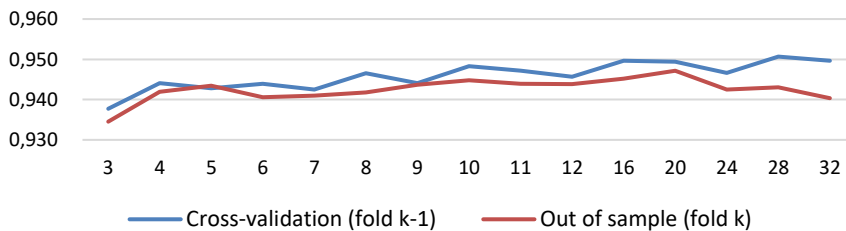
To assess feature importance across three model classes, we use **permutation feature importance**, since it is a model-independent method. The importance is calculated as the loss in model performance when its values are permuted between observations in a test set.

5. Findings

5.1 Assessing the Validity of k-fold Cross-Validation for XGBoost

With the k-fold cross-validation approach for XGBoost, the test fold will also be used during model training to determine the best iteration and stop the algorithm. As a result, there is a risk of label leaking.

Figure 1. Performance based on k, the number of folds



Source: own calculations.

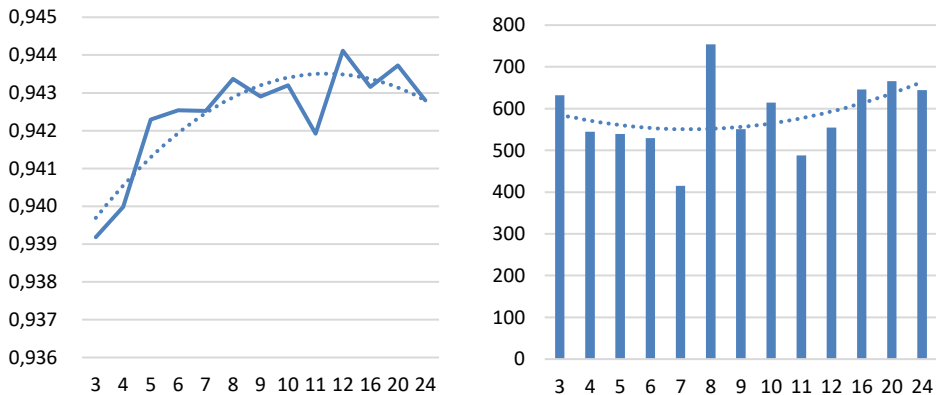
To assess the validity of using the k-fold cross-validation technique with XGBoost, we conducted an analysis with hierarchical cross-validation: each component model was trained using k-2 folds, the k-1 fold was used to determine the stopping point, and the kth fold was used for out-of-sample testing. We observed that (1) the performance differences between the k-1 and k folds are minimal and, more importantly, that (2) the performances on these two folds are highly correlated (correlation coefficient of 0.698). As a result, we concluded that the k-fold cross-validation technique remains viable.

5.2 Determining the Optimal k

The larger k, the more data can be used for model training, thus leading to better performance. Indeed, as Figure 1 shows, up to a point, larger ks produce higher performance out of the sample. On the downside, the larger k is, the smaller each fold is, hence potentially leading to overfitting the fold used to stop the algorithm’s training: as it can be seen in Figure 1, for ks above 20, the performance on the two test folds start to diverge, indicating overfitting the k-1 fold used to stop the algorithm. Another disadvantage of a large k is the time and computational resources required to train k models.

Hence, the smallest k that offers good performance is preferred. We also considered the variability of the stopping round number for each of the k component models as a measure of overfitting the k-1 fold. We have settled on k=7.

Figure 2. Indicators for choosing k – left: out of sample performance, right: standard deviation of stopping iteration



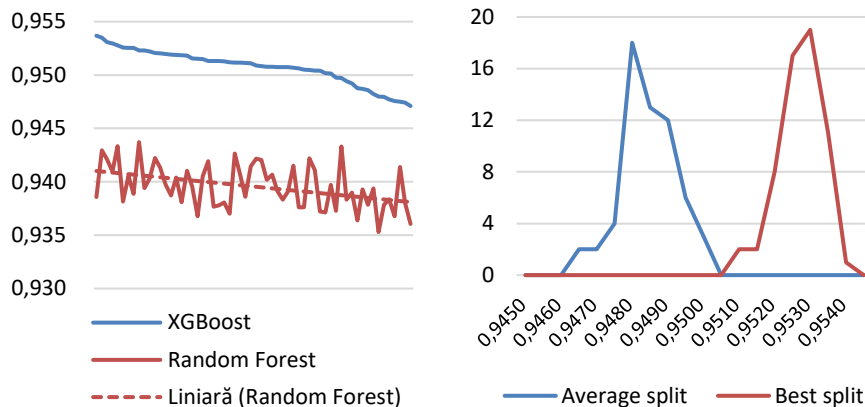
Source: own calculations.

5.3 Choosing a Specific Split for 7 Folds

We performed a random stratified sampling based on the target variable. We calculated model performance on various random splits to assess performance sensitivity. We noted that models trained on some splits outperform others. This performance gap remained even between model types (XGBoost vs. Random Forest).

We settled on the split that produced the highest performance across both types of models. To confirm the superiority of this split, we trained 60 XGBoost models on it and compared the results with 60 models trained on another split.

Figure 3. Criteria for choosing a specific split – left: XGBoost and RF model performance on 60 alternative splits, sorted by XGBoost model performance, right: performance for 60 XGBoost models on two random splits



Source: own calculations.

5.4 Logistic regression with Regularisation – Hyperparameter tuning

We used the *glmnet* library in R, which uses the gradient descend method for training, meaning that the algorithm is iterative, stochastic, and, in some cases, not convergent. There are two hyperparameters: α and λ . While α needs to be set by the user, for λ the library has an option to optimise it automatically.

The algorithm was run for 21 values of the hyperparameter α , ranging from 0 to 1, with a step of 0.05. During the use of the algorithm, it was observed that it does not always converge for the λ values that it chooses by itself. To correct this effect, λ values were manually set from the average values at which the algorithm converged. Therefore, for each of the 21 values of α , a λ value was manually set. Subsequently, 29 different values of λ were studied for each of the 21 values of α , totalling 609 models. The 29 λ values were chosen by multiplying the selected average value by a scaling factor ranging from 0.005 to 10.

The best performance was 0.9314, achieved for $\alpha=0.85$ and $\lambda=0.01004262$. Of the 609 models trained, 214 had at least one component model that was not convergent, while 395 were fully convergent.

5.5 Random Forest – Hyperparameter Tuning

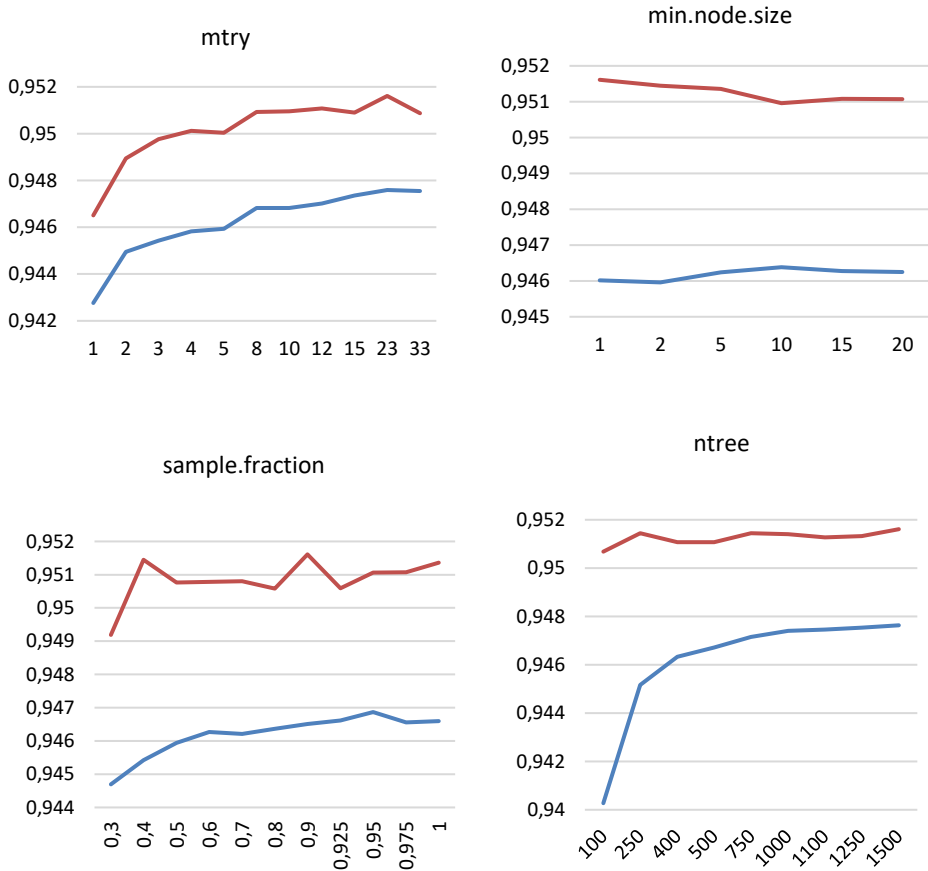
We used the *ranger* R library to train random forests. We used a full grid search methodology to tune the most important hyperparameters: *mtry*, *min.node.size*, *sample.fraction*, and *n.tree*. We also studied two-node splitting rules: Gini and Hellinger (controlled by the *splitrule* hyperparameter). The Gini rule is most commonly used for classification problems. The rule based on Hellinger distance is less commonly used; however, it is more suitable for classification problems with uneven classes, as in our case here. Indeed, using the Hellinger distance significantly improved the maximum performance, from 0.9448 to 0.9516.

For hyperparameter tuning, we trained 6,534 different models using the Hellinger splitting rule and 4,356 different models using the Gini rule. As mentioned earlier,

the Hellinger method yielded significantly superior results. The best model achieved a performance of 0.9516, significantly higher than the best logit model.

When hyperparameter tuning is performed, we obtained the following results:

Figure 4. Hyperparameter tuning for Random Forests using the Hellinger splitting rule (blue: average performance, red: best performance)



Source: own calculations.

5.6 XGBoost – Hyperparameter Tunning

Due to the high computational and time resources required to train an XGBoost model and also due to the high number of hyperparameters that can be tuned, we could not perform a full grid search, as in the case for logistic regression or Random Forest. We performed a guided, iterative, grid search where we varied a few hyperparameters at one time, retained their best values, and then proceeded to vary others. We repeated this process and even came back to previously tuned hyperparameters to check whether in a new context they can be further optimised.

We also experimented with various model architectures involving (1) different objective functions, (2) winsorizing and rescaling some explanatory variables, (3) using only the most important 30 or 40 explanatory variables (as identified by a previously best performing model), or (4) including predictions from other model types (logistic regression or Random Forest) as explanatory variables.

Regarding hyperparameter tuning, we found the following:

eta: it is the most important hyperparameter since values that are too high can severely impact performance. However, below a certain point, smaller values of eta will have a negligible impact on performance. Since training time is significantly increased for lower values of eta, finding the optimal value is important. We recommend performing an initial grid search on {0.001, 0.005, 0.01, 0.05, 0.1, 0.5, 1}, followed, if necessary, by a finer search around the best value.

colsample_bytree and subsample: after eta, these two hyperparameters had the highest impact on performance. We found optimal values in the interval [0.4, 0.6]. We recommend investigating the full range of values for these hyperparameters (from 0 to 1), possibly starting with a step of 0.1 and then refining the search by a step of 0.05 around the best values identified so far.

min.child.weight: variation of this hyperparameter brought moderate improvement in average performance at the value of 5 and had a significant negative impact on performance at higher values (15 or 20).

max_depth: in our case, the impact of varying this hyperparameter was not significant. We recommend exploring various values for this hyperparameter and, all else being equal, choosing the smallest value possible as higher values can increase the training time proportionately.

alpha and lambda: Variations in these parameters beyond the default values led to performance deterioration.

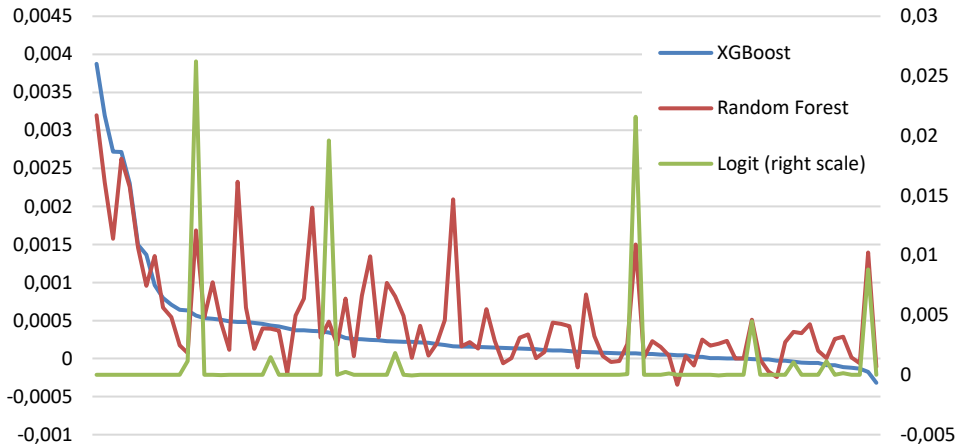
As mentioned previously, we used guided grid search, varying only some hyperparameters at a time while holding the others constant. At this point, one question arises: When moving to the next set of hyperparameters, what values should one choose for the ones just studied? Should they be based on the best model so far or on the average performance for all models trained? Taking another look at Figure 1, we can note that for models with the same architecture and the same values for all hyperparameters, the performance can vary greatly due to the randomness induced by the training algorithm. Hence, we recommend choosing values that produce the best average performance, since the best performing model could be an outlier.

5.7 Feature Importance

We calculated the feature importance for the best performing model in each class. For this purpose, we considered only models trained on the original set of features.

We found that the Random Forest models and the XGBoost models correlate to a high degree, assigning importance to the same variables. Moreover, these two types of model tend to use all variables; hence, all of them have at least some importance. In contrast, the logistic regression has only 10 important variables, the rest having an impact of almost 0.

Figure 5. Feature importance, sorted by XGBoost model's feature importance



Source: own calculations.

5.8 Performance for Different Model Types

In summary, excluding models that were obvious underperformers (for example, with wildly out of range hyperparameter values used for exploratory purposes), we obtained the following results:

Table 1. Summary of model performance by model type

Indicator	Logistic regression with regularisation	Random Forest	XGBoost
Minimum	0.8521	0.9271	0.9458
Maximum	0.9314	0.9516	0.9543
Average	0.9264	0.9462	0.9512
Standard deviation	0.0079	0.0031	0.0019

Source: own calculations.

6. Conclusions

We conclude that k-fold cross-validation is a valid method for training and testing when limited data is available even though some algorithms, such as XGBoost, use the test fold in the training process.

We found that Random Forests significantly outperform logistic regression with regularisation, while XGBoost outperforms Random Forests, but to a lesser degree.

We also conclude that hyperparameter tuning can have a significant impact on performance, but the randomness induced by the training algorithm is significant. As such, optimal values for hyperparameters should be chosen on average performance, not on the best model identified. Moreover, fine-tuning hyperparameters only marginally improves performance, well within the variability induced by the randomness of the training algorithm, further supporting the choice of best average performance over best performing model.

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Trends in Transition:
Fintech Credit Effects on Romanian Bank Stability

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Abstract

This research aims to look into the link between fintech lending and bank stability. In order to establish how fintech lending influences the stability of banks in Romania, regression analysis was performed for the timeframe 2017-2020. In this sense, indicators pertaining to fintech lending, Z-scores, and liquidity were used in the research. The findings of the study underline that improvements in fintech lending impact in a negative way the bank's Z-score. Given the altered competition between organisations in Romania, bank stability might have been threatened by an increase in fintech lending. Due to the availableness of credits, fintech organisations have the possibility to gain customers from traditional banking entities. As a result, competition will face an improvement and banks will find it difficult to keep fulfilling essential banking benchmarks. Additionally, changes in the legislation governing the two financial systems may limit the capacity of authorities to conduct supervision and thus hinder their ability to detect potential dangers within the financial system. On the other hand, it is possible to talk about a positive correlation between bank Z-score and liquid assets to deposits. Depending on that result, an increase in the ratio of liquid assets to deposits may a positive effect on the bank Z-score.

Keywords: Fintech, Fintech Lending, Romania Fintech Lending, Romania Bank Stability.

JEL Classification: F65, G21, E51.

1. Introduction

As technology-driven business models and digital developments change the shape in which companies create value and supply goods or services, they may allow new business opportunities for established players. On the other hand, it can contribute to the creation of strong lines by creating a deep relationship within the

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financial sector and reduce the human factor and allow all activities to be carried out on machines. In addition, with the existence of the entrepreneurial ecosystem, fintech technology has the ability to facilitate access to financial services and to compete among companies in the early stages. Of course, if companies want to survive here, they must first provide a good response system and follow a new effective strategy in order to adapt to tough competitive conditions (European Economy, 2018, p. 3). The term fintech can be expressed in various ways in the literature. Some of these are FinTech, Fintech, or Fin-Tech. However, all of these uses come to the same point. The term fintech is simply formed by combining the words technology and finance. To explain the term fintech, it covers the harmonisation of the financial service sector with these technologies, such as basic banking services, with mobile or cloud technologies playing a leading role as primary services (Gomber et al., 2017, p. 540). To define it from another perspective, it can be expressed as a collection of advanced technologies that can be applied to the financial system. This explains, for instance, the efforts of established traditional financial institutions to embrace technology or the efforts of major technology companies like Apple, which offers Apple Pay (World Economic Forum, 2017, p. 8). Fintech, as defined by the Financial Stability Board, is the application of technology to promote innovation in the financial services industry, potentially resulting in the creation of new business models, operational procedures, standards, or products that have the potential to significantly transform the financial markets, institutions, and financial services' delivery system. Consequently, this definition implies that fintech innovations have impacted and still do impact a wide range of financial services domains (FSB, 2017).

In its simplest form, fintech lending encompasses lending services that bring together borrowers and lenders, i.e., investors. These lending platforms are known as "peer-to-peer (P2P) lenders", "credit-based crowdfunders, or "marketplace lenders". Fintech companies have their own balance sheet systems as in the traditional banking system and therefore, since customer data is digital and they interact through online channels, they differ from the traditional banking system in terms of lending. This interaction is achieved through digital technologies that allow fintech companies to perform all their transactions, especially basic banking transactions such as providing loans and collecting deposits, through developed platforms. The first example of this technology was launched in the UK in 2005 with the Zopa application, but this structure later became complex. The reason for this complexity is that it is not as secure as the traditional banking system and therefore the system is still subject to various regulations (Claessens et al., 2018, pp. 30-31). In more detailed terms, these platforms are considered to be part of Internet finance or digital finance, they are distinct from traditional banking, and they reshape the manner in which financial services are supplied and provide their structure within a distinct area. This kind of platforms supply a variety of financial services in the financial field, for instance equity crowdfunding, donation-based crowdfunding, asset management services, and insurance solutions. Examples of

US companies in this sense are AmeriSave, Guaranteed Rate, Loandepot, and Quicken Loans

For example, Alifinance has provided short-term credit facilities to small and medium-sized companies since 2010 in order to contribute to their economic development (Chen, 2016). In Romania, in recent years, fintech companies such as Credius, NEO Finans and Viva Credit have made significant progress and enabled the development of Romania's fintech ecosystem.

In general, the fintech system is developing its current and potential areas in various areas such as payments, clearing, lending, deposits, capital increase, investment, fund management, risk, and insurance. This situation evolves and exerts major influence on traditional banking. To be more accurately, fintech companies provide lower search expenses, scale economies, cheap, and secure information transfer, and reduced verification expenses (European Economy, 2018, p. 12). Initially developed as decentralised platforms, fintech lending models allowed individuals to select borrowers to lend to within the parameters of the loans they offered. However, over time, institutional investors in addition to private investors have joined these platforms. On the other hand, platforms also aid in resolving the problem of asymmetric information as they offer data regarding borrowers and credit risks (Cornelli et al., 2023, p. 2).

Recently, together with the development of the fintech ecosystem, changes also took place in credit markets, thus producing new intermediaries apart from lenders, credit unions, and traditional banks. Although traditional capital markets and banks continue to be a source of financing for individuals and businesses, the transformation of the financial services system will accelerate with the entry of new digital financial institutions into the market. This type of loans, which are given through online platforms, unlike traditional banks or loans, are called “debt-based alternative finance”, which has gained momentum especially in the form of P2P loans and invoice trading, with the digital lender feature at the forefront (Cornelli et al., 2023, p. 1). While banks and other financial intermediaries remain the main source of financing for borrowers in most markets, fintech lending models are among the new financial institutions gaining popularity recently (Liem et al., 2022, p. 1).

This article examines the connection between fintech lending and bank stability. For this purpose, the relationship between Z-score values of commercial banks and fintech loans in the digital system in Romania for the years 2017-2020 is investigated. Regarding the rest of the research, section 1 details the literature and hypothesis, section 2 displays the data and the research methodology, while section delineates the analysis findings.

2. Related Literature and Hypothesis

In what regards the research that scrutinises the impact of fintech loans on bank stability, the work of Liem et al. (2022), who performed an analysis building on fintech loans, credit information sharing, and bank stability data that was sourced from different countries in the timeframe 2013-2017, found out that fintech loans

as well as the increase in this type of loans had a significant impact on bank stability. An additional study by Le et al. (2021), who employed data from 80 countries in the period 2013-2017 and explored the linkage between fintech loans and bank efficiency, revealed that this situation occurred more frequently in countries with a poorly developed fintech system, also underlining the negative influence of fintech loans on bank stability. The work of Le et al. (2021) also highlighted that bank stability alleviation was associated with fintech loans. Supplementary evidence was brought by Oh and Rosenkranz (2020), who researched the reverberations financial development and financial literacy on P2P loans, associated to different countries, between 2015 and 2017, and who acknowledged the positive correlation between financial institutions' steadiness and the amount of the P2P loan. In addition, the study of Yeo and Jun (2020) indicated that bank stability was influenced by the improvement in P2P loans. Moreover, in his study aiming to understand the influence of P2P loan platforms in the traditional banking system, Tang (2019) asserted that a swapping process took place digital banking and traditional banking, in terms of the loan volume augmentation. The work of De Roure et al. (2016) aimed to determine if P2P loan transactions acted as replacements of complements in the case of Germany and indicated that this loan type had a gap-filling role for the traditional banking demand regarding small-scale and high-risk loans. Furthermore, Cornelli et al. (2023) indicated that alternative financing methods were complementary for traditional credit channels and did not replace them. The study of Claessens et al. (2018), performed on 63 countries in 2016, noted the positive association between fintech credit volume and GDP per capita, and consequently digital lending was linked with the economic and institutional progress of countries.

From this point of view, the hypothesis for this study is that fintech lending is expected to contribute positively to the stability of the Romanian banking system. Because, although the banking system is based on the traditional system, there are many digital applications. As a matter of fact, one of the studies conducted in the literature addresses the question of whether fintech loans are alternative or complementary for banks. Cornelli et al. (2023) and Tang (2019) find that fintech lending complements the banking system. Therefore, this study's hypothesis is as follows:

Hypothesis: There is a positive and significant relationship between fintech lending and bank stability.

3. Data and Research Methodology

3.1 Data

The study investigates the relationship between fintech lending and bank stability. For this purpose, regression analysis is applied to reveal what kind of impact fintech lending has on bank stability in Romania between 2017 and 2020. The bank stability (Z-score) is based on Liem et al. (2022) and the fintech lending is based on Le et al. (2021). Liquid assets to deposits variable is also used as an exogenous variable. Moreover, the study tried to use return on assets and return

on equity as dependent variables and inflation, growth, the number of mobile banking and branch banking users, bank cost to income ratio and banking system concentration as independent variables, but these variables were excluded from the model due to the multicollinearity problem. Therefore, these results were not reported in this study. In the study, the fintech credits are obtained from the Cambridge Centre for Alternative Finance (The CCAF), while the banking system Z-scores and the liquid assets to deposits data are obtained from The Global Economy.

Platform-based data by The CCAF was collected using an online benchmarking survey. The survey was hosted by the CCAF, Judge Business School. The CCAF and its academic and industry research partners identified the participating platforms. The benchmark survey sought both quantitative and qualitative data on alternative finance platforms. This covers the following: total startup and company financing, yearly transaction volumes, geographic distribution, number and activities of funders and fundraisers, most financed sectors, longitudinal data on platform launches and approvals, and loan performance statistics. According to the classification developed by the CCAF, fintech lending is divided into two groups as: level 1 (subsegment) and level 2 (business model). Level 1 comprises invoice trading, debt-based securities, P2P marketplace lending, and balance sheet lending. The topics that each group in level 1 addressed are included in level 2 (business models). The lending operations that are included in the balance sheet lending category are balance sheet consumer, balance sheet property, and balance sheet commercial lending. In the same way, the P2P marketplace lending industry encompasses debt-based securities in addition to P2P marketplace business, property, and consumer loans. Debt-based securities include mini-bonds.

The dependent variable is banking system z-scores. The Z-score represents the likelihood that a nation's financial system will fail. The Z-score contrasts the capitalisation and return buffer of a nation's banking system with the return volatility of those assets. It is calculated using the formula $(ROA + (\text{equity}/\text{assets})) / \text{sd}(\text{ROA})$, where $\text{sd}(\text{ROA})$ is the ROA standard deviation. At the national level, assets, equity, and ROA reflect aggregated statistics. Another important factor to consider is the ratio of liquid assets (assets that can be quickly converted into cash) to total deposits plus short-term funding. Liquid assets include cash, bank loans, trading securities that are fairly priced and earned through proceeds, bank loans and advances, reverse repos, and cash collateral. Deposits and short-term funding items include total customer deposits as well as short-term borrowings. Money market instruments, certificates of deposit, and other deposits are examples of short-term debt; Short-term funding, current deposits, savings accounts, and time deposits constitute total customer deposits.

Furthermore, all variables' natural logarithms are employed. In this way, the analysis is conducted by eliminating the difference in scale between the dependent and independent variables. On the other hand, the study abbreviates the fintech lending as $\ln\text{Fintech}$, the banking system z-score as $\ln\text{Z-score}$, and the ratio of liquid assets to deposits as $\ln\text{LIQ}$.

3.2 Research Methodology

The model established to investigate the relationship between fintech credits and banking system Z-score is as follows:

$$\ln Zscore_t = \beta_0 + \beta_1 \ln Fintech_t + \beta_2 \ln LIQ_t + \varepsilon_t$$

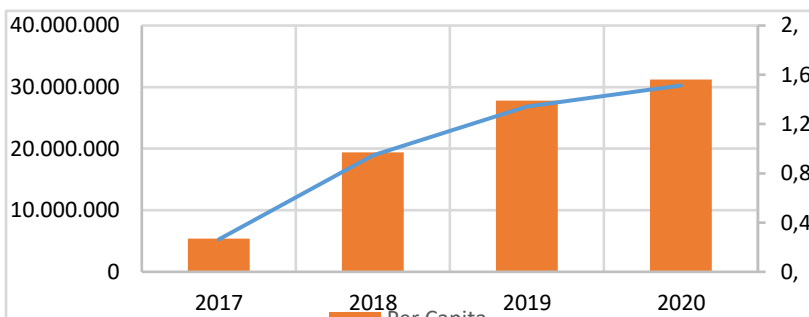
where $\ln Zscore$ is the dependent variable; β_0 , is the value of the dependent variable, i.e., $\ln Zscore$, if the independent variables are zero; β_1 and β_2 represent the amount by which the dependent variable changes in response to one unit change in the independent variables, holding constant the factors expressed by the error term ε .

The impact of fintech lending on banking system Z-scores is measured with least squares method. Prior to conducting the analysis, the basic assumptions of the model are tested, and the deviations resulting from these tests are controlled using various methods. The first is to investigate whether there is a problem of heteroskedasticity in the model. The test proposed by Breusch-Pagan (1979)/Cook-Weisberg (1983) is used for this purpose. Secondly, it is investigated whether there is an autocorrelation problem in the model. The Breusch-Godfrey (1978; 1978) LM test is used to detect the autocorrelation problem. According to Tatoğlu (2023, p. 137), this test checks whether there is a higher order autocorrelation in the model. As a result of the analysis, it is determined that there is first order autocorrelation in the model. In order to correct this autocorrelation problem, the approach proposed by Newey-West (1987, 1994) is preferred. This approach thus produces more consistent estimators with strong standard errors, which fixes the autocorrelation issue in the model. Last but not least, obtaining the normal distribution requirement is one of the presumptions of least squares. For this objective, the Jarque-Bera (1987) normality test is used to determine whether the error terms in the model are normally distributed.

4. Empirical Results

This section presents descriptive statistics, correlation matrix, and regression analysis results for the relationship between fintech lending and bank stability.

Graph 1. Fintech Lending and Lending per capita Volume, 2017-2020 (USD)



Source: The CCAF, 2024.

Graph 1 illustrates the fintech lending and lending per capita in Romania between 2017 and 2020. According to the graph, in 2017 the digital fintech lending volume amounted to more than \$5 million, while this number quintupled in 2019, reaching more than \$25 million. After 2019, it is going to increase less compared to the previous one. On the other hand, the lending per capita has been increasing from 2017 to 2020. While fintech lending per capita was USD 0.27, it increased to USD 1.56 in 2020.

Table 1. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
lnZ-score	4	2.412	.013	2.398	2.425
lnFintech	4	16.641	.801	15.476	17.225
lnLIQ	4	3.598	.420	2.870	3.711

Source: calculation from the dataset.

Table 1 displays the descriptive statistics of the variables. According to the descriptive statistics, the number of observations is four. Among the variables, the bank Z-score has the lowest mean, while the fintech lending have the highest mean. The bank Z-score also has the lowest standard deviation and the lowest minimum and maximum values. On the other hand, the fintech lending has the highest standard deviation, minimum, and maximum value.

Table 2. Correlation matrix between variables

	(1)	(2)	(3)
lnZ-score (1)	1.000		
lnFintech (2)	-0.629	1.000	
lnLIQ (3)	-0.412	0.968	1.000

Source: calculated from the dataset.

Table 2 displays the correlation relationship between the variables. According to the table, lnFintech, and lnLIQ have a negative correlation with lnZ-score. On the other hand, there is a highly positive correlation between lnFintech and lnLIQ.

Table 3 illustrates the regression analysis on the impact of the fintech lending on the bank stability. According to the table, the analysis is conducted using four-year data. The F-value of the model is significant. Accordingly, lnFintech and lnLIQ variables in the model are significant in explaining LnZ-score variable. Before explaining the coefficients of the model, the results obtained from the fundamental assumption tests will be explained. First, according to the Breusch-Pagan (1979)/Cook-Weisberg (1983) test for heteroskedasticity, there is no heteroskedasticity problem in the model. Second, the hypothesis tested in the Breusch-Godfrey (1978; 1978) LM test for autocorrelation is that there is first

order autocorrelation in the model, as indicated by both the test statistic (4.000) and the probability value (0.045). In the lagged value taken to test for second-order autocorrelation, it is found that there is no second-order autocorrelation in the model. We can see this from the probability value of 0.135. Robust standard errors are used to eliminate the autocorrelation problem. In this context, the method proposed by Newey-West (1987, 1994) can be used in the presence of heteroskedasticity and autocorrelation. When autocorrelation is present, the approach produces consistent estimators. Finally, for the normality test, the Jarque-Bera (1987) test statistic (.361) and the probability value (0.835) indicate that the error terms of the model are normally distributed.

Table 3. The effect of fintech lending on bank stability

Dependent Variable: lnZ-score			
Independent Variables	Coeff.	Newey-West Std. Err.	t-Statistic
Constant	3.032	.006	499.18
lnFintech	-.057**	.000	-99.80
lnLIQ	.092**	.000	96.59
No. Obs	4		
F-Statistic	5414.47 (0,009)		
Diagnostic Test Results			
Breusch-Pagan (1979) / Cook-Weisberg (1983) test for heteroskedasticity	1.27 (0.259)		
Breusch-Godfrey (1978; 1978) LM test for autocorrelation	4.000(0.045) (First order)	4.000 (0.135) (Second order)	
Jarque-Bera (1987) normality test	.361 (0.835)		

Notes: ***, ** and * indicate significance at the 1%, 5%, and 10% levels, respectively. Brackets indicate p-values. The lnZ-score, the natural logarithm of the banking system Z-score; the lnFintech, the natural logarithm of the fintech lending; the lnLIQ, the natural logarithm of the ratio of liquid assets to deposits.

Source: calculated from the dataset.

The coefficients in Table 3 indicate that the logarithm of the fintech lending has a negative effect on the logarithm of the bank Z-score. In other words, an increase in the fintech lending has a negative impact on the bank Z-score. The suggestion that there is a negative correlation between bank strength and fintech lending has thus been refuted. Le et al. (2021) examined the relationship between the fintech lending and the bank efficiency and found a negative relationship. Put another way, the inverse correlation found in Romania between fintech lending and bank stability offers the question that the rise in fintech lending may have had a negative effect on bank stability. One of the reasons for this could be increased competition. Given that fintech credit organisations are able to supply banking services to traditional bank users, the consequence of this fact is the altered competition between credit institutions, that can threaten bank stability and minimise profit margins. The components of the central regulatory framework are another factor which can raise the pressure put on traditional banks and reduce the strain on fintech institutions. In addition, high financing costs and market volatility can be among other problems. All contemplations, research is still being done on the effect of fintech lending on Romanian banking stability.

On the other hand, in the table, there is a positive relationship between $\ln LIQ$ and $\ln Z$ -score. Accordingly, an increase in $\ln LIQ$ has a positive impact on the Z-score. Liem et al. (2022) similarly find that LIQ has a positive effect on Z-score. This suggests that higher liquidity assets increase the stability of the banking system.

5. Conclusions

The goal of this research is to assess the linkage between fintech lending and bank stability. Regression analysis was employed for the timeframe 2017-2020 to understand the manner in which fintech lending influences the stability of banks in Romania. Fintech lending influences in a negative way bank Z-score.

Correctly understood, an expansion in fintech lending results in reduced in in the bank Z-score. The negative relation between fintech lending and bank stability displayed in Romania raises the possibility that a rise in fintech lending has had a negative effect on bank stability. Competition might have been the factor that determined the appearance of this situation. Knowing that fintech organisations are able to supply loans to traditional banking institutions, competition between fintech entities and the traditional banking field is enhanced, this influencing in a negative way the cohesion of the traditional banking structure, triggering the lowering of profit margins. A supplementary cause can be represented by regulatory aspects. On the other hand, it has been found that there is a positive relationship between bank stability and liquid assets/deposit ratio.

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**Supervised Learning Algorithms
for Non-Life SCR Ratio Forecasting**

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Abstract

The solvency is measured by the Solvency Capital Requirement (SCR). This study seeks to determine the best financial ratios to forecast SCR because it is significant. There is seasonality, data jumps, and shifts in insurance indicators, which make prediction of SCR difficult. Different machine learning algorithms are applied to the insurance market in this research to see how well they can describe and predict the SCR ratio. Gaussian process regression, ensemble methods, regression decision trees, stepwise regression, and neural networks were used as supervised learning techniques to find the most suitable method to predict SCR. According to our analysis of nonlife insurance data from Romania between 2016-2020, debt ratio, reserve adequacy, receivables, and liquidity are among the key indicators that should be considered when forecasting SCR. These findings can be useful for policymakers, regulators, actuaries, and professionals involved in risk management or the insurance industry.

Keywords: general insurance, machine learning, risk prediction, solvability capital requirement ratio.

JEL Classification: G22, G28.

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1. Introduction

The regulation of the insurance industry proved to present gaps in the 2007-2009 financial crisis, hence new laws were created for the protection of consumers. One of the laws which were set following this amendment was carried out is the Solvency II Directive, that entered into force in 2016 as a legally binding regulatory framework for all the insurers conducting activities in the EU and requests them to maintain a sufficient level of capital to steer clear from being declared insolvent.

Solvency II demands an insurance or reinsurance company to keep enough sufficient solvency capital as specified by different risk levels at a 99.5 percent level of confidence over one year. These include non-life underwriting risk, market risk, credit risk, and operational risk, amongst others that constitute the SCR. Moreover, compliance with SCR will assure the client about the financial soundness of the firm, including its capacity to meet all liabilities, with the penalty of closure by order of the authority in case of a breach at the firm's end.

The financial health of any insurance company may be viewed against the eligible equity in comparison with the SCR, which provides something known as the SCR ratio. A ratio below 100% suggests some financial instability in that not enough funds are set aside to cover losses above such a point, which hints at the lack of adequate reserves to cater for such situations. Therefore, accurate estimation of how much below or above this benchmark level might turn out true becomes very important not only for policymakers but also for regulators themselves, thus necessitating the development of different predictive models in relation to forecast accuracy.

This study employs machine learning algorithms when dealing with solvency capital requirement ratio predictions, something that has increasingly gained recognition within the insurance sector over past years, given the changing business landscape driven mainly by digitisation processes like automation, among others. Our main objective here is, therefore, twofold: first, we seek to identify those financial indicators that are highly correlated vis-a-vis SCRs; second, we evaluate performance diverse ML techniques under a similar context previously mentioned. For instance, some useful ratios could include receivables turnover rate, liquidity ratio, debt service coverage reserves to policyholders, etc. Based on this approach, supervised learning methods such as stepwise regression, decision trees regression, Gaussian process ensemble methods, and neural networks will be applied, thus providing information on the prediction precision levels of SCR according to different machine learning algorithms.

The purpose of this paper is to examine the applicability of machine learning algorithms in predicting solvency capital requirement ratios within the insurance sector. We intend to identify financial ratios that are most predictive of the solvency capital requirement and evaluate various machine learning techniques' performance under this setting. Our results can improve risk-based supervision and provide useful information for practitioners and regulators alike.

Our research work contributes largely towards literature development in relation to the use of machine learning algorithms, especially when it comes to predicting Solvency Capital Requirement (SCR). Through the identification of key financial

indicators such as receivables; liquidity; debt ratio; and reserve adequacy, among others, we offer insights concerning what should be taken into consideration while trying to come up with accurate forecasts on SCRs so that they can be used effectively during decision-making process by different stakeholders involved like investors, managers, or even policymakers at large. Moreover, our methodology involves the employment of various supervised learning methods, including stepwise regressions, decision tree regressions, and Gaussian processes ensemble neural networks, which highlights benefits brought about through the application of these models within areas like SCR forecasting where more accuracy is required. Furthermore, this research provides practical implications for those working in the insurance industry who may wish to use these findings so as to avoid falling into financial distress themselves or failing to protect the stability of firms under their watch.

2. Problem Statement

The Solvency Capital Requirement Ratio (SCR) has been an important gauge of insurance firms' financial health, leading to many investigations into developing accurate predictive techniques. Several studies have reviewed different methods, ranging from traditional statistical approaches to advanced machine learning algorithms, to correctly predicting SCR ratios.

2.1 Traditional Methods

Moreno et al. (2020) used a dynamic panel data model to analyse the solvency of Spanish insurers and found that solvency margins were positively correlated with profitability and underwriting risk but inversely related to company size, reinsurance usage, long-tail businesses, and life insurance specialisation. They also observed that economic downturns tend to reduce solvency margins. Caporale et al. (2017) assessed insolvency risk in UK nonlife insurers and pointed out that interest rates, liquidity, profitability and leverage – along with macroeconomic factors – were significant determinants of insolvency risk based on traditional risk factors alone. Hejazi et al. (2017) demonstrated how neural networks could estimate SCR for variable accidents, showing potential for machine learning in this area. They stressed that machine learning can take into account the complicated interdependencies among accounting indicators leading to better SCR forecasts.

2.2 Machine Learning Approaches

Machine learning algorithms are a notable improvement compared to classical statistical methods, that are frequently based on means, standard deviations, normal distributions, and linear regressions. Despite being advantageous, the traditional approaches may lack the capability to pinpoint low-risk factors or to showcase linkages on different levels. In contrast, flexible detailed machine learning methods like regression trees, ensemble methods, and neural nets offer more versatile ways of analysing data.

Henckaerts et al. (2021) utilized a tree-based machine learning approach in predicting both frequency and severity of an insurance portfolio and demonstrated superiority to traditional GLM models. Their work demonstrated the fact that gradient boosting and random forest algorithms usually lead to better predictions of the damage frequency and less painful problems compared to a GLM model. Another example is by Wüthrich, 2020, who applied the neural models to price general insurance and greatly surpassed the performance of generalized linear models (GLM). Fauzan and Murfi, 2018, compared several ensemble learning methods for predicting car damage: the XGBoost AdaBoost Stochastic Gradient Boosting and Random Forest. They found out that the algorithm used was XGBoost, and it gave higher levels of accuracy compared to other methods. Further, the findings of Weerasinghe et al. (2016) also reported that the neural networks produce the best estimates when car damage is predicted.

2.3 Regularisation and Feature Selection

To address overfitting and multicollinearity issues in linear regression models, various regularisation techniques such as ridge regression, lasso, and elastic net are used. When there is no clear economic intuition for selecting relevant factors, stepwise regression is a popular choice for feature selection. This automatically selects the most significant predictors for the dependent variable, in this case SCR. Hejazi and Jackson (2017) integrated a neural network calculation of SCR with portfolio estimation. A comparison of the the performance of variable anomalies was made between them. Castellani et al. (2021) simulated life insurer SCRs using deep learning models and support vector machines, further illustrating the success of advanced machine learning techniques in this domain.

3. Research Questions / Aims of the Research

The main goal of this study is to understand the effectiveness of various machine learning algorithms in predicting the solvability capital requirement (SCR) ratios for insurance companies. Research seeks to improve the accuracy and dependability of SCR forecasts about SCRs by identifying financial ratios that are most predictive of them, which would therefore contribute to effective risk-based supervision and robust regulation within the insurance sector. To elaborate on the problem statement, this research addresses the following questions:

What are some key financial indicators used by organisations when forecasting solvency capital requirements (SCRs)? This inquiry tries to find out what the main pointers that heavily affect SCRs, thus giving insight into the necessary elements for ensuring financial stability in the insurance industry.

How accurate are different types of machine learning algorithm in predicting an SCR ratio? The question assesses the performance of stepwise regression analysis methods, regression decision trees, Gaussian process regression models, ensemble methods, and neural networks, which were used in trying to forecast the ratio.

Can we use ML models to detect financial insolvency earlier than traditional statistical methods applied in insurance firms? This query investigates if such an ability exists, by comparing the predictions of those two approaches regarding potential vulnerability areas within insurance firms, thus allowing timely regulatory interventions.

What should be done practically when applying machine learning algorithms to predict SCR ratios for supervisors and practitioners working within insurance companies? This inquiry looks at ways to implement the results from this investigation under real-world conditions to enhance monitoring systems designed to promote the soundness of financial organisations, particularly those involved with insurance undertakings.

Since they focus on verifying how well these machines work, three hypotheses tested during this research:

Machine learning algorithms significantly outperform traditional statistical methods when predicting an SCR ratio: Here, it was suggested that more advanced techniques could give better results in terms of precision or reliability than the usual means.

Receivables (Debtors), liquidity (Quick Ratio), Debt Ratio (Debt Equity), and reserve adequacy are the Key Financial Ratios for predicting the SCR Ratio. This hypothesis indicates that some selected financial indicators should have a high impact on solving capital requirement forecasting.

Early detection of financial impairment in Insurance Companies is improved through Machine Learning Models: It was proposed under this hypothesis that regulatory authorities would be able to act faster if they used machine learning algorithms as compared to traditional ones, since the former can detect potential instability quickly.

Through these hypotheses and research questions, it is anticipated that there will be a better understanding of how machines work in the insurance industry, especially when predicting SCR ratios for the solvency capital requirement.

4. Research Methods

This study involved using an annual data set in the Romanian nonlife insurance sector between 2016 and 2020 as a basis for analysis. Initially, more than 40 accounting indicators were scrutinised for analysis in this dataset. The pre-processing of the data was performed to ensure that it was of high quality and consistency by removing duplicates, examining outliers and treating them, and handling missing data, among others. The z scores were calculated to standardise the values across all variables. The preliminary analysis used a stepwise regression method in which those indicators that had the least or no explanatory power toward the SCR ratio were removed. This helped address collinearity problems inherent in any such data set. We then applied three techniques of regularisation, namely lasso regression, ridge regression, and elastic net, to choose the most important variables. Lasso assigns small weights to zero, hence making it easy to identify important

variables, while ridge keeps them small and elastic net removes weight variables while reducing the influence of others.

The initial set of indicators that were selected for further testing with machine learning algorithms include:

- Profitability Ratio: Profit (loss) divided by gross premiums underwritten;
- Combined loss ratio: Recorded losses plus expenses divided by underwritten gross premiums;
- Receivables Indicator: The sum of reinsurance recoveries receivable balances insurance intermediaries' receivables plus reinsurance receivable balances divided by total assets;
- Liquidity Indicator: Total liquid assets divided by short-term liabilities;
- Debt Ratio: Total assets divided by total liabilities;
- Reserves Indicator: Sum changes RBNS+IBNR /sum RBNS+IBNR;
- Runoff ratio: adequacy ratio/ loss reserves;
- Equity Quality: Equity / Subordinated Liabilities.

To estimate the SCR ratio, we employed various supervised machine learning algorithms, including decision trees, Gaussian process regression ensemble models, neural networks, etc. Decision trees are hierarchical models that make predictions based on the best predictor at each node, while regression trees reduce the variance of response variables at each successive node, generating numerical predictions. We trained regression trees with different splits and we found that a tree with 8 splits provided the most accurate predictions. Cross-validation was used to assess model performance and avoid overtraining.

The Gaussian process regression (GPR) models represent the response by means of a probability distribution over functions. To handle non-smooth datasets more efficiently, we used an exponential kernel and achieved an R-squared value of 43%, which is comparable to the best-performing decision trees in regression. The response in Gaussian process regression is modelled using a probability distribution in function space. GPR models are nonparametric probabilistic kernel-based models.

Given a training dataset $(x_1, y_1), (x_2, y_2), \dots, (x_n, y_n)$ and a new test input x_* , GPR predicts a distribution for all possible values of y_* for x_* . A GPR model connects this data to the output with some Gaussian noise. After seeing the data, we revise our belief to obtain another Gaussian (posterior) process. We want to compute the mean and covariance (or kernel) for this posterior. With the Gaussian process framework, the posterior distributions are also Gaussian. We can make predictions about new points using the mean and covariance of this posterior distribution. In our case, an exponential kernel was used because, depending on which type you choose, it will consider different functions when building up your model within GPR, which gave us better results as it might be more appropriate while dealing with non-smooth datasets. The exponential kernel is defined as $k(x, x') = \exp(-(\|x-x'\|)/\lambda)$ (1)

Where x and x' are input data, $\|x-x'\|$ is the L1 norm for Manhattan distance between the input data and is a length scale parameter for the width of the kernel.

4.1 Ensemble Models

Ensembles like bagging, random forests, and gradient-boosting machines can overcome these challenges because of the sensitivity of decision trees to training data. An ensemble method refers to a supervised learning technique that combines predictions from many machine learning algorithms. These models are able to produce better outcomes by gathering weak "learners" outputs into one strong model. There are a variety of methods for aggregating learners, also known as algorithms, some of which include bagging trees, random forests, and boosting trees, among others. In this algorithm, bootstrapped samples are used from the data set; at every node, a random subset of factors is selected and thresholds are randomised. Bagging trees take a sample of data and replace it, creating new datasets called bags. The algorithm samples with replacement, meaning that some data are repeated while others are left out. And then, n times, the process is repeated until an ensemble of n replicates is done, just like in bootstrapping. Training in each replica created a model for each, and accuracy was tested on each model. Boosting is an algorithm similar to ensemble techniques, but predictions are made sequentially under the assumption that each submodel corrects mistakes.

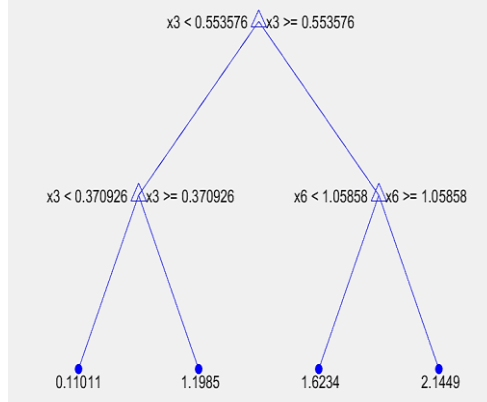
Artificial neural networks (ANNs) are supervised learning models that can learn relationships between input and output datasets, especially when such relationships are complicated or nonlinear in nature. A neurone computes a weighted sum over multiple inputs and then passes it through a nonlinear activation function, such as a threshold activation filter, to produce output. To amplify outputs from individual neurones, they need to be combined together within the network representation. The network itself can be thought of as a multivariate function that maps the input data set to an output vector. Neural networks have found useful applications within the insurance industry, among other sectors. There are different types of neural networks, depending on their capability to handle complex datasets. For our study, we employed feedforward two-layer neural networks for supervised regression. We adjusted the two-layer feedforward network in the hope that it might yield better performance than previously tuned ensembles. The data set was split into training, validation, and testing sets. After training, MSE and R-squared can be used to evaluate the network performance.

5. Findings

5.1 Regression Trees

A range of 3 to 8 splits has been used for training regression trees. The regression trees with 8 and 3 splits are presented below. This binary tree predicts the range of SCR ratio from the branching of the data. The first decision is whether the indicator of receivables is less than or greater than 0.56. If it does, follow either the left or right branch until you find the predicted SCR values. What this tree shows is that according to a company's low level of accounts receivables, its poor position of solvency can be predicted more accurately (explained by logic).

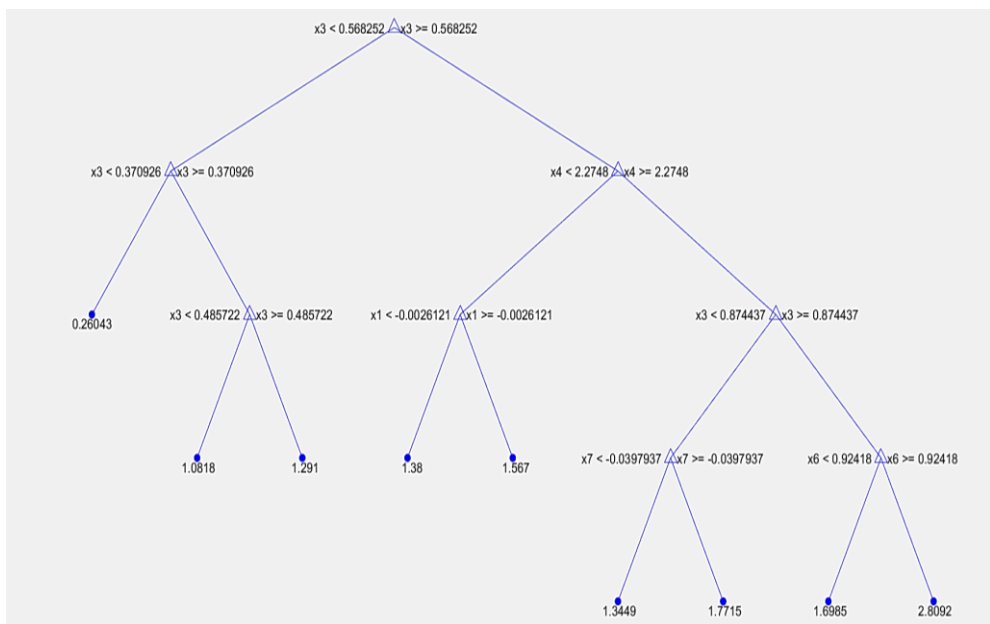
Figure 1. Partitioned Regression Trees with 3 Splits



Legend: Rentability (x1), the inverse of the combined loss rate (x2),
 Receivables/Total Assets (x3), Liquidity indicator (x4), Indebtedness ratio (x5),
 Adequacy of Reserves (x6), Runoff (x7), Quality of own funds (x8).
Source: authors' calculation.

In a partitioned regression tree with 8 splits, the receivables indicator is still the best predictor of low SCR values, but it supplies more information for other SCR values. Thus, a higher receivables indicator joined by higher values for liquidity and a higher adequacy reserve indicator will predict a high value for SCR ratio, which translates into a very good solvency position for the companies.

Figure 2. Partitioned Regression Trees with 8 Splits



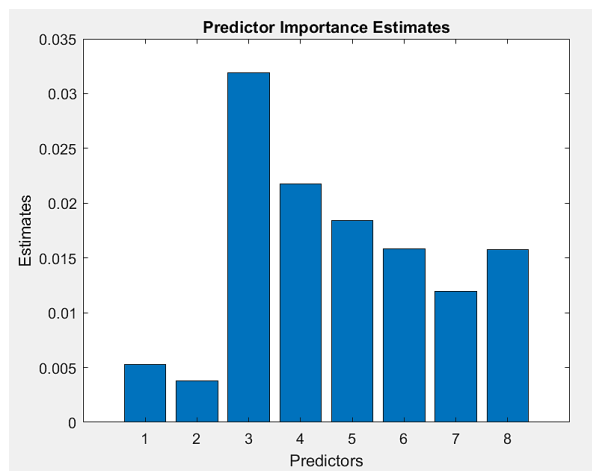
Source: authors' calculation.

Machine learning has some methods commonly used to reduce overfitting. These are cross-validation, bagging, random subspace, random forest, and boosting. Bagging decision trees do better regularisation than single decision trees that have been pruned. This regularization technique works well with models because it decreases the variance and increases the learning bias. An algorithm in machine learning divides sample data into three sets—training set, validation set, and test set—thus developing alternative strategies to increase model complexity. The test set also functions as an out-of-sample forecast tool by showing how good the model, or mixture of models, that has been chosen in advance is.

From our initial results of partitioned trees with 3 and 8 splits, we have chosen to do a cross-validation with a regression tree with a maximum number of splits equal to 8. Cross-validation, in this instance, is a procedure used for out-of-sample test performance, with repeated random sub-sample increments, achieved by dividing the dataset into equally sized folds used as validation sets, with the rest as training sets. This method is useful in estimating the predictive accuracy of a fitted tree.

We grew unbiased trees by specifying the use of curvature tests to divide predictors. We did a bar graph comparison regarding estimated predictor importance where the most important predictors selected by the regression tree. among the other 8 indicators shown above include receivables, liquidity, indebtedness, as well as adequacy of reserves, whose significance levels are displayed in the next figure with the tallest bars representing highly significant predictors selected by regression tree.

Figure 3. The importance of predictors

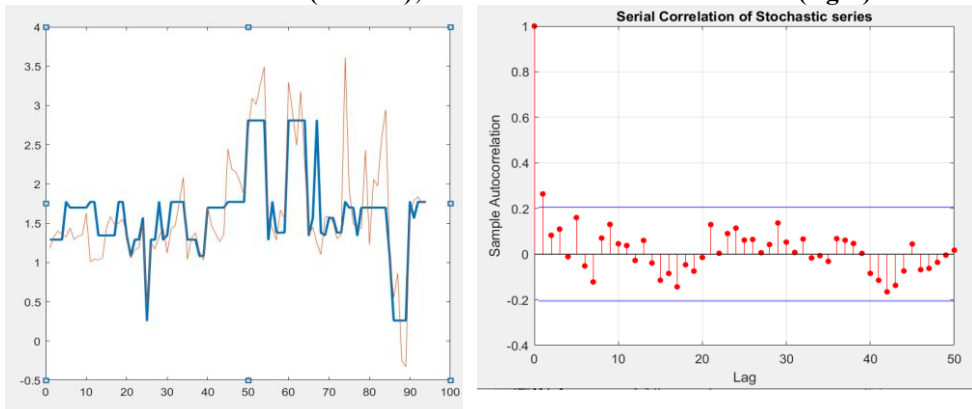


Source: authors' calculation.

The resubstitution mislaid for the most appropriate regression tree amounted to 17.8%, and it is the mean square error between predictions and actuals computed on given samples. If the error is high, then this shows that an underfit has occurred because predictions are too far from targets, while if it is too low, we may be over fitting our estimates to the sample.

The graph below shows how far off predictions were from reality as well as the self-correlation of errors in estimated trees with 8 splits. By considering the serial autocorrelation in residuals, one can observe that some autocorrelation still exists between these two variables. .

Figure 4. Partitioned Regression Trees with 8 Splits: predicted SCR (blue line) versus actual SCR (red line); Autocorrelation of the residuals (right)

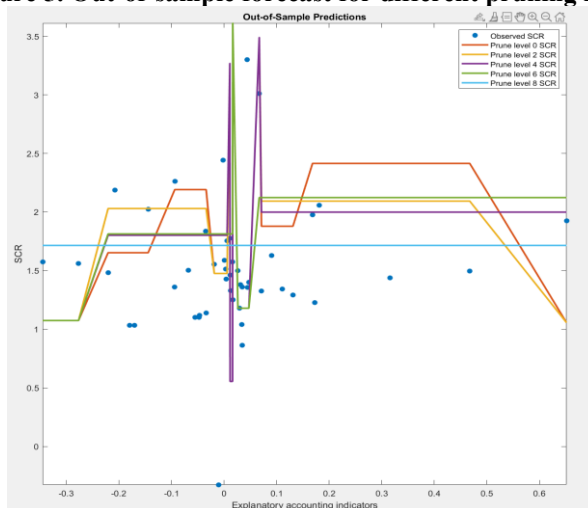


Source: authors' calculation.

We fitted the model again with only three splits and the results are poorer. The resubstituting error increased to 32%. This implies that a smaller model cannot explain SCR since it underfits the data. Out of the partitioned trees with 3 and 8 splits, the best regression tree has 8 splits and an R-squared of 43%.

We did an out-of-sample forecast for the regression tree for different pruning levels between 2 and 8 variables. For each pruning level, we predicted SCR and compared the results with the actual data.

Figure 5. Out-of-sample forecast for different pruning levels



Source: authors' calculation.

A higher pruning level implies fewer explanatory factors. As shown in Figure 4, the results indicate that only four explanatory levels are optimal to explain the largest variation of the SCR. The final explanatory variables chosen from the initial data set of eight variables are receivables, liquidity, indebtedness, and the adequacy of reserves.

Therefore, the regression trees with 8 splits showed that the receivables indicator was the most important predictor of the SCR ratio, supported by higher values for liquidity and reserve adequacy indicators. The 3-split tree was less effective, with a re-substitution error of 32%, indicating underfitting.

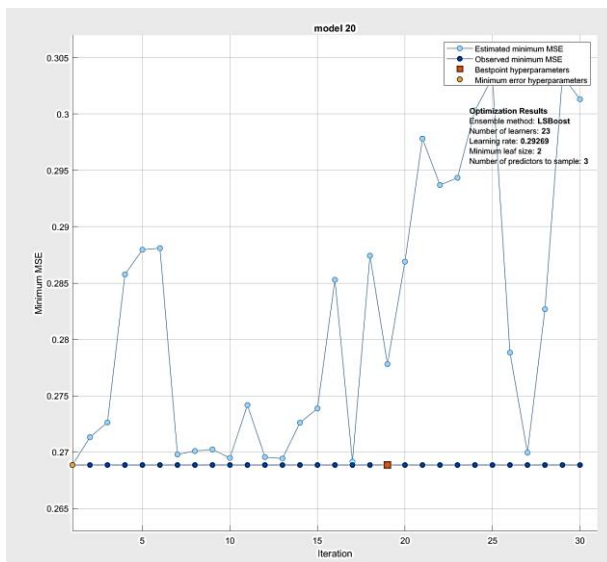
5.2 Gaussian Process regression

The GPR model with an exponential kernel achieved an R-squared of 43%. This result was on par with the best regression trees, strengthening the effectiveness of the selected indicators.

5.3 Ensemble Models

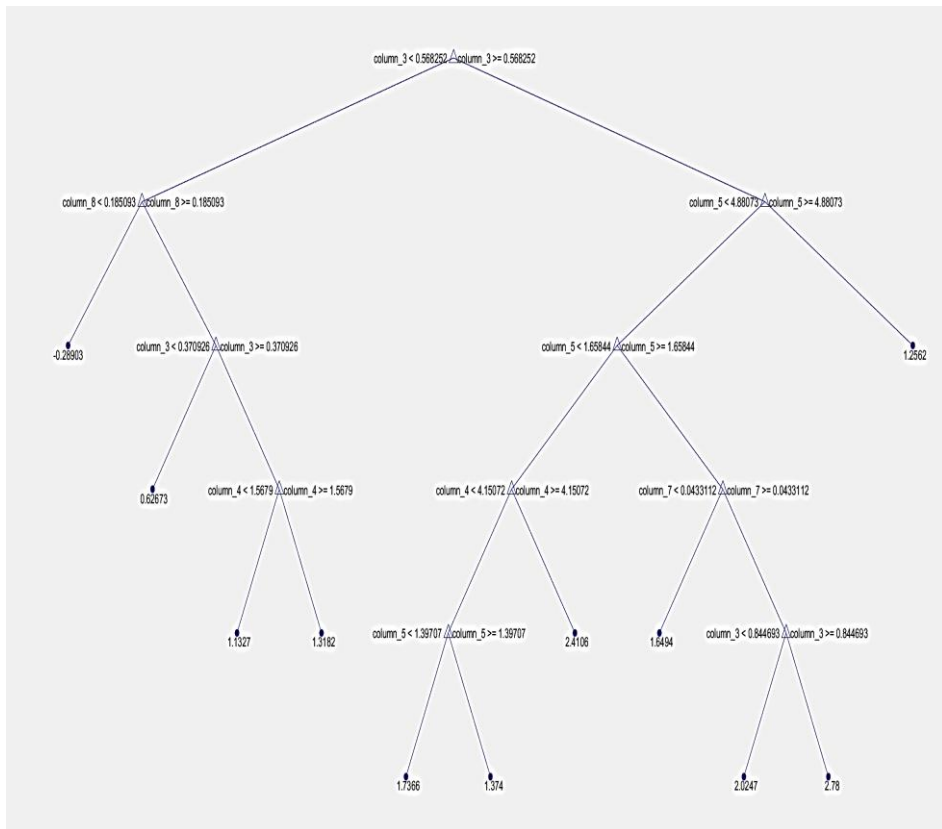
The highest R-squared of 54% is provided by boosting trees among ensemble methods. The model recognised accounts receivable, liquidity, debt, and reserve sufficiency as the most significant predictors. The best method was the boosting tree method with 23 learners. The minimum leaf size ranged from 1 to 47, and 1 to 8 predictors were taken into account during this process. The ensemble tree is presented below and confirms previous findings that an account receivables indicator is the best predictor of a firm's low SCR ratio. Trained Ensemble can be used to predict SCR.

Figure 6. Minimum MSE plot for trained ensembles



Source: authors' calculation.

Figure 7. Trained Ensemble (R-squared 54%)

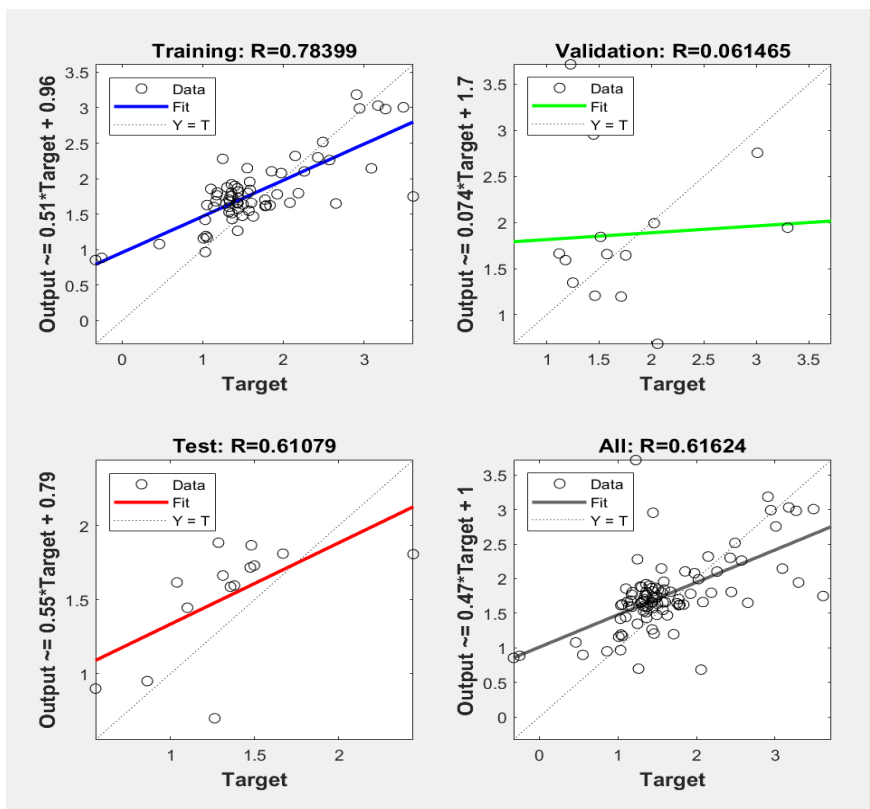


Source: authors' calculation.

5.4 Neural Networks

The graph illustrates the results of the neural network in all three stages: training, validation, and testing. The trained neural network recorded an R-squared coefficient of 62%, representing the best results obtained with the machine learning algorithms used in this study. These results indicated slightly superior performance to the ensemble methods (R-squared of 54%). Artificial neural networks (ANNs) are capable of modelling complex non-linear relationships. In this study, we used a two-layer forward network and split the data into sets for training, validation, and testing. The best performing neural network achieved an R-squared coefficient of 62%, outperforming all other models tested. This result highlights the superior ability of artificial neural networks to capture complex relationships in data. The network performance was consistent throughout the training, validation, and testing stages.

Figure 8. Neural network for SCR ratio



Source: authors' calculation.

5.5 Predictor Importance

The majority of the models selected for this study showed that assets, current ratio, debt ratio and reserve adequacy are the most significant indicators. Models were evaluated based on mean squared error (MSE) and R-squared values. Neural networks performed the best, followed by ensemble models and regression trees. The cross-validation process confirmed the stability of these models, reducing the risk of overtraining and ensuring reliable predictions.

The findings indicate that machine learning algorithms such as neural networks and ensemble models can greatly enhance the accuracy of SCR ratio forecasts. These models provide useful tools for insurance practitioners and regulators to actively monitor and manage the financial health of insurance companies. Precise prediction of SCR ratios can support early identification of deteriorating financial conditions with timely regulatory interventions.

Drawing on a few core indicators, the paper proposes a simplified approach to risk-based supervision that could simplify regulation while maintaining sound financial control. Empirical results strongly support hypothesis 1. Various machine

learning techniques such as decision trees, Gaussian process regression, ensemble methods, and neural networks have shown better performance in predicting SCR ratios than traditional methods. In particular, the neural network achieved an R-squared value of 62%, which is relatively high, indicating good predictive ability, among other things Ensemble methods especially boosting trees, also did well with an R-squared value as high as 54%. This suggests that machine learning algorithms can detect complex patterns or relationships between different variables, which may be missed by conventional statistical modelling techniques. Our findings thus validate our hypothesis that machine learning algorithms significantly outperform traditional methods when it comes to forecasting the SCR ratio.

Hypothesis 2 was confirmed through consistent identification of receivables liquidity indebtedness and reserve adequacy as being the most significant predictors across various models Decision trees, for example, an eight-split tree identified these factors as important towards accurate prediction achievement Similarly, ensemble approaches along with Gaussian Process Regression highlighted their relevance due to them being consistently more influential during prediction stage Bar graphs comparing importance levels within predictors further underscored the centrality of these financial ratios in determining SCR ratio Therefore our study affirms that those key financial ratios are strong predictors necessary for correct forecasts about the SCR ratio.

The performance of models and implications for regulatory practice validate Hypothesis 3 Machine learning models, particularly neural networks and ensemble methods, have brought about not only higher predictive accuracy but also better capabilities for early detection. Superior performance metrics (eg, R-squared values) show that these models can recognise signs of deteriorating financial condition earlier and more accurately than traditional methods. Ability to handle large volumes or variety of data sets by machine learning provides deeper insights into financial health, thereby enabling timely interventions by regulators. Hence, study findings strongly support hypothesis that ML improves early detection of FI in ICs.

These hypotheses, being shown to be true, have a number of implications in the real world. Initially, the fact that machine learning models have been shown to be superior means that regulators and insurance companies should adopt them as part of their risk assessment systems. Integrating these advanced methods into their frameworks would enable more accurate and timely monitoring of financial health, and thus overall market stability. Second, the discovery that key financial ratios are significant predictors emphasises the need for regulatory practice to focus on those indicators. Regulators can foresee and mitigate probable risks in a better manner by closely observing the receivables, liquidity, leverage, and reserve adequacy. Last but not least, there is an enhancement in the ability of machine learning models to conduct early detection, that stands as an irreplaceable tool for regulators who intend to act beforehand. This approach can help prevent insurance companies from going through periods of financial crisis, thereby safeguarding policyholders' confidence in the insurance industry.

6. Conclusions

The aim of this paper was to use machine learning algorithms in selecting indicators and predicting the Solvency Capital Requirement (SCR) ratio within Romanian nonlife insurance market. We were primarily interested in modelling certain relationships between some insurance indicators with deterioration of solvency positions among nonlife assurance firms.

We employed various supervised learning techniques such as regression decision trees; ensemble methods like Gaussian process regression; neural networks, etc., using an annual data set from 2016-2020 years inclusive. The analysis revealed key indicators for forecasting SCR ratio including receivables, liquidity, debt ratio, and reserve adequacy, the most important one being receivables indicator which is defined as summing up reinsurance recoveries together with all types of receivables related to insurance activities and then dividing it by total assets.

Based on empirical results obtained during this study, we can say that traditional statistical approaches were outperformed by machine learning models, thus confirming its superiority over other methods when it comes to SCR ratios predictions. Among all tested models, the neural network showed the best predictive performance having an R-squared value equal to 62% followed by ensemble model, which achieved R-squared value of 54%. These findings clearly show that the machine learning algorithm has the ability to capture complex patterns better than any other statistical method known so far while also improving accuracy in predictions.

The solvency levels unexplained by macroeconomic factors, market size, and business lines suggested the need for further investigations in these areas.

These findings have implications not only for insurance regulators but also for policy makers, actuaries, as well as professionals in the field of insurance and risk management. Incorporating machine learning models into their risk assessment framework will enable them to monitor financial health more effectively, thus making it possible for early intervention with appropriate regulations. What this study shows is how much impact can be made on analytic capabilities within the insurance industry through the use of machine learning.

While this research provides strong evidence supporting use of machine learning, there are few limitations worth considering. For instance, data used were specific to Romanian non-life assurance market; hence results cannot be generalised directly without additional validation from other markets. Also, the study period between 2016-2020 may not cover long-term trends and variations.

Further studies could take another angle such as different regions across the globe or extend the time frame, thereby enhancing external validity besides looking at integration deep learning models among others, which may improve early detection abilities as well accuracy in prediction.

To sum up, the investigation confirms that machine learning algorithms can forecast SCR ratios; it shows which financial indicators are strong predictors and demonstrates that these models enable earlier detection. The observations made

have important implications for regulation as they help make insurance industry oversight more precise and anticipatory in nature.

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Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors utilised ChatGPT to enhance readability and language clarity. Following the use of this tool, the authors meticulously reviewed and revised the content as necessary and assumed full responsibility for the final content of the publication.

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**Exploring the Influence of the COVID-19 Pandemic
on the Professional Trajectories of Young Women: Findings
from the Eurobarometer “Women in Times of COVID-19”**

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Abstract

The COVID-19 pandemic caused a deep global economic crisis, hitting the labour market very hard. Young women were among the hard-hit, hence a slight departure from the usual trend observed in the recent economic crises where men usually were more affected. The paper investigates how the pandemic affected the professional careers of young women in EU27 and Romania. Other aspects considered in the study are work-life balance, working hours, and the career decisions to be made, such as a change in income. In addition, this study adds to the literature in examining variations among different young women's socio-demographic groups to identify which groups are mostly hit by the pandemic in relation to career issues. Data for this study is taken from the Flash Eurobarometer 2712, "Women in times of COVID-19". In the research, there was a descriptive analysis, non-parametric tests, and six binary logistic regression models. The results indicated that the pandemic of COVID-19 hit the work life of young women in Romania more severely compared to the average of EU27. Young women aged 15-24, the self-employed, and workers with 16-19 years of education have been most severely affected among the EU27 in their professional careers due to the pandemic. This evidence will add to a rich tapestry of research related to the impact of the crisis on employment opportunities for young women.

Keywords: COVID-19 pandemic, young women, professional trajectories, labour market, logistic regression.

JEL Classification: J21, J24, J81, C14, C35.

1. Introduction

The COVID-19 pandemic has led to significant imbalances globally, not only from a medical point of view but also from an economic and social point of view.

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Although the pandemic caused an extremely strong impact on the economy as a whole, far-reaching consequences were transferred to the labour market. However, whereas this crisis affected most of those individuals participating in the labour market, one of the strongly affected groups has been young people – especially young women. One of the labour market groups that faces a lot of challenges, even outside periods of economic stability, is young women. Young women have been further added to the category of vulnerability by the COVID-19 crisis in view of their overrepresentation in sectors seriously hit by the crisis, such as hospitality and retail.

In the context of this, it is paramount for this paper to review how the COVID-19 crisis has affected young women's professional trajectories in the EU27 and Romania. This will be an attempt, as well, to see the extent through which some of the socio-demographic factors affect the negative consequences of the pandemic on the professional experiences of young women. The structure of this paper is as follows: Section 1 is represented by the introduction, which presents key concepts related to the theme of this paper, but also its main objectives. Section 2 presents a review of the specialized literature, summarizing the most important aspects regarding the impact of the pandemic on young women, but also the differences compared to other socio-demographic groups. Section 3 presents the description of the research objectives and the research questions, while section 4 presents the data and statistical methods used in this paper. Section 5 focuses on presenting the empirical findings of the analysis, while the final section summarizes the most relevant conclusions of the study.

2. Problem Statement

The COVID-19 pandemic started as a worldwide health crisis but quickly turned into economic and labour market issues, that have led to an unprecedented global job crisis (Lee et al., 2020). Even if it is very clear that this crisis has affected everyone in one way or another, it is important to specify that women have borne a substantial share of the economic repercussions and personal hardships (Goldin, 2022). Specifically, women have faced greater challenges compared to men regarding their participation in the labour market (Abraham et al., 2022). However, this represents a deviation from the typical pattern observed in recent economic crises, which tended to affect men more. A study by Alon et al. (2020) highlighted this fact, showing that there is a key difference between past economic downturns and the current one in terms of women's employment. Previous recessions typically hit men harder in terms of job losses, especially during the Great Recession following the 2007–2008 financial crisis, but not only, leading to the term "mancession" being coined (Alon et al., 2020). But, contrary to past recessions, women have experienced higher rates of job loss and departure from the labour force compared to men, during the pandemic (Luengo-Prado, 2021). An explanation of this fact is that, unlike traditional recessions that typically affected male-dominated sectors like construction and manufacturing, the current downturn has hit service industries hardest.

Some studies on this subject have revealed that young women were also adversely affected by the onset of the COVID-19 pandemic, which is the central focus of this paper. One of these studies, made on India's labour market, revealed that women face a sevenfold higher likelihood of losing employment compared to men, during the economic lockdown or afterward, but also the fact that, regarding women, individuals in the youngest working age category, specifically those aged 15-24 years, were 3.7 times more likely to experience job loss compared to those aged 35-44 years (Abraham et al., 2022). Likewise, according to ILO (2021), the decline in employment among youth, especially young women, was far greater than among adults in the majority of countries, which underscores the fact that youth employment is more sensitive to economic downturns compared to adult employment. Moreover, according to the same organisation, in 2020, young women were twice as likely as young men to be classified as NEET (Not in Education, Employment, or Training) (ILO, 2022).

The COVID-19 pandemic has affected young people more, especially young women, as opposed to other demographic groups, and several reasons explain this. One of the contributing factors represents vulnerability among young people entering this crisis. The reason can be traced back to global unemployment, which took over a decade to return to pre-crisis levels. Another reason that young people have been hit harder by the crisis of COVID-19 is that they were more vulnerable to easier and cheaper to dismiss, often in less secure forms of employment (ILO, 2021).

Nevertheless, where young people have been over-represented in job losses, they also experienced possibilities in the increase of some occupations such as sales occupation, administrative and public service occupations. However, these positive trends have still not adequately compensated the adverse impact in declining occupations, with young people faring significantly worse than older workers. Moreover, another supportive aspect for young people has been the ability to work remotely from home. A study by Eurofound (2022) showed that before and during the pandemic, women were more likely to work from home in EU member states. The increase from 2019 to 2021 was larger for women than for men; this trend is very sharp in the case of younger workers.

Work flexibility has played an important role in reducing gender labour market inequalities throughout the pandemic, considering that around 12% of employees aged between 15-24 years old reported working from home in 2021, as opposed to less than 3% in 2008 and 4% in 2019. That being the case, however, the benefit of such a measure does not extend to all categories of women. Particularly, mothers are seen to be in a more acute situation, their productivity decreasing when having to combine work and childcare (Alon et al., 2022).

Finally, one should be aware that the COVID-19 crisis increased the already existing vulnerability of young people, young women in particular, on the labour market through means of job loss, leaving the job, or delay entry to the labour market, increasing the challenge of this cohort of citizens (Konle-Seidl & Picarella, 2021).

However, although various studies have been conducted on the impact of the pandemic on young people, there is a lack of studies in the literature on the impact

of the pandemic crisis on the careers of young women in the EU27 and Romania. In this context, this work aims to provide a comprehensive analysis of the impact of the pandemic on the professional paths of young women.

3. Research Questions / Aims of the Research

The main objective of the paper is to investigate if the professional careers of young women have been affected by the COVID-19 pandemic crisis and whether or not there are differences between the EU27 and Romania. The second objective of the study is to explore potential significant variances among the different groups of young women analysed, based on socio-demographic factors, and to identify which of these groups have experienced greater or lesser impact from the COVID-19 pandemic on their professional trajectories.

4. Research Methods

To achieve these objectives, the analysis relied on data from Flash Eurobarometer 2712 (Women in Times of COVID-19). The data from this Eurobarometer were collected from January 25 to February 3, 2022, from 26741 women aged 15 and above from the 27 member states of the European Union, using self-administered questionnaires.

The analysis focused only on women aged 15 to 29 from the EU27 countries. The necessary analyses were carried out using SPSS software, version 26, after selecting relevant cases and applying database weighting.

First of all, graphs were made based on a descriptive analysis of the data to observe young women's perceptions of the impact of the COVID-19 pandemic on their professional lives, both at the EU27 and Romanian levels. The second objective required the use of non-parametric Mann-Whitney and Kruskal-Wallis tests as well as the calculation of mean scores. Finally, a binary logistic regression analysis was used to assess how the explanatory variables influenced the likelihood that the pandemic had a negative impact on young women's working lives.

Six binary logistic regression models were performed, the dependent variable being different for each model, while the independent variables were the same for all six models. The dependent variables were transformed into dichotomous variables, taking the value 1 if respondents agreed with the following statements and 0 if they disagreed with them: 1. The pandemic has had a negative impact on my work-life balance; 2. Because of the pandemic's impact on the job market, I could do less paid work than I wanted to (meaning less work for a salary or wage); 3. Because of the pandemic I'm considering / have decided permanently reducing the amount of time I allocate to paid work; 4. Because of the pandemic my professional decisions changed (such as changing jobs); 5. The pandemic had a negative impact on my income; 6. Because of the increase in work at home, I could do less paid work (for a salary or wage) than I wanted to.

Also, the analysis includes the following independent variables, which have been recoded as follows: Age: a dummy variable with 1- 15-24 years and 2- 25-29 years;

Years of education: a polychotomous variable with the following values: 1- up to 15 years, 2- 16-19 years, 3- 20 years and more, 4- Still in full-time education, 5- Never been in full-time education; Occupation: a trichotomous variable with values: 1- Self-employed, 2- Employee, 3- Manual worker; Type of community: a trichotomous variable with the following values: 1- Rural area or village, 2- Small/middle town, 3- Large town; Household composition: a polychotomous variable with the following values: 1- Couple with children, 2- Couple without children, 3- Single parent with children, 4- Single without children, 5- Multi-generational household, 6- Co-living. For all five independent variables, the reference category considered in the analyses conducted was the last one.

Logistic regression models explore the connection between a series of independent variables x_i (categorical, continuous) and a dichotomous dependent variable (nominal, binary) Y . The logistic regression model can be represented as follows:

$$\ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k, \quad (1)$$

where p represents the probability of the event and x_1, x_2, \dots, x_k represent the explanatory variables:

$$P(Y = 1|X_1, X_2, X_3, \dots, X_k) = \frac{e^{(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k)}}{1 + e^{(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k)}} \quad (2)$$

From this model, the coefficient formula can be extracted, as follows:

$$e^{\beta_0} = \frac{P(Y=1|X_1, X_2, \dots, X_k = 0)}{1 - P(Y=1|X_1, X_2, \dots, X_k)} = \frac{P(Y=1|X_1, X_2, \dots, X_k = 0)}{P(Y=0|X_1, X_2, \dots, X_k)} \quad (3)$$

5. Findings

5.1 Young Women Sample Profile in EU27 and Romania

Of the total of 4922 young women aged 15 to 29 interviewed, 237 are from Romania. Almost 65% of them are aged 15-24. In the EU27, most of the respondents are unemployed (47.6%), whereas in Romania, only 30% fall into this category, with more than half employed (54.9%). The majority of young women are still studying, 44.8% in the EU27 and 34.6% in Romanian, while a significant proportion have more than 20 years of education (27.7% - EU27 and 32.1% - Romania). A significant proportion come from small and medium-sized towns at EU27 level (38.4%), while in Romania 46% come from large cities and 35.4% from small and medium-sized towns, with the fewest coming from rural areas (18.6% - Romania and 27.5% - EU27). Moreover, in the EU27, most live in couples with children (28.8%), followed by couples without children (19.6%) and multigenerational households (19.3%). In Romania, most live in multigenerational households (29.5%), followed by couples without children (27%) and couples with children (20.7%).

5.2 Comparative Analysis of Young Women's Perceptions Regarding the Impact of the Pandemic on Their Professional Trajectories: EU27 versus Romania

In this section, the level of agreement and disagreement of young women from the EU27 and from Romania is presented with respect to the six statements that refer to the impact of the COVID-19 pandemic on their employment and career. These results show the average differences between the EU27 and Romania regarding the influence of the COVID-19 pandemic on the professional life of young women.

When taking into account the negative impact on the balance between professional and personal life, it can be seen that just over 57% of young women in the EU27 agreed that the COVID-19 pandemic had a negative impact on the balance between professional and personal life (21.7% - totally agree; 35.7% - somewhat agree), while in Romania the share of those who agreed with this statement was higher by approximately 11 percentage points (26.8 % - totally agree; 41.5% - somewhat agree). Instead, the share of those who completely disagreed with this statement is significantly lower, only approximately 2 out of 10 women from the EU27 level and only 1 out of 10 women from Romania had this opinion.

A share of 46.4% of young women in the EU27 and 65.2% in Romania admitted working less than they would like to due to the impact of the pandemic on the labour market. Furthermore, 39.3% of the EU27 respondents and 56.1% from Romania agreed that they worked less than they wanted to because of the increase in workload at home. On the other hand, the share of those who strongly disagreed with these statements is much lower in Romania than in the EU27 in both cases.

When considering women's choice to permanently reduce the time they spend on paid work, a higher proportion of women in Romania are inclined to do so than in the EU27 (45.4% compared to 31.5%). On the other hand, it has to be stated that, in Romania, over half of the young female respondents do not take into account such choice, while at the EU27 level more than two thirds of the respondents do not share this decision. Moreover, more than 60% of the Romanian surveyed women made a professional switch, for example, changing jobs, during the pandemic, while on the level of EU27, more than half of the respondents did not make professional decisions on account of the pandemic. Another important aspect is represented by the negative impact of the pandemic on the income of the young women. The proportion of women agreeing with this statement is relatively high in Romania, compared to the EU27 average (67.2% vs. 48.1%). In the EU27, a significant share of respondents, around 30%, strongly disagree with this statement, while in Romania this proportion is more than halved.

5.3 Exploring Socio-Demographic Influences in the Impact of the COVID-19 Pandemic on Young Women's Professional Trajectories

Five socio-demographic variables were considered (as shown in Table 1) and non-parametric statistical tests (Mann-Whitney; Kruskal Wallis) were used to

identify any notable differences in young women's perceptions of the impact of the pandemic on their professional lives.

When age is taken into account, there are significant differences between the perceptions of young women in the 15-24 age group and those in the 25-29 age group about the reduction in paid working hours, which can be attributed both to the impact of the pandemic on the labour market and to increased household responsibilities. Furthermore, if we take into account the years of education and the household composition, there are significant differences regarding the above-mentioned aspects, but there are also different perceptions of the analysed groups regarding the impact of the pandemic on their income. Furthermore, if we take into account the type of community of the respondents, the results show significant differences, especially with respect to the reduction of working hours due to the increase in household responsibilities, as well as with respect to changes in professional decisions due to the pandemic. On the other hand, when the occupation is taken into account, significant differences appear for all six statements analysed.

When they had to indicate their level of agreement or disagreement with the six work-life statements, the young women had the following four options: 1. Totally agree, 2. Somewhat agree, 3. Somewhat disagree, and 4. Totally disagree. The mean of the responses for each subgroup was calculated to assess how socio-demographic variables influence young people's perceptions regarding the pandemic impact on their professional lives (see Table 2). The lower the score, the more agreement with the statements among young women; thus, the greater the negative impact. Whereas the lower the score, the more agreement on the effect of the pandemic on their professional lives, a higher score represents greater disagreement, showing that the pandemic did not have a negative impact on their professional lives.

In this context, taking into account the age of the women, the lowest scores for all six statements analysed were consistently observed in the 15-24 age subgroup, indicating a more pronounced negative impact of the pandemic on their professional lives compared to the second group under analysis. Self-employed women also showed the lowest mean scores for all statements analysed, indicating that they were more negatively affected by the pandemic in terms of their professional lives compared to the other groups.

It turned out that among the people who had completed education – that is, 16-19 years of schooling – the young women were negatively affecting income and changing decisions, while among those still completing this education, the effects were negative regarding work-life balance. Moreover, if speaking about the kind of community of young women, it is worth mentioning that women from urban areas changed their career decisions due to the pandemic, which affected work-life balance. On the other hand, young women who lived in rural areas reported bad effects of the pandemic in terms of lower working hours and less income. Another socio-demographic factor is household composition. In this case, the pandemic negatively impacted child-raising couples by reducing work hours. Furthermore, the pandemic also affected those living with a number of people whereby work hours and income reduced, career choices changed, and work-life balance negatively

affected. Furthermore, six binary logistic regression models were run to assess the impact of the pandemic on the working lives of young women in the EU-27 (Table 3). Indeed, five of them showed Hosmer-Lemeshow values greater than 0.05, thus indicating a good fit of the model to the data. Nonetheless, the sixth model had a test value that was below the threshold set, thus rejecting the hypothesis that there is no difference between observed and estimated frequencies. However, the results for the omnibus tests still prove an overall good fit of the model to the observed data. It shows the degree of overlap between what the model had predicted and the actual response to that particular question analysed, which varied, with the percentage correctly classified ranging from 55.9% for the fourth model to 68.8% for the third model conducted.

The first model returns empirical results estimating an odds ratio of about for the 15-24 female age group to be found in the group affected negatively by the pandemic in work-life balance, net of the reference category represented by people in the 25-29-year age group. Besides, the pandemic also brought an undesirable effect on self-employed women concerning work-life balance, with an odds ratio of 1.4 in comparison to manual workers, while students were similarly affected, compared to those who never had full-time education with an odds ratio of 1.7. Instead, in terms of household composition, only couples without children showed statistical significance, with lower odds of a pandemic-related negative impact on work-life balance compared to those who live together.

The results of the second model show that women aged 15-24 and those who were self-employed were more likely to have less paid work than desired due to the impact of the pandemic on the labour market, compared to the reference categories analysed. On the other hand, single women, both with and without children, as well as those in childless couples, experienced a less pronounced negative impact of the pandemic in terms of reduced paid hours compared to individuals in co-living. The results of the third model show that self-employed women are the only statistically significant group, with an odds ratio of almost 1.5 for choosing a permanent reduction in paid hours due to the COVID-19 pandemic, compared to manual workers. This group is also statistically significant in model 4, and young women in this category have an odds ratio of about 1.8 of changing their occupational decision due to the pandemic compared to the reference group. Furthermore, in terms of household composition, the first four categories considered in the analysis, single women and women in couples with or without children, are less likely to change their career decisions due to the pandemic than the reference group, those in co-living.

Regarding the negative impact of the pandemic on income, model five shows that young women with 16-19 years of education are more likely to experience negative income effects due to the pandemic (with an odds ratio of more than 1.9) than those who have never been in full-time education. Furthermore, when considering the occupation, both analysed groups show statistical significance. Women in the self-employed category are more likely to experience negative income effects due to the pandemic, while women in employment are less vulnerable

compared to the reference group (manual workers). Single women and women in childless couples are also less likely to have their income affected by the pandemic than women in co-living.

In model six, there are several statistically significant categories. Self-employed women and those aged 15-24 are more likely to reduce their paid hours due to increased household responsibilities (with odds ratios of 1.9 and around 1.4, respectively) compared to the reference categories analysed. On the other hand, women who are still in the education system, as well as those with more than 16 years of education, are less likely to decrease their paid working hours due to an increase in household responsibilities compared to the reference category. This is also true for both single women and those in childless couples.

6. Conclusions

The objective of the research was to establish how the COVID-19 pandemic had influenced the career paths of young women and if there were any differences between the EU27 and Romania. The analysis findings indicated that, compared with their peers in the EU27, young women in Romania might have passed through more substantial barriers and negative implications on their professional lives. This is further supported by the fact that there are higher levels of agreement regarding issues like work-life balance, reduced working hours, and impact on income among the Romanian respondents.

Furthermore, the second objective of the study was to examine the differences between different groups of young women based on socio-demographic factors and to identify which groups were the most affected by the COVID-19 pandemic in their career. The analyses carried out in this direction showed that women in the 15-24 age group, those who are self-employed, those with 16-19 years of education, and those in co-living households were the groups most negatively affected by the pandemic in terms of work-life balance, reduction in paid working hours, changes in career choices, and reduction in income.

The limitations of this study must also be acknowledged. The data used in this research were collected at a time that may not best represent the long-term effects of professional trajectories on young women. Besides, this study is based on self-reported data from the Eurobarometer.

This means having to use self-reported data from the Eurobarometer and potentially leading to errors in the way that respondents report professional experience and status, or maybe not capturing professional experience for young women from some regions or socioeconomically diverse backgrounds. In addition, the number of Romanian respondents is small, which may limit the generalisation of the findings for the young female population in the country.

Regarding future research, I think it would be interesting to investigate the impact of the pandemic on different sectors of the labour market to see in which industries young women felt the impact of the pandemic.

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Appendix

Table 1. Differences in young women’s perceptions based on socio-demographic variables

	Age Mann-Whitney Test (Sig. 2-tailed)	Years of Education Kruskal Wallis Test (Sig.)	Occupation Kruskal Wallis Test (Sig.)	Type of community Kruskal Wallis Test (Sig.)	Household members Kruskal Wallis Test (Sig.)
The pandemic has had a negative impact on my work-life balance	975207.000 (0.211)	2.815 (0.589)	11.434 (0.003***)	1.965 (0.374)	8.001 (0.156)
Because of the pandemic’s impact on the job market, I could do less paid work than I wanted to (meaning less work for a salary or wage)	915080.500 (0.000***)	24.132 (0.000***)	55.793 (0.000***)	0.950 (0.622)	19.182 (0.002***)
Because of the pandemic I’m considering / have decided permanently reducing the amount of time I allocate to paid work	1000110.500 (0.940)	5.480 (0.241)	25.726 (0.000***)	1.594 (0.451)	5.082 (0.406)
Because of the pandemic my professional decisions changed (such as changing jobs)	977053.500 (0.247)	6.877 (0.143)	12.626 (0.002***)	4.903 (0.086*)	7.669 (0.175)
The pandemic had a negative impact on my income	968776.500 (0.122)	31.839 (0.000***)	40.593 (0.000***)	0.180 (0.914)	12.999 (0.023**)
Because of the increase in work at home, I could do less paid work (for a salary or wage) than I wanted to	926405.000 (0.000***)	26.008 (0.000***)	50.898 (0.000***)	15.107 (0.001***)	78.121 (0.000***)

Note: *** Correlation is significant at the 0.01 level (two-tailed).

** Correlation is significant at the 0.05 level (two-tailed).

* Correlation is significant at the 0.10 level (two-tailed).

Source: author’s own research based on data from Flash Eurobarometer 2712.

Table 2. Mean scores of young women's perceptions regarding the pandemic's impact on their professional trajectories based on socio-demographic variables

		The pandemic has had a negative impact on my work-life balance	Because of the pandemic's impact on the job market, I could do less paid work than I wanted to (meaning less work for a salary or wage)	Because of the pandemic I'm considering / have decided permanently reducing the amount of time I allocate to paid work	Because of the pandemic my professional decisions changed (such as changing jobs)	The pandemic had a negative impact on my income	Because of the increase in work at home, I could do less paid work (for a salary or wage) than I wanted to
Age	15-24 years old	2,3359	2,5535	2,9651	2,6211	2,5458	2,7023
	25-29 years old	2,4613	2,7683	3,0073	2,6603	2,6682	2,9217
Years of education	up to 15 years	2,3643	2,4344	2,9184	2,578	2,5602	2,5404
	16-19 years	2,3713	2,5583	2,9095	2,5285	2,4268	2,6775
	20 years or over	2,439	2,8294	3,0486	2,6978	2,7227	2,9749
	Still studying	2,3242	2,512	2,9969	2,6693	2,5589	2,7638
	No full time education	2,4782	2,4528	2,8258	2,6183	2,759	2,3268
Occupation	Self-employed	2,1958	2,3115	2,6731	2,4183	2,2209	2,399
	Employed	2,432	2,7473	3,0512	2,6808	2,6971	2,9108
	Manual worker	2,4241	2,5488	2,9399	2,6245	2,4651	2,6933
Type of community	Rural area or village	2,4404	2,6072	2,919	2,637	2,5562	2,7365
	Small/middle town	2,412	2,6598	2,9804	2,6866	2,5987	2,8024
	Large town	2,3626	2,7095	3,0431	2,598	2,6588	2,8911
Household members	Couple with children	2,411	2,5747	2,8728	2,6416	2,4901	2,6292
	Couple without children	2,4791	2,8358	3,0813	2,6636	2,7664	3,0492
	Single parent with children	2,432	2,7737	3,0883	2,6214	2,5998	2,681
	Single without children	2,3436	2,7525	3,0399	2,7565	2,7138	3,0399
	Multi-generational household(eg. grandparents, parents, children)	2,3851	2,5066	2,9408	2,5996	2,4786	2,7069
	Co-living or other forms of communal living (eg. Friends, students)	2,1967	2,4095	2,985	2,5066	2,4607	2,6437

Source: author's own research based on data from Flash Eurobarometer 2712.

Table 3. The empirical results of the logistic regression models

	Model I. The pandemic has had a negative impact on my work-life balance		Model II. Because of the pandemic's impact on the job market, I could do less paid work than I wanted to		Model III. Because of the pandemic I'm considering / have decided permanently reducing the amount of time I allocate to paid work		Model IV. Because of the pandemic my professional decisions changed (such as changing jobs)		Model V. The pandemic had a negative impact on my income		Model VI. Because of the increase in work at home, I could do less paid work (for a salary or wage) than I wanted to	
	β	Exp (β)	β	Exp (β)	β	Exp (β)	β	Exp (β)	β	Exp (β)	β	Exp (β)
Age (ref. category = 25-29 years)												
15-24 years	0.185*	1.203	0.197*	1.217	-0.038	0.963	-0.005	0.995	0.056	1.057	0.320***	1.377
Years of Education (ref. category = Never been in full time education)												
Up to 15 years	0.542	1.719	0.365	1.441	-0.659	0.517	0.152	1.164	0.213	1.237	-0.659	0.517
16-19 years	0.288	1.334	-0.052	0.949	-0.147	0.863	0.207	1.230	0.663**	1.941	-0.561**	0.570
20 years and more	0.381	1.464	-0.357	0.700	-0.392	0.676	-0.130	0.878	0.269	1.309	-0.832***	0.435
Still in full-time education	0.544**	1.722	-0.075	0.928	-0.491	0.612	-0.077	0.925	0.412	1.510	-1.008***	0.365
Occupation (ref. category = Manual worker)												
Self-employed	0.336*	1.399	0.527***	1.695	0.390*	1.477	0.572***	1.772	0.391**	1.479	0.642***	1.901
Employee	-0.007	0.993	-0.122	0.885	-0.238	0.788	0.036	1.036	-0.254*	0.776	-0.136	0.873
Type of Community (ref. category = Large town)												
Rural area/village	-0.124	0.884	0.068	1.070	0.038	1.038	-0.161	0.851	-0.034	0.967	0.029	1.029
Small/middle town	-0.019	0.981	-0.029	0.971	0.011	1.011	-0.143	0.867	0.007	1.007	-0.069	0.934
Household composition (ref. category = Co-living)												
Couple with children	-0.235	0.791	-0.318	0.727	0.021	1.021	-0.450**	0.638	-0.176	0.839	0.115	1.122
Couple without children	-0.335*	0.715	-0.542***	0.582	-0.170	0.843	-0.342*	0.710	-0.527***	0.590	-0.584***	0.558
Single parent with children	-0.414	0.661	-0.668**	0.513	-0.339	0.713	-0.504*	0.604	-0.214	0.808	-0.106	0.900
Single without children	-0.153	0.858	-0.543**	0.581	-0.180	0.835	-0.540**	0.583	-0.508**	0.602	-0.517**	0.596
Multi-generational household	-0.238	0.788	-0.236	0.790	-0.020	0.980	-0.296	0.744	-0.197	0.821	-0.013	0.987
Constant	0.083	1.087	0.359	1.431	-0.229	0.795	0.255	1.290	-0.013	0.987	0.392	1.480
Number of obs.	2781		2526		2481		2592		2665		2359	
-2 Log likelihood	2638,205		2384,867		2125,942		2474,088		2517,282		2097,718	
Cox & Snell R2	0.013		0.034		0.017		0.017		0.030		0.055	
Nagelkerke R2	0.018		0.045		0.024		0.022		0.040		0.075	
Sig. (Hosmer and Lemeshow Test)	0.357		0.268		0.638		0.925		0.826		0.036	
Correctly classified percentage	58.1		58.7		68.8		55.9		57.1		63.8	

Source: author's own research based on data from Flash Eurobarometer 2712.

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Measuring the Dynamics of Inequality of Opportunity by Income Sources

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Abstract

Decomposing the inequality into several factor components makes it possible to understand where most of the observed inequality comes from. In this paper, we offer a methodological proposal for the identification of the drivers of inequality of opportunity through a non-parametric estimation strategy. Specifically, we propose to merge existing techniques for inequality decomposition by factor components (Shorrocks, 1982, 2012; Lerman & Yitzhaki, 1985) with non-parametric strategies for inequality of opportunity estimation in order to identify the contribution of different income sources (e.g. work income, capital income, transfers) to observed overall inequality of opportunity in societies. This analysis may be of particular interest for policy-makers because once the channels of transmission are identified, public policies can be better targeted toward mitigating – and eliminating – inequality of opportunity. Our proposal is validated through a simple application to SHIW (Survey on Household Income and Wealth), by which it emerges that inequality of opportunity amounts to 10% of overall inequalities in Italy, with a greater contribution (8%) originating from capital income and a compensation role of social transfers (-1%).

Keywords: inequality, opportunity, decomposition, measurement.

JEL Classification: D630.

1. Introduction

Within the egalitarianism of opportunity tradition, a distinction has to be made between fair and unfair inequalities. The latter may originate from factors beyond individual control (circumstances, such as ethnicity, gender, family background). Conversely, choices that imply individual responsibility (effort in education, in job) may also have a role in generating inequalities. Given that the factors generating

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inequalities may be different, it is therefore crucial to investigate their origins using parametric and non-parametric techniques. To our knowledge, the inequality decomposition technique has never been applied in the analysis of inequality of opportunity.

In this paper, in order to measure the contribution of each income source to the observed level of inequality of opportunity, we propose to merge the existing technique for inequality decomposition by income sources with a non-parametric strategy for inequality of opportunity estimation. Consequently, this paper may be of particular interest for policy-makers, since the promotion of equality of opportunity strongly relies on the definition of ad hoc measurement strategies, which can be optimally defined only if the specific drivers of inequality are precisely identified.

The nineties – due to pillar contributions (Rawls, 1958, 1971; Roemer, 1998) – have been characterised by the estrangement from the utilitarian tradition, which focus only on the level of utility reached by individuals, without considering the path's fairness. From that moment on, ethics takes place in the egalitarian scenario, and political philosophers start to include responsibility into the judgment of inequality. Thanks to these contributions, there has been an ongoing interest in measuring inequality of opportunity, and large literature has emerged in this field. For instance, Checchi and Peragine (2010) compute inequality of opportunity within the population of Italian workers differentiated by regions; Ferreira and Gignoux (2011) employ parametric and non-parametric approaches to measure inequality of opportunity between-group in Latin America; Abatamarco (2015) proposes a decomposition of the Gini index for the measurement of opportunity inequality and its contribution to inequality of outcome. Our proposal has been validated using the SHIW (Survey on Household Income and Wealth) database for the year 2022. The methodology we propose is based on the initial subdivision and grouping of individuals into *types* – groups of individuals with the same circumstances (i.e. factors beyond individual control) – in order to construct the counterfactual income distribution (i.e. the income that would be observed if all individuals had the same circumstances). Then, in order to capture the effect of different circumstances in each component of income, – following Shorrocks (1982) – we apply the decomposition technique on both the real and counterfactual income distribution. Lastly, the measure of inequality of opportunity by income source has been computed by applying the indirect ex-post measure proposed by Checchi and Peragine (2010). Note that, although circumstances and effort may not be independently distributed, to carry out the empirical exercise, we assume that the distribution of effort is independent of the circumstances. Undoubtedly, our proposal has several advantages. Precisely, decomposing inequality and emphasising differences in factors beyond individual control allows us to (i) investigate the contribution of each source of income to inequality of opportunity and (ii) examine the channel of transmission through which circumstances affect overall inequality. This is crucial from a policy perspective because, knowing the specific sources and causes of inequality, the design of policy measures can be better targeted towards

eliminating and reducing it. In addition, knowing the share of unfair inequality in the distribution of transfer income, we emphasise how much existing public policies are already reducing inequality of opportunity by means of generic subsidies transfers.

2. Problem Statement

In recent decades, there has been a growing academic interest in understanding the origins of inequality. This interest has led to the development of a large literature on techniques for decomposing inequality, such as the decomposition by income source and the decomposition by population subgroups (Shorrocks 1980, 1982, 2013; Lambert & Aronson, 1993; Lerman & Yitzhaki, 1985), which allow the analysis and the identification of the roots of inequality. Other studies (Fields, 1987; Pyatt, 1980; Shorrocks, 1982) focus on measuring inequality by decomposing income into different factor components. The latter is a useful technique to find out from which income sources the overall inequality comes from. Shorrocks (1980, 1982) that decomposition generates as many separate contributions as there are income components, under the assumption that the impact of each factor could be summarised in a single term, and he derives the “natural” decomposition rule for the variance and for the Gini index. However, what has been proven for the variance also holds for the Coefficient of Variation (CV) – which belongs to the class of generalised entropy measures $GE(\alpha)$. In this paper, we restrict our attention to $GE(2)$, which is known to be half the squared CV.

Despite scholars have focused for a long time on inequality in income distribution, there is also a non-income dimension of inequality that matters and that gives emphasis to the differences that exist in opportunities. A traditional approach to measuring inequality of opportunity might start from the distinction proposed by Roemer (1998) between circumstance and effort variables. The former refer to factors beyond individual control and generate unfair inequalities. Effort variables result from responsible choices made by individuals and, therefore, the resulting inequalities are usually considered as fair. Starting from this distinction, large literature has emerged in recent years (Bourguignon et al. 2007; Lefranc et al., 2008; Pistolesi, 2009; Checchi & Peragine, 2010; Almas et al., 2011; Ferreira & Gignoux, 2011; Bjorklund et al., 2012; Abatemarco, 2015). According to Ramos and Van de Gaer (2021), the most commonly used techniques to measure inequality of opportunity can be grouped into different categories; however, for the purpose of this paper, we focus our attention on indirect measures. Particularly, in the literature on the measurement of inequality of opportunity, a counterfactual analysis has been developed that allows to consider a virtual income distribution through which the share of inequality of opportunity can be identified. In fact, one of the categories accounts for the way in which this virtual distribution can be constructed: direct and indirect approaches. The latter measure inequality of opportunity among individuals of the same type. These measures are implemented by comparing the counterfactual income distribution, in which all inequality due to circumstances has been eliminated, with the actual income distribution. On the other hand, direct measures directly allow us to calculate the amount of inequality of opportunity, because the

virtual income distribution is constructed by dropping all disparities that exist in outcomes due to effort variables.

To our knowledge, the inequality decomposition technique has never been applied in the analysis of inequality of opportunity.

3. Aims of the Research

Given that the promotion of equality of opportunity strongly relies on the definition of ad hoc measurement strategies, which can be optimally defined only if the specific drivers of inequality are precisely identified, we propose to merge existing techniques for inequality decomposition by income sources with non-parametric strategies for inequality of opportunity estimation. Indeed, despite the importance of investigating the origins of inequality – which may be different – the decomposition technique has never been applied in the analysis of inequality of opportunity. Through this proposal, we aim to measure the contribution of each income source to the observed level of inequality of opportunity. In particular, decomposing inequality and emphasizing differences in individual opportunities allows us to (i) examine the determinants of inequality of opportunity, (ii) investigate the contribution – of each circumstance – and the channels of transmission through which circumstances affect overall inequality, and (iii) identify the share of inequality of opportunity in each factor component. In order to do this, with this paper we examine how different sources of income contribute to overall inequality and attempt to determine what proportion of this overall inequality is attributable to each of these sources.

This approach may be of particular interest from a policy perspective because decomposing inequality into several factor components makes it possible to understand where the most of inequality comes from, and this represents a fundamental pillar for the policy-makers' decisions, as by knowing which specific source of income is generating the most inequality within a society, they could define an ad hoc policy measure, not only in order to promote social justice, but also in order to reach the best solution in terms of resource allocation.

4. Research Methods

Let Y_i be the income of individual i with $i = 1, \dots, n$, and let Y_i^k be the income of individual i from source k with $k = 1, \dots, K$. As a source of income, we consider work income w , capital income c , and transfer income t . So, $Y = (Y^w, Y^c, Y^t) \in \Omega$ with $Y^K = (Y_1^K, \dots, Y_n^K)$ with $K = w, c, t$ indicating the distribution of total income – from source k within the population of n individuals. So, $Y = Y^w + Y^c + Y^t$ is the overall income.

Shorrocks (1982) shows that if we want to use the variance to measure inequality by income sources, we have to consider

$$\begin{aligned} & \sigma^2(Y) \\ &= \sum_k \sigma^2(Y^k) + \sum_{j \neq k} \sum_k \rho_{jk} \sigma(Y^k) \sigma(Y^j) \end{aligned} \quad (1)$$

where the second term on the right hand-side is zero in the case of no correlation between two income sources.

However, since we want to obtain the contribution of factor k on total income inequality, we should consider – as in Shorrocks (1982) – the following

$$S_k^*(\sigma^2) = \sigma^2(Y^k) + \sum_{j \neq k} \rho_{jk} \sigma(Y^k) \sigma(Y^j) \quad (2)$$

where covariance factors between factor k and all the rest of factors are “naturally” assigned to the contribution of factor k .

Provided that $cov(Y^k, Y^j) = \rho_{jk} \sigma(Y^k) \sigma(Y^j)$, from (1) it follows that (2) can be rewritten as

$$S_k^*(\sigma^2) = cov(Y^k, Y) \quad (3)$$

that is a measure of the contribution of factor k to overall variance.

Now, according to Shorrocks, since the variance is not mean independent, it is possible to extend what has been said so far to the square of the coefficient of variation, $I_2(Y)$, which is not affected by this problem. So,

$$if \rho_{jk} \neq 0 \forall j \neq k \Rightarrow S_k^*(I_2) = \frac{cov(Y^k, Y)}{\mu^2(Y)} \quad (4)$$

Since the aims of this paper is to carry out an inequality decomposition by income source, it is preferable to use the generalized entropy measures because – in line with Shorrocks’ point – they are additive decomposable by sources.

The generalized class of entropy measures $GE(\alpha)$ – with $\alpha \in \mathbb{R}$ – is defined as follows

$$GE(\alpha) = \begin{cases} \frac{1}{n\alpha(\alpha - 1)} \sum_{i=1}^n \left(\left(\frac{Y_i}{\mu(Y)} \right)^\alpha - 1 \right) & \alpha \neq 0, 1 \\ \frac{1}{n} \sum_{i=1}^n \frac{Y_i}{\mu(Y)} \ln \frac{Y_i}{\mu(Y)} & \alpha = 1 \\ -\frac{1}{n} \sum_{i=1}^n \ln \frac{Y_i}{\mu(Y)} & \alpha = 0 \end{cases}$$

Note that α is a parameter indicating the weight given to the distances between incomes at different part of the income distribution. Given that incomes may have a value equal to zero, and since we know that the Coefficient of Variation is additive decomposable, we restrict our attention to $GE(2)$, which is known to be half the square Coefficient of Variation (CV), that is,

$$GE(2) = \frac{1}{2} \frac{\sigma^2(Y)}{(\mu(Y))^2} = \frac{1}{2} CV^2 \quad (5)$$

In order to measure the contribution of the three-factor components, we use (4) that here becomes

$$CV = \sum_{k=1}^3 \frac{cov(Y^k, Y)}{(\mu(Y))^2} \quad (6)$$

so that the proportional k-factor contribution to overall inequality of income is

$$CV_k(\%) = \frac{cov(Y, Y^k)}{\sigma^2(Y)} \quad (7)$$

that sum up to unity for all factors.

Now, in order to obtain a measure of inequality of opportunity, we consider the assumption that the only information we observe regarding the income of individuals concerns their circumstances and their effort, so we have m^C distinct circumstances and m^E distinct efforts. Consequently, individual i 's income is a function of her observed circumstances and effort, a_i^C – with $a_i^C \in \mathbb{R}^{d^C}$ a vector of circumstances – and a_i^E – with $a_i^E \in \mathbb{R}^{d^E}$ a vector of efforts – unobserved variables u_i , and random variables ε_i . Formally,

$$Y_i = f(a_i^C, a_i^E, u_i, \varepsilon_i)$$

whit $f : \mathbb{R}^{d^C} \times \mathbb{R}^{d^E} \times \mathbb{R}^{d^u} \times \mathbb{R} \rightarrow \mathbb{R}^+$.

Starting from the definition – proposed by Roemer (1993) – of a type, that is, the set of individuals with the same circumstances for each $a_i^C \in d^C$, we use a non-parametric procedure in order to obtain the average income within each type of the N -population, that is computed as

$$\bar{Y}|i \in N_k = \frac{1}{|N_k|} \sum_{i \in N_k} Y_i \quad (8)$$

where $N_k = \{i \in N | a_i^C = a_n^C\}$. Then, considering the proportion $(Y_i) : (\bar{Y}|i \in N_k) = (\hat{Y}) : (\bar{Y})$ we obtain the non-parametric indirect strategy proposed by Checchi and Peragine (2010) to construct the counterfactual income distribution, \hat{Y} , that is expressed as follows:

$$\hat{Y} = Y_i \frac{\bar{Y}}{\bar{Y}|i \in N_k} \quad (9)$$

where \hat{Y} is the income that would be observed if all individuals had the same circumstances.

Once the virtual income distribution has been constructed, given an inequality index, we can compute both the inequality in the actual and in the counterfactual (i.e., income inequality that would be observed if all individuals had the same circumstances) income distribution. By applying the indirect measure $I(Y) - I(\hat{Y}) = I^{OP}(Y)$ we obtain a measure of inequality of opportunity. We choose to use an indirect measure rather than a direct one. The motivation behind this stems from the fact that in Y there are inequalities due to effort, circumstances and unobserved variables, while in \hat{Y} all differences due to circumstances are eliminated, so here only inequalities due to effort and unobserved variables remain. Consequently, we obtain $I^{OP}(Y)$ that effectively is a measure of inequality of opportunity because in this distribution the effect of effort and unobserved variables is cancelled out. In other words, we can control for unobserved variables, and this result would not have been achieved if we had used direct measures.

Remarkably, so far, the decomposition by income sources Y has never been applied in the analysis of inequality of opportunity. Therefore, we propose to standardise Y

in order to get \hat{Y} . However, given that $Y = Y^W + Y^C + Y^T$ and, given that we are interested in differentiating the impact of circumstances by income sources, it would be ineffective to directly standardize Y . So, we have to apply the (8) separately on Y^W, Y^C and Y^T and then, compute \hat{Y} as $\hat{Y} = \hat{Y}^W + \hat{Y}^C + \hat{Y}^T$. The motivation behind this is that the two standardisations are not equivalent; in fact, if we assumed that they were, we would get

$$\frac{\bar{Y}}{\bar{Y} | i \in N_k} = \frac{\bar{Y}^W}{\bar{Y}^W | i \in N_k} = \frac{\bar{Y}^C}{\bar{Y}^C | i \in N_k} = \frac{\bar{Y}^T}{\bar{Y}^T | i \in N_k} \quad \forall i \tag{10}$$

that is, circumstances generate the same relative effect on each income source, which would be a very demanding assumption.

At that stage, we introduce the decomposition by income sources technique as follows

$$\begin{aligned} [I(Y^W) + I(Y^C) + I(Y^T)] - [I(\hat{Y}^W) + I(\hat{Y}^C) + I(\hat{Y}^T)] = \\ = I^{OP}(Y^W) + I^{OP}(Y^C) + I^{OP}(Y^T) = I^{OP}(Y^K) \end{aligned} \tag{11}$$

this allows us to obtain the contribution of each source of income to overall inequality, as well as to understand how the impact of circumstances is differentiated by work, capital, and transfer income.

Our proposal has been validated using the SHIW (Survey on Household Income and Wealth) database. We carry out the analysis by considering information about individual incomes and restrict our analysis to people aged 20-57 in order to consider all individuals who are active in the labour market and exclude pensioners.

As source of income, we use work income,, capital income and transfer income. Table 1 shows the main statistical information for each source of income and of total income. Among different income components, by comparing the mean values, it can be seen that work income, capital income, and transfer income, respectively, account for 69.11%, 29.75%, and 1.14% of total income.

Table 1. Summary statistics of incomes

<i>Income</i>	<i>Obs.</i>	<i>Mean</i>	<i>Std. Dev</i>	<i>Min</i>	<i>Max</i>
Y^W	3402	22383.99	33660.04	-5000	420000
Y^C	3402	9638.216	12228.34	-1381.831	338523
Y^T	3402	369.6786	1783.811	0	15600
Y	3402	32391.89	40228.73	0.155	425491.9

Source: author's computation.

As circumstance variables, we consider gender, parents' level of education, and the unemployment rate of the region of birth. Note that parents' level of education is used as a proxy of parental background and this variable has been obtained considering the average of the educational level of both parents. The unemployment rate of the region of birth is a proxy of socioeconomic conditions of the place of origin. Table 2 shows information about income according to these circumstances.

The combination of the three circumstance variables produces eight *types*, each with specific characteristics.

Table 2. Summary statistics of source of income and circumstances

<i>Circumstances</i>	<i>Obs.</i>	<i>Y</i>	<i>Y^W</i>	<i>Mean Y^C</i>	<i>Y^T</i>
<i>Male</i>	1673	31141.58	21678.2	9156.155	307.2209
<i>Gender</i>					
<i>Female</i>	1729	33753	23152.33	10163	437.6716
<i>Low</i>	1492	38979.56	27196.41	11631.55	151.6037
<i>Unemployment</i>					
<i>rate</i>					
<i>High</i>	1910	23623.06	15978.2	6984.898	659.9572
<i>Low</i>	1445	21039.11	13704.79	6685.892	648.4241
<i>Parental</i>					
<i>background</i>					
<i>High</i>	1957	43220.44	30662.42	12454.21	103.8045

Source: author’s computation.

5. Findings

Given the distribution of total income $Y^K = (Y_1^K, \dots, Y_n^K)$ from sources k with $k = w, c, t$ within the population of n individuals, we compute the contribution of each source of income to overall observed inequality of opportunity (i.e. due to circumstances). The results we obtain through the (actual) income decomposition into three factor components (Table 3) show that work income accounts for most inequality in the total income distribution (80,4%). 19.9% of the contribution to inequality in the total income distribution comes from capital income. The contribution of transfer income (-0.004) is negative because $cov(Y^T, Y) < 0$. In work income, the amount of inequality is 0.50 compared with 0.12 and 0.002 in capital income and transfer income, respectively.

Table 3. Inequality decomposition of actual incomes

<i>GE(2) = 0.77</i>			
<i>CV = 1.242</i>			
	<i>S_k[*]</i>	<i>S_k[*]</i>	<i>I(Y^k)</i>
<i>Y^W</i>	0.804	0.999	0.50
<i>Y^C</i>	0.199	0.248	0.12
<i>Y^T</i>	-0.004	-0.005	0.002

Source: author’s computation.

Table 4 shows the results obtained by applying the decomposition technique in the counterfactual income distribution. As before, most of inequality comes from income from work, even if to a slightly greater extent (81%). When one looks at the third column as expected, the amount of inequality in the counterfactual work and

capital income distribution is smaller than that in the actual distribution, while it is higher in the transfer income distribution.

Table 4. Inequality decomposition of counterfactual incomes

$GE(2) = 0.74$ $CV = 1.215$			
	S_k^*	S_k^*	$I(\hat{Y}^k)$
\hat{Y}^W	0.810	0.985	0.49
\hat{Y}^C	0.184	0.224	0.11
\hat{Y}^T	0.004	0.006	0.003

Source: author's computation.

Merging the two procedures, we compute (11) and obtain the contribution of each source of income to overall observed inequality of opportunity, shown in Table 5. According to the analysis, in Italy in 2022, 10% of the observed inequality stems from factors beyond individual control (circumstances). By adding the decomposition technique, it can also be said this 2% of that inequality originates from work income and 8% from capital income. -50% is the share in transfer income, that is, the reduction in inequality of opportunity that should be reached through generic subsidies transfers.

Table 5. The measurement of inequality of opportunity

	$I(Y)$	$I(\hat{Y})$	$I^{OP}(Y)$	$I^{OP}(Y^K)$	$\frac{I^{OP}(Y)}{I(Y)}$
Y	0.30	0.27	0.03		10%
Y^W	0.50	0.49		0.01	2%
Y^C	0.12	0.11		0.01	8%
Y^T	0.002	0.003		-0.001	-50%

Source: author's computation.

6. Conclusions

Measuring the origins of inequality through its decomposition into several factor components is relevant from a public policy perspective because policy-makers can focus on major drivers of inequality and, as such, they can more accurately target interventions to face this phenomenon. However, starting from relevant contribution (Rawls, 1958, 1971; Roemer, 1998), social justice starts to be incorporated in the analysis of inequality. Thus, various dimensions of inequality, such as inequality of opportunity, began to be discussed and measured. In this paper, we focus on differentiating the impact of circumstances on work, capital, and transfer income to provide a comprehensive understanding of the factors that contribute to income inequality. The relevance of this proposal lies in the possibility of (i) examining the determinants of inequality of opportunity, (ii) investigating the contribution – of each circumstance – and the channels of transmission through which circumstances affect overall inequality, and (iii) identifying the share of inequality of opportunity in each

factor components. In order to assess our proposal, we have run an empirical exercise, and the analysis shows that overall inequality is 0.30 and its main driver is work income (80.4). A minor contribution comes from capital income (19.9), and the contribution of transfer income is negative (-0.004). The amount of overall inequality of opportunity is 0.03. Specifically, applying the proposed methodology, we observe that 10% of the observed inequality is due to different circumstances. By adding the decomposition technique, it can also be seen this 2% of that inequality originates from work income and 8% from capital income. -50% is the share in transfer income, that is, the reduction in inequality of opportunity that should be reached through generic subsidies transfers. This result may be a valuable starting point for the introduction of new types of taxation on capital gains that can lead to the reduction of unfair inequalities. However, this analysis faces a strong limitation: its weakness relates to the use of the database mentioned above, which does not contain the necessary information on all the circumstances we could have considered. Future research will be devoted to improving the methodology, applying it to a database that allows for a better identification of circumstances.

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**Sentiment Analysis of Research on AI Ethics:
A Web-Based Study**

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Abstract

The field of Artificial Intelligence has experienced significant growth in recent years, both in terms of technological development and global adoption rates. AI-based solutions are now finding their way into the lives of an increasing number of people worldwide, being used both professionally and personally. However, along with this progress, numerous controversies have arisen regarding the ethics of their use in various domains. In the specialised literature, there are a growing number of publications focused on the discussion of this topic. The present study focusses on analysing the general trends of these scientific works in relation to the ethics of the use of AI. Using the Web of Science Clarivate database, a set of publications was selected based on keywords and subsequently subjected to analysis. Sentiment analysis techniques are used to identify the positive or negative trend among specialists and how it has evolved over the years. Latent Dirichlet Allocation is used to highlight the main topics developed in these writings. On the basis of the obtained results, it can be noted that the concern for AI ethics issues is increasingly addressed in specialised writings. Sentiment analysis reveals that, in recent publications, on average, sentiments tend to be slightly positive, but the polarity value has decreased in recent years. Thus, this study contributes to a better understanding of specialists' positions regarding identified AI ethics issues, highlighting results obtained through the application of modern natural language processing techniques and by presenting important aspects emphasised in existing scientific works on this topic.

Keywords: artificial intelligence, ethics, research publication, latent Dirichlet allocation, sentiment analysis.

JEL Classification: C55; O33; I23.

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1. Introduction

In recent years, marked by an indisputable development of Big Data and the Internet of Things (IoT), solutions based on artificial intelligence have begun to play an increasingly important role in both the lives of individuals and the activity of companies in all fields. Having the ability to be integrated in numerous and diverse scenarios, artificial intelligence has come to have a considerable impact on society, but this has also been accompanied by concerns regarding the ethics of using AI solutions (Etzioni & Etzioni, 2017). Previous studies in the specialised literature have analysed people's opinion expressed in the online environment regarding the ethics of AI. A study conducted in 2023 used data extracted from the YouTube and Twitter platforms to analyse the general trend of users' feelings regarding the ethics of using artificial intelligence. Following the application of methods based on the Naive Bayes Classifier and algorithms to calculate the frequency of terms and the inverse frequency of documents (TF-IDF), the study concluded that most of the texts analysed reflect a rather negative attitude, 62.4% of the scores obtained being negative (Yoga Saputra et al., 2023). An article published in 2022 subjected to analysis a set of data that included only user posts extracted from the Twitter social media platform, obtaining a result that indicates predominantly neutral feelings (Dwivedi et al., 2022). It is important to mention that many previous studies suggest the importance of addressing the problems and limitations related to AI ethics in order to increase the level of transparency and acceptance of AI solutions (Charan, 2023; Karoo & Chitte, 2023). The present study aims to investigate the opinion of the academic community regarding AI ethics by analysing abstracts of scientific indexed Web of Science works between 1991 and the year of publication of this work. For this purpose, multiple natural language processing (NLP) techniques were used. NLP methods represent a branch of AI that facilitates the dissemination and extraction of relevant information from large volumes of data with an appreciable level of precision. Among the forms of application of NLP algorithms are text processing, spelling checking, and error correction, methods of extracting and classification information from texts, answering questions, and automatic translation (Chowdhary, 2020). The modelling of the topics addressed was carried out by means of the Latent Dirichlet Allocation (LDA) method. In the following sections, the objectives of this study will be detailed, the application of the methods listed above will be described, and the results obtained will be presented and interpreted.

2. Problem Statement

As Gao et al. (2024) presented, in the absence of an ethically fitting trajectory for the development of artificial intelligence, the main associated risks are related to unpredictability, lack of transparency, damage to human privacy, and lack of fairness caused by bias. In the specialised articles, different particular vulnerabilities of the use of AI are highlighted depending on the field of applicability. In areas of activity such as national defence (Blanchard et al., 2024; Hadlington et al., 2024), cybersecurity (González et al., 2024), medicine (Heyen & Salloch, 2021),

telemedicine (Pool et al., 2024), education (Leal Filho et al., 2024; Tossell et al., 2024), human resources (Hamilton & Davison, 2022), the importance of using artificial intelligence responsibly to maximise the level of efficiency and benefits is highlighted. For this purpose, the use of unbiased machine learning algorithms must be targeted, which maintain equity between people as individual beings, with specific needs, with their own vulnerabilities (Giovanola & Tiribelli, 2023). One such area that sparks many debates on the ethics of AI-based solutions is the field of medicine. Despite significant progress in AI solutions in recent years and many years since the application of machine learning algorithms in medicine began, patient safety, minimising the risk of errors or bias, and the efficiency of technologies remain at the forefront of concerns for specialists in all branches of medicine (Drabiak et al., 2023).

However, according to what was previously stated, the field of medicine is not the only field that has shown scepticism regarding the use of solutions based on artificial intelligence, and one of the reasons behind this scepticism is the ethical problems of AI. The academic community is increasingly addressing these problems through scientific work. Thus, through this study, it is desired to identify the main topics addressed by the specialists and the evolution of the community's feeling in relation to this topic. Therefore, the contributing elements of the current study that lead to the achievement of the previously stated goals are: (a) Analysis of the set of relevant publications for the chosen topic and identification of the related central topics using NLP techniques; (b) Sentiment analysis applied to scientific work, offering a new perspective and extending the conclusions previously obtained through research based on data from the social media environment (Yoga Saputra et al., 2023) or Wikipedia data (Wei et al., 2024); (c) Using the probabilistic LDA model, an advanced analytical technique of natural language processing, to identify the main topics. Subsequently, t-SNE was used to generate a graphical representation that allowed the visualisation and interpretation of the relationships and distances between the different subjects identified by LDA. Using t-SNE helps to convert complex topic distributions into a two-dimensional space. This makes the differences and similarities easy to see.

3. Research Questions / Objectives of the Research

This research aims to describe the trend in the specialised literature on the topic of AI ethics, highlighting how sentiments towards the chosen subject have evolved over time. Considering the results of sentiment analysis whose results were presented in the articles referred to in the introductory section of this work, it is desired to find out if the hypothesis will be accepted that the scientific community tends to express predominantly negative feelings towards neutral ones or if it has rather a positive attitude in relation to the ethics of using AI solutions. Also, it is desired that through the interpretation of the results obtained, it will be found out if the topics extracted really reflect concern and reluctance or if the topics addressed inspire confidence in the development and improvement of AI ethics. Given the hypotheses stated, this paper aims to answer three main questions:

(Q1) What are the most relevant and frequently discussed topics by the scientific community in relation to the ethics of artificial intelligence?

(Q2) What is the general trend of researchers' feelings regarding AI ethics?

(Q3) How have the feelings expressed by the authors of scientific works evolved over the years?

The contribution brought about by this paper lies in the approach to understanding the link established between the ethics of artificial intelligence and the perspective that the scientific community has regarding this aspect.

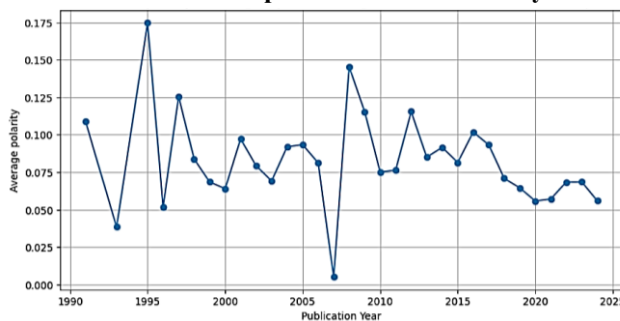
4. Research Methods

For analysis, a data set was utilised, exported from the Web of Science Clarivate platform, following the filtration of records through representative keywords for the topic of interest (“Artificial intelligence ethics,” “AI ethics,” “Ethics of AI”). This resulted in 5.041 records from the Web of Science Core Collection database, including the texts from the Abstract section of publications. 56% of the articles were published in European countries, 40% in the North American continent, and the remaining 4% had publishers from other continents. Among these, 279 were excluded from the analysis because they did not have an associated abstract. Therefore, a total of 4.762 abstracts were included in the analysis.

Each method applied in this process aims to extract, process, and visualise valuable information related to scientific articles related to AI ethics, through the use of abstracts, facilitating a better understanding of the content and feelings expressed. These techniques, from pre-processing to advanced modelling and visualisation, help transform data into knowledge. The first step consisted of the initial preparation for analysis of the texts in the Abstract section of each article by removing missing values and by pre-processing the text to remove noise (such as punctuation, common words, and stop words). Thus, the records containing null values in the “Abstract” column were eliminated. Then tokenization of texts, removal of stop words and punctuation, and lemmatisation of words were performed to reduce lexical variation. A WordCloud diagram was built as a visual representation of the frequency of words in the data set, in order to quickly identify the words and implicitly the key themes. The diagram was adjusted by excluding stop words to focus on keywords that add value to understanding the subject of the abstracts. Sentiment analysis was used to evaluate the general tone (positive, negative, neutral) of the abstracts using a pretrained sentiment analysis model. Using the TextBlob library to calculate the polarity scores for each individual abstract. Subsequently, the scores were aggregated to determine the prevailing sentiment for the entire data set. The evolution of feelings over the years was also tracked (the set includes articles published between 1991 and today). The main keywords used in the abstracts of scientific works were extracted by means of NLP techniques. Later, a HeatMap graph was built to highlight the prevalence of the different topics addressed over time. The main keywords used in the abstracts of scientific works were extracted by means of NLP techniques. Later, temporal analysis was performed, and a HeatMap-type graph was built to highlight the prevalence of the various themes addressed over

It should be noted that the words with the highest frequency of appearance are “AI”, “artificial intelligence”, “ethic”, “ethical”, “human”, and “data”, which are closely related to the very criteria according to which data filtering from the Clarivate database is performed. There are also words that reflect the increased level of interest shown for the potential problems related to the use of AI: “risk”, “problem”, “concern”, and “critical”. There are also terms specific to the medical field, which, as was previously mentioned in this work, are linked to many debates on AI ethics, the stake in this case being very important, namely the patient's well-being, “patient”, “healthcare”, “clinical”.

Figure 3. Graphic representation of the evolution of the abstract polarity expressed regarding articles related to AI ethics (published between 1991 and April 2024 and indexed by Web of Science)



Source: Author.

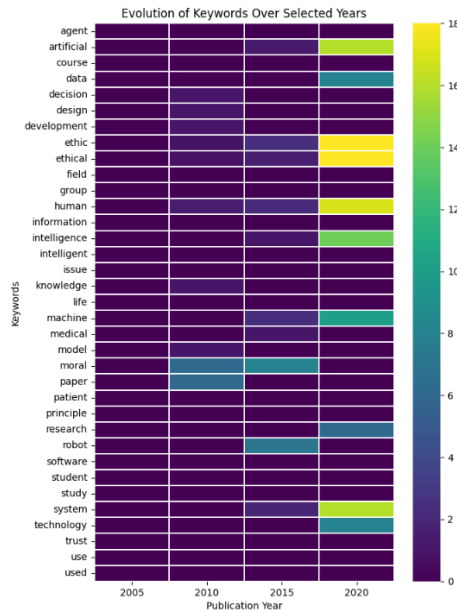
Sentiment analysis was performed using the Python library called TextBlob, based on the Natural Language Toolkit (NLTK). Subsequently, the Naive Bayes model, implicitly used by TextBlob, was applied to evaluate the sentiments outlined in the abstracts of the selected articles. Subsequently, the polarity is calculated, which can have values ranging from $[-1, +1]$. The resulting sentiment mean is slightly positive, equal to 0.066, with a standard deviation of 0.087, indicating moderate variation. The minimum value encountered is -0.75, and the maximum value is 0.55. The slightly positive mean value reflects a rather optimistic tone, which can be translated into a vision marked by confidence in the potential of existing AI solutions, technological advancements in the past decade, as well as the potential to increase efficiency levels and reduce the risk of errors. After the analysis, the results showed that 81.5% of the abstracts are positive, 18.1% negative, and 0.4% neutral.

To highlight the evolution of sentiments over the years expressed in scientific works related to AI ethics and trends in the field, a sentiment analysis was carried out depending on the year in which the articles were published. The results can be seen in the figure above (Figure 3). Observing the evolution over the years of the polarity mean calculated through sentiment analysis, we notice that between 2005 and 2010, its value experienced a rather abrupt decrease and came closest to neutrality (value 0), but still remained positive. Behind the sudden drop in the score related to 2007 are multiple significant events. Technological advancement could

generate concerns about the ethical aspects of the use of technology. The beginning of the financial crisis could also have led them to adopt a more reserved position and closer to neutrality. It is also notable the progressive decrease in the polarity score that manifests itself starting with the year 2016 and until 2020. The implementation of GDPR in EU member states also brought challenges to companies that were developing AI solutions through stricter requirements regarding confidentiality protection. The years 2020 and 2021, years in which the effects of the COVID-19 pandemic were acutely felt, also had low scores, a sign that this can also be an event with a strong influence on the feelings of the scientific community.

The evolution over the years of the frequency of appearance of keywords in the abstracts of publications included in the study was also analysed.

Figure 4. HeatMap of the evolution of the score of the main keywords



Source: Author.

For this purpose, natural language processing (NLP) techniques such as tokenization and lemmatisation were used. After identification, extraction of keywords, and calculation of appearance frequencies for each word, the Seaborn Python library was used to generate a heatmap graph (Figure 4). It is observed that between the years 2010-2015 there was a greater concern for morality, for what should be considered right or wrong. However, after 2020, concurrently with technological advancements in the field of AI, the incidence of the words “ethical” and “ethic” has increased significantly. Thus, the principles that should govern the field of artificial intelligence and dictate its development directions have acquired multiple nuances, not just black/white, right/wrong, giving rise to many questions that have become intensely debated in specialised literature.

Later, the latent Dirichlet allocation model was used to identify the main topics debated by the academic community regarding the ethics of artificial intelligence. LDA can provide support for a deeper understanding of textual content and for identifying meaningful relationships between words.

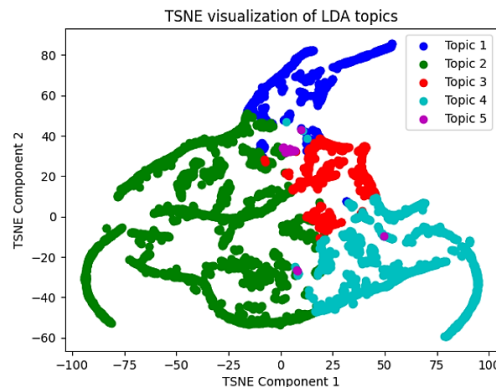
**Table 1. The results of applying the LDA model:
The main groups of words and the score of each word**

No. of topic	Score*The First Keyword	Score*The Second Keyword	Score*The Third Keyword	Score*The Fourth Keyword
1	0.010*"patient"	0.010*"data"	0.010*"study"	0.009*"method"
2	0.015*"ethical"	0.013*"technology"	0.011*"intelligence"	0.010*"artificial"
3	0.009*"system"	0.008*"bias"	0.007*"human"	0.006*"algorithm"
4	0.020*"human"	0.013*"moral"	0.013*"ethical"	0.012*"system"
5	0.004*"model"	0.004*"urban"	0.004*"case"	0.004*"language"

Source: Author.

In the first topic that results, the presence of the word “patient” is notable, confirming the increased concern about the use of AI solutions in the medical field. The well-being of the patient should be the focus of the attention of specialists. The word “study” reinforces the idea that the analysed documents are an integral part of the specialised literature. The second emerging topic seems to focus on examining the impact of AI solutions' evolution on ethical grounds. The third topic seems to involve arguments and opinions on the shortcomings of machine learning algorithms that underlie artificial intelligence, issues related to bias, and their influence on people. The fourth topic is more diffuse and allows multiple interpretations. It could refer to urban planning, smart cities with technology as a main component, or it could refer to studies based on data from the urban environment.

Figure 5. LDA results displayed by t-SNE



Source: Author.

The graphical representation highlighting the relationships between these 5 main topics was constructed by applying t-distributed Stochastic Neighbour Embedding (t-SNE). Through this method, the dimensionality of the topic distribution obtained

by LDA was reduced. In Figure 5 it can be seen that the clusters are generally well defined, but there are also intersection points between them, indicating that there are documents that combine two or more of these topics.

6. Conclusions

After analysing the data set exported in April 2023, which contains data related to 4762 articles in the Web of Science database that refer to the subject of AI ethics, it can be concluded that the sentiments expressed in academic works have a slightly positive sentiment tendency, fuelled by advances in the field. Following the application of the LDA model, it is observed that the subject of AI ethics is a vast one, and the clusters of the main topics addressed are well defined, with their intersections being rare. In the specialised literature, it is noted that there are fields, such as the medical field, where concern about the potential risks and errors of AI is major, and the importance of drawing ethical rules regarding the use of AI solutions is emphasised. Among the limitations of the current study is the fact that the research is based on data extracted from the Clarivate Web of Science platform. Therefore, it is possible that many publications relevant to this topic are not included in this study. At the same time, this study focusses mainly on identifying the main topics and analysing feelings. The method used in the current study for sentiment analysis may encounter difficulties in modelling the nuances of natural language and complex grammatical structures, so in future studies, other methods can be applied to compare the results. In addition, in future work, articles present in other important databases and platforms can be added, and interpretations related to the main ethical problems of AI algorithms described in the specialised literature and the impact they can have on people can be added.

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**Enhancing Portfolio Structure
with Evolutionary Multi-Objective Optimisation**

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Abstract

In this study, we define the criteria for fund allocation in an investment portfolio based on three key issues: maximizing returns, minimizing risk, and optimal asset allocation. The context of solving these issues reveals that the best solutions are not those that sequentially maximise or minimise each criterion but rather those that achieve an optimal compromise between them, known in the specialised literature as the Pareto front.

To identify a set of nondominated solutions, we utilise a specialized evolutionary algorithm for multi-objective optimisation, the Nondominated Sorting Genetic Algorithm II (NSGA-II). This is a fast and elitist evolutionary algorithm based on a process of sorting and selecting the best agents for the repopulation of new solving sets. By using this algorithm, we generate different sets of possible solutions, also testing various mutation rates of the agents to study different approaches to favourable combinations for fund allocation. The subjects of these iterations will be a set of some of the most successful assets listed on the Bucharest Stock Exchange, simultaneously including a considerable part of the Bucharest Exchange Trading Index, over a period that encompasses both the COVID-19 pandemic and the Ukrainian war shocks. Subsequently, we evaluate the performance of these portfolio weights over time, analysing their performance and identifying differences in the evolutionary genome behaviour in comparison to the traditional Markovitz method of quadratic mean-variance equation.

Keywords: Evolutionary Multi-Objective Algorithm, NSGA-II, Portfolio, Risk, MOEA, MOOP.

JEL Classification: G11, C61, G17, G12, C63.

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1. Introduction

When speaking of financial time series, a set of particular characteristics must be taken into consideration, precisely their stochastic nature, given by a high sensitivity to shocks, the existence of volatility clustering, nonstationary structure, and ultimately inconsistent variability over time. Having said this, we can conclude the unpredictable nature of financial markets, ranging from sudden changes in prices and returns to unexpected changes due to policy decisions or market sentiments.

To address such uncertainty issues, analysts and investors use vast quantitative models and statistical frameworks to continuously validate market models and identify vivid relations between different assets and the market.

One way of preparing financial data for modelling is working with returns, discrete or continuous, instead of stock prices. Thus, we obtain a more desirable way to understand gains and an easier set of statistical properties to work with, as Campbell and MacKinlay (1997) highlight. The advantages of working with returns can be associated with operating within the risk dimension, obtaining the ability to directly observe the level of volatility in a given period while maintaining a data set with an average value and standard deviation close to 0 and 1.

Past research and theorems assumed that financial markets are a stable economic environment and that all investors have an equal level of utility and risk aversion. In fact, this has been shown on many occasions to be otherwise. Independent of the specific problem at hand, one general problem which has been given much attention concerns how to optimally estimate portfolio weights. In particular, the problem in portfolio risk optimization consists of competing objectives that must be optimized, involving maximizing returns and minimizing risk. These two main objectives have been mathematically formalized by the mean-variance optimization problem of Markowitz in 1960 and have since then been extended to include a variety of constraints and additional considerations. Once again, the inadequacy of this method lies in the optimization under a set of traditional market hypotheses.

The traditional optimization methods very often fail when we add real-life constraints. Already limiting the number of assets to invest in, which we will be considering in our further analysis, creates major problems for these methods. They might even turn computationally infeasible with the rising complexity of the constraints, turning even some of the cases into NP-hard (Weilong, 2023).

With the enhancements made in computational processes, we are getting closer and closer to finding better ways of exploring the interactions between assets and financial markets. As noted above, our approach lies within the realm of evolutionary algorithms, which turned out to be very effective in solving computationally intensive tasks. Of these, the Nondominated Sorting Genetic Algorithm II is chosen in this work due to its remarkable efficiency in handling multi-objective optimisation problems with considerable efficiency. (Deb et al, 2002). NSGA-II utilises a rapid non-dominated sorting method and a crowding distance mechanism to preserve solution diversity, making it well-suited for financial portfolio optimisation.

As stated above, the constraints of our objectives are taken from the biobjective problem of mean-variation of Markovitz and, lastly, the taking into consideration of cardinal assets. Thus, we obtain a tri-objective optimisation issue. Numerous studies also took an approach to this matter by using evolutionary algorithms, noteworthy for this article that as inspiration the research of Anagnostopoulos & Mamanis (2010), in which they observe the performances of 3 MOEA's methods (Multi Objective Evolutionary Algorithms). In our case, we will further observe how NSGA-II will compare with one traditional technique based on the quadratic mean-variation estimation of assets. By examining both approaches, we aim to highlight the advantages and limitations of the traditional efficient frontier method and demonstrate how evolutionary algorithms can offer robust solutions in the realm of financial portfolio optimisation.

In the following sections, we will provide a brief explanation of how the constraints are integrated into the objective function, the operational mechanisms of genetic algorithms within this framework, and the computational methodology of our comparison counterpart.

2. Multi-Objective Portfolio Optimisation

In portfolio theory, the concept of an efficient portfolio is central to optimising returns while managing risk. According to the seminal work of Huang & Litzenberger (1988) an efficient portfolio is defined as one that lies on the portfolio frontier with an expected rate of return strictly higher than that of the minimum variance portfolio. To achieve that, we make use of the following constraints:

$$\min \rho(\mathbf{x}) = \sum_{i=1}^n \sum_{j=1}^n x_i x_j \sigma_{ij} \quad (1)$$

$$\max \mu(\mathbf{x}) = \sum_{i=1}^n x_i \mu_i \quad (2)$$

For the formulations above, σ represents the variation and covariation of our assets, respectively, the risk they contain and μ symbolizes the expected return of one asset. Furthermore, the efficient portfolio is also limited by the fact that one must expend all his funds into this set of securities, therefore $\sum_i x_i = 1$.

To further refine the portfolio, we incorporate the cardinality constraint aimed at minimising the number of assets with nonzero weights, thereby simplifying the portfolio and forcing the algorithm to choose the best ratio of risk and return for an asset.

$$\min \text{card}(\mathbf{x}) = \sum_{i=1}^n 1_{x_i} > 0 \quad (3)$$

Evolutionary algorithms (EAs) are methods inspired by real-life processes, specifically the idea of natural selection and evolution (Coello, 2007). MOEAs are characterised by generating a set of Pareto-front solutions, focussing on finding

the best non-dominated outcomes. This approach ensures that all constraints are partially satisfied without having any single solution dominated by another. With this diversity we also obtain different ways the algorithm can build a portfolio, seeing how for every iteration a different approach is taken.

An MOEA is called an elitist algorithm when it is able to generate new populations based on combining the best performing agents of past iterations. By doing this, each generation is slightly improving; later, we find an optimum point or we limit the number of simulations.

3. Quadratic Problem for Mean-Variance

The mean-variance optimisation framework is widely used in finance to construct efficient portfolios that provide the best possible return for a given level of risk (Elton, 2014). It can be formulated as a quadratic programming problem with the objective of minimising the portfolio variance subject to constraints on the expected return and the portfolio weights. The problem is states as the following (Huang & Litzenberger, 1988):

$$\min_{\mathbf{w}} \frac{1}{2} \mathbf{w}^T \Sigma \mathbf{w} \tag{4}$$

$$\mathbf{w}^T \boldsymbol{\mu} = p \tag{5}$$

$$\mathbf{w}^T \mathbf{1} = 1 \tag{6}$$

It is stated that a portfolio is of frontier if and only if the weight vector of the portfolio is the solution of the quadratic equation. Consequently, we have the constraint for minimising risk, where w is the, then the p being the targeted expected return of portfolio.

$$\mathcal{L}(\mathbf{w}, \lambda_1, \lambda_2) = \frac{1}{2} \mathbf{w}^T \Sigma \mathbf{w} - \lambda_1 (\mathbf{w}^T \boldsymbol{\mu} - p) - \lambda_2 (\mathbf{w}^T \mathbf{1} - 1) \tag{7}$$

The Lagrangian function incorporates the objective function and the constraints using Lagrange multipliers (λ_1 and λ_2). This formulation helps in solving the optimisation problem by finding the stationary points of the Lagrangian, which satisfy both the objective function and the constraints.

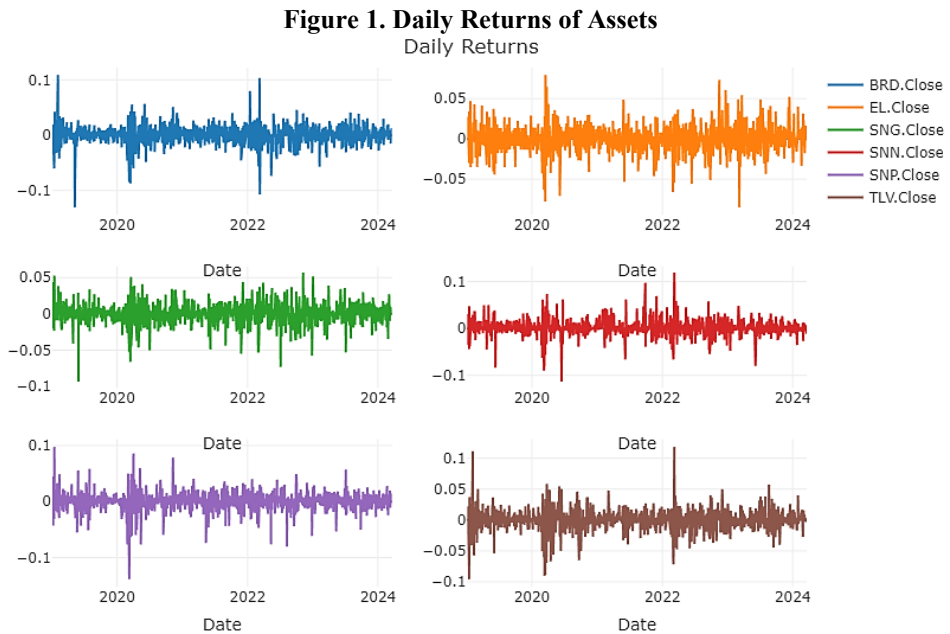
Although the mean-variance optimisation formula pioneered in Modern Portfolio Theory, a set of significant drawbacks had been associated with it (Haugh, 2016). It is highly sensitive to input estimates of expected returns and covariances, at the same time being incapable of taking into account asymmetry and kurtosis, making the optimal asset allocations prone to significant changes with small estimation errors. Additionally, this is a static model that only relies on historical data for estimating only one outcome for asset allocation. Compared to our testing counterpart has a dynamic and can estimate different scenarios using the same initial dataset.

4. Empirical Results

Our database consists of six assets, some of the best performing ones included in the Bucharest Exchange Trade Index (BET), having a proportion of around 60% of it. They have the following symbols: BRD, TLV, SNP, SNG, SNN, EL. BRD and TLV belong to the banking sector, while the other classify in the energy sector.

For this study, we used a period of approximately 5 years, from 2019/01/04 to 2024/03/19. This time axis also includes the effects of the COVID-19 pandemic and the Ukrainian war, thus having an even more volatile set of dates.

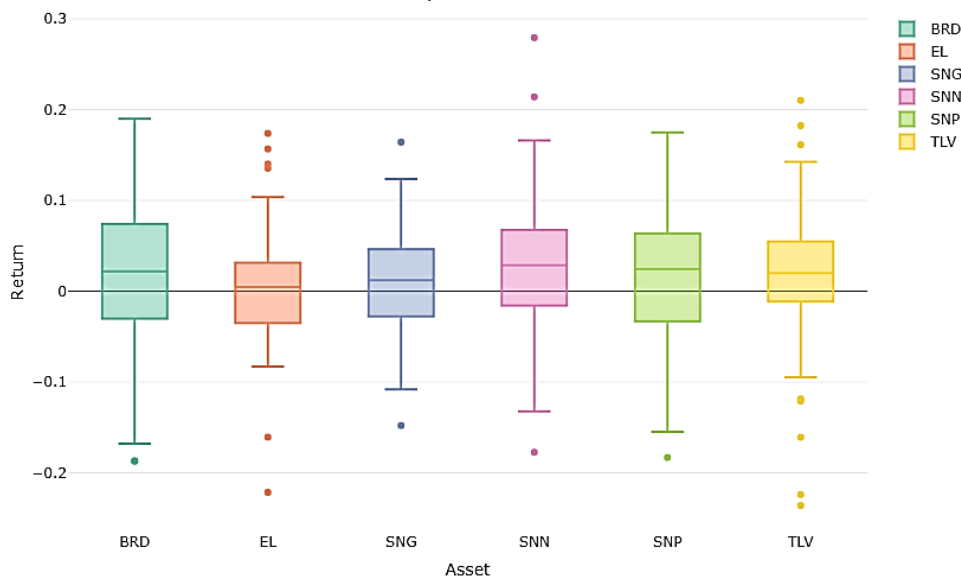
It is also worth mentioning that this dataset was obtained from the Bucharest Stock Exchange (BVB) through a formal request for academic use of the information, ensuring the accuracy and relevance of the information used in this study.



Source: Self-computed in RStudio using Plotly library (2024).

Before computing the algorithm, we took a step back to analyse the average return of each series and its level of volatility. By visualising the monthly returns using boxplots, we observed that the mean returns tend to be positive, even though there were periods of increased volatility, particularly around significant global events such as the COVID-19 pandemic and the Ukraine war. This increased volatility can be attributed to the phenomenon of volatility clustering, as noted by Mandelbrot (1963), where periods of high uncertainty tend to be followed by even higher uncertainty. Letting the algorithm experience these effects will also demonstrate its ability to avoid risk and capacity to evaluate assets.

Figure 2. Monthly Returns of Assets. Boxplots representation
Monthly Returns of Assets



Source: Self-computed in RStudio using Plotly library (2024).

For the NSGA-II method, we performed three sets of simulations across four different mutation rate settings. In each simulation, a total of 1000 iterations were set, with a standard population size of 100. The crossover probability was maintained at 0.9 in all scenarios and mutation rates were established at 0.01, 0.05, 0.10, and 0.15.

Computational analysis was performed using RStudio, using the “nsga2R” library (Tsou, 2022) to execute NSGA-II simulations and the ‘series’ package (Trapletti, 2024) for traditional estimates. This implementation was inspired by the methodology outlined in Adyatama's work published in RPubS (2021), with the distinction of excluding a risk-free rate. The risk-free rate would typically act as a baseline for expected returns on risky assets, as they would be derived from governmental bonds (Damodaran, 2008). As a result, exclusion was necessitated by the extended time period over which the model was tested.

Table 1. Estimated return of simulated portfolios

Total returns	0.01	0.05	0.1	0.15
I	0.00037	0.00064	0.00068	0.00065
II	0.00088	0.00091	0.00091	0.00067
III	0.00092	0.00054	0.00066	0.00063

Source: Self-computed in RStudio, 2024.

Table 2. Estimated risk of simulated portfolios

Risk	0.01	0.05	0.1	0.15
I	0.00058	0.00014	0.00016	0.00015
II	0.00014	0.00017	0.00032	0.00065
III	0.00014	0.00018	0.00014	0.00016

Source: Self-computed in RStudio, 2024.

In the first table, we have arranged the results of simulated portfolio returns based on their number of simulations and the rate on mutation. This was done to study the randomness of each computation. In the following table we have the risk correspondence of each simulation. From this set we obtained both satisfying combinations of return/risk and lesser performing variants. Based on this, we have observed some patterns that suggest that the algorithm undergoes the most significant changes during the initial iterations of the simulated environment. Such behaviour can be attributed to the algorithm's exploration phase. As the iterations progress, the algorithm tends to exploit the most promising regions of the solution space, leading to a reduction in variability and a gradual convergence towards optimal or near-optimal solutions.

In addition, we decided to extract the best options from each mutation rate value based solely on the performance of the returns. We did this because we want to study why the algorithm took such paths even when confronted with significant levels of risk, like the case of simulation II.0.15 where the risk is almost the same as the return, respectively, 0.00067 and 0.00065.

From the results shown in Table 3, it appears that with a higher mutation rate, without being restricted in terms of minimum and maximum fund allocation for one asset, the algorithm tends to distribute most of its resources into two securities. Specifically, as the mutation rate increases from 0.01 to 0.15, we observe a significant concentration of weights in the SNN and SNP assets.

This phenomenon can be attributed to the exploration-exploitation trade-off inherent in evolutionary algorithms. At higher mutation rates, the algorithm introduces more substantial changes in each iteration, increasing the diversity of the portfolio compositions. However, this can also lead to a higher likelihood of converging on a few highly dominant solutions, especially if those solutions appear to offer superior return-risk trade-offs early on.

Table 3. Weights of portfolios

	0.01	0.05	0.10	0.15	M-V equation
BRD	0.037	0.024	0.175	0.026	0.087
EL	0.134	0.009	0.059	0.223	0.200
SNG	0.102	0.030	0.107	0.024	0.261
SNN	0.315	0.235	0.521	0.662	0.188
SNP	0.386	0.238	0.104	0.049	0.177
TLV	0.026	0.464	0.034	0.016	0.088

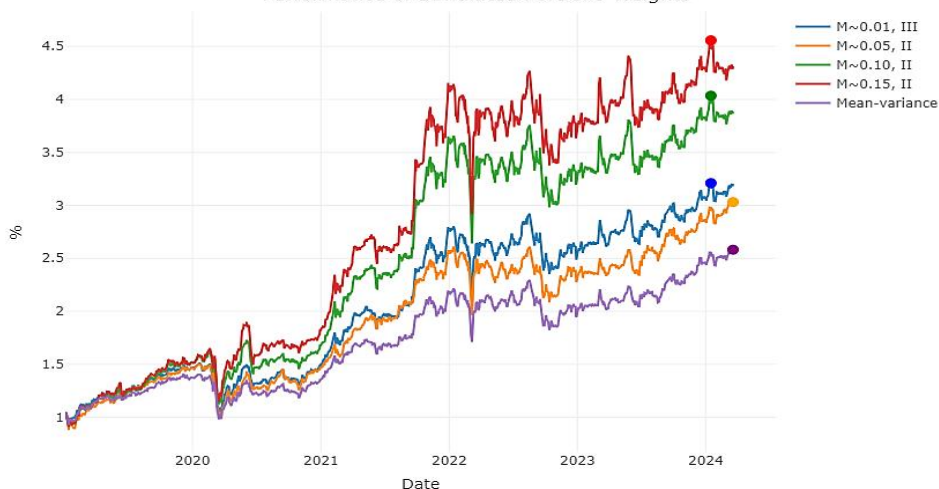
Source: Self-computed in RStudio, 2024.

In our case, the asset SNN seems to dominate the portfolio allocations at higher mutation rates. This could be due to these assets demonstrating favourable return characteristics that align well with the algorithm's objectives. The mutation rate of 0.15, in particular, shows a very pronounced allocation to SNN with a weight of 66.2%.

On the other hand, the mean-variation method tends to spread the weights more evenly across multiple assets, with no single asset substantially dominating the portfolio.

Figure 3. Wealth index representation

Performance of Simulated Portfolio Weights



Source: Self-computed in RStudio using Plotly library (2024).

Lastly, we have generated five different portfolios based on the weight we obtained through simulation and the mean-variance method and tested their performance on the time axis. The wealth index was chosen to reflect how many times the portfolio grow in a time span while testing different structures. The y axis represents the percentage growth rate (x times, 1.5 = 150%). It is also noted that the output of the mean variance formula was a return of portfolio of 0.00075 and an overall risk of 0.00012.

On a general note, NSGA-II managed to select more rewarding portfolios, even if all the simulations had a bigger risk ratio, some of them with a small increase, the ones with a mutation rate of 0.01% and 0.05%, they still found a better allocation of funds for a greater income. This shows how the mean-variance is a lot more focused on minimal risk rather than truly identifying the best option in fund allocation.

It is also notable that the portfolios had the best overall performance, earning a multiplication of 4.56 times of initial investment for the highest mutation rate (red line) and the second highest of 4.03 (green line). Even if the return value of the initial simulation was 0.00092 for the green line and 0.00067 for the red, those results were caused by the higher risk rates of 0.00032 and 0.00065.

5. Conclusions

The NSGA-II algorithm turned out to be a great solution for multiobjective optimization problems, thus creating different efficient scenarios with time and even handling higher ratios of risk. It arrives at high-return options and at the same time also gives some safer and lower-risk alternatives, therefore attracting many

Investment strategies.

In the present research, all the sets were created using a formula similar to the mean-variance equation with nonzero asset allocations. This flexibility makes NSGA-II search for an even larger space of feasible solutions and hence proves to be better in portfolio optimization.

We amassed enough evidence to suggest that multi-objective evolutionary algorithms can detect even more complex solutions, given further research on constraints and adaptability. On the other hand, sensitivity to parameter settings and tendencies towards premature convergence are defects that cannot be ignored in NSGA-II. These limitations suggest that perhaps our model was not fitted for this portfolio performance test.

Integration of long-term and short-term memory methods in stock behavior, dynamic portfolio structure over time, and conditional volatility would improve the performance of algorithms. Integrating methods for identifying long-term and short-term memory in stock behaviour, dynamically altering portfolio structure over time, and taking into account conditional volatility could enhance algorithm performance. One way would be the integration of more advanced Machine Learning (ML) techniques like ARIMA or SARIMA for testing and identification of recurrent patterns or seasonal windows or even augmentation via neural networks (NN). These advancements could lead to more precise and reliable portfolio optimisation, benefiting investors with better-informed strategies.

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Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the author(s) utilised ChatGPT to enhance readability and language clarity. Following the use of this tool, the author(s) meticulously reviewed and revised the content as necessary and assumed (s) full responsibility for the final content of the publication.

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**The Development of a Quantitative Measurement Scale
to Assess Romanian Knowledge and Attitude Towards
Sustainability and Sustainable Clothing**

Anastasia COSMA¹

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Abstract

In the recent years, sustainability has received great emphasis, focusing on balancing environmental conservation with economic growth. While different approaches towards sustainability tend to focus on green, ethical, and political consumption practices, there is still a significant gap in the green literature regarding measurement tools for assessing individuals' comprehension and attitudes toward sustainable clothing consumption. To address this highlighted issue, our study proposes the development of a quantitative measurement scale created to evaluate sustainability, knowledge, and attitudes among Romanian consumers. The designed scale includes dimensions related to general sustainability concepts, sustainable clothing practices, and attitudes towards sustainable clothing. Conducted in Romania, our study investigates a sample of 1,087 respondents. With the help of the statistical method Exploratory Factor Analysis, we have determined the construct validity of the scale, showing strong reliability and validity, with high internal consistency and significant correlations between the found dimensions. The main contribution of our study consists of the usefulness brought with this novel tool for both researchers and practitioners to explore knowledge and attitudes toward sustainability and sustainable clothing. The application of the Sustainable Clothing Measurement Scale comes with the potential to assist consumer behaviour studies, along with policy initiatives, and educational activities that have the purpose of promoting or shaping sustainable practices within the textile industry and beyond. Nonetheless, this study offers insights to advocate for the continuous process of developing or discovering different sustainability initiatives in the context of consumer behaviour and industry practices by putting forward a measurement scale for understanding sustainable clothing consumption and closing in the literature's gap.

Keywords: sustainable clothing consumption, sustainability, scale development, measurement scale, attitudes.

JEL Classification: D12; C20; C10; Q56.

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1. Introduction

Sustainability has been recognised in the literature as a multidimensional concept that embodies through delicate consideration the balance of meeting present demands while ensuring future generations' ability to satisfy their own. This wide-ranging concept proposes the creation of an agreement between economic growth and environmental preservation (World Commission on Environment and Development, 1990). In addition, scholars performed a thorough investigation of various approaches to defining and forecasting the broad topic of sustainability (Balderjahn et al., 2013; Costanza & Patten, 1995). Among this vast terrain of inquiry, attention has increasingly converged on sustainable consumption, which encompasses practices such as green consumption (Peattie, 2010), political consumption (Halkier, 2004), and ethical consumption (Devinney et al., 2010; Newholm & Shaw, 2007). However, these approaches often focus on specific aspects or drivers of sustainable behaviour, leaving gaps in understanding the broader scope of sustainable consumption (Balderjahn et al., 2013).

Numerous measurement tools have been developed to capture dimensions of sustainability, including environmental, social, and economic aspects (Balderjahn et al., 2013; Gilg et al., 2005; Iwata, 2006; Pepper et al., 2009). Recent efforts have seen the development of scales that assess sustainable consumption behaviour (Fischer et al., 2017; Geiger et al., 2018) and awareness of sustainable consumption (Balderjahn et al., 2013). Considering this well-documented progress, there is still a lack of theoretical frameworks and measurement scales for assessing individuals' understanding and attitudes toward sustainable clothing consumption.

2. Problem Statement and Research Aims

Intending to address the existing gap that was identified in the literature, the research aim is to develop a scale that will solve the absence of theoretical frameworks that measure sustainable consumption. This novel measurement tool will focus mostly on the sustainable consumption of clothing and the textile market. Unlike other sustainability measures, this particular scale does not refer to specific behaviours or situations; instead, it looks, in general terms, at one's perceptions of sustainability. This study intends to encapsulate the main understanding and attitudes toward sustainability posed by respondents in the fashion context by diverting certain agenda items and considering only those elements which bring benefits to the purpose of the measurement aid.

Importantly, this scale contains the personal assessments of the respondents regarding sustainability in the fashion industry instead of advising how the subject should be reached. This approach contrasts with existing scales that assess attitudes toward governmental, corporate, or educational actions (Michalos et al., 2011) or focus on personal conservation behaviours tied to specific lifestyles (Milfont & Duckitt, 2004).

The identified research gap lies in the lack of a comprehensive measurement tool for assessing Romanian consumers' knowledge and attitudes towards sustainable

clothing consumption. Building on existing literature on sustainable consumption and measurement scales, our study seeks to fill this void by developing a scale tailored to the Romanian context.

Our main research objective is to create a reliable and valid measurement scale to evaluate people's attitudes and knowledge towards regarding the consumption of sustainable clothing, in light of the identified research gap.

The study's findings add to the body of knowledge on sustainable clothing consumption, as well as the practical interventions that may be implemented in Romania to encourage sustainable clothing consumption habits.

The paper overall structure is as follows: the next section details the methodology employed, while main findings are briefly presented in the fourth section. The study's conclusions and recommendations for further in-depth research areas, alongside practical implications are put forward in the final section.

3. Research Methodology

Data were collected in Romania starting from November until December 2020 with the help of an online self-administered questionnaire that has been shared on Facebook, LinkedIn, WhatsApp, and other social media networks. The sample comprises the responses of 1,087 respondents who have voluntarily and anonymously participated. They gave their consent to participate in this study and have been informed of its purpose. The questionnaire embraces both convenience sampling (Baltar & Brunet, 2012) and snowball sampling (Browne, 2005; Heckathorn, 2011) techniques.

3.1 The Development of a Data Collection Tool

In the framework of this study which focusses on sustainable clothing, we intensively evaluated relevant pertinent literature on the development of measurement scales for sustainable clothing. Drawing on the insights gathered from previous research, we formulated a global 13-item scale to assess respondents' comprehension of sustainability in general and sustainable clothing in particular. The Sustainable Clothing Measurement Scale (STB) measures dimensions such as the conceptualisation of sustainability, attitudes toward sustainability, particularly in the context of clothing, and the knowledge regarding sustainable clothing practices.

The components of this proposed scale wish to reflect fundamental notions for understanding of sustainability while incorporating pivotal insights like the need for environmental conservation and the demand for resource preservation. Thus, we introduced items showing the general idea of sustainability and we used, for instance, statements like "Sustainability refers to establishing a balance between economic growth and environmental protection". In addition, we have captured the perception statements appreciating attitude view in regard to sustainability and sustainable clothing like, "A sustainable attitude means taking into account the need to preserve the planet for present and future generations whereas considering the economic, environmental, and social factors". In addition, the STB will assess people's awareness of sustainable clothing by attaining their perception of topics like

restricting the natural environmental impact of agrochemicals and sourcing materials from in an environmentally responsible manner.

The items of the scale were formulated in Romanian as this would guard against cultural alienation and ensure the items were accessible and easily understood. The STB was included as an introduction put in the main questionnaire. Basically, STB was to help identify the perceptions and attitude of the respondent.

Respondents answered the scale using the seven-point Likert scale, from 1 for very low agreement to 7 for very high agreement. Table 1 leaves no place for doubt of what kind of scale constructs were used, so that its methodology is fully transparent and reproducible.

Table 1. Sustainability measurement scale constructs

Dimension	Items	Abbreviation
Sustainability Measurement Scale	Sustainability refers to the quality of an activity that must be carried out without exhausting available resources and without destroying the environment.	STB1
	Sustainability refers to the establishment of a balance between economic growth and environmental protection.	STB2
	Sustainability involves finding alternative resources without compromising the ability to meet the needs of future generations.	STB3
	The principles of sustainability are: reduction, reusing, and recycling.	STB4
	A sustainable attitude means taking into account the need to preserve the planet for present and future generations, while also considering economic, environmental, and social factors.	STB5
	Sustainable fashion implies not changing our clothes based on the ongoing trend, but adapting fashion so as to protect the ecological footprint.	STB6
	Sustainable clothing refers to fabrics derived from environmentally friendly resources, such as sustainably grown fibre crops, or recycled materials.	STB7
	Sustainable clothing is special since they are processed in an environmentally friendly way.	STB8
	Sustainable clothing reduces the impact of agrochemicals on the environment.	STB9
	Through the use of sustainable clothes, it is intended to reduce the amount of clothing discarded in landfills.	STB10
	Having a sustainable attitude towards clothing implies purchasing clothes from second-hand outlets.	STB11
	To have a sustainable attitude towards clothing means donating or recycling clothes in order to be reused or resold.	STB12
	To have a sustainable attitude implies to have few things and of very good quality.	STB13

Source: author's own research.

3.2 Research Methods

For the statistical procedures we used R software, version 4.0.3 (R, 2021). We launched our analysis by checking primarily the reliability of the measurement scale, along with the correlation matrix and the adequacy test. We continued with the evaluation of the construct validity of the scale and conducted an exploratory factor analysis (EFA) to determine potential latent constructs within the STB dimension. The functions involved in performing EFA for this study, are accessible in the “psych” package in R. For the purpose of this paper, we use the principal axis as an extraction method and the “varimax” rotation. Exploratory factor analysis is a useful strategy for model specification prior to cross-validation with confirmatory factor analysis (Gerbing & Hamilton, 1996). Therefore, subsequently to extracting the factors, we performed a confirmatory factor analysis (CFA) to evaluate the model performance (Schreiber et al., 2006). The confirmatory factor analysis functions are found in the “lavaan” package in R (R, 2021).

4. Findings

The final sample consists of 1,018 respondents (87.3% female), aged 10 to 80 (mean 33.75, SD = 11.88), 84.2% of them having a monthly income greater than 1000 RON. We structured our findings in three sections: the first one approaches the reliability and homogeneity of the instrument, followed by the exploratory factor analysis, while the last one explores the confirmatory factor analysis. We have chosen this method for a more complete summarisation of the data.

4.1 Exploratory Factor Analysis (EFA)

We started the analysis by testing the reliability and homogeneity. During this stage, we used Cronbach’s Alpha reliability index, the Kaiser-Meyer-Olkin (KMO) coefficient, and the Bartlett test to control whether the data were suitable for further tests. For a KMO coefficient above the threshold of 0.60 and a significant result obtained with Bartlett’s test, we consider to have an indication of the data stability for factor analysis (Çelikler & Aksan, 2016). Furthermore, Cronbach’s alpha returned satisfactory results, above the 0,7 threshold (Cortina, 1993).

We gather enough evidence to demonstrate the suitability of the data set for the factor analysis based on Bartlett’s test, which was carried out to evaluate the stability for the factor analysis of the data from our 13-item scale, the significant statistic chi-square, the KMO coefficient and Cronbach’s alpha. The results are shown in Table 2.

Table 2. Reliability and homogeneity tests’ results

Measurement index	Value	
Cronbach’s alpha	0.86	
KMO measure of sample adequacy	0.92	
Bralette’s test approximate Chi-square value	1566.2	Df = 2, p-value <2.2e-16

Source: author’s own research.

Following the exploratory factor analysis (EFA), three factors were identified, with a cut-off point of 0.4. The total variance accounted for by them was 50%, while the total variance estimated by each factor was 21%, 18%, and 11%. According to the standard methodology for the EFA, the item factor should be 0.30 or greater. Research on scale development and adaptation indicates that item factor load values should be at least 0.30 concerning this subject. Based on our estimations, we discovered that item 13 had a value below the proposed threshold, for this reason it was decided to be dropped from the scale. Therefore, the main principle for evaluating the results of the factor analysis is the factor load, defined as the correlation between variables and factors (Çelikler & Aksan, 2016).

Using the “varimax rotation technique” (R, 2021), the items were dispersed between three distinctive factors, with factor load values ranging between 0.43 and 0.80. An evaluation of the content indicated that they were grouped under factors with good internal compatibility. This gave us the opportunity to name the factor-based subject of their respective latent variable. Furthermore, we performed an analysis to calculate the Cronbach Alpha to determine the reliability of the dimension scores. The alpha reliabilities of the first, second, and third factors were calculated as 0.8, 0.82, and 0.68. The estimated values illustrated these factors to perform reliable assessments. The factor values identified for the sustainability measurement scale items along with their given dimensions and their reliability index are shown in Table 3.

Table 3. Sustainability measurement scale constructs

Dimension	Items	Factor 1 0.21	Factor 2 0.18	Factor 3 0.11
General Sustainability 0.8	STB1: Sustainability refers to the quality of an activity that must be carried out without exhausting available resources and without destroying the environment.	0.61		
	STB2: Sustainability refers to the establishment of a balance between economic growth and environmental protection.	0.62		
	STB3: Sustainability involves finding alternative resources without compromising the ability to meet the needs of future generations.	0.66		
	STB4: The principles of sustainability are: reduction, reusing, and recycling	0.58		
	STB5: A sustainable attitude means taking into account the need to preserve the planet for present and future generations, while also considering economic, environmental, and social factors.	0.58		

Dimension	Items	Factor 1 0.21	Factor 2 0.18	Factor 3 0.11
Sustainable clothing 0.82	STB6: Sustainable fashion implies not changing our clothes based on the ongoing trend, but adapting fashion so as to protect the ecological footprint.		0.43	
	STB7: Sustainable clothing refers to fabrics derived from environmentally friendly resources, such as sustainably grown fibre crops, or recycled materials.		0.61	
	STB8: Sustainable clothing is special since they are processed in an environmentally friendly way.		0.71	
	STB9: Sustainable clothing reduces the impact of agrochemicals on the environment.		0.66	
	STB10: Through the use of sustainable clothes, it is intended to reduce the amount of clothing discarded in landfills.		0.50	
Sustainable attitude 0.8	STB11: Having a sustainable attitude towards clothing implies purchasing clothes from second-hand outlets.			0.80
	STB12: To have a sustainable attitude towards clothing means donating or recycling clothes in order to be reused or resold.			0.62

Source: author’s own research.

4.2 Confirmatory Factor Analysis (CFA)

Confirmatory factor analysis (CFA) was performed to assess the structural validity of the instrument developed according to the model attained following the exploratory factor analysis. During this stage of the analysis, the Root Mean Square Error of Approximation (RMSEA), the Standardised Root Mean Square Residuals (SRMR), the Comparative Fit Index (CFI) and the Tucker-Lewis Index (TLI) were used as the model’s fit indices. Their values were juxtaposed with those described and identified in the literature. Therefore, we took into account the general cut-off for the four indexes, RMSEA lower than 0.06, SRMR lower than 0.08, CFI above 0.9, and TLI above 0.9. Based on the results obtained, the fit indices were determined as RMSEA = 0.045, SRMR = 0.029, CFI = 0.976 and TLI = 0.969. The results were satisfactory, therefore, we proceeded to explore a second-order model with a four-factor solution. We checked for the same goodness-of-fit indicators using two different statistical methods. For the “marker” method provided by the “lavaan” library (R, 2021), the results were as follows: RMSEA = 0.053, SRMR = 0.055, CFI = 0.966, TLI = 0.958. We also tested the model using the “var std” method, from the same library (R, 2021), and the identified values for our second order model were RMSEA = 0.048, SRMR = 0.034, CFI = 0.973, TLI = 0.966. The results of this analysis are provided in Table 4.

Table 4. Confirmatory Factor Analysis Goodness of Fit Indices

	RMSEA (* < 0.06)	SRMR (* < 0.08)	CFI (* > 0.9)	TLI (* > 0.9)
Three factor model	0.045	0.029	0.976	0.969
Second order model 1	0.053	0.055	0.966	0.958
Second order model 2	0.048	0.034	0.973	0.966

Source: author's own research.

According to our confirmatory factor analysis, both the three-factor and the four-factor models have good performance, and in this sense, they seem to be measuring the same thing. Both second-order models show that there is an integrative latent construct, namely the meaning of sustainability.

5. Conclusions

In this study, our aim of addressing the research gap on the measurement of Romanian consumers' knowledge and attitudes toward sustainable clothing consumption has culminated in the development and validation of the Sustainable Clothing Measurement Scale (STB). By synthesising insights from existing literature and drawing from principles of sustainability, we constructed a comprehensive instrument tailored to the Romanian context.

The STB, consisting of thirteen handmade items, serves as a versatile tool to assess multiple dimensions of sustainable fashion consumption. Based on the fundamental principles of sustainability, the scale includes aspects such as the conceptualisation of sustainability, attitudes toward sustainability in the context of clothing, and knowledge of sustainable clothing practices. The new developed tool was measured on a seven-point Likert-type scale and, by translating the items, we ensured the cultural relevance and accessibility of the scale to our target respondents in Romania. The new instrument was then evaluated by 1,018 respondents.

The findings of both the exploratory factor analysis (EFA) and the confirmatory factor analysis (CFA) showed strong evidence of the STB's reliability and validity. With the help of the EFA the scale used in this study was found to consist of three distinct factors: general sustainability, sustainable clothing, and sustainable attitude. These factors showed satisfactory internal consistency as indicated by high Cronbach's alpha values. Additionally, the CFA supported the structural validity of the scale, with both three-factor and four-factor models exhibiting good fit indices.

Here, the "meaning of sustainability" is established as an overarching latent construct. Accordingly, there is a strong focus by STB on the integrative nature of sustainability. With such an overarching perspective, there is a view to going beyond the specific dimensions, underlining the complementarity of the economic, ecological, and social factors in the development of sustainable behaviors.

This paper should have major practical and academic implications for actions aimed at promoting sustainable fashion consumption in Romania. The development process of STB contributes de facto to the academic literature with the development

of a new instrument promising to assess someone's knowledge and attitude towards sustainable clothing consumption and, therefore, pave the path for future empirical investigations in this field of research. The results of this study could also serve as an inspiration in designing programmes and policies aimed at inducing sustainable behaviour among Romanian consumers.

One of the key actors who would very greatly benefit from STB's findings is the fashion industry. This could be done by employing the scale to better discover and understand consumers' perceptions and preferences for shaping the group's needs with regard to sustainable fashion. These are the insights the tool provides, with which businesses can make adjustments to their marketing strategies and product offerings in a manner that resolves consumers' needs and at the same time reflects their values. It is, at last, going to benefit and contribute to the ecosystem's betterment in terms of sustainable fashion. There are certain limitations that need to be acknowledged, despite of the highlighted contributions made through this study. One of these limitations stands in the different biases that can appear as a result of using the online survey method and also based on the reliance on self-reported data. These biases could restrict the applicability of our findings. Another limitation of this study stands in a demographic characteristic, namely the large percentage of sample's respondents that had greater monthly incomes. This specific part of the sample has the potential of skewing our results in favour of a more affluent demographic. However, future research could correct this limitation through the use of different method approaches that would broaden this study's viability and include a larger demographic group. Also, it is possible that when designed, the scale's items have not included all of the relevant characteristics on the subject of sustainability and sustainable clothing. Future studies should be conducted to identify and correct these flaws to improve its return of value. Acknowledging these limitations stands as a starting point for further research wishing to contribute to the consumption of sustainable clothing.

On a concluding note, this study's development and validation of the Sustainable Clothing Measurement Scale wants to make a first step in comprehending sustainable clothing consumption in Romania. This also constitutes a step toward fostering a more sustainable future for the fashion industry and past it.

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Bayesian Symbolic Regression and Other Similar Methods as a Tool for Forecasting Commodities Prices

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Abstract

Bayesian Symbolic Regression (BSR) is used to predict spot prices of 56 commodities. BSR is a certain improvement over the symbolic regression technique based on genetic programming. Besides, there has been limited applications of the symbolic regression to forecasting prices in economics and finance. Contrary to prior simulations of BSR with synthetic data, this study discusses an application to the real-world data derived from commodities markets. In particular, forecasting one month ahead spot prices of 56 commodities. Indeed, BSR presents valuable capabilities for addressing the complexities associated with variable selection in econometric modelling. It is expected to also handle also some other challenges smoothly. Therefore, this study is carefully tailored to deal with commodity markets time-series data. Moreover, several alternative techniques are also tested, i.e., the symbolic regression with genetic programming, Dynamic Model Averaging, LASSO and RIDGE regressions, time-varying parameters regression, ARIMA, and no-change method, etc. In particular, the main aim is to focus on forecast accuracy. The obtained outcomes can give valuable insights for both researchers and practitioners interested in implementing BSR in econometric and financial projects in the future.

Keywords: Bayesian econometrics, commodity prices, model uncertainty, time-series forecasting, variable selection.

JEL Classification: C32, G17, Q02.

1. Introduction

The objective of this work was to forecast one month ahead spot prices of 56 commodities with Bayesian Symbolic Regression (BSR) and some other methods dealing with variable uncertainty. In particular, 19 potentially important explanatory variables were considered. The accuracy of the forecasts obtained was analysed.

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2. Problem Statement & Research Questions / Aims of the Research

Two main obstacles emerge when forecasting commodity spot prices. First, the multitude of factors influencing these prices (such as supply and demand dynamics, exchange rates, financial market interactions, speculative pressures, various indices of uncertainty, etc.) challenges the selection of important variables for constructing econometric models like multilinear regression (Gargano and Timmermann, 2014). The second challenge stems from the temporal variability in the impact of specific drivers on commodity prices, suggesting the use of time-varying model parameters and structures (Huang et al., 2021). Additionally, the model's functional form should account for non-linear effects and the intricate nature of the market (Caginalp & Desantis, 2011).

Symbolic regression captures these conundrums. It starts with a set of operators (functions) and employs evolutionary processes such as crossover, mutation, and selection to evolve into a suitable functional form for the model (Koza, 1988). It is a kind of regression analysis, but unlike traditional regression approaches reliant on predefined functional forms (e.g., linear, quadratic), it offers greater flexibility, allowing the method itself to identify the most appropriate mathematical structure and coefficients directly from the data. The algorithm traverses a space of mathematical expressions starting from a population of randomly generated mathematical expressions represented as trees with mathematical operators and variables. These expressions undergo evaluation based on their fitness to the training data, evaluated by a specified fitness function. The algorithm iteratively selects the best evaluated expressions from the current population, and then generates the next population, until a predefined stopping criterion is met (Koza, 1988). Recently, BSR was introduced by Jin et al. (2019). It replaces genetic algorithms with Bayesian symbolic trees, substituting evolutionary processes with Bayesian prior-posterior inference.

The objectives of this study were to compare the performance of forecast accuracy obtained from BRS and competing benchmark methods. Second, we analyse the most desirable specification of the initial parameters for BSR. The main research question was whether BSR generates significantly more accurate forecasts than the benchmark models.

3. Data and Research Methods

Spot prices of 56 commodities, i.e., Brent, Dubai and WTI crude oil, Australian and South African coal, US and European natural gas and Japan liquefied natural gas, cocoa, Arabica and Robusta coffee, Colombo, Kolkata and Mombasa tea, coconut oil, groundnuts, fish meal, palm oil, soybeans, soybean oil, soybean meal, maize, Thai 5% and 10% broken rice, US soft red winter and hard red winter wheat, US bananas, orange, beef, chicken meat, Mexican shrimps, European, US and world sugar, US import tobacco, Cameroon and Malaysian logs, Malaysian sawnwood, plywood, cotton (A index), Singapore traded rubber, phosphate rock, diammonium phosphate, triple superphosphate, urea, potassium chloride, aluminium, iron ore,

copper, lead, tin, nickel, zinc, gold, platinum and silver spot prices were analysed (The World Bank, 2022). Logarithmic differences were inserted into the models.

Similarly as, for example, Gargano and Timmermann (2014) and Drachal (2018), the following explanatory variables were considered: dividend to price ratio, price earnings ratio (Schiller, 2022), US 3-month treasury bills secondary market rate representing short-term rate and US long-term government 10-year bond yields representing long-term rate, term spread, i.e., the difference between the long-term rate of US bonds and US treasury bill rate, default return spread, i.e., the difference between US long-term corporate bonds yield and US treasury bill rate, where long-term corporate bond yield was taken as the index based on bonds with maturities 20-years and above, US Consumer Price Index transformed into logarithmic differences, US industrial production transformed into logarithmic differences, US M1 money stock transformed into logarithmic differences, Kilian global economic activity index (Kilian, 2009), US unemployment rate, real effective exchange rates based on manufacturing Consumer Price Index for US transformed into logarithmic differences, S&P GSCI Commodity Total Return Index transformed into logarithmic differences, US dollar open interest transformed into logarithmic differences, Working's dollar T-index (FRED, 2022; Bloomberg, 2022; Working, 1960; CFTC, 2022), VIX index, i.e., implied volatility based on 30-day S&P 100 index at-the-money options, Global Geopolitical Risk Index, i.e., The Benchmark GPR Index (Caldara & Iacoviello, 2022a; 2022b), MSCI WORLD for developed markets index and MSCI EM for emerging markets index (MSCI, 2022).

The initial data set consisted of 404 monthly observations, beginning on January 1988 and ending on August 2021. The first 100 observations were taken as the in-sample period. Time-series were standardised (i.e., mean was subtracted and outcome divided by standard deviation; both computed over the in-sample period). Explanatory variables were lagged 1 period back.

Computations were done in Python and R (Van Rossum & Drake, 1995; Jin, 2021; R Core Team, 2018) with the help of some additional packages and libraries, for example, implementing benchmark models (Stephens, 2021; Raftery et al., 2010; Onorante et al., 2016; Friedman et al., 2010; Gramacy, 2019; Hastie & Efron, 2013; Hyndman & Khandakar, 2008). All models are listed in Table 1. "Fixed" models are the ones for which parameters were estimated over the in-sample period, and then applied to forecasting over the out-of-sample period. For "recursive" models, rolling estimations with expanding window were done starting from the end of the in-sample period. Benchmark models were taken as by Drachal (2023a), where they are described in detail.

The BSR is fully described by Jin et al. (2019). In short, let $x_{1,t}, \dots, x_{n,t}$ be the explanatory variables, and let y_t be the forecasted commodity price (after the mentioned possible transformations). Then, $y_t = \beta_0 + \beta_1 * f_1(x_{1,1,t-1}, \dots, x_{1,i,t-1}) + \dots + \beta_K * f_k(x_{K,1,t-1}, \dots, x_{K,i,t-1})$, with $x_{i,j,t}$ being some of explanatory variables out of $n = 19$ possible ones which are present in the i -th component expression, i.e., f_i , with $j = \{1, \dots, n\}$ and $i = \{1, \dots, K\}$, is estimated with the Ordinary Least Squares method. The number of components, K , is specified at the initial stage. $K = \{1, 2, \dots, 10\}$

were considered. Components f_i are represented by symbolic trees constructed from a set of operators, such as, +, *, 1 / x, etc. In this study, 6 sets were considered. They are presented in Table 2. These sets vary from a very simple one, to the ones capturing non-linear effects, and containing some specific features of economic and financial time-series (Nicolau & Agapitos, 2021; Keijzer, 2004). Prior-posterior inferences were done with parameters' values as suggested by Jin et al. (2019). All possible pairwise values of K and F were applied for each commodity during the in-sample period. Then, the pair minimising Root Mean Square Error (RMSE) was chosen for the out-of-sample predictions. GP models were estimated with the same set of operators as indicated by the BSR model for a given commodity.

Table 1. Estimated models

Abbreviation	Description
BSR rec	Bayesian Symbolic Regression (recursive)
BSR av MSE rec	Bayesian Symbolic Regression (recursive) with averaging and weights inversely proportional to Mean Square Error (MSE)
BSR av EW rec	Bayesian Symbolic Regression (recursive) with equal weights
GP rec	Symbolic Regression with Genetic Programming (recursive)
BSR fix	Bayesian Symbolic Regression (fixed parameters)
BSR av MSE fix	Bayesian Symbolic Regression (fixed parameters) with averaging and weights inversely proportional to MSE
BSR av EW fix	Bayesian Symbolic Regression (fixed parameters) with equal weights
GP fix	Symbolic Regression with Genetic Programming (fixed parameters)
DMA	Dynamic Model Averaging with Occam window
BMA	Bayesian Model Averaging with Occam window
DMA 1V	Dynamic Model Averaging over one-variable component models
DMS 1V	Dynamic Model Selection over one-variable component models
BMA 1V	Bayesian Model Averaging over one-variable component models
BMS 1V	Bayesian Model Selection over one-variable component models
LASSO	LASSO regression (recursive)
RIDGE	RIDGE regression (recursive)
EN	Elastic net regression (recursive)
B-LASSO	Bayesian LASSO regression (recursive)
B-RIDGE	Bayesian RIDGE regression (recursive)
LARS	Least-angle regression
TVP	Time-Varying Parameters regression with the forgetting factor equal to 1
TVP f	Time-Varying Parameters regression with the forgetting factor equal to 0.99
ARIMA	Automatic ARIMA (recursive)
HA	Historical average
NAIVE	No-change method

Source: own elaboration.

Table 2. Operators

Abbreviation	Description
F = 1	$\text{neg}(x_{i,t}) = -x_{i,t}$; $\text{add}(x_{i,t}, x_{j,t}) = x_{i,t} + x_{j,t}$
F = 2	$\text{neg}(x_{i,t}) = -x_{i,t}$; $\text{add}(x_{i,t}, x_{j,t}) = x_{i,t} + x_{j,t}$; $\text{square}(x_{i,t}) = (x_{i,t})^2$
F = 3	$\text{neg}(x_{i,t}) = -x_{i,t}$; $\text{add}(x_{i,t}, x_{j,t}) = x_{i,t} + x_{j,t}$; $\text{ma12}(x_{i,t}) = (x_{i,t} + \dots + x_{i,t-11}) / 12$; $\text{lag}(x_{i,t}) = x_{i,t-1}$
F = 4	$\text{neg}(x_{i,t}) = -x_{i,t}$; $\text{add}(x_{i,t}, x_{j,t}) = x_{i,t} + x_{j,t}$; $\text{square}(x_{i,t}) = (x_{i,t})^2$; $\text{mul}(x_{i,t}, x_{j,t}) = x_{i,t} * x_{j,t}$
F = 5	$\text{neg}(x_{i,t}) = -x_{i,t}$; $\text{add}(x_{i,t}, x_{j,t}) = x_{i,t} + x_{j,t}$; $\text{square}(x_{i,t}) = (x_{i,t})^2$; $\text{mul}(x_{i,t}, x_{j,t}) = x_{i,t} * x_{j,t}$; $\text{inv}(x_{i,t}) = 1 / x_{i,t}$; $\text{cubic}(x_{i,t}) = (x_{i,t})^3$; $\text{sqrt}(x_{i,t}) = \sqrt{x_{i,t}}$; $\text{log}(x_{i,t}) = \ln(x_{i,t})$; $\text{ma12}(x_{i,t}) = (x_{i,t} + \dots + x_{i,t-11}) / 12$; $\text{lag}(x_{i,t}) = x_{i,t-1}$
F = 6	$\text{neg}(x_{i,t}) = -x_{i,t}$; $\text{add}(x_{i,t}, x_{j,t}) = x_{i,t} + x_{j,t}$; $\text{lt}(x_{i,t}) = a * x_{i,t} + b$, with a and b being some real numbers

Source: own elaboration.

The derived price forecasts were transformed back (from differences to levels) prior to evaluation. RMSE was taken as the primary metric, but outcomes were similar, if Mean Absolute Error or Mean Absolute Scaled Error (Hyndman & Koehler, 2006) were applied.

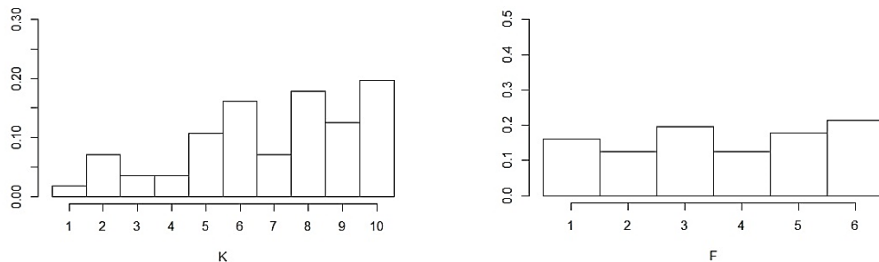
Forecasts from two different models were tested against each other with the Diebold-Mariano test (Diebold & Mariano, 1995; Harvey et al., 1997) and the Giacomini and Rossi fluctuation test (Giacomini & Rossi, 2010). Forecasts from multiple models were tested with the Model Confidence Set (MCS) (Hansen et al., 2011; Bernardi & Catania, 2018). The squared errors loss function was applied to stay in line with the RMSE metric.

In BSR the outcome expression is obtained in the last iteration. Let y_1, \dots, y_M be the forecasts obtained from M iterations. Let w_1, \dots, w_M be weights (such that they sum up to 1) ascribed to each of these forecasts. The weighted average forecast is defined as $w_1 * y_1 + \dots + w_M * y_M$. In this study, two averaging schemes were applied. The first with weights inversely proportional to MSE-s of the component models. The second, with equal weights for component models. MSE-based weights were divided by the sum of all individual weights in order to sum up to 1 (Stock & Watson, 2004).

4. Findings

Figure 1 reports frequencies of K-s and F-s which minimised RMSE in the in-sample period. It can be seen that, in general, there is a tendency to select higher values of K. Small values are rarely chosen, but the behaviour for higher K-s is quite irregular. Anyways, the most often chosen was K = 10, i.e., the highest considered value. In case of F-s, the most often chosen was F = 6 representing the simplest set of operators expanded with the operator lt. The second most frequently chosen was F = 3 representing the simple set of operators expanded by 12-months moving average and 1st lag operators, which are commonly used in economic and financial time-series analysis. This means that the standard functional forms are preferred over complicated formulas.

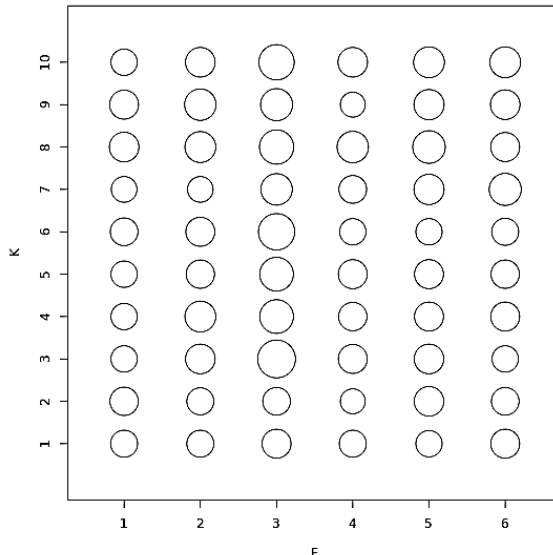
Figure 1. Histograms of K-s and F-s which minimised RMSE in the in-sample period



Source: own elaboration.

Figure 2 reports outcomes from the MCS test for various K-s and F-s over the in-sample period. In particular, the radius of a circle is proportional to the frequency (over all commodities) that the model with a given combination of K and F was kept by the MCS test. It can be seen that the most preferred was the combination of K = 3 and F = 3. This means that, despite results reported in Figure 1, smaller values of K can be used without statistically significant difference in forecast accuracy. This can be beneficial for computational costs of the models.

Figure 2. Outcomes from the MCS test over the in-sample period



Source: own elaboration.

Table 3 reports frequencies (over all commodities) when the p-values of the Diebold-Mariano tests were less than 5%. The null hypothesis is that the forecasts from both models have the same accuracy. The alternative hypotheses are stated

row-wise in Table 3, due to various tests performed. By the “best” model is understood the one which minimised RMSE for a given commodity out of all models considered (i.e., listed in Table 1). “Model X > Model Y” denotes “The forecast from the Model X has greater accuracy than the forecast from the Model Y”. For the first three rows in Table 3 cases when the “best” model was the same as the competing one were excluded from counting the frequency. Indeed, for 19 commodities, ARIMA minimised RMSE. For 2 commodities it was NAÏVE, and for no commodity it was BSR rec. It can be seen that it is hard to “beat” ARIMA, but quite easier to “beat” NAÏVE. BSR rec does not outperform “best” models often. However, it is also not so often much worse than ARIMA or NAÏVE. Surprisingly, very rarely recursive computations improved forecast accuracy in the case of BSR models. Generally, there is no strong evidence that, in general, recursive computations improved the forecast accuracy over fixed computations. The strongest evidence in favour of recursive computations was found for BSR av EW models. In a reasonably high number of cases BSR rec was found to be more accurate than GP rec.

Table 3. The Diebold-Mariano test outcomes

Alternative hypothesis	Frequency
“best” > ARIMA	16%
“best” > NAÏVE	41%
BSR rec < “best”	66%
BSR rec < ARIMA	36%
BSR rec < NAÏVE	34%
BSR rec > BSR fix	5%
BSR av MSE rec > BSR av MSE fix	39%
BSR av EW rec > BSR av EW fix	75%
GP rec > GP fix	30%
BSR rec > GP rec	45%
BSR fix > GP fix	25%

Source: own elaboration.

Table 4 reports frequencies of all considered models selected by the MCS test (with 90% confidence level, “TR” statistic and 1000 bootstrap simulations). It can be seen that the most often surviving model was DMA. The second was ARIMA. Other models were kept in less than 50% of the cases. The most often surviving BSR-type model were BSR rec and BSR av MSE rec in 7% of cases each. However, also in 7% of cases, the GP rec was surviving.

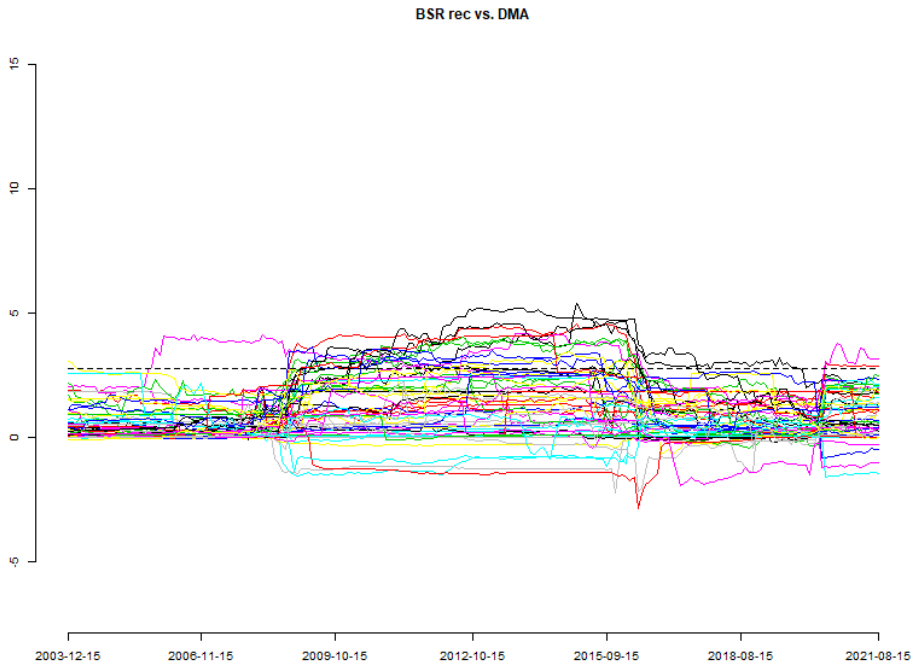
Table 4. The MCS test outcomes

Model	Frequency	Model	Frequency
DMA	77%	BMA 1V	5%
ARIMA	59%	RIDGE	5%
BMA	34%	BSR fix	4%
NAÏVE	20%	GP fix	4%
B-LASSO	13%	EN	4%
BMS 1V	11%	BSR av MSE fix	2%
LASSO	11%	BSR av EW fix	2%

Model	Frequency	Model	Frequency
B-RIDGE	11%	DMA 1V	2%
BSR rec	7%	DMS 1V	2%
BSR av MSE rec	7%	LARS	2%
GP rec	7%	TVP	2%
BSR av EW rec	5%	TVP f	2%
		HA	0%

Source: own elaboration.

Figure 3. The Giacomini-Rossi fluctuation test outcomes



Source: own elaboration.

Figure 3 reports the Giacomini-Rossi fluctuation test outcomes (with $\mu = 0.3$ corresponding to approximately 7.5-years periods, and with 5% significance level). In particular, the null hypothesis is that BSR rec and DMA forecasts accuracies are the same, and the alternative hypothesis is that BSR rec forecasts are worse than those generated by DMA model. The dotted line corresponds to the critical value of the statistic. The test statistics for different commodities are plotted in colours. For most commodities the test statistics are below the critical value in most of the time; therefore, the null hypothesis is not often rejected. However, between 2008 and 2016 in a reasonable number of cases the null hypothesis can be rejected, so it can be assumed that BSR rec forecasts are worse than DMA. In particular, the null hypothesis cannot be rejected in any period of time for 36 commodities: Australian

and South African coal, European natural gas, Japan liquefied natural gas, Colombo, Kolkata and Mombasa tea, groundnuts, fish meal, palm oil, soybeans, soybean oil, soybean meal, Thai 5% and 10% broken rice, US soft red winter and hard red winter wheat, US bananas, beef, chicken meat, European, US and world sugar, US import tobacco, Malaysian logs, Malaysian sawnwood, plywood, cotton (A index), phosphate rock, diammonium phosphate, triple superphosphate, urea, potassium chloride, iron ore, zinc, and silver.

5. Conclusions

This study undertook the estimation of various econometric models addressing variable uncertainty across various commodities spot prices. Much attention was put on Bayesian Symbolic Regression (BSR), which, as a novel and yet not much explored tool, was anticipated to yield more precise forecasts compared to standard symbolic regression with genetic programming and other alternative models. However, BSR did not fully meet the anticipated expectations. Therefore, the main research question was negatively answered. However, this method still appears to possess great potential for economic and financial applications. On the other hand, Dynamic Model Averaging (DMA) was found as a highly effective method for forecasting commodities spot prices, which is in line with some previous studies (Drachal, 2018). Despite the lack of strong evidence to favour BSR in terms of forecast accuracy, this study still systematically compared numerous commonly used forecasting models across a wide basket of commodities. The obtained outcomes are also consistent with some other similar studies of BSR, but with different explanatory variables sets (Drachal 2023a; 2023b). In particular, it was found that rather prudent specification of the initial parameters for BSR would be quite sufficient. This can have a positive effect on the computational costs of the models applied in future studies. Moreover, in the case of the initial set of operators (functions), those representing quite common, simple, and standard transformations used in econometrics were found enough – with no great need to apply more complicated formulas. For example, moving average or lagging were found more important than transformations representing non-linear effects.

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Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author used ChatGPT in order to improve readability and language of few paragraphs and sentences in the work. After using this tool/service, the author reviewed and edited the content as needed and take full responsibility for the content of the publication.

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**Identifying Factors for the Development of Sustainable
Urban Transport in the Context of Urban Sprawl –
A Comparative Study among EU's Capitals**

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Abstract

Sustainable urban transport is one of the goals of the Sustainable Development Goal; 11 sustainable cities and communities. With the main purpose of sustainable urban development, the paper aims to identify related fields associated with sustainable urban transport and the principal factors that influence the development of sustainable transport in the urban environment. In order to achieve these objectives, in a first phase, a bibliometric analysis is carried out based on the theme of sustainable urban transport, then to achieve the second objective, a random forest algorithm is implemented at the level of the 27 capitals of the Member States of the European Union. The main results of the paper define the concept of sustainable urban transport from the perspective of noise pollution, transport policies, transport equity, urban planning, and the transport pattern of urban citizens.

Keywords: travel behaviour, noise pollution, travel policy, transport justice, urban planning.

JEL Classification: R41, R58.

1. Introduction

Urban transport sustainability is a critical issue in the development of modern cities, particularly in the context of urban sprawl (Banister, 2008). Urban sprawl refers to the uncontrolled expansion of urban areas into the surrounding rural land, leading to low-density, car-dependent communities (Ewing et al., 2014).

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This phenomenon poses significant challenges for sustainable urban transport, which aims to reduce environmental impact, enhance mobility, and improve the quality of life for city dwellers. Taking into account the desiderata of the European Green Deal on carbon neutrality in European cities, as well as those of the Sustainable Development Strategy, the paper aims to identify the directions for developing a sustainable policy for the development of public transport in urban areas. The second objective is to identify the factors that determine the increase in sustainability in the urban environment. To achieve these goals, scientific articles indexed in the Web of Science database were initially analysed, with the keyword "transport policy" as a keyword. Subsequently, on a sample of the 27 capitals of the Member States of the European Union, a random forest model was estimated to identify the importance of predictors at the level of cities that have implemented underground transport.

Until now, in the international scientific databases, no scientific work with a similar approach, which uses predictive techniques to identify the urban development pattern of cities in the context of the implementation of the subway, has been identified.

The originality elements of this paper consist of calculating new variables based on GIS technology, using coordinates from the Open Street Map platform.

The first chapter deals with literature review, the second chapter deals with working hypotheses, the third chapter presents the methods used and the description of variables, the fourth chapter presents the main results, while the last section, dedicated to conclusions, describes the main conclusions, the limits of the research, as well as the future directions of research development.

2. Problem Statement

The United Nations goal 11.2 is to provide an accessible, safe, and sustainable urban transport system for all citizens by 2030. There are a multitude of factors that can characterise a sustainable transport system, but this paper aims to focus on transport equity, noise pollution, transport policies, urban planning, and travel patterns.

Pereira et al. (2017) argue that a certain minimum level of accessibility to key destinations is a basic need that people must satisfy. Moreover, accessibility highlights the spatial dimension of equal opportunity concerns and is a necessary but insufficient condition for promoting these. In addition, all this plays a crucial role in people's personal development and allows them to pursue a life they consider meaningful. On the other hand, Karner et al. (2024) promote the concept of equity in transport to increase the social inclusion of all urban citizens and, implicitly, to reduce urban development gaps.

Shepherd et al. (2006) points out that optimal urban transport planning strategies involve reducing fares, increasing the frequency of public transport, and implementing road charges for efficiency and financial sustainability, with the need for careful assessment of the model used and impact on society before decisions are made. On the other hand, May et al. (2006) state that although synergy of policy

instruments is frequently promoted in urban transport policy, it is rarely clearly defined and achieving it remains difficult.

Current demographic and socioeconomic changes present a very volatile and unpredictable pattern of urban development, and urban planning legislation needs to take these factors into account and adapt to the dynamism of the twenty-first century Korah et al. (2017). To meet these challenges, architects and city managers must have a solid foundation of up-to-date theoretical knowledge. However, Hurlimann et al. (2021) show that study programmes in the field do not address to a significant extent key concepts of climate change, such as greenhouse gas emissions, sea level rise or wildfires, or sustainable urban development.

Another problem identified in sustainable urban transport planning is noise pollution. The biggest impact on road noise is two-wheelers during the day and cars at night, the main sources of noise being honking and the speed at which vehicles are driving (Balaji et al., 2022). Traffic noise is a source of disturbance for city dwellers, especially when it interferes with sleep, degrading quality of life (Zannin & Bunn, 2014). Da Paz et al. (2005) argue that noise pollution in urban environments has harmful effects on human health, with the hearing comfort threshold being at 65 dB. Exceeding it can seriously harm health regardless of age. Also, the results of his research on urban noise in Curitiba, Brazil show a large difference between the values measured in sound-controlled areas (residential neighbourhoods) and uncontrolled areas (city centre), the latter being much larger.

There are different types of ways to achieve sustainable urban transport, including subways, walking, or cycling. Sun (2020) claims that, on average, the subway is used daily for about 31 minutes to get to work and about 17 minutes for personal travel. Other sustainable means of transport, such as walking or cycling, have decreased in frequency of use, and the reasons for this change are lack of infrastructure (sidewalks, cycle paths), bad weather, and the danger of collision with cars. These findings are also supported by Vos (2019), who states that in order to boost public transport use and active travel, policymakers need to invest in measures that improve the passenger experience, such as separate lanes for public transport and bicycles, aesthetically and functionally attractive walking environments, or improved conditions inside public transport.

3. Research Questions / Aims of the Research

With the main purpose of sustainable urban development, the paper aims to identify related fields associated with sustainable urban transport and the principal factors that influence the development of sustainable transport in the urban environment. In order to achieve these objectives, in a first phase, a bibliometric analysis is carried out based on the theme of sustainable urban transport, then to achieve the second objective, a random forest algorithm is implemented at the level of the 27 capitals of the Member States of the European Union. Then, to achieve these two objectives, the research has been started from two research hypotheses:

H1: there is an association between urban transport patterns and citizens' quality of life.

H2: There are significant differences regarding sustainable urban transport at the level of the capitals of the Member States of the European Union.

4. Research Methods

In order to achieve the first of the objectives of the paper, the Web of Science Collection to extract the metadata of the articles that have transport policy as a keyword. Later, the co-occurrence network among key words of these article was analyzed using VOSviewer.

In order to achieve the second objective of the paper it was used Random Forest algorithm. Breiman (2001) created Random Forest, which is a member of the decision tree family. Decision tree models have a hierarchical structure similar to that of a tree and make predictions by dividing the prediction space into several subsections. There are two processes involved in the development of decision trees. First, divide the feature space (the range of values for each characteristic) into several different regions in each division. Second, the average values of the predicted variable are forecast for each observation falling within the same region. Finding value by dividing the prediction space more effectively is the challenge. The threshold value is determined to minimise the total sum of square errors (Kuhn & Johnson, 2013). As both a classifier and a regressor, Random Forest can quickly process large amounts of data to produce highly accurate results. Adjusting hyperparameters requires less work than with other machine learning models. The number of trees, maximum tree depth, and decision factors (such as sample division and criteria for leaf nodes) are hyperparameters of this model (Ahmad et al., 2017).

Table 1. Description of indicators

Acronym	Indicator	Unit of measures	Period of references	Source
ADE	Average Distance to Education	yards	2024	Open Street Map
ADPT	Average Distance to public transport	yards	2024	Open Street Map
ADMS	Average Distance to Medical Services	yards	2024	Open Street Map
GAC	Green Area per Capita	yards	2022	OECD
PK	Parking	Number of parking place	2024	Open Street Map
CPE	4 floors	Number of buildings	2024	Open Street Map
CZE	10 floors	Number of buildings	2024	Open Street Map
DGS	Density of Green Space	Percentage	2024	Open Street Map

Acronym	Indicator	Unit of measures	Period of references	Source
DCI	Density Commercial Industrial	Percentage	2024	Open Street Map
DPK	Density Park	Percentage	2024	Open Street Map
ADS	Average Distance Supermarket	yards	2024	Open Street Map
ADF	Average Distance Fuel	yards	2024	Open Street Map
GDPG	GDP Capita	Dolars per capita	2022	OECD
LPR	Labour Productivity	Dolars per employed persons	2022	OECD
UPE	Urban population exposed to harmful levels of long-term road traffic noise	%	2022	European Environment Agency

Source: own work.

The variables that have Open Street Map as a data source were calculated by the authors based on geospatial coordinates, which were taken in R, using the *osmdata* package. Distance variables (ADE, ADPT, ADMS, ADS, ADF) were calculated as average distances from residential buildings (apartments, residential blocks, residential houses) to schools, kindergartens, high schools, gas stations, supermarkets, public transport stations, hospitals, or doctor's offices (Table 1). To calculate these distances, the entire road network was entered for each statistical unit. In the case of ADE variables, ADPT distance was calculated using the entire road network allowing movement without a means of locomotion ("by foot"), while in the case of ADF, ADS, ADMS variables, the entire public road network was used, which can be used by transport by motor vehicle ("by motorcar"). These two approaches were chosen because it is important that access from residential buildings to public transport stations and educational establishments is achieved without using a vehicle, thus leading to traffic congestion relief.

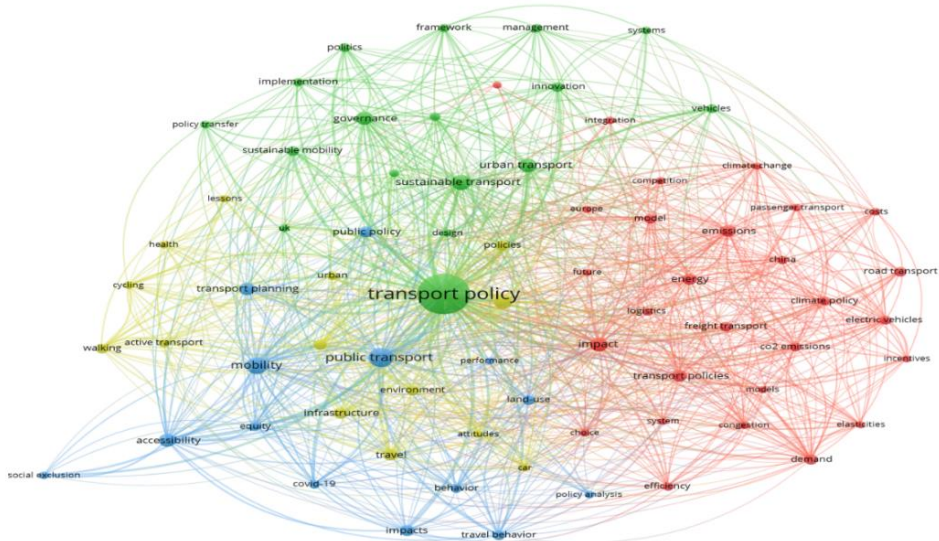
On the other hand, for the other distances, the distance travelled by a means of locomotion is much more relevant, because the frequency of these routes is lower, and, for example, in the case of access to medical services, in case of emergency, the trip is made by ambulance. All distances were calculated using the package *dodgr* from RStudio. The density variables are calculated as the share of the area of the units of interest (e.g., parks) in the total area of the statistical unit (Table 1).

These variables have been selected in accordance with the principle of completeness of data. Another important aspect regarding the quality of the data was their relevance, so variables were selected mainly in the urban mobility area, but also in the social / environmental area.

5. Findings

In a first phase, the network linking the keyword “transport policy” and the associated keywords was analysed.

Figure 1. Transport policy co-occurrence network

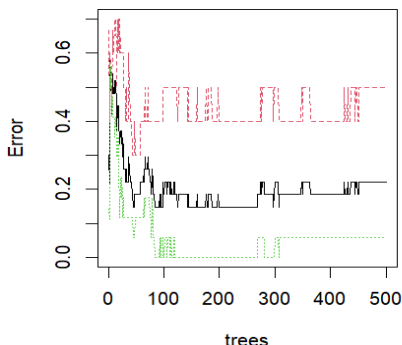


Source: own working using VOSviewer.

The transport policy process is defined by 4 clusters. The first cluster (blue) contains words such as public transport, transport planning, mobility, accessibility, equity, covid-19, which denotes that in these articles the emphasis is on unhindered access to public transport, but also on the Coronavirus pandemic, which suggests that they were written in the last 3-4 years. The second cluster (red) contains words such as electric vehicles, climate policy, emissions, impact, and climate change, which suggests that these articles address the impact of transport on the environment and climate change, offering the use of electric vehicles as a more environmentally friendly alternative. The third cluster (yellow) is made up of words such as cycling, walking, health, and active transport. Thus, these articles address healthy alternatives, both for people and the environment, to travel by car or public transport. In doing so, these modes of transport are effective in conserving fuel, reducing vehicle emissions, and improving individual and public health. The fourth cluster contains words such as sustainable transport, governance, implementation, management, and sustainable mobility, which suggests that these articles talk about how sustainable public transport policies must have the support of those in charge in order to be implemented.

As for the random forest model, the predicted variable is Metro (coded 0 for capitals that do not have subways and 1 for those that do), while the rest of the variables played the role of predictor.

Figure 2. Trees versus Errors model



Source: own work using RStudio.

The algorithm used 500 decision trees, and three discriminating variables were used for each division. Given the randomness of the decision trees, the estimate with 300 trees did not give a classification error consistently less than if we took 500 trees (Figure 2). That is why we chose to use the latter value, noting that that is when the model stabilises.

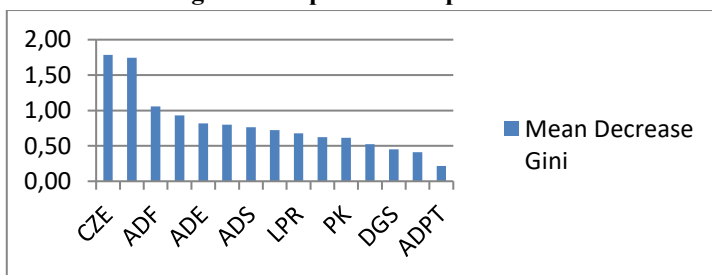
Table 2. Confusion matrix

Category	0	1	Error
0	5	5	50%
1	1	16	5,9%

Source: own work using RStudio.

The Random Forest model has a classification error equal to 22.22%, quite small, which brings into question the possibility of the existence of several capitals that did not correlate the existence of the subway with predictors. The algorithm classifies more efficiently the capitals that have a subway, having an error of only 5.88%, while those that do not have a subway classify them randomly, the error being 50%. Thus, it can be said that the model is suitable for cities that have implemented underground public transport. To better analyse the influence predictors have on the predicted variable, we need to look at their importance in classification.

Figure 3. Importance of predictors



Source: own work using Excel.

It can be stated that the predictors with the greatest influence on classification are: 4 and 10 floors buildings, density of parks and average distance to a gas station, while the least influence has GDP per capita and average distance to a public transport station (Figure 3). It follows that, mainly, the implementation of underground public transport does not depend fundamentally on economic development or on the infrastructure of public transport in a capital, but on the model of urban development, horizontally or vertically, on public places of agreement (parks) and the average distance to gas stations, confirming the idea stated by Sun (2020). Thus, the hypothesis is opened that vertical urban development would be beneficial for the implementation of the subway, because the population being more concentrated on a smaller area, not many lines and metro stations should be built to cover the entire city, resulting in lower costs. It is also interesting to note which capitals were misclassified. Thus, Athens behaves differently from capitals that use underground transport infrastructure, similar to Nicosia, Ljubljana, Luxembourg, Vilnius and Zagreb. On the other hand, Valletta, Tallinn, Dublin, Riga and Bratislava have a similar urban development pattern to cities that have metros, which opens the hypothesis for developing this means of transport in order to increase urban sustainability. Therefore, decision-makers in these cities should consider the concept of urban equality as defined by Karner et al. (2024).

6. Conclusions

Public transport policies focus on mobility, accessibility, public transport, transport planning, climate policy, road transport, and sustainable transport. Regarding the second objective, cities that develop vertically need underground urban transport, because there is an acute problem of lack of parking spaces and congestion of the city, and the implementation of underground transport would replace the need of residents to use the car and crowd traffic. The results of this study can contribute to the decision-making process at the level of local communities, in order to adopt the decision for the implementation of underground transport. In addition, the results of the study give a better understanding of the related concepts in the area of public policies in transport. H1 is therefore partially confirmed, as urban transport patterns influence citizens' quality of life from an urban mobility perspective. Regarding H2, the existence of significant differences in the development of sustainable urban transport (subway) is also confirmed.

There are some European capitals that have not yet implemented underground urban transport, but are sufficiently developed so that the natural step would be to build an underground public transport network. Among the limitations of research is the small sample volume. Also, data collected through the Open Street Map platform may have problems with the timeliness of the data, so there may be a potential gap in our results. Future research directions aim to add new predictors and also to enlarge the sample.

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**Teaching ITC in European Universities:
A Non-Parametric Efficiency Approach**

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Abstract

The Information Technology and Communication field of studies became popular among young people while choosing a career path in the last years due to digitalisation, artificial intelligence, automation. The purpose of this study is to measure the teaching efficiency of 40 European universities from Italy, the Czech Republic, and Croatia during the 2016-2017 academic year using the ETER database. The technical efficiency estimates of the Higher Education Institutions are computed using a Data Envelopment Analysis (DEA) estimator and a statistical inference using the Simar-Wilson Bootstrap technique is employed to correct the results. Depending on the country, the most efficient universities were identified, and an analysis of all the sample efficiency estimates allows us to compare universities based on teaching activities they employ.

Keywords: DEA, efficiency, Higher Education, ITC, Bootstrap DEA.

JEL Classification: C14, I23, N34.

1. Introduction

The higher education system includes educational institutions, academic, nonacademic, and administrative staff which work in these institutions in order to train and distribute knowledge to students depending on their educational level. This system can be classified using the ISCED levels, an international classification of educational standards used to organise study programmes based on the specialisation and year of study. ISCED levels start with ISCED 0 which represents early education and end with ISCED 8 (doctoral studies).

The activity developed in the higher education system can be quantified using multiple processes, the most important being teaching and research activities.

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The main objective of this study is to analyse the efficiency of universities which provide study programmes based on ICT (Information and Communications Technology) using a fully defined nonparametric model and a DEA estimator. Statistical inference is provided using the Simar - Wilson bootstrap technique, and corrected measures of efficiency are reported along with their confidence intervals.

Over the last decade, the number of ICT specialists increased significantly, the share of ICT employees in total employment expanded by 1.5 percentage points from 2013 to 2023 and the number of ICT specialists increased by approximately 59% during the mentioned period. The latest available data on ICT specialists concludes that the share of ICT specialists that were engaged in tertiary education increases by 10.2 percentage points according to Eurostat (2024).

2. Problem Statement

Over time, it was studied how firms from different sectors (healthcare, banking, education, agriculture, transport) use their resources or raw materials defined as inputs to obtain different outputs, such as finished products or provided services. The efficiency of different types of observations included in a selected sample is measured. Each observation is known as a decision-making unit (DMU).

The concepts of efficiency and productivity were defined as the ratio between outputs and inputs used by a decision-making unit in the production process by Sengupta (1995) and Cooper, Seiford and Tone (2000).

In order to estimate the efficiency of the DMUs, parametric methods or nonparametric methods can be used. The most used parametric methods are Stochastic Frontier Approach (SFA), Thick Frontier Approach (TFA) and Distribution Free Approach (DFA). The nonparametric methods used in the study of efficiency are Data Envelopment Analysis (DEA) and Free Disposal Hull (FDH).

The efficiency analysis can also be applied for non-profit organisations, such as Higher Education Institutions (HEIs). The next section includes several studies that focus on the analysis of efficiency of the HEIs.

A different approach used in the process of study of the efficiency of the Higher Education Institutions based on the country of origin. Some studies are focused on the efficiency analysis of HEIs from one country: UK (Johnes, 2006), Australia (Abbott & Doucouliagos, 2001), Canada (Ghimire et al., 2021), and Italy (Bonaccorsi et al., 2006). Other studies compare the performance of the educational system within countries: 12 countries from Europe (Grădinaru et al., 2019), 10 countries from Europe and SUA (Wolszczak-Derlacz, 2017), 16 countries from Europe (Herberholz & Wigger, 2021; Daraio et al., 2015).

The countries from Europe and SUA may be compared based on their predominant activity (teaching, research, or a mixt of both): German universities are less efficient in the teaching activity compared to the research activity (Daraio et al., 2015); in Belgium, Netherlands and Poland, the universities are oriented on a mixt activity between teaching and research, their main focus is on the total number of graduates ISCED 5-7, the number of publications and the number of citations (Herberholz & Wigger, 2021); the Australian tertiary educational system is

homogeneous regarding the teaching and research activities, most of the Australian universities are technical efficient (Abbott & Doucouliagos, 2001); low publishing activity universities are less efficient compared to those with an intensive publishing activity, but in the same time, low publishing universities from Italy, UK, Lithuania and Ireland are also efficient in teaching activities (Grădinaru et al., 2019); universities from Poland, UK, Netherlands (Derlacz, 2017) and Italy (Bonaccorsi et al., 2006) are efficient in the teaching-research activity.

The dimension of the Italian universities quantified by the students enrolled does not impact the efficiency of the teaching process, and the efficiency of the research activity is not influenced by the number of faculties, number of lectures, or number of courses reported to 100 professors (Daraio et al., 2006). The authors extended the analysis on the European tertiary system and concluded that the dimension and specialisation of the university have a significant impact on the efficiency of the teaching process. However, the specialisation of a HEI does not have a substantial effect on research focused universities (Daraio et al., 2015). Similar results were obtained by Herberholz & Wigger (2021) concluding that the number of students enrolled and the share of external financing are associated in general with a high measure of efficiency. The same conclusion was proposed by Wolszczak-Derlacz (2017), where tuition fees are positive correlated with technical efficiency.

3. Research Questions / Aims of the Research

This paper aims to analyse the technical efficiency of ICT (Information and Communication Technology) European universities from Italy, the Czech Republic, and Croatia. The teaching activity efficiency of the mentioned universities is estimated using a nonparametric approach (Data Envelopment Analysis), and the statistical inference using the Simar-Wilson Bootstrap technique is applied to correct the initial measures of efficiency obtained.

4. Research Methods

The concept of production process or production technology is defined using Debreu (1951) and Koopmans (1951) considering $x \in \mathbb{R}_+^p$ the input vector and $y \in \mathbb{R}_+^q$ the output vector.

Using Simar and Wilson (2000) the production set is defined as follows:

$$\Psi = \{(x, y) \in \mathbb{R}_+^{p+q} \mid x \text{ can produce } y\} \quad (1)$$

Where an inputs vector, x is used in order to produce a desired outputs vector, y .

The efficient part of the production set Ψ is defined as the efficient frontier:

$$\Psi^\partial = \{(x, y) \in \Psi \mid (\gamma^{-1}x, \gamma y) \notin \Psi, \forall \gamma > 1\} \quad (2)$$

The measure of technical efficiency in an input-oriented model is denoted by the minimal radial contraction of the inputs in order to represent a point on the efficient frontier:

$$\theta(x, y) = \inf\{\theta \mid (\theta x, y) \in \Psi\}, \text{ where } \forall (x, y) \in \Psi, \theta(x, y) \leq 1. \quad (3)$$

The measure of technical efficiency in an output-oriented model is given by the maximal radial expansion for the point is projected on the efficient frontier:

$$\lambda(x, y) = \sup\{\lambda | (x, \lambda y) \in \Psi\}, \forall (x, y) \in \Psi, \lambda(x, y) \geq 1. \quad (4)$$

The value 1, no matter the orientation of the model, indicates that the decision-making unit is efficient and it is represented by one point (x,y) that is placed on the efficient frontier of the sample.

A Data Envelopment Analysis estimator was used for the first time by Farrell (1957) and later by Charnes et al. (1978). The DEA estimator implies that the production set is convex.

The VRS-DEA estimator for an output-oriented model is given by the following linear program:

$$\hat{\lambda}_{VRS}(x, y) = \max_{\lambda, \gamma_1, \dots, \gamma_n} \{\lambda | \lambda y \leq \sum_{i=1}^n \gamma_i Y_i, x \geq \sum_{i=1}^n \gamma_i X_i, \sum_{i=1}^n \gamma_i = 1, \gamma_i \geq 0, \forall i = \overline{1, n}\} \quad (5)$$

Simar and Wilson (2000a, 2007) created a special bootstrap technique that can be employed for a small sample in a nonparametric framework. The aim of the bootstrap algorithm is to create finite replications from sample data X_n generated from the initial data generation process (P) using a number of infinite replications (B). After this step, two subsamples are used: the first represents the original one, and the second represents the bootstrap subsample. When the technique is applied on the bootstrap subsample, the estimators from the original subsample are considered here the real estimators. The new sample X_n^* from the bootstrap subsample is created using the data generation process (\hat{P}) from the original subsample. In the bootstrap subsample, each point has a new estimator associated $\hat{\theta}_{VRS}^*(x, y)$. The new estimator can be considered an estimator of the estimator from the original subsample $\hat{\theta}_{VRS}(x, y)$. The sample that contains a number of B replicas obtained by using the data generation process (\hat{P}) and by the implementation of the initial estimator to the bootstrap samples will provide a set of pseudo-estimates $\hat{\theta}_{VRS,b}(x, y)$, where $b = \overline{1, \dots, B}$. Based on Simar and Wilson (2007), B=2000 replicas should be used in order to obtain a good prediction for confidence intervals.

To measure the efficiency of a production process, the FEAR package in R can be used. Created by Wilson (2008), the package is used to determine DEA and FDH estimates under different hypotheses of return to scale (variable returns to scale, constant returns to scale or decreasing returns to scale). The representation of the efficient frontier was facilitated by using the Benchmarking package (Bogetoft et al., 2011).

5. Findings

5.1 Data Description

The data used is collected from ETER database and we extracted information regarding the first forty universities ordered by total number of graduates ISCED 5-7 from 2016/2017 academic year. The universities selected include study

programmes from ICT (Information and Communication Technology) in their curriculum. Our sample includes 40 universities from three European countries: 21 Italian universities, 15 Czech Republic universities and 4 Croatian universities.

A few indicators, such as total number of academic staff and total graduates ISCED 5-7 are selected for a teaching activity model that assesses the efficiency of higher education institutions (HEIs). The total number of academic staff is used as input, while total number of graduates ISCED 5-7 is the intended output, since the result of a teaching activity is actually measured by the number of graduates in a university. We define an output-oriented model using variable returns to scale (VRS) since, in education, the production to scale varies based on the use of inputs, salary, work condition, etc. The aim of each university is to maximise the number of graduates using a constant level of teaching staff which explains the choice in an output-oriented model.

Some statistics of the sample is provided in Table 1.

Table 1. Descriptive statistics

Variable	Input / Output	Minim	Average	Maxim	Skewness	Kurtosis	Standard deviation
Total academic staff	Input	417	1793	7368	1.96	3.97	1538.33
Total graduates ISCED 5-7	Output	971	6194	21265	1.44	5.3	4813.94

Source: RStudio 2024.04.1 version.

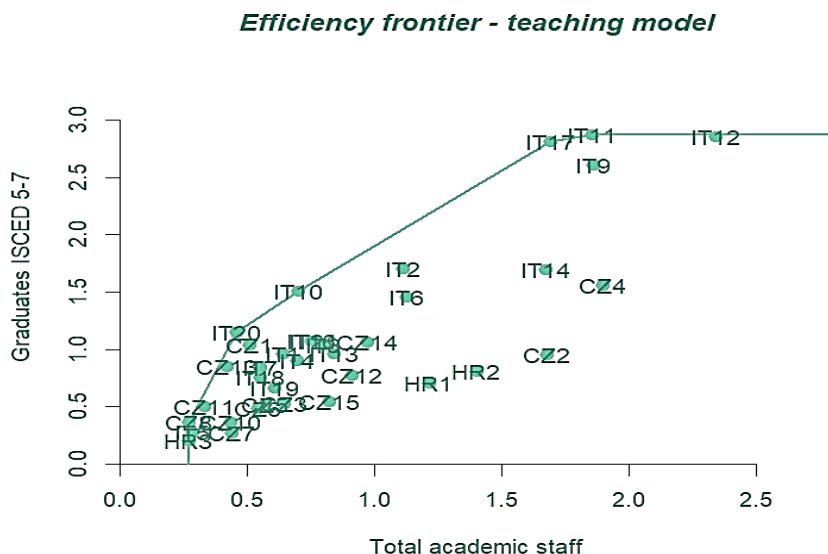
The 40 universities are characterised by reduced resources which consist of total academic personnel and total number of full professors (hypothesis sustained by the value of skewness, which is positive). In the considered universities, the personnel that is working, on average, consists of 1793 academic persons, with values ranging between 417 and 7368. The same pattern is observed for the total graduates at ISCED 5-7.

In the preliminary analysis, using the descriptive statistics and the scatter plots between the input and output, 4 outliers were identified. These DMUs are recognised as large and prestigious universities in teaching and/or research activity, and in order to not create a false efficiency frontier, we decided to remove them from the sample. Later work implies using standardised variables to their respective standard deviations. The correlation coefficient (0.68) of input to output shows a moderate to strong and direct relationship as it is expected.

5.2 Efficiency Analysis of Teaching Activities in Universities from Italy, the Czech Republic, and Croatia

The efficiency of the teaching process is quantified by how much and how well each university uses their resources, in this case, how the academic staff performs in order to maximize the number of ISCED 5-7 graduates.

Figure 1. Efficiency frontier for teaching model



Source: RStudio 2024.04.1 version.

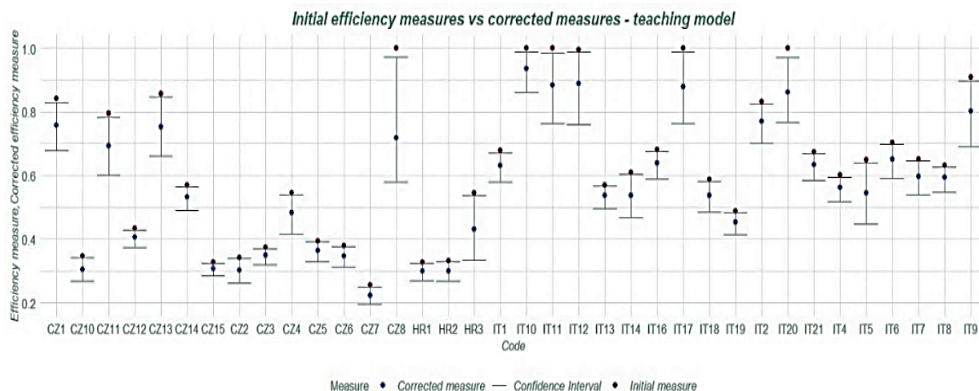
The average measure of DEA estimates is 63.63%, the measures fluctuating between 25.4% and 100%. 17 of our 36 universities are considered efficient in the teaching activity (the measure of efficiency is greater than 63.63%), which represents 47.22% of the sample and 19 of them are inefficient (the efficiency measure is less than the average value), which consists of 52.78% of the analysed observations. Ten universities have a measure of efficiency greater than 80% and 5 of them are placed on the efficient frontier, which means fulfilling a measure of efficiency equal to 100%. The 5 unitary-efficient universities are located in Italy (4 of them) and in the Czech Republic.

In the efficient universities, on average, 1419 personnel from academic staff are working in order to facilitate, on average, 6780 ISCED 5-7 graduates. On the other hand, the inefficient universities use the relatively same resources in the teaching process (1375 personnel from academic staff on average) and obtain approximately half of the output generated by the efficient ones (3754 graduates ISCED 5-7).

In order to solve the problem of the efficiency estimators, the bootstrap technique proposed by Simar and Wilson (1998) was used. This technique contributes to determine the corrected efficiency measures along with their confidence intervals., 2000 bootstrap replicas of the original sample are generated in order to obtain the corrected measures.

The average corrected DEA estimate is now equal to 56.86%, with values between 22.13% and 93.38%. In general, the average efficiency measure in teaching activity declines by 7.35%.

Figure 2. Initial efficiency measures vs corrected efficiency measures



Source: RStudio 2024.04.1 version.

In order to classify the universities based on their performance in the teaching activity, top 10 efficient universities and top 5 inefficient universities were selected.

Table 2. Initial versus corrected efficiency measures for top 10 efficient universities

DMU	Initial measure (%)	Corrected measure (%)
CZ8	100.00	72.38
IT10	100.00	93.37
IT11	100.00	88.32
IT17	100.00	87.75
IT20	100.00	86.12
IT12	99.49	88.69
IT9	90.77	80.18
CZ13	85.62	75.00
CZ1	84.21	75.46
IT2	83.11	77.03

Source: Computed in RStudio 2024.04.1 version.

Italian universities are more efficient in the teaching activity compared to the ones from the Czech Republic or Croatia. 7 of 10 efficient universities are located in Italy and the other 3 DMUs are located in the Czech Republic. IT11 (University of Naples Federico II) is one of the enormous efficient universities in teaching activity with a corrected efficiency measure of 88.32%. In this university, one person from the academic staff is working in the process of production with a load of, on average, 5 graduates ISCED 5-7. IT10 (University of Milano-Bicocca) with a corrected measure of 93.38% uses almost optimally its resources in order to maximize the total graduates ISCED 5-7, the ratio academic staff to total ISCED 5-7 graduates is equal to 1:7, which means that, in this particular HEI, one person from the academic staff category is participating in the process of graduation of 7 students.

Table 3. Initial versus corrected efficiency measures for top 5 inefficient universities

DMU	Initial measure (%)	Corrected measure (%)
CZ2	34.11	30.00
HR2	33.20	30.01
CZ15	32.66	30.66
HR1	32.60	29.97
CZ7	25.39	22.12

Source: RStudio 2024.04.1 version.

Similarly, the Czech Republic universities are the most inefficient compared to those in Italy or Croatia. The 5 least inefficient universities in the teaching activities include 3 universities from the Czech Republic and 2 universities from Croatia. The most inefficient university in the teaching activity is CZ7 (Technical University of Liberec) with a corrected measure of efficiency equal to 22.12%, where each person in the academic staff category coordinates approximately two graduates. This DMU can improve its efficiency in teaching activity by increasing the total number of graduates ISCED 5-7 to each academic personnel.

6. Conclusions

We aimed to analyse the efficiency of different universities from 3 countries such as Italy, the Czech Republic, and Croatia in their teaching activity. One conclusion is, obviously, that European universities can consistently increase their performance in the teaching activity. Efficiency can be improved by increasing the number of total graduates from ISCED 5-7, which implies increasing the graduation rate for bachelor and master programmes.

Due to the size of the sample analysed, the DEA efficiency measures determined are not consistent, and the Bootstrap DEA technique was applied to obtain the corrected measures. Universities from Italy, the Czech Republic, and Croatia are more efficient in the teaching activity, the corrected average efficiency measure is greater than 55%. Universities from Italy are more efficient in the teaching activity compared to the ones from the Czech Republic or Croatia; for the first 10 best performing DMUs the corrected values vary between 77.03% and 93.37%.

To improve the quality of the teaching model, some recommendations can be taken into consideration, such as: including more inputs (administrative expenses; personal expenses; number of educational spaces which includes number of laboratories, number of libraries; government allocations) and/or outputs in the model; using an aggregated input and/or output in order to represent the efficiency frontier and reduce the dimensionality; using other types of estimators (FDH or hyperbolic); extending the database by including universities from all European countries; classify the universities based on their size using the cluster analysis, etc.

A future direction of research will include the increase of dimensions employed in the sample together with the use of a different efficiency technique that will allow us to fully rank the universities such as the hyperbolic measure of efficiency.

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**Leveraging Digital Technologies
for Sustainable and Inclusive Development Strategy
in Leading Innovative Nations**

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Abstract

The widespread implementation of digital technologies is considered a key prerequisite for increasing the sustainable competitiveness of national economies. Information and communication technologies not only offer economic restructuring potential but also provide new opportunities for all citizens in access to various services, including high-quality education and medicine. Consequently, such advancements contribute substantively to the implementation of the UN Sustainable Development Goals and foster inclusive growth. This study aims to undertake a comprehensive analysis of both theoretical and practical frameworks concerning the implementation of sustainable development and to evaluate the potential of leveraging digital technologies to advance sustainable competitiveness. This study examines the link between digital inclusion and its long-term impact on global economic development. Systematisation of the relationship between digital transformation and sustainable competitiveness is carried out in the context of the impact of digital technologies on market dynamics and the distribution of sustainable competitive advantages between countries. The potential of digital transformation within a sustainable development framework can trigger significant economic transformations aimed at improving living standards and strengthening international competitiveness. The study's forecasting of the impact of sustainable competitiveness on economic growth underscores the need for national economies to adopt appropriate strategies for inclusive growth.

Keywords: sustainable development, sustainable competitiveness, digital technologies, digitalisation, digital inclusion, inclusive growth.

JEL Classification: Q01, Q56, O33, L86.

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1. Introduction

From a sustainable development perspective within the SDGs agenda, economic prosperity, environmental conservation, and social well-being are not disjointed components but part of an integrated system. The combination of global, multidimensional, and intergenerational characteristics of SDGs brings out complexity in structuring the policies and strategies for implementation. Improving one socio-economic or environmental dimension could impact other dimensions and there may be trade-offs between various SDGs and targets. From scholarly materials, a very good example is the concept of sustainable competitiveness itself (Corrigan et al., 2014). Sustainable competitiveness is based on a core strategy, one that tends to long-term competitive benefits that do lead to positive economic effects, and thus fulfilling the mission of the economic entity. Concurrently, obtaining competitive advantages in the present business environment is almost ill-achievable without acknowledging the role of environmental and social components in the activities of enterprises that have appeared to be the business's response to the corresponding demands of the society. Foremost, therefore, considerations of economic growth should be done in terms of sustainable competitiveness, since sustainable competitive economies become more innovative, more resilient, and better-capacitated in the responsiveness to external shocks. In addition, this uses the power of digital technologies toward fostering innovation in the quest to drive economic advance and finding solutions to societal challenges for sustainable and inclusive growth.

2. Problem Statement

Despite the cyclical pattern of economic development and the evolving landscape of research determinants, achieving sustainable competitiveness remains a central focus of economic science. This dynamic shift is connected with the pressure of challenges of various origins (including climate, energy, migration, changes in local labour markets, pandemics, etc.).

The main methodologies for measuring sustainable competitiveness, progress in achieving SDGs and the corresponding use of ICT are the following methodologies analysed by international organisations: the UN SDG Index (UN, 2023), the Global Sustainable Competitiveness Index (Solability, 2023), the IMD Digital Competitiveness Index (IMD, 2023), the ITU ICT Accessibility Self-Assessment Toolkit (ITU, 2021), and the Digital Inclusion Index (Berger, 2021). The United Nations is responsible for measuring countries' progress in achieving sustainable development goals.

The most significant research on international competition and the theory of competitive advantages of countries, as well as the factors determining competitiveness on micro- and macro- levels, was conducted by the American scholar Michael Porter (1985). The concept of “sustainable value” and the role of innovation in creating competitive advantage through environmental and social initiatives were explored by Hart and Milstein (2003). Environmental management and corporate strategy, particularly how firms can align environmental objectives

with competitive goals to achieve long-term success, was researched by Reinhardt et al. (2005). Corporate sustainability, including the integration of environmental and social considerations into corporate strategy, performance measurement, and reporting, were explored by Epstein and Buhovac (2014). The strategy of integrating economic, social, and environmental performance metrics into business decision-making for sustainable competitiveness was researched by Elkington (2004), who is also credited with coining the term “Triple Bottom Line”. Several researchers have researched a bridge between sustainability and leadership at different levels (Glynn, 2013; Laszlo, 2008; Kanter, 2009; Andreola & Meloni, 2016). Separate studies focus on the potential for businesses to drive positive environmental and social change through innovative approaches to sustainability (Hawken, 1994; Jones, 2017; van Dijk, 2020). Studies on sustainability science emphasise the need for fundamental shifts in societal values and systems thinking to address sustainability challenges and foster sustainable competitiveness (Pankaj & Pisano, 1997; Ehrenfeld, 2005; Henderson, 2015).

Separate attention requires research on the investigation of the model of Ukraine's digital economy, the impact of ICT on human capital, which involved developing a roadmap for human capital (Antoniuk et al., 2021). The commercial perspective on economic development is focused on science-based decision-making in building sustainable competitive advantage (Bayer, 2023).

This study is focused on the relationship between digital transformation and sustainable competitiveness and forecasting of the impact of sustainable competitiveness on economic growth.

3. Research Questions / Aims of the Research

This study aims to undertake a comprehensive analysis of both theoretical and practical frameworks concerning the implementation of sustainable development and to evaluate the potential of leveraging digital technologies to advance sustainable competitiveness. Therefore, the research questions, which arise are, firstly, how digital technologies could be used in advancement of sustainable competitiveness and, secondly, how impact of sustainable competitiveness on economic growth could be measured.

4. Research Methods

In addition to general research methods utilised such as the literature review and Document Analysis, the study employed specialised research methods, including econometric methods, specifically forecasting the impact of sustainable competitiveness on economic growth through the construction of an econometric model. A multifactor linear regression model was built, valid for the entire population. Factors x_1 , x_2 , x_3 are non-random variables, independent of each other. For each i -th observation, the expected value of the random variable i equals zero, and the variance is constant regardless of the observation number. The model errors are not correlated for different observations. The model was constructed using the ordinary method of least squares.

5. Findings

The contemporary outlook of the digital economy is shaped by the convergence of various streams of economic activity within an information society that is based on a number of digital ecosystems and the Internet. Digital technologies act as cornerstones in the process of the digital transformation of the traditional sectors of world economic society. Digitalization, in that matter, within the paradigm of the digital society, may well be the driver in further implementation of SDGs. By improving the pace and enabling a broader scale of economic and social transformation, digitalization assumes center stage in cross-sectoral outcomes of sustainable development and is able to diffuse into society integratively. Its multi-dimensional systemic impact underlines the fact that digitalization is highly important for the future design of the trajectory of societal progress towards sustainable development. On the economy, digital technologies have huge potential to facilitate the acceleration and scale of many state-of-the-art technologies, applications, and digital platforms, thereby helping low-income countries to meet some of the critical development milestones onto economic growth. Several elements are involved in the rapid and successful deployment of digital technologies, as indicated in Figure 1. Essential are policies and institutions that shape the foundational system of the ICT sector: They oversee the deployment of physical infrastructure, regulate the necessary workforce skills at the state level, determine the local operational presence of the digital technologies industry, and influence the readiness of key sector stakeholders to adopt key solutions within the digitisation process. This insight underscores the importance of the policy and institutional frameworks in driving the effective integration of digital technologies into national development strategies.

Figure 1. Interconnected Components for Successful Digital Technologies Deployment in Achieving SDGs



Source: authors' own research contribution.

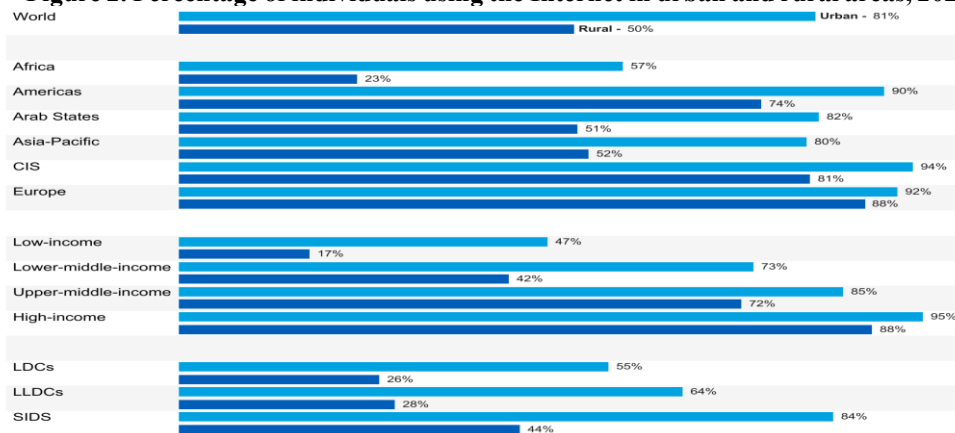
Digital technologies have both direct and indirect impacts on achieving the sustainable development. ICTs are explicitly mentioned in four SDGs (SDG 4, SDG 9, SDG 5 and SDG 17), which recognise the transformative power of digital technologies in fostering economic growth and promoting social inclusion. Digital technologies are also presented as a cross-cutting category for sustainable development, where the acceleration of their adoption has the potential to increase the competitiveness of non-ICT sectors.

The digital divide is a crucial issue in the context of advancing economic growth and ensuring sustainable competitiveness. Such a gap poses a serious challenge to the achievement of a reduction in digital inequality among the population. Digital inclusion is extremely important both for an increase in one's individual income and, more broadly, for economic development at large. Acquiring digital skillsets by the population demonstrably leads to enhanced long-term economic competitiveness, promoting an overall rise in the quality of life with advanced development of the digital sector. The need for increased digital integration became especially realized during the COVID-19 pandemic, in which digital tools played a big role in facilitating everyday business. The pandemic has exposed further a rift between the 'included' and the 'excluded.' As such, in most cases, these marginalized groups lacked the required support systems necessary for critical updates on the COVID-19 situation, therefore being more vulnerable to the virus and misinformation.

On the contrary, this has been made possible by the deployment of fixed and mobile connectivity in developing countries, reduction in costs of data transmission tariff plans, increase in the usage of mobile devices (smartphones and tablets), and faster speeds accessed on the Internet.

"According to the 2019 estimates by UNCTAD, more than half of the world's population used the Internet compared to slightly more than one-tenth at the beginning of the 2000s. The percentage of worldwide households with access and use of the Internet in 2023 is about 81 percent in urban areas, more nearly by a third than in rural areas – about 50 percent – according to Figure 2."

Figure 2. Percentage of individuals using the Internet in urban and rural areas, 2023

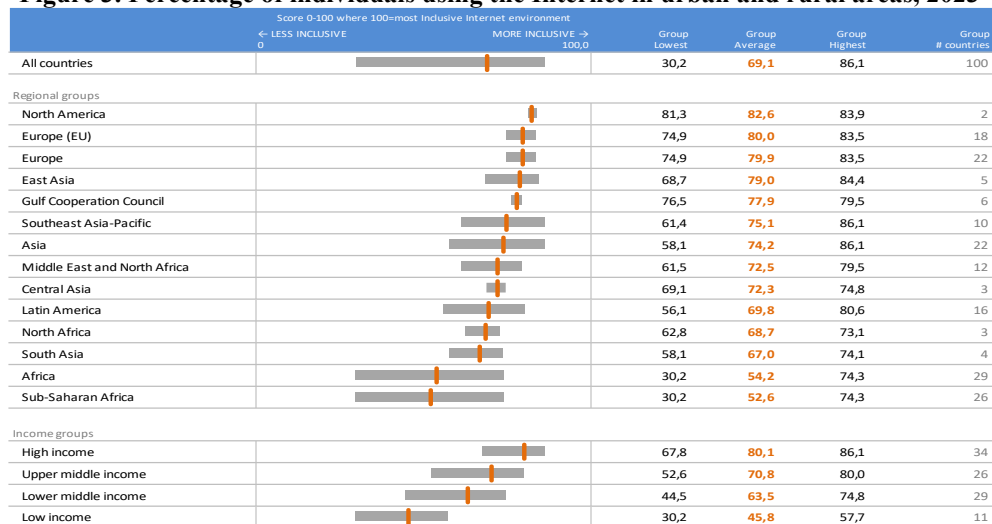


Source: compiled by the authors based on data from ITU, 2023.

Although the urban-rural gap was relatively narrow in high-income nations, Internet access in urban areas of low-income nations was 2.8 times higher than in rural areas.

Over the last half-decade, there has been a noticeable reduction in the digital gap between those with robust internet access and those with limited connectivity, by results of the Inclusive Internet Index. In 2022, most countries, including developing countries, improved their results in different dimensions of Inclusive Internet, however, the pace of improvement over the last years is disappointingly slow (Figure 3). The nature of the divide has also changed from a “coverage gap” associated with insufficient network coverage to a “usage gap” marked by people unable, unwilling, or uninterested in using the Internet.

Figure 3. Percentage of individuals using the Internet in urban and rural areas, 2023



Source: compiled by the authors based on data from The Economist, 2022.

Achieving inclusive growth for the effective management of the digital divide and reducing poverty, which is an outline of an inclusive economy, is directly related to sustainable competitiveness. Contemporary trends of digitalisation confirm that economic growth needs to encapsulate social inclusiveness and resilience for the achievement of long-term benefits for human development (WEF, 2020).

Sustainable competitiveness therefore tries to emphasize the dimension associated with economic competitiveness in driving prosperity and lasting growth while underlining issues of environmental and social consideration. Sustainable development is a multi-dimensional concept, integrating the principles of economic, environment, and social aspects for the well-being and advancement of the societies. Sustainable competitiveness addresses those issues that go far beyond the mere economic results and focuses on other critical components important to the stability and prosperity of societies through the assurance of quality growth. A different angle to the definition of sustainable competitiveness is reflected in its assessment not only

of a country's ability to generate long-term growth but also of whether the process of national development generates a society in which people would want to live.

As these critical sustainability trends—globalization, climate change, energy and resource shortage, water constriction, aging population, and so forth—go on to influence the corporate setting, correspondingly will their importance to sustainable management practices increase in the future. Hence, an integrated corporate sustainability strategy that is comprehensive and underpinned by a long-term perspective might optimize intangible assets with bottom-line and competitive benefits while working toward societal and environmental well-being.

The following are the key priorities of using digital technologies in advancing sustainable development at the current stage of society development:

1. Increase the financial inclusiveness of the population;
2. Accelerate the modernization of the most critical services in the spheres of health care and education;
3. Introduction of innovative technologies of smart agriculture and systems of low-carbon power production;
4. Decrease in the cost of resolution of complex urbanization-related problems;
5. Engagement of the widest circle of the populace in the management of socially creative procedures;
6. Labour productivity-oriented improvement in different ICT sectors;
7. Improving the quality of services and creating more employment.

On the other hand, digital technologies appear to have an explicit role in financial inclusion, which is one of the factors crucial for achieving sustainable competitiveness. Universal access to finance among various segments of the population lays the basis for effectively dealing with no fewer than 9 different SDGs – from eradicating hunger and poverty to ensuring gender equality and fostering the financial prospects of SMEs.

Probably the most important cause of financial inclusiveness is FinTech innovation, especially the turning of regular mobile phones into channels for access to financial services. Worldwide, during the decade 2011-2021, account ownership grew from 50% to 76% of the global adult population (World Bank, 2021). Given that a significant portion of the global population remains unbanked and even lacks access to a bank account, simplified mobile applications offer the opportunity for many impoverished segments of society to engage in the financial market without relying on traditional banking services. For example, the mobile-based system for money transfers, financing, and microfinance known as "M-pesa" is currently used by 33 million residents of Kenya and has been successfully introduced in 10 other countries worldwide (ITU, 2020).

To examine the role of sustainable competitiveness in driving economic growth, an econometric model was constructed utilizing statistical databases from UNCTAD, GSCI, HDI, and UN SDG for over 90 countries worldwide. The multifactor linear regression equation for the model is as follows:

$$\ln Y = -17,38 + 0,55 \ln x_1 + 5,24 \ln x_2 + 0,47 \ln x_3 + \varepsilon \quad (1)$$

where:

Y – per capita GDP (USD)

x_1 – Global Sustainability Competitiveness Index (only Natural Capital Competitiveness, Resource Intensity Competitiveness, and Governance Efficiency Competitiveness)

x_2 – Human Development Index (excluding GNI)

x_3 – UN SDG Index for Goal 9

ε – Model error

Since the factors have different units of measurement, their indicators were logarithmically transformed for calculations. The model was estimated using the ordinary least squares (OLS) method.

$R^2 = 0.907$, which means that the variation in GDP per capita between countries is explained by the variation in factor values by 90.7%. The following statistical tests were conducted to assess the adequacy and validity of the model:

- F-test: The F-value calculated ($F = 257.12$) was significantly higher than the critical F-value ($F = 3.96$), indicating that the model is statistically significant overall.
- t-tests: The individual t-values for each parameter ($t = 2.20, 9.40, 2.07$) were all significantly higher than the critical t-value ($t = 1.99$), implying that all three independent variables have a statistically significant impact on the dependent variable.
- Goldfeld-Quandt test for heteroscedasticity: F calculated ($F = 2.27$) was lower than the critical F-value ($F = 2.40$), indicating that the model's variance is homoscedastic (i.e., constant), and heteroscedasticity is not present.

Therefore, it can be concluded that the model is adequate and can be used for further analysis and assessment of changes. The analysis performed suggests that a 1% increase in a country's Global Sustainability Competitiveness Index is associated with a 0.47% increase in its per capita GDP, holding other factors constant. A 1% increase in a country's Human Development Index is associated with a 5.24% increase in its per capita GDP, holding other factors constant. A 1% increase in a country's UN SDG Index for Goal 9 is associated with a 0.55% increase in its per capita GDP, holding other factors constant. A forecast performed on the basis of this model indicates that with a 5% increase in all independent variables, the per capita GDP will be 28% higher than the initial value.

This econometric model, as presented in this research, confirms the positive influence of sustainable competitiveness on economic welfare. Results underpin significant potential economic and social gains to be acquired from policies aimed at creating an enabling environment to promote inclusive digital development. Considering the high positive relationship between the technological structure of production and economic productivity, the foregoing is evidence that digital inclusive transformation will not only affect productivity but will also entrench major changes in competition dynamics and the configuration of value creation chains. Notwithstanding, new business models have increased participation by new stakeholders and are, per se, digital market players.

To that end, achieving higher levels of sustainability will require the government, businesses, and civil society to act in unison to address emerging challenges. Addressing the challenges will require a lot of harmony among the stakeholders, just as in environmental regulation, where there is a need to ensure a balance between productivity and sustainability, and social integration, where businesses can be counted upon to contribute to the development of human capital. This cooperation is also indispensable for more pragmatic progress to be achieved and thus help countries make a transition to more sustainable growth models.

6. Conclusions

Digital technologies and Information and Communication Technologies stand at the core of infrastructural platforms for achieving Sustainable Development and offer significant potential for scalability towards sustainable competitiveness. Within these two sides of the potential of digital technologies, the gaps are very substantial that exist between the developed and developing countries, and between the well-off and underprivileged groups within countries. A meticulous analysis of the Digital Inclusion Index should reveal that availability indeed corresponds well to economic development. Much stronger, however, is the correlation that casts a different light—that concerning the disparity of internet use between actual access to the internet. This means an individual might have the physical means to connect himself to the Internet yet not be active with it. It is key to managing the "usage gap" in designing an online environment and digital ecosystem that extracts the best possible experience from the user. The scaling of digital services is seen to stem from the actual adoption of the digital technologies and the creation of complete ecosystems among the regulators and the digital industry. This is to be followed by the establishment of an enabling environment in which regulations will support transparency and the development of digital literacy. Indeed, research on a model showed that the enhancement of sustainable competitiveness has far-reaching implications for the economic growth of nations across the globe, and the concretization of the potentials of digital technologies and ICT, from the perspective of the Southern nations, into the constraints of sustainable societal and economic development, is leading to formidable economic transformations aimed at reshaping and improving the quality of life. This should be accompanied by the creation of a regulatory environment conducive to transparency and the promotion of digital literacy development. A forecast based on a model revealed that enhancing sustainable competitiveness leads to long-term effects on the economic development of countries worldwide, and the expansion of the potential of digital technologies and ICT within the framework of sustainable development in countries worldwide triggers significant transformative economic changes aimed at improving the quality of life and enhancing international competitiveness. To achieve sustainable development goals, an organic synthesis of digital technologies with national innovation and economic policies is required to ensure the transformation of societal development at unprecedented speed and scale.

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**Evaluating the National Innovation Systems
of EU Countries through Innovation Indicators**

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Abstract

The innovative capacity of a nation is crucial for effectively achieving the sustainable development goals. The European Union exemplifies leadership in this domain through the implementation of comprehensive technological, financial, and regulatory strategies at the supranational, national, and regional governance levels. These practices provide invaluable insights for developing countries seeking to enhance their innovation processes. Moreover, the EU represents a unique case for analysing national innovation systems (NIS) due to its diverse policies and the differing levels of integration among its member states. The research was based on the analysis of complex innovation indicators and indices, which have gained wide recognition and are used for benchmarking. To determine the key factors that shape a country's innovation potential, we undertake graph visualisation and techniques of structural analysis of the European Innovation Scoreboard, and propose an alternative methodology to assess the innovation potential by constructing the European Index of Innovation Potential. This analysis enables the evaluation and comparison of innovation capabilities, simultaneously validating the innovative achievements of leading nations and providing a strategic framework for identifying potential directions to enhance innovation opportunities. Building on these findings, and incorporating alternative analytical approaches, a new methodological framework has been developed for assessing the innovation capabilities of EU countries. This framework aims to delineate the strengths and weaknesses of their national innovation ecosystems. By utilising cluster and taxonomic analysis, it maps EU countries in terms of their innovation potential and achievements. Strategic recommendations have been formulated based on these results to craft national strategies and roadmaps for fostering innovative ecosystems and leveraging innovation as a means to achieve more sustainable development.

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JEL Classification: O32, O52.

1. Introduction

The realisation of the sustainable development goal relies heavily on innovations, encouraging competitive advantages, and enhancing economic transformations both at the corporate and national levels, systematising their growth in governmental policies. Countries present different particularities of the innovation policy, as a consequence of the differences in innovative potentials and prerequisites, requesting a variety of approaches to encourage innovation. In addition, countries with an alike condition level can display distinct efficiency of innovation policies, indicating diversity with respect to national innovation systems and their development paths.

Innovation indices are increasingly used to assess the performance of national innovation systems. In the course of the past two decades, there is an increasing trend in employing these indices to compile rankings, conduct comparative policy analyses, and policy-making for selected activities. Specifically, the European Innovation Scoreboard (EIS), developed by the European Commission, serves both to assess and compare the innovation potential of the European Union countries and as a tool for continuous monitoring and periodic reporting on research, development, and innovation achievements.

The complex nature of innovation processes and their results necessitates the utilisation of composite indices which mix different sets of individual indicators. However, even if the indices supply useful ratings and values, they cannot define what determines an innovation in being successful or the manner in which innovations are conveyed in the economic potential of a country. They also prove inappropriateness in setting out policies and actions to generate, disseminate, and put innovations in practice. A more comprehensive comparative analysis is needed to analyse the factors influencing index changes in individual EU countries, to assess specific national innovation systems, and to examine the relationship between innovation potential and innovation results.

2. Problem Statement

Innovations play a vital role in modern sustainable socioeconomic development both in times of war and peace. As our cooperation with GFCC on driving innovation in times of crisis has revealed, the way to get out of a crisis and grow competitiveness goes through innovations, and the deeper the crisis, the more incremental innovations should be (GFCC, 2023). The efficient use of any resource, including natural ones, with simultaneous economic growth is evident only when innovations are put into practice, as updated by Namazi and Mohammadi (2018) and Wilson and Vellinga (2022). For most countries, innovations that trigger a circular economy and sustainable entrepreneurship lead to improved quality of life and social welfare

(Manea et al., 2021). While green transformations take time, the ongoing digital transformations could significantly enhance competitiveness through skills development (Ligonenko et al., 2022).

Many researchers are trying to identify the best set of indicators, their normalisation, and weighting schemes in order to rank countries by innovation and entrepreneurial performance. Grupp and Schubert (2010) showed that different traditional methods, such as equal weighting, Benefit of the Doubt weighting, or principal component analysis weighting, could yield results that are radically different. Sotirelis et al. (2020) offered a Multiple Criteria Decision Aid approach to improve the ranking introduced on the EIS. As Corrente et al. (2023) have argued, a set of composite innovation indicators is the best choice for now, and EIS is one of them. So, the multiple-criteria decision-making approach would be the one to be used in order to rank or benchmark countries' innovation performance. A synthetic index obtained from the arithmetic mean of the 21 EIS indicators to build a ranking was offered by Salazar-Elena and Zabala-Iturriagoitia (2022) to overcome the problem of the large number of indicators required to measure the complex phenomenon of regional innovation systems. Moreover, Fabri et al. (2023) offer to use a fuzzy-set qualitative approach to highlight the interlinkages among EIS innovation measures.

Various international institutions have started to collect innovation system indicators and build rankings and indices to make their policies sounder and more reasonable. Examples include Science, Technology, and Innovation Scoreboard by OECD, Global Innovation Index by WIPO, European Innovation Scoreboard and European Research Area Scoreboard by EC, as well as Bloomberg Innovation Index etc., which differ by sets and coverage of innovation system indicators. These tools vary in their sets and coverage of innovation system indicators, highlighting an ongoing need for refinement. Therefore, a better set of innovation determinants and outputs has been offered by Hamidi and Berrado (2018). EC has initiated a Regional Innovation Scoreboard to take a deeper look at innovations on a regional level (EC, 2023). The development of international innovation system monitoring facilities creates the foundation for research and policy development. For example, Ivanová and Čepel (2018) have used the Global Competitiveness Index as a basic data source to find that Visegrad countries could be found in the same cluster by economic development but in different clusters by innovation performance. This allowed Fabri et al. (2023) to conclude that the development of an innovation system is based primarily on the nonlinear relationship between indicators.

In the last two decades, various researchers allocated efforts to develop the innovation structure by the provision of a universal methodological reasoning that most stakeholders can utilise. The launch of the EIS in 2000 was the milestone of the strategic advancement, many indicators being capable for usage in their existent form or through an intricate methodology. In the first place, the evaluation of EIS indicators was made by researchers through basic analytical techniques, the elements of emphasis being trends, structures, and correlations. Katz (2006) provided scale-adjusted indicators and models. In the case of complex systems, for instance an

innovation system, Data Envelopment Analysis (DEA) can be used to reveal the interaction between multiple inputs and outputs in the absence of a universally accepted methodology. In addition, Androutidou et al. (2022) observed various divergences within the EU and put them into a methodological, political, and economic context. More recently, the input-output approach has gained popularity among innovation system researchers. Zofio et al. (2023) used it in combination with a functional approach to identify innovation system bottlenecks.

Simultaneously, other researchers have sought to assess the performance of the innovation system with the use of EIS indicators. Although the first attempts, such as the widely cited paper by Zabala-Iturriagoitia et al. (2007), showed promise as they used data envelopment analysis methodology to combine previous quantitative and qualitative analyses to improve systemic policymaking, later it was questioned by practice and policymakers. The DEA has become a popular tool for assessing innovation efficiency in the EU (Meda et al., 2023). Complementary to the DEA, cluster analysis had been successfully exploited to identify innovation efficiency improvability by Wilson and Vellinga (2022). The well-known factor analysis is helpful to investigate the innovation system value added and its impact on technological transformations (Antoniuk & Cherkas, 2018).

Quality improvement in an innovation system emerges out of many other drawbacks which are found by researchers when they have access to credible data. Zygmunt (2022) has found that in some EU countries patents, R&D personnel, and innovation performance of SMEs have much lower levels of correlation due to underdeveloped knowledge networks. Coutinho and Au-Yong-Oliveira (2023) revealed that for Portugal many European innovation indicators have a negative impact on innovations, while creativity makes an outstanding impact. Both developed and developing countries rely on government support to make the innovation system work for a sustainable future (Novillo-Villegas et al., 2022).

Meanwhile, the understanding of the innovation system has moved towards an innovation ecosystem, so the system has become even more complex. Consequently, research in this field should employ a clear vision of its aims and targets in order to make the best use of EIS and other data sources. The next level of complexity we see when combining economic processes, actors, and trends with past indicators and their forecasts. This is highlighted by Ogorean and Herciu (2022), who observe that Romania has big expectations to use innovations for smart specialisation to boost the economic development of the nation's regions and their competitiveness. Our efforts to systematise relationships within the European innovation ecosystem gives us the reason to insist on the necessity to include the institutional dimension into the analysis of innovation systems at any scale or level (Antonyuk & Zaremskyi, 2018).

Clustering has become one of the most widely used methods for grouping countries, mapping, and identifying their innovation system models. This approach is well documented in studies by Orlovskaya and Morozova (2021), Dworak et al. (2021), and Hajjighasemi et al. (2022). However, there has been no research where clustering has been combined with multiple inputs and outputs in order to increase precision and address specific issues more effectively.

3. Research Questions / Aims of the Research

The purpose of the research is to conduct an in-depth analysis of the effectiveness of NIS in EU countries to identify strategic priorities that support their competitive leadership. The specific tasks of this study include:

- analysing and systematising EIS indicators to distinguish between preconditions and resources necessary for innovative development, and the achieved outcomes and impacts for evaluating the effectiveness of NIS;
- positioning countries featured in the EIS within a matrix defined by input factors and outcomes, developing an index to measure the effectiveness of the innovation system's potential implementation, and ranking the countries based on this index;
- clustering countries based on their innovation input factors and identifying the most influential differentiators.

4. Research Methods

The research data are based on the European Innovation Scoreboard 2023 database (EC, 2023). The index covers four primary types of activities, each subdivided into three dimensions, encompassing a total of 32 independent indicators. The internal structure of the EIS was analysed using Network Graph Analysis, a robust tool for extracting insights from complex, interconnected data. Aimed at revealing hidden patterns, connections, and relationships, it has found wide application in many different domains (Barabasi, 2016). In this study, the nodes within the graph represent indicators, while the connections show aggregation links that are important in building complex indices within the EIS framework. To identify clusters of indicators and organise their grouping, graph-colouring techniques were used to visually distinguish various segments of the graph. This approach effectively highlights different categories of nodes, producing a clear and informative visualisation that facilitates the interpretation of the underlying data. The visualisation was created using the Gephi software.

Based on the experience gained from the Global Innovation Index (WIPO, 2023), a unique structuring of EIS indicators was developed to assess the competitive potential of national innovation systems. The indicators were organised into two main components of the innovation process: conditions and resources (InnovINPUT) and outcomes and impacts (InnovOUTPUT). The groups of indicators are detailed in Table 1.

Given that the EIS indicators are multidimensional, a taxonomic analysis methodology has been employed to generate comprehensive evaluations. This method includes standardising primary indicators, constructing a reference vector by classifying indicators into stimulators and destimulators relative to the assessment object, calculating deviations from this benchmark, and computing the taxonomic indicator. The detailed step-by-step algorithms for this process are presented in many studies, including those by Pocięcha (2008), Sej-Kolasa (2009), and Boichenko et al. (2022).

Table 1. Grouping EIS indicators for evaluating the national innovation systems

Components of InnovINPUT	Indicators of InnovINPUT	Components of InnovOUTPUT	Indicators of InnovOUTPUT
INPUT 1 Human resources	1.1.1 New doctorate graduates	OUTPUT1 Innovators	3.1.1 SMEs introducing product innovations
	1.1.2 Population with tertiary education		3.1.2 SMEs introducing business process innovations
	1.1.3 Population involved in lifelong learning		
INPUT 2 Digitalisation	1.3.1 Broadband penetration	OUTPUT2 Intellectual assets	3.3.1 PCT patent applications
	1.3.2 Individuals with above basic overall digital skills		3.3.2 Trademark applications
			3.3.3 Design applications
	2.3.1 Enterprises providing ICT training	OUTPUT3 Attractive research systems	1.2.1 International scientific co-publications
2.3.2 Employed ICT specialists	1.2.2 Scientific publications among the top 10% most cited		
INPUT 3 Linkages	3.2.1 Innovative SMEs collaborating with others	OUTPUT4 Employment impacts	1.2.3 Foreign doctorate students as % of all doctorate students
	3.2.2 Public-private co-publications		4.1.1 Employment in knowledge-intensive activities
	3.2.3 Job-to-job mobility of HRST		4.1.2 Employment in innovative enterprises
INPUT 4 Finance and support	2.1.1 R&D expenditure in the public sector	OUTPUT5 Sales impacts	4.2.1 Exports of medium and high technology products
	2.1.2 Venture capital expenditures		4.2.2. Knowledge-intensive services exports
	2.1.3 Direct and indirect government support of business R&D		4.2.3 Sales of new-to-market and new-to-firm innovations
	2.2.1 R&D expenditure in the business sector	OUTPUT6 Environmental sustainability	4.3.1 Resource productivity
	2.2.2 Non-R&D innovation expenditures		4.3.2 Air emissions by fine particulates
	2.2.3 Innovation expenditures per person employed		4.3.3 Environment-related technologies

Source: grouped by the authors based on the EIS (EC, 2023).

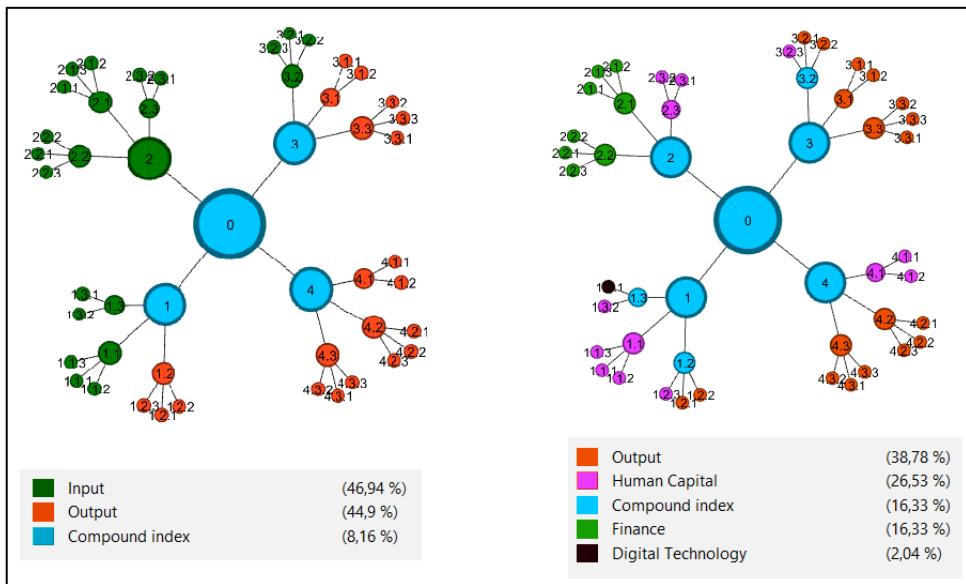
Following the structuring process, the development potential of the EU National Innovation Systems was assessed using matrix positioning. This evaluation was further complemented by a cluster analysis of EU countries' innovation activities based on InnovINPUT category indicators, performed using STATISTICA 10.0 software. Ward’s method was chosen for hierarchical clustering analysis, in which the objective function calculates the sum of squared distances between each object and the mean of the cluster. The result was clusters of approximately equal sizes, with the differentiation criteria being indicators standardised by scaling them to a uniform factorial measurement scale. This was supplemented by the use of the k-means method, which maximises the initial distances between clusters.

5. Findings

5.1 Network Graph Analysis

Our detailed analysis has revealed significant heterogeneity in the structure of the EIS (Figure 1).

Figure 1. Graph representation of the structure of the EIS



Source: developed by the authors.

The InnovINPUT and InnovOUTPUT components each account for approximately half of its composition. However, three out of the four sub-indices cannot be distinctly classified as inputs or outputs. Consequently, employing the index for strategic decision-making should be based on a more thorough analysis of its component values. Indicators related to the “Human Capital” category constitute 26.53% of the overall index structure, underscoring the importance of this factor. In contrast, digitalisation processes are only represented by the “Broadband

penetration” indicator, which does not adequately reflect the impact of information and communication technologies on the innovation processes typical of the digital economy, as shown by Antoniuk et al. (2021). This highlights the necessity to re-evaluate the composition of the indicators to increase their relevance.

5.2 Benchmark of the National Innovation Systems

To effectively benchmark the potential of NIS across EU countries, a nine-quadrant matrix has been developed. This matrix facilitates the interpretation of the consistency between InnovINPUT and InnovOUTPUT taxonomic indicators (Figure 2). The boundaries of each quadrant are established by dividing the potential range of the taxonomic indicator (from 0 to 1) into three equal segments. The identifiers assigned to countries within specific quadrants – linguistic assessments of their current positions – reflect expert judgments on the competitive potential of the NIS, its current development level, and its prospects for further growth.

Figure 2. Innovation potential matrix InnovINPUT – InnovOUTPUT

OUTPUT	+++	Unforeseen	Follower	Leader
	++	Unexpected	Average	Chaser
	+	Emerging	Potential	Unrealised
		+	++	+++
		INPUT		

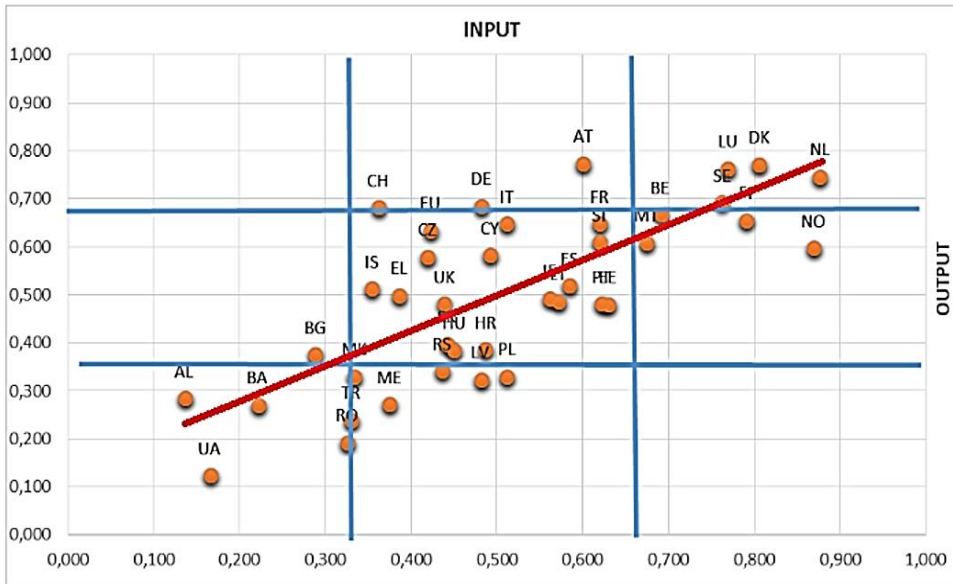
Source: developed by the authors.

The positioning of countries within this nine-quadrant matrix (Figure 3) provides detailed insights into their current states and future development prospects. It also forms a foundational basis for developing strategic recommendations for groups of countries within each quadrant. Countries located in the quadrants above the matrix diagonal should prioritise the development of INPUT components, which are essential for building competitive NIS. In contrast, those in the quadrants below the diagonal should focus on improving OUTPUT components, which reflect the realisation of NIS potential. This strategic prioritisation will facilitate quicker advancement to more favourable quadrants of the matrix, thereby accelerating the country's progress toward becoming a leader in NIS development.

For a quantitative assessment of the effectiveness of forming and realising innovation potential, we suggest calculating the European Index of Innovation Potential (EIIP) using the taxonomic indicators InnovINPUT and InnovOUTPUT (see Equation 1):

$$EIIP = \text{InnovINPUT} * \text{InnovOUTPUT} \tag{1}$$

Figure 3. Positioning countries within the matrix InnovINPUT - InnovOUTPUT



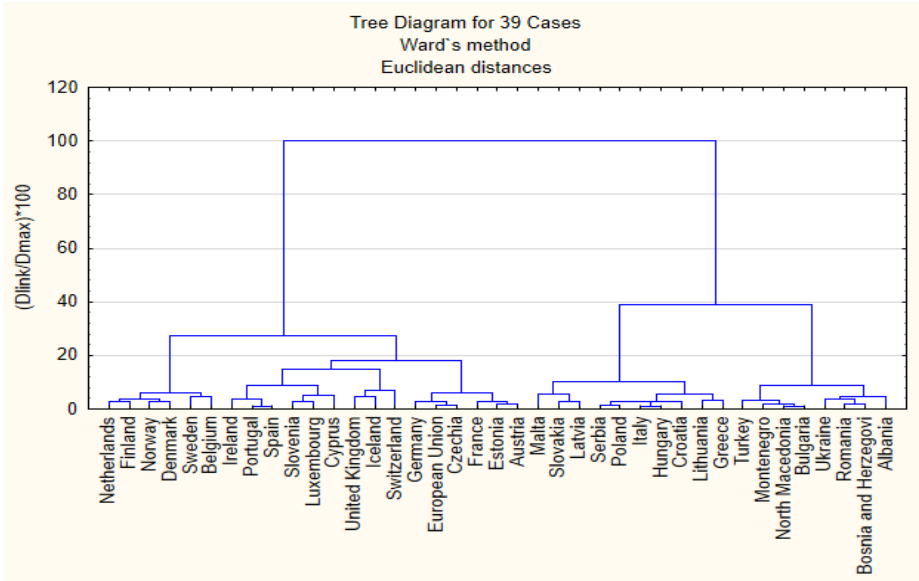
Source: developed by the authors.

The results of the calculations are given in Appendix 1. Six countries top the ranking, each with an EIIP index value above 0.5. Among these, the Netherlands, Denmark, Luxembourg, and Sweden are Innovation Leaders. Norway and Finland are Chasers, possessing high but not fully realised innovation potential, as their innovative achievements are rated as average. Emerging innovators are Albania, Bosnia and Herzegovina, Romania, and Ukraine. These countries currently have limited innovation potential and achieve lower outcomes and impacts from innovative activities compared to other European nations. The experience of Bulgaria is noteworthy, as it uniquely entered the “Unexpected” quadrant, similar to the countries in the “Follower” quadrant. Notably, the level of innovation results and impacts in these countries surpasses their initial innovation potential.

5.3 Analysis of the Input Factors Influencing Innovation Potential

To refine the input factors that significantly influence the effectiveness of NIS, a cluster analysis was conducted using the InnovINPUT indicators. Employing Ward's method and k-means, six clusters were identified (Figure 4).

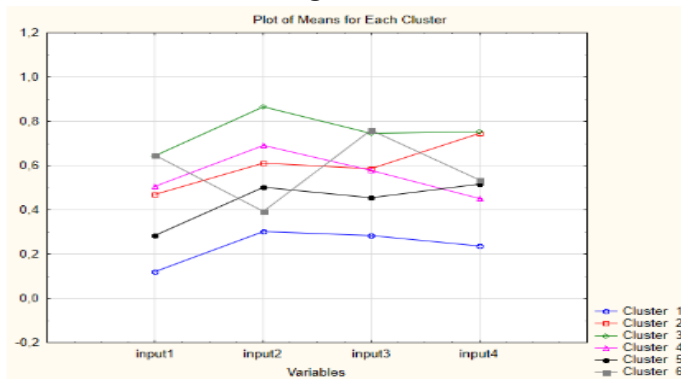
Figure 4. Distribution of countries by clusters based on input factors



Source: developed by the authors.

The calculated Euclidean distances between the clusters are significant, indicating a clear distinction between them. Clusters 3 (Belgium, Denmark, Finland, Netherlands, Norway, Sweden) and Cluster 6 (Iceland, Switzerland, United Kingdom) exhibit the highest indicators. However, in terms of the average value of the Input 2 “Digitalisation” indicator, which contributes the most significantly to the classification, Cluster 6 ranks among the lowest (Figure 5). Ukraine, along with Albania, Bulgaria, Bosnia and Herzegovina, North Macedonia, Romania, Turkey, and Montenegro, forms a cluster of countries with currently unrealised innovation potential (Cluster 1).

Figure 5. Average values of input factors by the clusters, calculated using the k-means method



Source: developed by the authors.

6. Conclusions

The EIS provides a comprehensive comparative analysis of the NIS of EU countries and their regional neighbours by monitoring and evaluating a wide range of factors, offering valuable insights for policymakers and stakeholders. It highlights significant differences in Europe's NIS with respect to their long-term competitive potential. This study analyses the effectiveness of EU countries' NIS to justify the need for targeted strategies aimed at enhancing innovation capacity, contribute to economic growth, and support the achievement of the SDGs.

The main idea of our paper is that understanding the volume and quality of input factors – including human resources, digitalisation, linkages, finance, and support – is important for developing place-based innovation policies. We propose an alternative methodology to assess innovation potential by constructing the EIIP, which uses the taxonomic indicators InnovINPUT and InnovOUTPUT. Positioning countries within the InnovINPUT-InnovOUTPUT matrix, as well as ranking them according to the EIIP, forms a sound basis for developing NIS development roadmaps. These roadmaps aim to refine or enhance policies in areas where countries show insufficient performance according to specific taxonomic indicators. This includes input policies such as developing human capital, advancing digitisation, enhancing collaboration, and providing financial and institutional support. Output policies should focus on encouraging the growth of entrepreneurial innovators, facilitating the creation of intellectual and scientific assets, promoting employment in innovative sectors, supporting the production and sale of innovative products, and advancing environmental sustainability.

The results of the cluster analysis have confirmed that the leading countries in NIS development are those with significant success in both quantitative and qualitative terms to ensure INPUT factors. Specifically, Belgium, Denmark, Finland, Netherlands, Norway, and Sweden have been identified as key examples. Given that the analysis highlighted Digitalisation as the primary driver in clustering countries based on development preconditions and resources, we prioritise the creation of a Digitalisation Policy and Roadmap for countries with unrealised innovation potential. Implementing such a policy will significantly stimulate the advancement of both the INPUT and the OUTPUT components.

The study revealed limitations in the NIS dimensions included in the EIS, which prompts us to suggest adding new aspects to the analysis of innovation systems at any level concentrating more on institutional environment and digitalisation processes. The expansion of digital infrastructure, along with the implementation of Industry 4.0 technologies, ICT diffusion processes, and smartisation, not only accelerates innovation, but also contributes to the achievement of the SDGs. We argue that a comprehensive digital transformation of the NIS is crucial to enhance the innovation capacity of European countries. In the future, this approach will enable a more detailed assessment of the competitive potential of NIS and its implementation, aiming to ensure the innovation leadership of the EU countries and Ukraine by 2030.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors used ChatGPT4 solely to improve the readability and language. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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Appendix

Country rankings based on NIS competitive potential

Country	INPUT	OUTPUT	EIIP	Matrix Identifier	Cluster
Netherlands	0,876	0,746	0,654	Leader	3
Denmark	0,806	0,772	0,622	Leader	3
Luxembourg	0,770	0,764	0,588	Leader	4
Sweden	0,762	0,693	0,528	Leader	3
Norway	0,870	0,597	0,519	Chaser	3
Finland	0,790	0,656	0,518	Chaser	3
Austria	0,600	0,774	0,464	Follower	2
Belgium	0,691	0,668	0,461	Chaser	3
Malta	0,675	0,609	0,411	Chaser	4
France	0,620	0,648	0,402	Average	2
Slovenia	0,619	0,610	0,378	Average	4

Country	INPUT	OUTPUT	EIIP	Matrix Identifier	Cluster
Italy	0,512	0,648	0,332	Average	5
Germany	0,482	0,685	0,330	Follower	2
Spain	0,584	0,519	0,303	Average	4
Estonia	0,630	0,480	0,302	Average	2
Portugal	0,622	0,482	0,300	Average	4
Cyprus	0,492	0,582	0,286	Average	4
Lithuania	0,572	0,486	0,278	Average	5
Ireland	0,562	0,493	0,277	Average	4
Switzerland	0,362	0,683	0,247	Follower	6
Czechia	0,419	0,579	0,243	Average	2
United Kingdom	0,439	0,481	0,211	Average	6
Greece	0,386	0,499	0,193	Average	5
Croatia	0,487	0,386	0,188	Average	5
Iceland	0,354	0,513	0,182	Average	6
Slovakia	0,442	0,398	0,176	Average	5
Hungary	0,450	0,385	0,173	Average	5
Poland	0,512	0,330	0,169	Potential	5
Latvia	0,481	0,324	0,156	Potential	5
Serbia	0,436	0,342	0,149	Average	5
North Macedonia	0,334	0,330	0,110	Potential	1
Bulgaria	0,288	0,375	0,108	Unexpected	1
Montenegro	0,375	0,271	0,102	Potential	1
Turkey	0,330	0,240	0,079	Potential	1
Romania	0,325	0,193	0,063	Emerging	1
Bosnia and Herzegovina	0,221	0,271	0,060	Emerging	1
Albania	0,136	0,285	0,039	Emerging	1
Ukraine	0,166	0,124	0,020	Emerging	1

Source: developed by the authors.

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**Analysis of Stock Indices during the SVB Bank Run
in March 2023 based on Sentiment Analysis**

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DOI: 10.24818/ICESS/2024/068

Abstract

This paper examines the Silicon Valley Bank (SVB) bank run event on March 9, 2023, and seeks to contribute to the understanding of market dynamics during this crisis. The bank run was unique and chilling because of two factors: first, the event was amplified by widespread panic on Twitter following a message by Peter Thiel, a renowned technology entrepreneur; and second, the speed of withdrawals was unprecedented because of the power of social media and the technology that allowed quick reactions. In this paper, we start by examining the market volatility and the impact of the SVB crisis on key indices in the United States and Europe. Then, we analyse the Twitter activity and the corresponding sentiment that emerged throughout the event. Our data indicates that Twitter sentiment accurately mirrored the market's fluctuation and volatility. Moreover, employing readily available Large Language Models (LLMs) for sentiment analysis can potentially serve as an early indicator of market shifts and provide a cautionary signal in the event of a similar occurrence in the future.

Keywords: Bank Run, Stock Indices, GARCH Volatility, Artificial Intelligence, Sentiment Analysis, Social Media Influence.

JEL Classification: G15.

1. Introduction

In this paper, we refer to the holding company Silicon Valley Bank Financial Group as “SVBFG”. We refer to the Silicon Valley Bank as “SVB”. SVBFG filed for bankruptcy on March 17, after the failure of SVB.

On Wednesday, March 8, 2023, Silicon Valley Bank (SVB) announced a plan to restructure their balance sheet. According to the Federal Reserve analysis (The Fed, 2023) and the SVBFG reporting (Silicon Valley Bank, 2023), SVBFG had sold \$21

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billion in available-for-sale (AFS) securities, booked a \$1.8 billion after-tax loss, and it was planning to increase term borrowings by \$15 billion to \$30 billion and was seeking to raise \$2.25 billion in capital (Silicon Valley Bank, 2023; Becker, 2023). This announcement worried investors. Founders Fund, a venture capital (VC) firm headed by Peter Thiel, one of the co-founders of PayPal, began to remove their cash from the bank. Furthermore, they recommended that their investors follow suit, instigating widespread panic. By Thursday, the rate of withdrawal for deposits not covered by insurance had increased significantly, reaching a total of US\$42 billion. According to the Federal Reserve report (The Fed, 2023), there were other underlying concerns regarding the bank, which seemed to have been triggered by various interconnected factors: increased uncertainty and shifting mood towards the technology sector, as well as the possibility of adverse actions by credit rating agencies. Nevertheless, the decisive factor was the extensive network of venture capital investors and technology enterprises spearheaded by the Founders Fund's warning. These entities, driven by the influence of social media, systematically withdrew uninsured deposits at an unparalleled speed (Lang & Lang, 2023). On March 10, 2023, the California Department of Financial Protection and Innovation (DFPI) seized SVB and placed it under the receivership of the FDIC.

The bank run unfolded on March 9, 2023, a Thursday. By Thursday morning, VC companies had started withdrawing funds (Basel Committee on Banking Supervision, 2023). Our analysis below shows the shift in market indices, as well as the increased volatility of the markets as the crisis happened. There was also panic online, and rumours started to fly about an imminent collapse of the entire tech sector in Silicon Valley, and of many other banks. At noon, the CEO of SVB posted a tweet telling everyone to "Stay Calm", which angered the investors and accelerated the withdrawals. It was not until March 17, several days after the bank collapsed, that the President of the USA made a statement that all those affected will receive their deposits back as guaranteed by the Federal Reserve. A simple analysis of sentiment on Twitter that day reveals the panic and fear that took hold. The analysis was done using publicly available Large Language Models (LLMs) that are easy and cheap to use. On purpose, no advanced programming techniques were used. We show that even with a simple prompt, the signals of panic and negativity can be picked up by LLMs.

2. Problem Statement

Social media is the main source of information for all categories of people, and this has led to the way information is spread. As indicated in the existing literature, social media's significance for stock markets is on the rise (Bales et al., 2023; Bianchi et al., 2023). Since Twitter serves as a primary source of information for so many investors around the world today, tweets have the potential to exert powerful influences on people's individual trading behaviours. On the other hand, Twitter also represents an excellent platform through which people are able to transmit their sentiments and fears at incredible speeds, thus posing great risks. For instance, the GameStop saga presents one major event in which retail investors were able to push

stock prices very high, therefore shaving massive losses for short-selling hedge funds (Umar et al., 2021). With Twitter reaching every nook and corner of the world, it can be of crucial importance to financial stability, although the potential effects of social media in causing bank runs are still relatively unexplored (Yousaf & Goodell, 2023). SVB was one of the biggest banks in the United States that focused on meeting the banking needs of tech startups and venture debt.

With over 50% of all US venture-backed companies and many VC firms as its customers, SVB gave banking facilities to many of the then-up-and-coming tech firms like Cisco Systems and Bay Networks (Sharma et al., 2023). The bank collapsed because of its overexposure to the risk-laden startups and the consequent panic amongst the investors and depositors after it disclosed its plans to raise funds to fill the gaps in its balance sheet. The sudden collapse of SVB stranded billions of dollars, hurting companies, investors, depositors, shaking the startup industry, and rocking banking sector stocks. Event studies have become highly diffused in recent times for evaluating the effects of key global events, such as the COVID-19 pandemic (Alabbad & Schertler, 2022; Guadalupe et al., 2023; Pandey & Kumari, 2021; Yarovaya et al., 2021, 2022) and the Russian-Ukrainian war (Boubaker et al., 2022; Martins & Gresse von Wangenheim, 2023; Arfaoui & Yousaf, 2022).

Lately, generative AI models have received much interest from the AI research community and the wider public because of their ability to answer a wide array of complex language-based problems.

These advances in the capability of the LLMs have been conditioned by several factors, including the increased number of model parameters, increased volume of training data, and better training settings. Advanced LLMs, such as Claude, Llama, and GPT-4, have a wide range of applications including translation, classification, creative writing, and code generation (Lee, 2024). In sentiment analysis, the LLMs have proven acceptably capable, specifically in few-shots scenarios (Zhang et al., 2023).

In this paper, we set to use LLMs to identify sentiment analysis in the market at the time of a market crisis and map the sentiment to the market volatility experienced across all global markets.

3. Aim of the Research

The purpose of this paper is to add to the analysis of the bank run crisis for SVB in March 2023. We trace the market volatility of the SVB stock throughout the day, as well as the impact on the national and international market indices. We then study the social media reactions to the crisis, and identify the sentiment changes and fluctuations, in order to visualise how they relate to the market instability.

4. Research Methods

For market volatility analysis, the main method used was multivariate GARCH model, called DCC GARCH (Dynamic Conditional Correlation). They are multivariate GARCH models designed to take into account interrelationships

among a set of variables; in particular, volatilities. In the DCC-GARCH model, it investigates time-varying correlations. It combines the flexibility of univariate GARCH models with efficient parametric modeling of correlations and allows investigating dynamic correlations.

The BEKK-GARCH and DCC-GARCH models are both used for modeling conditional variances and correlations in financial data. The difference between them is basically in the way they estimate and update the conditional correlations. Whereas the BEKK-GARCH model directly estimates conditional correlation with the help of realised covariances, the DCC-GARCH model does it in an indirect way by first estimating conditional variances and then updating the correlations according to these variances. The DCC-GARCH model is of more flexible nature and allows for time-varying correlations; however, the BEKK-GARCH model assumes constant correlations over time. The conditional variances and correlations of these models have appeared in empirical research for purposes of inference and forecasting. Of the two, DCC-GARCH generally outperforms BEKK-GARCH in terms of forecasting performance.

First, estimation of the generalized VAR model is required in order to construct the DCC-GARCH model. Subsequently, the residuals are standardised using a univariate GARCH model. This process not only addresses asymmetries in volatility and shock transmission but also accounts for time-varying cross-correlations among the variables.

$$\text{VAR}(1) : X_{1,t} = \alpha_1 + \beta_{11}X_{1,t-1} + \beta_{12}X_{2,t-1} + \epsilon_t$$

$$\epsilon_t \approx \text{Dist}(0, H_t)$$

$$H_t = D_t P_t D_t$$

$$D_t = \text{diag}\{\sqrt{h_{2t}}\}$$

- H_t is the conditional variance matrix of the DCC model,
- D_t is the diagonal matrix of h_t of univariate GARCH models
- P_t is the correlation matrix that contains expressions from univariate GARCH models

$$P_t = Q_t^{-1} Q_t Q_t^{-1}$$

$$Q_t = (1 - \alpha_{DCC} - \beta_{DCC}) Q_t^* + \alpha_{DCC} \phi_{t-1} + \beta_{DCC} Q_{t-1}$$

- Q_t is the conditional covariance matrix,
- Q_t^* is the unconditioned covariance matrix
- ϕ_{t-1} is the matrix of standardised residues.
- α_{DCC} and β_{DCC} involve the persistence of shocks. Their amount, which measures the persistence of volatility, must be less than 1.

The second part of the paper is based on sentiment analysis methods. The tweets data set was downloaded from Kaggle (Kaggle, 2023), a platform where data scientists share data and models. The data set structure is shown in Table 1.

Table 1. Tweet data set structure

	date	id	tweet	username	likecount	retweetcount
0	2023-04-03 23:57:12+00:00	1.64E+18	The Biden administration, placing blame on Trump-era rollbacks, called on federal banking regulators to reinstate safeguards for regional banks after the record-setting collapse of Silicon Valley Bank and Signature Bank of New York earlier this month. https://t.co/KqLxvOIFPW	TiffinOhioNews	0	0
1	2023-04-03 23:56:59+00:00	1.64E+18	@1Niedar With a quick call to his Washington democrats, the Nuisense saved his millions locked up in the Silicon Valley Bank. But only democrats can do this.	DennisDhg2	0	0

Source: Kaggle.

There were originally 279804 tweets, covering from March 1, 2023 to April 1, 2023.

We cleaned up the data set with the following operations:

- Deleted tweets that were not in English, or had illegible characters
- Only kept the tweets for March 9, 2023 (total 1,291 tweets)
- Deleted the columns for username, retweets, and likes.

We used two LLMs (Claude 3 Sonnet and Copilot/ChatGPT4.5) and we asked them to perform a sentiment analysis on a data set of tweets from the day of the crisis. The clean data file was uploaded to ChatGPT first (Microsoft Copilot in Bing, www.bing.com) and to Claude (claude.ai).

Both LLMs used their own scale to rate sentiment, without any prompting or direction from us. ChatGPT/Copilot created a Neutral category as well, however, when manually reviewing the tweets these were mostly retweets of the big news, so we made the decision to count them as Negative (second sheet in the Excel file, we have both tables with Neutral category and without).

We focused on the day of the crisis, March 9, 2023, only during market open hours (9 am to 4 pm EST). The resulting graphs are in the appendix.

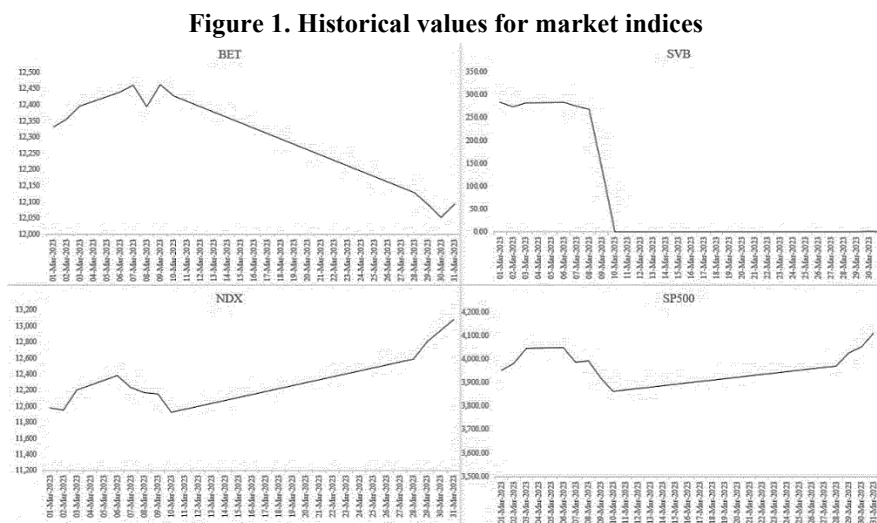
Possible biases in our methodology:

- 1) The Kaggle data set is manually provided by a Kaggle user, so it could be missing data. However, from our empirical observations, it accurately reflected the number of tweets and the sentiment of the market that day.
- 2) The number of tweets analysed (1,291) is statistically small, but it still provided enough information. On March 1, there were 10 tweets about SVB. On March 2, there were only 5. Having 1,291 tweets in a day is significant in this situation and it does reflect the flurry of activity and the negative sentiment that was present during the crisis.
- 3) LLMs are generating answers each time with variations, so reproducibility of the exact conversations is not possible. However, we ran the same queries several times and the results were extremely similar. We chose a representative query and results for each LLM.
- 3) Both LLMs, ChatGPT and Claude, used their own scale to score sentiment without our guidance or prompting. We wanted to prove that it is useful to use the LLMs in this manner, and it will still capture the sentiment accurately. We wanted to show that even out-of-the-box, simple prompt LLMs can provide some level of warning and can be used by analysts without any technical complexity to possibly identify and prevent another bank run.

5. Findings

The SVB stock SVB lost 87% of its stock market value between March 8 and March 10 (in pre-market trade). The stock closed down 60% on March 9, and continued to plunge another 65% in premarket trade before trade in the shares was halted, according to the Wall Street Journal (WSJ, 2023).

For the market volatility analysis, we used the market data sets publicly available. The historical prices of the variables are presented in Figure 1.



Source: authors' own research.

Notably, all four variables recorded a substantial decline between March 8 and March 10, 2023. A correlation between these variables becomes apparent. Particularly, the highest impact is highlighted in the SVB index series, evidenced by a precipitous 48.09% decrease on March 9 from its value the day before, and subsequently reaching a value of 0.00 on the following day. This significant impact cascaded to other indices, precipitating notable decreases in their respective values as well.

The Table 2 represents the estimation of DCC-GARCH parameters.

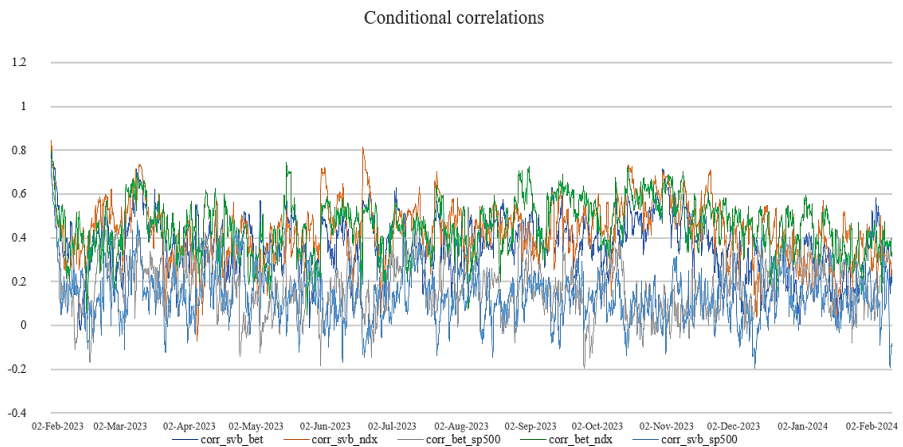
Table 2. DCC-GARCH Parameters

	ω	$\alpha 1$	$\beta 1$	γ	Skew
BET	0.0000	0.1326	0.0000	1.0000	1.2257
SVB	0.0000	0.7239	0.4206	0.4156	1.2076
NDX	0.0000	0.1245	0.2095	0.9701	0.9656
S&P500	0.0000	0.0521	0.8092	1.0000	0.8856
α DCC	0.215082				
β DCC	0.78445				

Source: authors' own research.

All ARCH and GARCH coefficients, denoted as α and β respectively, exhibit statistical significance, involving the fact that when the market moves, volatility reacts strongly and it takes a while for things to settle down. High values of the β coefficient for all variables suggest that volatility tends to stick around for a while between these variables. The γ term is also significant across the board, hinting at how good or bad news affects volatility differently. With γ being negative, it means that bad news tends to shake things up more than good news. Moreover, the skew coefficient for residue distribution is also significant, and it can claim that the Skew t-Student distribution fits our leftover data best.

Figure 2. Conditional correlations



Source: authors' own research.

Method 1. We used Microsoft Copilot (ChatGPT Large Language Model) for the sentiment analysis. We uploaded the comma-delimited file with tweets.

Results

ChatGPT did not detect the fear, panic, or overall negativity that was spreading through Twitter. Retweets of the negative news items are just marked as Neutral.

Table 3. Copilot Results

Date	Hour	Negative	Positive
09/03/2023	09:00	4	0
09/03/2023	10:00	6	1
09/03/2023	11:00	4	0
09/03/2023	12:00	4	1
09/03/2023	13:00	7	2
09/03/2023	14:00	8	2
09/03/2023	15:00	14	4
09/03/2023	16:00	9	7

Source: author’s own research.

Method 2. Large Language Model: Claude 3 Sonnet

Results

Claude’s analysis is much better, more detailed, more in-depth, and captures the exact sentiment of the market at that time. Copilot has marked retweets of the news stories as “Neutral”, if there were no other words added. To compare the two methods, we consolidated the Neutral and Negative tweets.

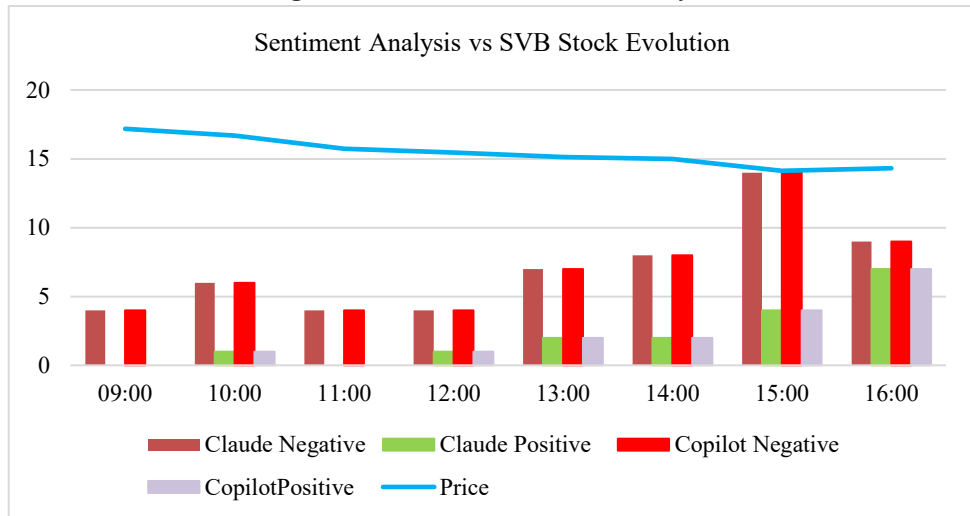
Table 4. Claude Results

Date	Hour	Negative	Positive
09/03/2023	09:00	11	0
09/03/2023	10:00	8	0
09/03/2023	11:00	6	0
09/03/2023	12:00	10	0
09/03/2023	13:00	3	0
09/03/2023	14:00	5	0
09/03/2023	15:00	4	0
09/03/2023	16:00	5	0

Source: authors’ own research.

The resulting chart is shown in Figure 5. As we can see, both the sentiment analysis with each method correlates tightly with the stock price tendency and generally with the market indices across US and Europe and paint a clear picture of a crisis in development.

Figure 4. Combined Sentiment Analysis



Source: authors' own research.

Given that the prompts were kept as simple as possible, both models returned valid analyses. The negative sentiment is shown throughout the day. Even if ChatGPT is more inclined to see likes and retweets as positive or neutral, it still captures the negative values and the overall crisis as the volume of tweets increases drastically.

6. Conclusion

We posed the question if we could use an LLM's native sentiment analysis capabilities to identify signals in the market that could possibly indicate an upcoming crisis such as a bank run. We showed that it is possible, and the LLMs correctly picked up as the crisis unfolded.

Panic set in immediately and spread fast. SVB was seen as the bank supporting all tech start-ups in Silicon Valley. Wild theories and rumours started to appear: Etsy buyers worried they will have no cash payments available (Archive 2023); companies such as Facebook or Apple could run out of funds; partner banks of SVB could stop working (Archive 2023); crypto currency would become worthless if crypto startups remain without funds; regional banks would be overwhelmed trying to support the firms and would collapse as well. A list of possible banks in the US that were "ready to collapse" circulated on Twitter in the next days, with most US banks on the list. By March 15, 2023, Credit Suisse in Europe was rumoured to also collapse because of SVB, even though the two banks were not connected in any way:

“Credit Suisse has been a slowing-moving car crash for years,” wrote Peter Boockvar, chief investment officer of Bleakley Financial Group. “But now today’s news of course is happening in the vortex of SVB” (Morrow, 2023).

The speed of the withdrawals was unprecedented and a reflection of the ease of doing so using technology. “The fact that people can communicate so much more quickly ... (has) changed the dynamic of bank runs and perhaps changed the way we have to think about liquidity risk management”, said Todd Baker, a senior fellow at Columbia University’s Richmond Centre (Lang 2023). While the bank run could have happened as well without Twitter, the social media site contributed to the panic and negative sentiment about the bank and to the speed of withdrawals.

Since most people receive their news online and follow the same important influencers that disperse information, it makes sense that the regulatory agencies should also monitor social media with great attention. “In theory, a robust system of internal controls at individual banks would include constant social media monitoring for depositor rumours and panic as well”, Patricia McCoy, professor at Boston College Law, told Regulatory Intelligence. “This is particularly important for larger banks that pose the risk of contagion to the larger financial system...Recent events tell us that regional banks can spark systemic risk, just as megabanks” (Lang 2023).

Using LLMs to constantly process social media-selected posts for financial stocks and categorise for sentiment can offer an early view into any rumours or stories that could affect the markets. In our paper, Claude LLM performed a better analysis with a simple prompt, however, with advanced prompting or Retrieval Augmented Generation (RAG) methods, better sentiment analysis results are possible with Claude and other LLMs. We wanted to show that even out-of-the-box, simple prompt LLMs can provide some level of warning, and can be used by analysts without any technical complexity.

If the Federal Reserve had seen the trend in sentiment on Twitter that day, they could have stepped in and made an official announcement about the investors having their money safe. If SVB would have read the sentiment on Twitter correctly, they could have devised a much more effective message than a condescending “Stay Calm”. Both of these actions could have stopped the spread of panic and negativity and maybe avoided the bank run altogether.

The LLMs currently available will evolve and get even better. Because they are pre-trained, anyone can use them for a low price. Companies must take advantage of the new technology and use it to monitor spikes of negativity, so they are hopefully able to step in and avert the next bank run.

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**IMF Tariff Conditionality, Aid for Trade and Trade:
Evidence from Sub-Saharan Africa**

Seboka Alemu GEMECHU¹

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Abstract

Recently, world tariff rates based on the Most Favoured Nation have declined with more significant drops observed in Sub-Saharan Africa (SSA) particularly on agricultural products. However, the IMF conditions tied to aid for aid-receiving countries during the economic crisis are criticised for biased decision-making and their ineffectiveness in trade reform policies in relation to the Sustainable Development Goals. The purpose of this study is to investigate how IMF-tariff conditions tied to aid for trade impact agricultural product trade in SSA through Structural Adjustment Programmes (SAPs). Precisely, it seeks to determine whether conditions linked to Aid for Trade (AfT) foster agricultural trade growth in SSA while reducing tariffs. I hypothesised that IMF tariff conditionality impacts SSA agricultural product trade through intricate channels encompassing trade systems, pricing and marketing policies, and tax reforms. The study uses panel data from 2011-2023, covering 26 SSA countries, at the disaggregated HS-6-digit product level, using 832 agricultural products. The panel data fixed effect model estimation results indicate that IMF conditionality and ODA-AfT had a negative association with agricultural product trade growth. This suggests that ODA AfT is potentially counterproductive in promoting agricultural trade growth of SSA countries. The study reveals that IMF tariff conditionality, IMF SAPs pricing and marketing policies, and the interactions between SAPs trade system reforms and ODA-AfT are negatively associated with tariff binding overhang. Conversely, there is a positive relationship between binding overhang and SAPs in tax and trade system reforms.

Keywords: IMF tariff conditionality, MFN tariff, SAPs trade reform, Sub-Saharan Africa.

JEL Classification: F02, F13.

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1. Introduction

International trade is recognised as a catalyst for fostering inclusive growth and alleviating poverty within the framework of the 2030 Agenda of Sustainable Development (ESCAP, 2017). Trade liberalisation has emerged as a pivotal policy for developing countries and has taken centre stage on the global trade agenda.

However, the WB open data² shows that the World tariff rate based on the Most Favoured Nation (MFN) declined from 9.7% in 1994 to 4.2% in 2017 and a more significant drop in Sub-Saharan Africa from 45.3% in 1995 to 7.8% in 2017. Despite reductions in average tariff rates by low- and middle-income countries, nontariff measures (NTMs) have become more prevalent, serving purposes such as protection purposes by the government, and public policy measures to secure product safety (Carrère & De Melo, 2011; Beverelli et al., 2019).

Simultaneously, aid conditionality, rooted in the efficiency of international trade, specifically the condition/policy attached to Aid for Trade (AfT), has been a subject of extensive debate in the realm of international development (Fentahun, 2023; Lee & Oh, 2022; Roy et al., 2021). This debate questions whether aid should be tied to policy changes and enhanced governance in recipient countries (Collier & Dollar, 2002). The policy attached to aid requirements is enforced to guarantee that trade reforms are implemented to foster trade liberalisation (Dreher, 2009), which entails the elimination or reduction of restrictions or impediments, like tariffs and quotas, on the free flow of goods between nations. While opponents claim that conditional aid violates sovereignty and ignores political realities, supporters contend that it drives necessary reforms and fosters accountability (Kanbur, 2000). However, the traditional approach of providing aid with conditions, often driven by the donor countries or international financial institutions, may not necessarily lead to the desired outcomes (Easterly, 2006).

Previous studies have explored various relevant factors in the literature on aid conditionality and trade liberalisation. For example, Annen and Kosempel (2009) and Basnet (2013), trade liberalisation, and development, aid, and IMF conditionality and policy (Kentikelenis et al., 2016), tariff commitment (Ruckteschler et al., 2022).

Though, recent literature suggests that the IMF tariff conditionalities tied to IMF programmes were criticised for biased decision making and support of dictatorships, prompting speculation about its ineffectiveness in trade liberalisation in relation to Sustainable Development Goals particularly in Sub-Saharan Africa (Bretton Woods Project, 2019). For example, the available studies show that IMF's Structural Adjustment Programmes (SAPs) effectively lowered tariffs without increasing the usage of NTMs, and programmes containing tariff conditionality decreased tariff rates (Busse & Vogel, 2023). This implies that IMF programmes focused narrowly on tariff rates with ought balanced attention to NTMS, and abrupt tariff cuts conflict with development needs like protecting infant industries or managing adjustment

² We used the tariff rate of the most favoured nation (MFN), the weighted mean of import all products (%) shares corresponding to each partner country. <https://data.worldbank.org/>.

costs. On the contrary, according to Kuenzel (2023) there is no correlation between applied tariff reduction and NTMs.

Though, this study aimed to analyse the effectiveness of IMF tariff conditionality tied to Aft in SSA agricultural product trade. I hypothesised that IMF tariff conditionality impacts SSA agricultural product trade through intricate channels encompassing trade systems, pricing and marketing policies, and tax reforms. I intend to study IMF tariff conditionality and SSA agricultural product trade, as this region is a focus of IMF interventions. As a result, understanding the effects of tariff conditionality on trade reform programmes and their effectiveness in the region is crucial.

Particularly, IMF introduced various forms of conditionality in its SAPs for aid-receiving countries during the economic crisis. Besides the main goal of the IMF programme, which is to restore the balance of payments viability and macroeconomic stability for sustained economic growth and poverty reduction in developing countries through SAPs, the IMF also provides financial aid with the condition that the recipient governments implement specific structural reforms. These programmes commonly contained trade reform condition consists of reducing tariffs rates or abolishing nontariff measures, dismantling import quotas, and eliminating other trade restrictions to encourage exports and attract foreign investment (Siddika & Ahmad, 2022).

As a lender of last resort, many arguments have been made regarding why the IMF attaches conditions to its programmes. Among these reasons are³: (a) To guarantee more openness of the conditions and decisions of individual countries, (b) Strengthen the financial sector of the countries involved (c) Increase preventive measures and response capability. In terms of preventive measures, it has been suggested that long-term capital flows (particularly FDI) should be liberalised before short-term flows; also, a new credit facility for preventive action has been developed (Acocella & Jones, 2005).

However, there are many critics regarding these conditionalities tied to IMF programmes in case of giving support for recipients. Among these reasons are: 1) The insufficiency of the financial aid offered by the IMF, restricting aggregate demand which leads to recession, unemployment, and financial difficulties and the liberalisation of international capital movements, which can negatively impact systemic stability (Acocella & Jones, 2005). 2) It reduces policy space. For example, a cross-country study by Stubbs et al. (2017) covering 16 West African countries from 1995 to 2014 reveals that IMF policy reforms reduce fiscal space for health investment. This leads to limitations in expanding medical staff, such as doctors and nurses, and poses budget execution challenges in health systems. Furthermore, IMF intervention in low and middle-income countries are associated with an increase in government revenue from goods and services taxes but a decrease in revenues from

³ <https://www.imf.org/> When a country takes out an IMF loan, the government agrees to change its economic policies to address the challenges that caused the need for financial assistance. These policy changes serve as requirements for IMF financing, with the goal of ensuring that the government implements strong and efficient policies.

trade taxes (Ruckteschler et al., 2022). Reducing a government's policy space might also lead to a loss of ownership of implemented reforms (Kentikelenis et al., 2016). However, the IMF exercises significant influence through its Structural Adjustment Programmes (SAPs), which are tied to financial aid. Typically, countries receiving this aid are in a weak situation because of a severe economic or financial crisis. As a result, this study intends to analyse the effectiveness of IMF SAPs in trade reform programmes, specifically in achieving the liberalisation of trade policies in SSA.

Previous studies have examined aspects of IMF conditionality, trade liberalisation, and their impacts. To the best of my knowledge, there has been no previous research on how IMF-imposed conditions affect agricultural products in international trade through IMF conditions and SAPs in SSA. Therefore, I am investigating whether the conditions tied to AfT encourage growth in trade of agricultural products in SSA, as well as reduce tariffs imposed by SSA countries and the use of NTMs.

This paper contributes to filling that gap by evaluating the trade reforms, in terms of trade growth, trade openness (i.e. evaluating IMF-tariff impact on import and export), the change in agricultural product tariff (i.e., evaluated in terms of binding overhang) that have resulted from IMF conditionality targeting trade reform policies in the region. It aims to provide an in-depth analysis of how IMF conditionality has influenced trade reform policies, and what are the potential channels applied by IMF in aid receipt SSA country.

The paper will be structured as follows: The first part will cover the basic tenets of the study along with the main research questions and objectives. The second and third parts will focus on the review of literature and research methodology, respectively. Finally, the fourth section of the paper will present a study that examines the IMF aid conditionality in trade reform in Sub-Saharan Africa.

2. Literature Review

According to WTO (2022), the projection of global real GDP growth at market exchange rates for 2023 indicates that the war in Ukraine, high energy prices, inflation, and monetary tightening will have an adverse impact on trade and output. The projected growth rate of 2.4% for 2023 is below the average of 2.6% and 2.7% for trade and output growth, respectively, over the past 12 years. To analyse the pattern of trade and the International Monetary Fund's (IMF) conditionality in its Structural Adjustment Programme (SAP) application in developing Sub-Saharan African countries, it is appropriate to begin by examining the estimations of the effects of IMF conditionality and SAPs in trade system on trade growth.

Thus far, I have reviewed four studies conducted on the impact of IMF conditionality on trade reform policies. The first study examined the effect of trade reform conditions on trade policy instruments in 115 developing countries from 1993 to 2009 (Busse & Vogel, 2023).

Busse and Vogel (2023) focused on applied favoured nation (MFN) tariffs, nontariff measures (NTMs), and trade to investigate IMF conditionality as an

external pressure influencing tariff dynamics. They used IMF conditionality as the external factor influencing trade liberalisation. However, their analysis of NTMs was limited to WTO member countries. Subsequently, their data may lack details on the IMF's conditional impact on trade policies in non-WTO Sub-Saharan African countries.

To analyse the trade policy substitution effect, the authors estimated changes in tariff rates due to variations in IMF tariff conditionality and control variables such as population, GDP, balance of payments, exchange rates, and inflation crises. They also estimated the probability of NTMs based on tariff conditionality dummies, structural adjustment programme dummies, and interaction terms for conditionality and tariff changes. Import pressure in the HS-6 sectors was controlled by including import trade shares, while protective export sectors were accounted for using export shares. They found that tariff conditionality in structural adjustment programmes led to a statistically significant reduction in tariff rates. Additionally, they discovered IMF programmes decreased tariff levels even without tariff conditionality requirements.

Erero and Bonga-Bonga (2018) study the effects of tariff reduction on employment, export performance, welfare, and productivity in the Democratic Republic of Congo (DRC) using CGE model. They used the General Equilibrium Model Package (GEMPACK) to perform a policy simulation. They argued that tariff reduction increases formal employment and output but it hurts informal producers, as output decreased in informal sectors such as livestock and clothing.

Ruckteschler et al. (2022) analyse the politics of trade protection in an autocracy in case of Morocco evidencing EU tariff liberalisation. They focus on 1993-2009 using a difference-in-differences regression framework to examine the impact of political connections on trade protection differences before signing a free trade agreement with the EU and after the agreement. The authors show that the sectors with royal ownership had higher median ad valorem equivalents (AVEs) of NTMs than non-royal sectors and they suggest that following EU trade agreement NTM applied to royal sectors provided greater trade protection, despite overall increase in NTMs favouring non-royal cronies.

Kuenzel (2023) used a product-level global panel of World Trade Organisation (WTO) members and the application of NTMs over the period of 1996-2019 to analyse the empirical link between various tariff measures and the imposition of NTMs. He finds that the sectoral tariff overhangs (i.e. WTO members' bound and imposed tariff rates) are a key margin to identify an NTM-tariff trade-off. Countries with small tariff overhangs will be more inclined to employ alternative tools to prevent imports from abroad if NTMs are largely utilised to replace tariff protection. The authors further claimed that a nation's tariff overhang serves as a barometer of that nation's flexibility in terms of its lawful trade policy. Using sanitary and phytosanitary (SPS) and technological trade barriers (TBT) NTM protection mechanism, WTO members with small tariff overhangs will be more inclined to employ alternative tools to prevent imports from overseas if NTMs are largely utilised to replace tariff protection. This paper aims at analysing the effectiveness of

IMF conditionality tied to aid through SAPs in achieving trade liberalisation in Sub-Saharan African countries.

The question here is does IMF aid conditionality influence SSA trade reform for the country i at year t with the presence of IMF conditionality? To what extent has IMF conditionality been effective in lowering applied tariff rates, influencing a usage of NTMs, and growth in trade particularly for agricultural product trade? Because the effectiveness of aid for trade determined by the growth in aid for trade (i.e., $g = g(\gamma)^4$).

2.1 IMF and Developing Countries

As a result of the Uruguay Round of trade negotiations, which aimed to reduce trade barriers and establish new trade rules, and involved developing countries as full participants, most developing countries reduced their trade barriers and adopted more market-oriented policies between 1985 and 1995 (Irwin, 2022).

During 1980s, Sub-Saharan Africans faced a severe economic challenge. The collapse of international lending, declining commodity prices, and overvalued currencies led to widespread debt crises. The World Bank, IMF, and WTO influenced the reforms in the region (Easterly, 2021).

In response to this crisis and aid for developing countries, IMF has introduced several aid conditions in times of crisis and resolve balance of payments problems.⁵ For example, IMF forms conditionality such as lowering tariff rates or abolishing NTMs in its SAP for countries when these programmes much-needed financial aid (Jafarey, 1992). However, the World Bank and IMF were criticised for biased decision making and support of dictatorships according to Bretton Woods Project (2019). For example, the IMF's support in 2010 for Greece's unpopular lending programme has been seen as a bailout of private debt holders, most notably Europe's finance institutions.

The problem of moral hazard, which has a negative impact on aid recipients' incentives to reformulate their system, is the major reason for the low levels of overall foreign aid performance. The conditionality of this issue could, in principle, be partially addressed by the altruistic donor (Svensson, 2000).

I assessed four relevant mechanisms that IMF impacts developing countries' trade policies. (1) reducing government's policy space. For instance, IMF effectively promotes tax revenue from consumption taxes instead of trade taxes (Crivelli & Gupta, 2016; Kentikelenis et al., 2016; Reinsberg et al., 2020); (2) applying the policy recommendations of the IMF such as decreasing tariffs, and NTMs, elimination of foreign exchange restrictions, controlling inflation or maintaining a specific exchange rate (Irwin, 2022). (3) The IMF provides financial support to developing countries for trade reform adjustments through the Trade Integration Mechanism (TIM). This intervention in the trade reform of developing countries is

⁴ Where gt_{it} is growth rate in trade as % of GDP,
 γ is percentage of share of aid for trade (AfT)

⁵ See, <https://www.imf.org/>

more effective for smaller trading economies (Hoekman & Shingal, 2021). (4) Another driver that we identify in the literature is economic activity. IMF conditionality drives recipient countries to liberalise trade policies by substituting policies, while developing countries meet macroeconomic targets by reducing trade barriers instead of implementing other reforms (Busse & Vogel, 2023). This demonstrates that IMF programmes indirectly encourage more open trade regimes by promoting domestic liberalisation as a condition. Furthermore, they argued that IMF's SAPs are effective in lowering tariffs without increasing the usage of NTMs.

Furthermore, examining the influence of the IMF, World Bank, and WTO on trade reforms in 111 developing countries between 1960 and 2000, a study (Irwin, 2022) utilised a difference-in-differences estimating technique. The findings suggest that the impact of IMF programmes on trade liberalisation surpassed that of World Bank adjustment loans or GATT/WTO membership. Countries completing IMF programmes, on average, reduced import duties by over 5% compared to non-programme nations. This highlights the heightened impact of the IMF through macroeconomic conditions linked to trade barriers. In contrary to this, IMF policy reforms reduce government policy space for investment in health by decreasing government spending and IMF policy reforms are selection biased (Stubbs et al., 2017). Additionally, IMF conditions of tariff reduction, while increasing formal employment and output, have adverse effects on informal producers by intensifying import competition without offering additional opportunities for the informal sectors access foreign export markets (Ero & Bonga-Bonga, 2018). This creates disparities in economic opportunities and outcomes create decline in domestic savings.

3. Trade Direction and Tariffs in SSA

My analysis consists of 41 Sub-Saharan African countries data spanning from 1995 to 2022⁶.

The SSA direction of trade has strong connection with the trade policies of MFN and NTMs. As per my analysis and related literature finding tariffs, as traditional trade barriers and NTMs, encompassing regulatory measures beyond tariffs significantly influence the flow and composition of trade, thereby shaping the direction of trade in SSA.

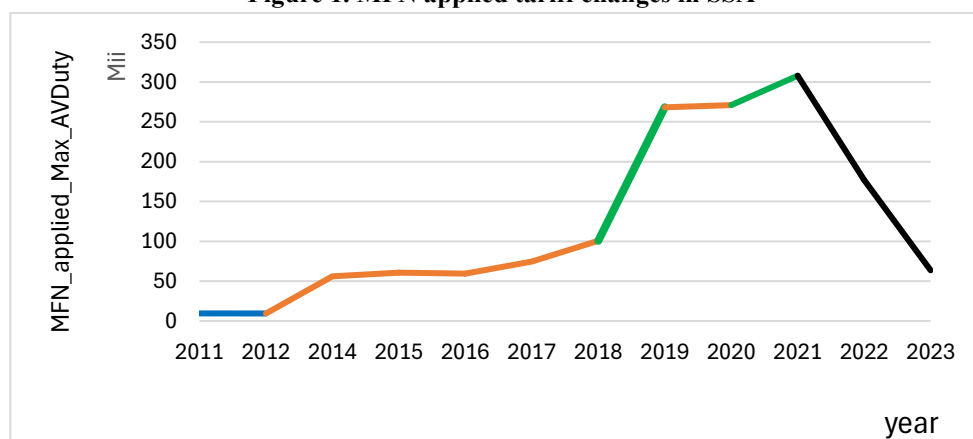
Between the period 2011-2023, annually, the average total SSA exports range from \$80-86billion. Odijie (2022)'s comparative study during the Yaoundé era affiliated and unaffiliated West African countries from 1960-1975 demonstrate that, those countries tied to EU trade agreements tended to experience a continuation of colonial economic patterns, while unaffiliated countries pursued economic change. In line with this argument, I begin to analyse the direction of trade (DOTs) of SSA illustrated in Appendix Figure A1.

⁶ I take 1995 as the base year because of UNCTAD began to collect and classify non-tariffs measures in 1994 and many countries of SSA have no data. <https://unctad.org/publication/guidelines-collection-data-official-non-tariff-measures>.

The above figures show that the trade directions of Sub-Saharan Africa are significantly influenced by the external economic conditions. Between 2011 and 2015 both the exports and imports of the region were averaging around \$60 billion. However, the figures have experienced a significant decline, falling to less than \$40 billion. This decline highlights the region's susceptibility to global disturbances. The onset of the COVID-19 pandemic in 2020 is a clear example of this, as it caused a sharp drop in the region's exports, which fell to just under \$60 billion. The volatility of trade direction in SSA emphasises the fragility of the region's economy, which is reliant on global trade patterns. Therefore, the region's economic growth is heavily influenced by the global economic atmosphere. The impact of the COVID-19 pandemic on the region's trade activities emphasises the need for Sub-Saharan Africa to focus on developing its internal economic structure.

However, the direction of trade (DOTs) of SSA is characterised by volatility cause of the tariffs, whether applied under MFN principles or preferential trade agreement, directly impact the cost of importing and exporting of goods, thereby influencing the attractiveness of trade relationships.

Figure 1. MFN applied tariff changes in SSA



Source: author's, UNCTAD comtrade, 2024.

Figure 1 above reflects that the Most-Favoured Nation (MFN) has registered a slight escalation from 2011 up to 2018. However, the MFN_applied_Max_AVDuty has undergone a significant transformation from 2018 to 2019. The considerable increase in the applied MFN tariff on agricultural products can be attributed to the SSA region's adoption of import substitution policies, which entail the imposition of elevated tariff barriers on agricultural imports. Notably, between 2019 and 2021, there was a marginal increase followed by a substantial decline. These might be due to the impact of COVID-19 pandemic (2019-2021) and may also be attributed to temporary tariff hikes implemented by governments to boost food security amid severe disruptions in global supply chains.

4. Data and Study Design

This study explains the variables and data sources selected from the literature reviews. The study employed panel data spanning from 2011 to 2023. Notably, some Sub-Saharan African (SSA) countries joined the International Monetary Fund (IMF) programme in early 1993. Besides, the United Nations Conference on Trade and Development (UNCTAD) began to collect and categorise nontariff measures in 1994, while the World Trade Organization (WTO), replacing the General Agreement on Tariffs and Trade (GATT), which had overseen world trade since 1948, was established in 1995. However, the availability of data for most of the countries in the sample are after 2011.

To investigate the impact of IMF conditionality on trade and tariffs, data was collected from the IMF database, specifically the Monitoring of Fund Arrangements (MONA) Database. This archive contains IMF conditionality data from 1993 to 2023. However, the study focused on data from 2011 to 2022. The study primarily concentrated on variables such as the country name, given that IMF Structural Adjustment Programmes (SAPs) which is implemented in country “i”. Subsequently, the study ascertained the effects of IMF conditionality, which target enhancing the international trade policy reforms of developing countries, such as prior criteria (PA). For instance, Ethiopia requested trade system policy reforms in 2004, which included the adoption of a plan for the reduction of trade protection, elimination of trade restrictions and administrative controls on wholesale foreign exchange, an increase in the top sales rate to 15%, and the simultaneous elimination of the 10% import duty surcharge as prior criteria. Structural benchmarks (SB) were utilised to attain these conditions.

Similarly, in 2003, Kenya requested trade system reforms via the elimination of significant import exemptions awarded to the public sector. Performance criteria (SPC) were also utilised. In 2002, the IMF requested Ghana to improve the trade system by eliminating the special import tax in the 2002 budget, effective immediately (3/31/2002).

Furthermore, I used MONA databases of a three-year period preceding the IMF programme and the four years that followed it can aid in the evaluation of the effects of IMF conditionality on the agricultural product trade growth of SSA. The extent of a country’s involvement in international trade can be measured by assessing the impact of IMF conditions on the trade growth, change in agricultural product tariff, and tariff overhang of a given country (i) at a specific time (t). The impact of trade openness over time can be determined by examining the data through the interaction of a year dummy variable with key explanatory variables.

To assess the impact of IMF SAPs programmes impact on trade and Non-Tariff Measures (NTMs)⁷, I used UNCTAD (2023) TRAINS database of World Bank WITs and product tariff level HS-6-digit lines import and export trade following countries impose tariffs using SPS and TBT protection mechanisms and exchange

⁷ The NTM is a policy instrument of a nontariff barriers such as traditional trade policy (quotas, price controls) and regulatory and technical measures (SPS, TBT).

rate data. Tariff⁸ data were collected from the World Trade Organisation's (WTO)⁹ Tariff Download Facility, a comprehensive database of information on Most-Favoured-Nation (MFN) applied and bound tariffs at the Harmonised System (HS) standard codes for WTO members. Moreover, this platform provides data at the HS subheading level on non-MFN applied tariff regimes that a country grants to its export partners.

To achieve the research objectives, only WTO member countries belonging to the Sub-Saharan region were selected. Furthermore, countries for the analysis were chosen based on the availability of MFN-tariff, both applied and bound MFN-tariffs¹⁰, membership in the WTO, and participation in at least one of the International Monetary Fund (IMF) programmes.

The WTO tariff download facility provides product information in Agricultural (AG), Non-Agricultural Manufacturing (NAMA), and all categories. However, the primary objective of this study is to examine the impact of IMF conditionality and Structural Adjustment Programmes (SAPs) on the trade of agricultural products in Sub-Saharan Africa (SSA). Therefore, only AG products of the HS-6-digit subheading line were included in the sample.

The countries belonging to SSA's are consisted in the country sample based on availability of MFN-tariff both applied and bound-tariff data and member of WTO. I considered the NTMs of countries' imposition of Sanitary and phytosanitary (SPS) measures and technical barriers to trade (TBT)¹¹. Finally Aid for trade (Aft) data was collected from OECD QWIDs¹².

5. Empirical Estimation

To examine the impact of IMF conditionality on trade growth rate, a panel data fixed effect estimation approach was utilised, incorporating IMF conditionality

⁸ Tariff data on Most-Favoured-Nation (MFN) applied & bounded at HS-6-digits will be collected from WTO WITS Database and classified as Bounded, applied, and preferential tariff. In this study, only bound and applied tariffs are considered.

Bound tariff: Maximum tariff rates that a country has committed to under international agreements such as those negotiated in WTO. Applied tariff: Are actual tariff rates that each country currently imposes on imported goods.

Preferential tariff: Are special reduced tariff rates granted to certain countries or regions as part of preferential trade agreements. (<http://tariffdata.wto.org/>)

⁹ <http://tariffdata.wto.org/>

¹⁰ MFN tariffs represent the commitments made by countries to levy tariffs on imports from fellow members of the WTO, unless they are involved in a preferential trade arrangement like a free trade area or customs union. In essence, MFN rates typically denote the highest tariffs that WTO members apply to each other (<https://wits.worldbank.org/WITS>).

¹¹ According to WTO's agreement, each country government favours their domestic industries subject to the regulations of WTO's.

¹² December 6th Ministerial Conference in Hong Kong, China, Article 57 stipulates that the Aid for Trade, as discussed among Financial and Development Ministers, including the Development Committee of the World Bank and the International Monetary Fund, aims to assist developing countries, particularly the least developed countries, in enhancing their supply-side capacity and trade-related infrastructure. The primary objective is to enable such nations to successfully implement and benefit from WTO agreements, as well as to broadly expand their trade.

dummy variables, SAPs dummy variables, and country income level and geographical location being in the landlocked region. In this research, key variables included trade growth rate, changes in tariff rates, tariff overhang, SAPs implementation, and IMF tariff conditionality. The objective was to investigate the effects on trade and tariffs at each product level in country *i* during the presence of an IMF programme. The analysis was conducted for country *i* across *k* products. Since the changes occurred at the product level, and SAPs programmes were implemented within country *i*, the focus was on understanding the dynamics of trade and tariffs in this context.

My analysis was split into two sections to investigate how the IMF's conditionality affected the trade reform policy of SSA countries. In the first case, I examined the agricultural product trade growth rate of country *i* with IMF conditionality. Secondly, I investigated the impact of IMF conditionality and SAPs programmes on tariffs overhang within country *i*. Disaggregated HS-6-digit product-level data was used, obtained from global trade and tariff databases covering multiple countries. This enabled us to conduct our study for *K* products at the country level, as SAPs took place at the country *i* level for each product *k*.

To examine the impact of IMF conditionality on the trade growth rate, I run multiple regression analyses with IMF conditionality dummy, year dummy, & SAPs dummy.

$$gt_{ikt} = \alpha + \beta_1 IMFcond_{it} + \beta_2 SAPs_{it} + \beta_3 appliedMFN_{ikt} + \mu \gamma_{it} + \omega IMFcond_{ikt} * \gamma_{it} + \sum \beta_j X_{ikt} + \sigma_{ik,t} + \delta_{it} + \varepsilon_{it} \quad (1)$$

where, α is the intercept, which is the average trade growth rate in the absence of IMF conditionality, and the coefficient on $IMFCond$ is the difference in the average percentage change in trade growth between trade growth rate in the presence of $IMFcon$ and without. In other word β_1 captures the impact of IMF conditionality on trade growth rate changes.

gt_{it} is growth rate in trade as % of GDP,

$IMFcond_{it}$ is coded as dummy variable 1= IMF condition

0 = no IMF condition for country *i* at time *t*

$SAPs_{it}$ is coded as dummy variable 1= if country is in the IMF SAPs programme

0 = if the country is not participated in the programme.

$appliedMFN$ is the average of all Ad valorem duties in the HS code. The number of Ad valorem equivalents for no-Av duties is included.

$\gamma = \frac{AfT}{GDP}$, and AfT is total Aid for trade.

γ_{it} is aid for trade (AfT) share of GDP, μ is the coefficient of AfT as % share of GDP.

X_{ikt} is a vector of time-varying country controls like GDP per capita, population, exchange rate, and inflation.

$\sigma_{ik,t}$ product fixed effects, δ_{it} are country fixed effects, and ε_{it} are error terms.

The second analysis is to assess the impact of IMFcon on the trade openness of a particular country (i) at a certain time (t).

Our final estimation is on the change in tariff rate and tariff binding overhang which shows the policy impact of IMF conditionality at HS-6-digit product level in country i.

$$\Delta\text{Tariff}_{ikt} = \alpha + \beta_1\text{IMFcond}_{it} + \beta_2\text{SAPs}_{it} + \mu\gamma_{it} + \omega\text{IMFcond}_{it} * \mu\gamma_{it} + \sum \beta_j X_{jit} + \sigma_{ikt} + \delta_{it} + \varepsilon_{it} \quad (2)$$

where, $\Delta\text{Tariff}_{ikt}$ is the change applied MFN tariff in the tariff imposing country I at the HS-6-digit product level k in in year t.

$\Delta\text{overhang}_{it}$ refers the change in tariff overhang = bound tariff $_{ik,t-1}$ – applied tariff $_{ik,t-1}$

Indicates the difference between the MFN bound and applied tariffs at the HS-6-digit level in country i of k product at time t. low values of overhang tariffs indicates applied tariffs are almost approached to the upper limit standard of tariff rate set by WTO’s Multilateral Trade Negotiations (MTN).

Multilateral Trade Negotiations (MTN).

6. Results

Firstly, I would like to present the results of the estimations of the effects of the IMF tariff conditionality on agricultural product trade growth in SSA, as shown in Table 1. The estimated coefficients for the fixed-effect regressions in columns (1) and (2) are reported. The first equation presents the effect of IMF tariff conditionality in the presence of the Average of all Advalorem duties in the HS-6-digit code measured by Advalorem equivalents for non-Av duties (MFN_Applied_Avg_AV_Duties). The second equation Binding overhang¹³ (tariff overhang) replaces (MFN_Applied_Avg_AV_Duties measured by Average of all advalorem duties in the HS-6-digit code.

Table 1. Regression Results – growth in trade

Variables	(1)	(2)
	trade growth FE	trade growth FE
IMF cond dummy	-5.660***	-5.756***
	(0.171)	(0.171)
SAPs tradesystem	19.036***	19.032***
	(0.349)	(0.348)
oda aft	-1.161***	-1.163***
	(0.190)	(0.190)

¹³ Binding overhang (tariff overhang) is the difference between bound and applied MFN. Bound tariffs are the maximum tariff levels agreed upon by WTO members for specific goods. They represent commitments made during WTO accession or trade negotiations, specifying the highest allowable tariffs, although actual applied rates may be lower.

Variables	(1)	(2)
	trade_growth FE	trade_growth FE
IMF_cond_oda_aft	0.413***	0.414***
	(0.017)	(0.017)
MFN_Applied_Avg_AV_Duties	0.006***	
	(0.001)	
Pop	1.510	1.490
	(0.937)	(0.935)
averg_cpi	-0.017	-0.017
	(0.031)	(0.031)
ln_gdp	14.462**	14.539**
	(7.116)	(7.098)
tariff_overhang		-0.003***
		(0.000)
Constant	-16.675	-15.757
	(13.394)	(13.325)
Observations	2,380,118	2,375,935
R-squared	0.002	0.002
Number of countries	26	26
country FE	YES	YES
Year FE	YES	YES

Notes: product in country i, country, and year fixed effects are included.

Standard errors are in parentheses.

*** p < 0.01, ** p < 0.05, * p < 0.1.

Source: author's own research.

Column (1) identified various significant variables that influence agricultural product trade growth in SSA. I found that stricter IMF tariff conditions, represented by IMF_cond_dummy, had a negative coefficient (-5.660) and were negatively associated with agricultural product trade growth¹⁴. The result is the same for agricultural product import as % of GDP at country level where imports as a percentage of GDP are negatively associated with IMF conditions and the Official Development Assistance (ODA) AfT (See Appendix, Table A1). Conversely, IMF SAPs in trade system reform, as represented by SAPs_tradesystem, had a positive coefficient (19.036) and experienced higher trade growth¹⁵. For example, Kenya's three-year IMF programme P1 launched in 2011 and ended in 2014 under SAPs of

¹⁴ I also estimated the relationship between import % GDP and export % GDP at the country level, and the results are consistent with IMF conditions constraining import values as a percentage of GDP. Trade growth and the import/export data are agricultural products that do not consist of the others. NOTE: My analysis focuses only agricultural products of the HS-6-digit-level are in the sample.

¹⁵ The regression results of effect of IMF SAPs in trade system on the values of import %GDP is consistent with IMF SAPs effect on trade growth in which SAPs trade system reform has positively related to import. IMF Structural Adjustment Programmes (SAPs) still encourage trade growth, as they are positively related to imports as a percentage of GDP. The results of the regression analysis show that the implementation of IMF SAPs in the trade system has a positive impact on the import %GDP values (See Appendix, Table A2).

international trade policy reform increases exports of goods and services from 536.39 NCU (billions) in T-3 (i.e., 3 years before IMF project) to 988.02 NCU (billions) in T+3 (i.e., 3 years after project). This indicates that countries participating in the IMF SAPs programmes for trade system reforms benefit from the programmes, as they encourage trade growth and increase the import and export of goods and services.

Another crucial factor was official development assistance (ODA) aid for trade¹⁶, as captured by *oda_aft*, which displayed a negative coefficient (-1.161) and was associated with decreased trade growth. The coefficient -1.161 implies that a 1% increase in ODA aid for trade is associated with a decrease in trade growth by approximately 1.161% which is almost similarly to column (2). It can infer that higher levels of ODA AfT are associated with lower trade growth rates. This suggests that the effectiveness of ODA AfT in promoting agricultural product trade growth of SSA country is potentially counterproductive.

The positive coefficient (0.413) shows that the interaction between IMF tariff conditionality and ODA-AfT has a mutually reinforcing impact on trade growth. When countries joined and engaged in IMF's SAPs trade system reforms in line with IMF conditions and simultaneously received AfT, the combined effect enhanced trade growth. This suggests a synergistic relationship between trade system policy reforms and external ODA's AfT financial support.

Moreover, the average applied ad-valorem duties under the Most Favoured Nation (MFN) principle, as represented by "*MFN_Applied_Avg_AV_Duties*", had a positive coefficient (0.006). This suggests that higher average duties were associated with greater trade growth. The size of the population, represented by "*pop*," demonstrated a positive coefficient (1.510), indicating that countries with larger populations experienced a higher trade growth, unfortunately, it is insignificant. However, the average consumer price index (CPI), denoted by "*averg_cpi*," exhibited a negative coefficient (-0.017), implying that a higher average CPI was associated with a lower trade growth in agricultural products of the SSA countries. For GDP per capita, I obtained consistent results in both regression results and statistically strong positive relation in enhancing trade growth in agricultural outputs of the SSA countries to the partners. Therefore, the natural logarithm of GDP, represented by "*ln_gdp*," had a positive coefficient (14.462), indicating that a higher GDP was associated with greater trade growth. The inclusion of country fixed effects (FE) and year fixed effects (FE) was controlled for unobserved country and year-specific factors.

Column (2) built upon column (1) by including an additional variable, binding overhang¹⁷ represented by *tariff_overhang*. It is a measure of the difference between the bound tariff rates (maximum MFN tariff commitments made by a country in

¹⁶ At the Sixth Ministerial Conference held in Hong Kong in 2005, the members of the World Trade Organization (WTO) introduced the Aid for Trade initiative to strengthen the trade capabilities of developing countries, especially the least developed ones, by enhancing infrastructure and expanding trade opportunities (UN, 2017) <https://financing.desa.un.org/>.

¹⁷ All countries who are a member of the WTO are committed to bound tariffs which is the maximum MFN tariff level for a given commodity line.

international agreements) and the applied MFN rate (actual tariffs imposed on imports). This variable exhibited a negative coefficient (-0.003), indicating that higher average binding overhang were associated with lower trade growth. Thus, as the gap between bound and applied tariff rates increases, trade growth tends to decline because a high binding overhang can act as a barrier to trade growth in the trade growth of SSA agricultural products. In addition to this, a large binding overhang makes a region’s trade policies less predictable.

Then next, I will discuss the estimates of the tariff binding overhang and evaluate the impact of IMF tariff conditionality on changes in agricultural product tariffs in SSA. In my previous estimation, I found that the binding overhang has a negative relationship with the trade growth of agricultural products in SSA. Therefore, I am sceptical whether this relationship is caused by IMF interference.

The estimates were utilised to analyse how IMF conditionality narrows the gap between the MFN applied tariffs and MFN bound tariff levels on agricultural products. According to recent research by Lorz and Thede (2024), affluent countries leverage development AfT to secure tariff concessions from developing countries. The compensation received by the poorer countries determines the extent of their applied tariff reduction below the bound tariff rate. In anticipation of this mechanism, countries can negotiate a bound tariff rate that optimises the applied tariff and aid outcomes.

Accordingly, in Table 2 below, in column (1) the coefficients of IMF conditions and ODA- AfT are negative, which implies that, both IMF interference and ODA-AfT in the aid-receiving countries of SSA’s are successfully reducing the gap between applied and bound tariffs.

When the applied tariffs are lower than the bound tariffs, it creates a situation where countries have room to increase tariffs without violating their international commitments. This difference, or overhang, represents untapped policy space in trade policy.

Table 2. Regression Results – tariff binding overhang

Variables	(1)	(2)	(3)
	overhang FE	overhang FE	overhang FE
IMF_cond_dummy	-2.261*** (0.208)	-2.210*** (0.198)	-2.379*** (0.201)
SAPs_tradesystem	6.427*** (0.604)	4.481*** (0.459)	5.544*** (0.518)
SAPs_Pricing_mrktng	-0.691* (0.390)		0.281 (0.452)
oda_aft	-0.027 (0.262)		
SAPs_tradesystem#c.oda_aft (1)	-0.085* (0.043)		
ln_pop	-32.477 (39.730)		

Variables	(1)	(2)	(3)
	overhang FE	overhang FE	overhang FE
ln_gdp	19.384		
	(17.208)		
averg_cpi	-0.015		
	(0.040)		
ln_trade	1.061		
	(3.211)		
SAPs Tax reform			1.241***
			(0.267)
Constant	85.301	49.709***	49.023***
	(65.698)	(0.393)	(0.440)
Observations	2,375,909	2,570,712	2,570,712
R-squared	0.011	0.018	0.018
Number of unique ID	71	75	75
country FE	YES	YES	YES
Year FE	YES	YES	YES

Notes: product in country i, country, and year fixed effects are included.

Standard errors in parentheses.

*** p < 0.01, ** p < 0.05, * p < 0.1.

Source: author's own research.

Consistently in both columns (2) and (3), IMF conditionalities exhibit significant negative coefficients. This suggests that the IMF tariff conditionality requirements have successfully nudged SSA countries towards honouring their tariff commitments as part of the international trading system. However, disaggregating the IMF SAPs impact on tariff binding overhang shows their differential effects. The large positive coefficient on SAPs trade system reform (SAPs_tradesystem) implies trade liberalisation reforms had the strongest influence on diminishing tariff overhang by lowering applied tariffs towards bound levels for agricultural product of SSA. This finding is consistent with the theoretical model presented by Lorz and Thede (2024), whereby trade liberalisation and aid dependence can interact to affect a country's tariff overhang in which countries receive more AfT have stronger incentives to set high bound tariffs despite the liberalisation of trade. This is to maintain bargaining power and flexibility for negotiating future aid and imports.

In other words, implementing SAPs for trade system reform in SSA can lead to growth in agricultural trade by raising MFN applied tariffs on agricultural products imported from other countries. It indicates a virtuous cycle where more open markets incentivised further tariff cuts. As an illustration, within the ambit of IMF's structural benchmark conditions (SB) for international trade policy reform under code 754, Benin has requested a diagnostic assessment of its primary trade barriers. This assessment will be based on the framework adopted for the notification phase of the WTO Trade Facilitation Agreement, as part of Benin's trade reform efforts between 2017 and 2020 and will have a significant impact on Benin's participation in international trade (see Appendix Figure A2).

The graph in Appendix Figure A2 illustrates that Benin's export-import trade has increased from 4.1% and 4.4% to 4.47% and 4.65%, respectively. This suggests that Benin's participation in the IMF SAPs for trade system reform has had a positive impact on its international trade.

Consistently, within the same period, the IMF SAPs prompted the government of Senegal to request a tax reform study on the impact of tax exemptions resulting from the relocation of Senegalese enterprises to the new integrated special economic zone. This study was to be completed before signing a contract with the zone's investor and based on a methodology agreed with the Fund staff. The macroeconomic impact of IMF conditions showed that Senegal's export of goods and services rose from 3.4% before the T-3 project (3 years before the IMF project) to 3.9% after the T+4 project (4 years after the IMF project), while import increased from 3.7% to 4.01%.

The outcome of the regression analysis indicates that the coefficient for SAPs pricing and marketing policies has a statistically significant negative impact on tariff binding overhang in column (1). However, this coefficient was found to be statistically insignificant in specifications (2) and (3). These results provide empirical evidence that pricing and marketing policies reform prescribed by the IMF through SAPs have effectively reduced tariff binding overhang situations over time in SSA countries.

For instance, under arrangement 760, which spanned from 26 June 2017 to 17 July 2019, the government of Cameroon was required to implement a three-year IMF structural benchmark condition. As part of this condition, the Cameroon government was mandated to reform the price control and marketing policies to simplify and revise the existing fuel price structure. This condition serves as an example of the effectiveness of SAPs in reducing tariff binding overhang situations in SSA countries.

The Appendix Figure A3 shows that there has been a notable increase in both import and export of goods and services. Specifically, the export figures have risen from 405,000 NCU in the T-3 period to 503,000 NCU in the T+4 period. It is worth noting that the increase in import is relatively lower than that of export during this time.

In column (1), the coefficient for ODA aid for trade (*oda_aft*) is not significant. This indicates that ODA alone may not have a substantial impact on tariff binding overhang. However, the interaction term between SAPs related to trade systems and *oda_aft* (*SAPs_tradesystem#c.oda_aft*) displays a significant negative coefficient. This suggests that when countries simultaneously implement trade system reforms and receive ODA_AfT, the combined effect leads to a reduction in tariff binding overhang. This finding underscores the potential synergies between trade policy reforms and external financial assistance in addressing tariff constraints.

In column (3) IMF, it appears that SAPs aimed at tax reforms can increase tariff binding overhang in the region. The statistically significant coefficients of 1.241 suggest a passive association between the two. The theoretical reasoning behind this is that tax reforms under SAPs may involve reducing tariffs and import

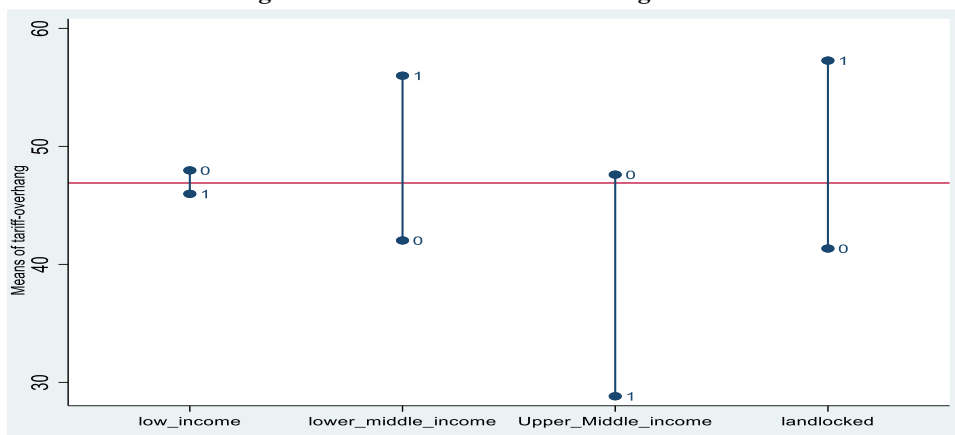
duties, leading governments to set higher bound tariff rates than their applied rates to maintain bargaining power in future trade negotiations.

In this analysis, I did not observe any significant impact of variables such as population size, GDP, inflation, and trade % GDP on the binding overhang. However, my argument is that IMF-led SAPs, especially those targeted at trade systems and tax reforms, have contributed to higher agricultural product tariff binding overhang in SSA countries.

To investigate the characteristics of tariff overhang, the countries in the SSA sample group were categorised based on their income level and geographical location. Specifically, the countries were classified into four groups, namely low income, lower middle income, upper middle income, and landlocked. Each group was represented by a binary dummy variable which assumed a value of 1 if the country belonged to that group and 0 if it did not. This approach allowed for a comprehensive analysis of the factors that potentially contribute to tariff overhang in SSA countries.

The data presented in Figure 2 indicates that countries with low-income have a mean value of tariff overhangs exceeding 48%, whereas lower middle-income countries have an average value of tariff overhangs that surpasses 55%. Conversely, upper middle-income countries have a mean value of tariff overhangs that falls below 30%. In addition, it is noteworthy that landlocked countries exhibit a significantly higher tariff overhangs' value than all other countries that do not belong to this group.

Figure 2. Features of tariff overhang in SSA



Source: author's, 2024.

Figure 2 above suggests that lower-income countries, especially those that are landlocked, tend to maintain higher tariff overhangs, which may indicate a trade policy that is less open to foreign investment. Although higher tariff overhangs can provide countries with more leverage in trade negotiations, they also introduce market unpredictability, which could have an impact on economic decision-making. The particularly high tariff overhangs in landlocked countries highlight the unique

challenges they face when attempting to access international markets, which prompts them to adopt more protective trade policies.

7. Extension

The above regression result provides evidence of binding overhang are inversely linked to the agricultural trade growth of SSA. Furthermore, IMF tariff conditionality, IMF SAPs pricing and marketing policies, and the interactions of SAPs trade system reforms & ODA_AfT are negatively associated with the tariff binding overhang. However, IMF SAPs in trade system and SAPs in tax reforms are positively linked with binding overhang.

The above result demonstrates an inverse link between the binding overhang and agricultural trade growth in SSA. Moreover, the study reveals that IMF tariff conditionality, IMF SAPs pricing and marketing policies, and the interactions between SAPs trade system reforms and ODA-AfT are negatively associated with the tariff binding overhang. Conversely, there is a positive relationship between binding overhang and SAPs in tax and trade system reforms. In this part, I analysed the relationships between the change in MFN applied tariffs and IMF SAPs policy reforms in the trade system, tax, exchange rate, and Pricing and marketing policies in SSA.

Table 3. Regression Results – tariff change

Variables	(1)
	tariff change FE
SAPs_tradesystem	-1.939*** (0.475)
SAPs_tax reform	-0.921*** (0.297)
SAPs_pricing & marketingsystem	-0.619 (0.436)
SAPs_exchange rate reform	-0.585 (0.446)
Constant	0.856*** (0.286)
Observations	2,562,681
Number of unique_ID	75
R-squared	0.016
country FE	YES
Year FE	YES

Notes: product in country *i*, country, and year fixed effects are included.

Standard errors in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: author's own research.

Table 3 shows the impact of IMF SAPs policies reform in tariffs at the agricultural product HS-6-digit level, while considering the fixed effects of the country, product, and year. All SAPs policy variables have negative coefficients and are statistically significant, except for SAPs_pricing & marketing system, which has a negative but statistically insignificant coefficient. This suggests that overall, IMF SAPs programmes are associated with reductions in agricultural product tariffs of SSA. Specifically, SAPs_tradesystem is associated with a 1.939%-point larger reduction in tariffs compared to countries not implementing trade system reforms under SAPs. Similarly, SAPs_tax reform leads to a 0.921 %-point larger tariff cut relative to countries without tax reforms. Lastly, SAPs_exchange rate reform correlates with a 0.585 percentage point bigger tariff decrease.

In conclusion, the SAPs of IMF have effectively reduced tariff of HS-6-digit level agricultural product in SSA countries. The measures implemented to achieve this outcome include trade liberalisation and market-oriented reform policies that were attached to AfT. The policies related to the trade system, tax, and exchange rate within the SAPs programme have contributed independently to the reduction of agricultural product tariffs.

However, an important question arises as to whether the IMF's tariff conditionalities and SAPs programmes have been successful in reducing agricultural product tariffs, given that almost all SSA countries rely on agricultural products for trade. Therefore, it is necessary to ascertain if SSA can effectively compete with advanced economies, or if the IMF provides compensation for the reduction in tariffs through AfT financing for SSA trade.

8. Discussions

In this study, I have analysed the impact of IMF tariff conditionality on agricultural productivity in the case of Sub-Saharan African (SSA) countries. The study considers 26 SSA countries and 832 HS-6-digit level agricultural products, and more than 2.3 million observations are analysed. SSA countries are chosen for this study for two main reasons. Firstly, the region is one of the focus areas of the IMF as an international financial institution. Secondly, the SSA region is characterised by the vulnerability of international trade, in which agricultural products are the main dominance of SSA trade. Countries in the sample are selected based on the availability of data, being in at least the IMF SAPs programme, and being a member of the WTO. The data are mostly collected from MONA database, WITS tariff download facilities, UNCTAD comtrade, the OECD, and the WB.

The reviewed literature can be divided into three main points. Firstly, it concerns the effectiveness of IMF conditionality and its SAPs programmes towards tariff reduction and enhancement of developing countries' trade in the international trade. Secondly, aid conditionality rooted in the efficiency of international trade, particularly policy tied to AfT, has an extensive debate. At this point, there are arguments that support aid conditionality. For example, Collier and Dollar (2002) and Dreher (2009) have argued that the policy attached to aid requirements is enforced to guarantee that trade reforms are implemented to foster trade

liberalisation. The third concept concerns the continuous issue of foreign aid effectiveness in development economics. This concept can be seen in two ways: First, there are those who believe that official assistance is ineffective and has harmed poor countries over the years. This view is advocated by authors such as Rich (2014) and Moyo (2010), who argue that official aid creates dependency, fosters corruption, encourages currency overvaluation, and does not allow countries to take advantage of the opportunities provided by the global economy. However, scholars like Eyben (2010) and Stiglitz (2002) argue that the levels of aid have historically been too low and that a large increase in foreign aid could be greatly effective in helping to reduce poverty.

Furthermore, in the analysis of development aid as a possible explanation for tariff overhang, which refers to the gaps between negotiated tariff ceilings and actual tariff rates, some researchers argue that tariff overhangs can be viewed as collateral to induced aid payments from developed to developing countries. Lorz and Thede (2024) have put forth the argument that AfT is increasingly perceived as tool for opening markets, particularly with the WTO's placing greater emphasis on developing countries.

Concerning my focus areas of IMF conditionality, trade, and AfT there exists a range of literature offering different perspectives. Some criticise IMF conditionality tied to IMF programmes for biased decision-making and support of dictatorships, as mentioned in the Bretton Woods Project (2019) and IMF intervention can limit a government's policy space, reducing ownership of implemented reforms, in line with Kentikelenis et al. (2016). Additionally, IMF conditions push countries to liberalise trade by swapping policies, focusing on macro targets through trade barrier reductions rather than broader reforms, according to Busse and Vogel (2023).

In line with the review literature, stricter IMF tariff conditions namely prior actions (PA), performance criteria (SPC), and structural benchmarks (SB) are negatively associated with agricultural product trade growth, while IMF SAPs in trade system reform are positively associated with trade growth. Prior actions are measures taken by countries receiving aid before the IMF approves an arrangement, completes a review, or grants a waiver that is essential for programme implementation. On the other hand, performance criteria are specific and measurable objectives that the recipient must meet, and failure to comply with them may result in programme termination, although the IMF has the power to waive such noncompliance. Whereas conditionality taken in the form of structural benchmark does not lead to automatic termination, it will be assessed with the programme's overall performance¹⁸.

I have conducted a highlighting assessment of 15 countries, including non-World Trade Organization (WTO) members, to gain insight into how SSA countries react to declining tariffs. It has been observed that developing countries use NTMs as an alternative to MFN tariff reduction. This enables them to protect their infant agricultural products from the influence of advanced economies.

¹⁸ IMF Conditionality

NTMs encompass all policy interventions besides tariffs, which could potentially influence the quantities and prices of traded goods. As a result, SSA countries utilise NTMs strategically to regulate export-import policies and shape trade dynamics. The study exclusively focused on technical categories of NTMs, such as technical barriers (TB) and Sanitary and Phytosanitary (SPS) NTMs, which are primarily intended to fulfil public policy objectives, including the protection of human, plant, and animal life and health, as well as the environment. SSA countries predominantly employ SPS measures as alternative mechanisms to respond to tariff decline, with technical NTMs having a limited impact. This is owing to the presence of IMF tariff conditionality and SAPs programme. SPS measures are concentrated in this sector, as demonstrated in Appendix Figure A4.

The binding overhang has a negative correlation with the growth of agricultural product trade in SSA, signalling that countries in the landlocked and lower-middle-incomes are with maximum MFN tariff commitments that are higher than actual tariff commitments. As the gap between bound and applied tariff rates widens, trade growth tends to decline because a high binding overhang can act as a barrier to trade growth in the region's agricultural products. Furthermore, a large binding overhang renders a region's trade policies less predictable.

However, the results also indicate that the participation in comprehensive IMF structural reform efforts centred around trade policy liberalisation under SAPs can foster greater trade expansion. The positive and significant coefficient for the SAPs trade systems variable implies that trade opening measures successfully increase agricultural trade growth.

Interestingly, aid for trade alone does not achieve the same benefits, as the negative coefficient for ODA assistance in Table 1 implies. However, the interactive term between IMF conditionality and aid indicates financing support works best in a complementary reform environment of trade opening, pointing to potential synergies when approaches are aligned, as also emphasised by McKinnon (2012) in their policy discussion paper.

Examining tariff barriers more directly, the results clearly show that the tariff binding overhang acts as an impediment to agricultural trade growth, with a negative coefficient in Table 1 column 2. This corresponds with the theoretical work by Lorz and Thede (2024) demonstrating that uncertainty from the gap between bound and applied rates creates trade distortions. Moreover, the participation in IMF programmes through conditionality and coordinated aid appears to help reduce this overhang over time as evidenced by the negative coefficients on these variables in Table 2 column 1. This suggests that IMF engagements have aided SSA countries' progression towards more binding and predictable trade policies.

Disaggregating the effect of different SAPs in Table 2 further reveals that trade and tax reforms under IMF auspices are most effective at lowering the overhang. However, tax changes may inadvertently motivate setting higher bound rates to retain flexibility, as proposed by the theoretical model developed by Limao (2006). This helps explain the differing impacts. Finally, Table 3 shows that the IMF intervention has systematically contributed to lower applied tariffs across the board

for agricultural products through its various policy-based lending instruments focused on trade, fiscal, and exchange rate reforms.

In conclusion, while tariff liberalisation alone linked to IMF programmes may negatively impact certain sectors like agriculture, holistic reform packages combining trade opening, aid support, and policy adjustments yield net trade expansion. Moreover, sustainably reducing uncertainty in the trade regime through progressive bindings appears key to maximising gains from trade, where IMF conditionality and SAPs have played a constructive role. Careful policy sequencing and compensation will still be important to offset vulnerability.

9. Conclusion

This study examines the impact of the IMF conditions and SAPs on agricultural trade and tariffs in SSA countries. The research finds that IMF tariff conditions have a negative impact on trade growth, while SAPs have a positive impact. ODA aid for trade has a negative association with trade growth. However, when there is an interaction between IMF tariff conditionality and ODA-AfT, the combined effect enhances trade growth. The average applied ad-valorem duties under the MFN principle have a positive correlation with trade growth. The tariff binding overhang has a negative impact on trade growth. The coefficient for pricing and marketing policies prescribed by the IMF through SAPs has a statistically significant negative impact on the tariff binding overhang in SSA countries.

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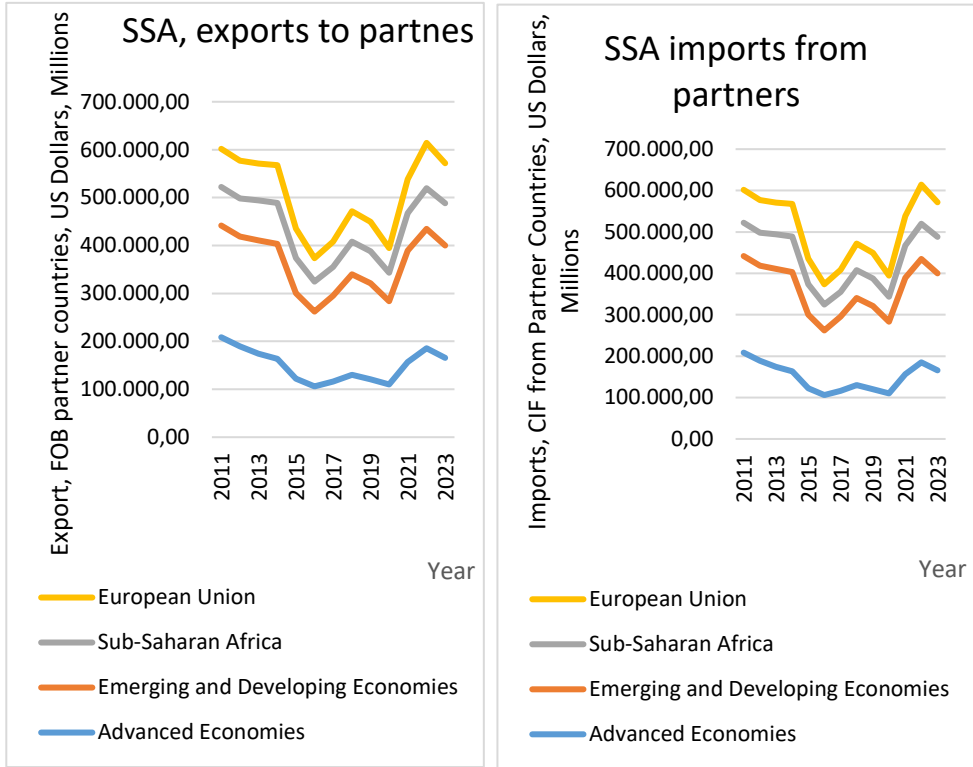
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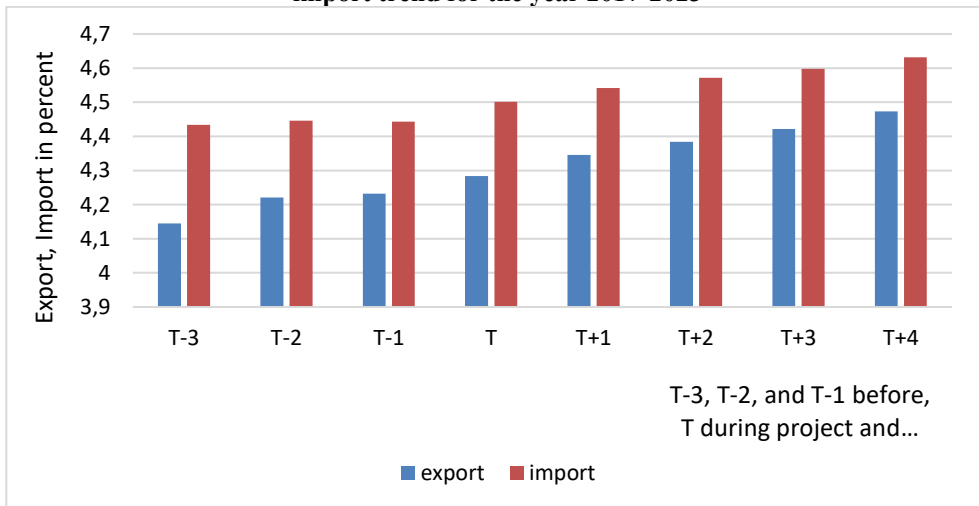
Appendix

Figure A1. SSA direction of trade



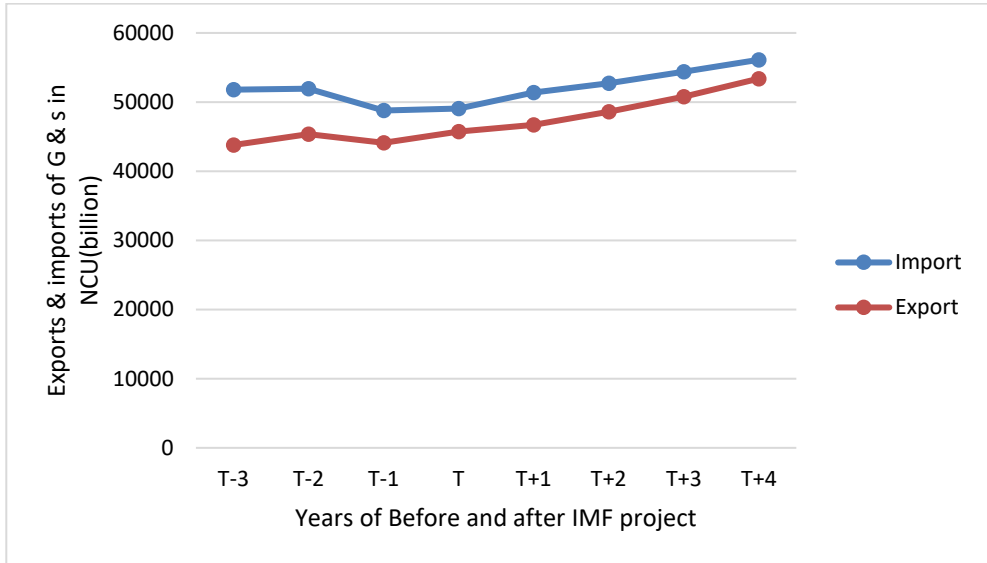
Source: author's, IMF DOTS, 2024.

Figure A2. IMF SAPs trade system reform and Benin export, import trend for the year 2017-2023



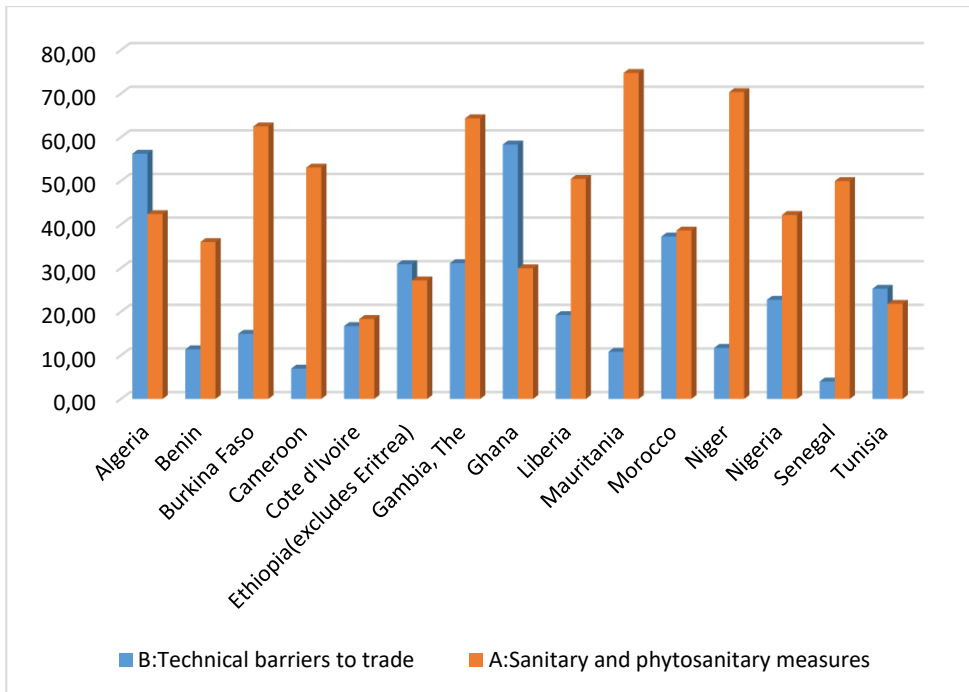
Source: author's construction, MONA data 2023.

Figure A3. IMF SAPs pricing and marketing reform and Cameroon export, import trend from 2017-2023



Source: author's, MONA data 2023.

Figure A4. Ad valorem equivalent of NTMs in SSA Countries



Source: author's, 2024.

Table A1. Regression result – Import as % of GDP

Variables	(1)
	Import %GDP FE
IMF_cond_dummy	-0.0003* (0.0001)
SAPs_tradesystem	0.0001 (0.0003)
oda_aft	0.0088*** (0.0001)
IMF_cond_oda_aft	-0.0001 (0.0000)
MFN_Applied_Avg_AV_Duties	-0.0011 (0.0000)
pop	-0.0001 (0.0007)
averg_cpi	0.0018 (0.0000)
ln_gdp	-0.0003 (0.0055)
Constant	99.4201*** (0.0104)
Observations	2,380,118
Number of countries	26
R-squared	0.0015
country FE	YES
Year FE	YES

Notes: product in country i, country, and year fixed effects are included Standard errors in parentheses.

*** p < 0.01, ** p < 0.05, * p < 0.1.

Source: author's own research.

**Table A2. Summary statistics: Mean.
Group variable: country1 (Country)**

	MFN Applied Avg AV Duties	Bound Avg AV Duties	tariff overhang	oda aft	trade growth
Angola	19.892	52.733	32.723	1.296	129.543
Benin	15.772	61.402	45.250	.008	24.448
Burkina Faso	15.772	97.828	81.808	6.504	24.448
Burundi	20.874	94.334	74.076	0	102.421
Cameroon	22.09	76.464	54.158	.709	124.101
Central African Republic	22.09	35.02	12.746	.254	124.101
Chad	22.09	72.813	50.624	.251	124.101
Chile	6	26.895	20.909	1.702	102.421
Djibouti	14.313	52.771	46.072	.109	51.607
Egypt	65.322	97.306	28.823	6.688	-57.153
Ghana	15.772	91.67	75.547	1.471	24.448
Guinea	15.772	39.638	23.526	.057	24.448
Guinea-Bissau	15.772	45.369	29.294	16.387	24.448
Kenya	20.806	91.276	70.428	.034	102.421
Liberia	15.772	23.493	7.653	.997	24.448
Madagascar	14.666	43.135	28.236	1.831	124.101
Malawi	17.731	106.728	90.003	7.723	-89.116
Mali	15.772	55.161	39.126	1.618	24.448
Mauritania	11.105	42.989	36.178	.324	-171.396
Morocco	27.667	63.041	37.197	4.987	52.85
Mozambique	13.926	76.709	67.315	0	119.264
Niger	15.772	111.413	95.831	9.843	24.448
Nigeria	15.772	122.63	107.070	12.841	24.448
Rwanda	20.833	56.726	36.430	3.148	102.421
Senegal	15.772	24.492	9.455	32.33	24.448
Seychelles	4.968	25.701	20.536	.068	24.448

Source: author's own research.

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Green Bonds in EU Countries: Towards Sustainable Finance

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Abstract

Green bonds have become a key tool in driving sustainable investment within the European Union (EU). The concept of green bonds has been growing over the last two decades, with an extraordinary emphasis in between 2010 and 2019, when its utilization took off among the financial institutions, governments and companies seeking capital for sustainable ventures. This study investigates the role and relevance of green bonds in the financial architecture of the European Union, focusing on the analysis of key actors and the regulatory framework influencing the evolution of this financial instrument. It discusses, from both a theoretical and empirical approach, the motivations and strategies of financial institutions, governments, and non-governmental organizations in promoting and developing the green bonds market.

Keywords: green bonds, sustainable financing, environmental policies, EU countries.

JEL Classification: G18, Q56.

1. Introduction

Innovative financial instruments are more topical than ever in a period when environmental and sustainability issues attract high attention in the process of fighting climate change and protecting the environment. One such instrument that has come to the forefront in the European Union is the green bond, which has taken the place of an important financing pillar to achieve sustainable development.

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Green bonds in particular are financial instruments that raise funds to aid projects with the least negative environmental impact, connected with renewable energy, enhancing energy efficiency, or supporting sustainable transportation (Zhao et al., 2022). They offer investors the opportunity to participate in projects that enable the transition to a low-carbon economy and the conservation of natural resources. Interest in green bonds in the EU has grown, fuelled by factors such as the EU's increased commitment to combat climate change and promote sustainability, together with growing investor awareness of the associated risks and opportunities. In order to understand the dynamics of the green bond market in the EU, it is necessary to analyze the role played by different stakeholders in promoting and advancing green bonds in the region, including financial institutions, governments, companies and NGOs (Harangozo and Zilahy, 2015).

Financial institutions, such as banks and investment funds, have been promoters in issuing and investing in green bonds, contributing to the flow of funds into sustainable projects (Ilic et al., 2019). Governments, those implementing initiatives such as the European Green Deal, are creating favorable environments for the expansion of the green bond market and also encouraging investments in green infrastructure. The public and private corporate sectors are giving greater priority to sustainability, integrating environmental, social and governance (ESG) factors into their strategies and may issue green bonds. NGOs, an important stakeholder in the journey to decarbonize the planet, are again seminal for monitoring and promoting the sustainable practices of issuers and investors. In light of growing interest in green bonds, the EU has developed regulatory mechanisms, such as the EU Taxonomy for Sustainable Activities and the Non-Financial Reporting Standards (NFRS), to combat ambiguity and provide transparency on the standards and criteria for issuing these green bonds.

The paper aims to present the detailed landscape of green bonds in the EU, analyzing the drivers of their recent interest and highlighting their key role in promoting sustainable financing. In the first part, we present a detailed description of what the concept of green bonds is and underline which factors contributed to its popularization in the European region. Then, we analyze the implications and contributions of most relevant players in the development and promotion of such bonds. Finally, it gives a presentation of the regulatory framework influencing green bonds in the EU and underlines its importance for transparency and compliance. The purpose of the paper is to provide a comprehensive informative perspective on the impact and direction taken by green bonds toward financial sustainability in the EU.

2. Problem Statement

Researcher Sartzetakis (2021) is of the opinion that green bonds are an innovative financial instrument designed to support projects and initiatives with a positive impact on the environment and at the same time to promote the transition towards low-carbon economies. They first appeared among investors in the 2000s, but their popularity has grown significantly in recent years, especially in the European Union.

The scriptural history of green bonds can be traced back to 2007, when the European Investment Bank (EIB) issued the first green bond, channeling its funds to projects dedicated to the transition to renewable energy and energy efficiency (Nikolaou, 2018). Over time, other financial institutions, governments and companies have adopted this practice, contributing significantly to the development of the green bond market.

From the literature in the field, green bonds are likewise described as financial instruments designed to support projects and initiatives with a positive environmental impact (Agliardi and Agliardi, 2019; Sartzetakis, 2021; Fatica and Panzica, 2021; Alamgir and Cheng, 2023, Mecu et al., 2021). They are issued by specialized institutions such as governments, financial institutions or companies and aim to finance projects that promote the transition to a low-carbon economy and the efficient use of natural resources (Versal and Sholoiko, 2022).

Green bonds are described as essential for channeling capital towards sustainable initiatives, including smart and green infrastructure, renewable energy and energy efficiency (Monk and Perkins, 2020; Muhammad et al., 2022; Muhammad et al., 2022; Ning et al., 2023; Almagir and Cheng, 2023; Mecu et al., 2021). They are seen as catalysts for efficiently transitioning to a low-carbon economy and encouraging sustainability innovation.

The green bond market has experienced rapid growth, attracting more issuers and investors of such financial instruments (Gianfrate and Peri, 2019; Tang and Zhang, 2020; Caramichael and Rapp, 2024). Investor attraction is not only due to financial returns, but also for their alignment with European and global sustainability goals (Broadstock et al., 2022; Ahmed and Isahque, 2023).

Studies in the literature highlight the need for a clear and concise regulatory framework to ensure transparency and trust in green bonds (Ramstad, 2019; Bhutta et al., 2022). Concrete standards and certifications are required to facilitate comparability and assess environmental impacts. These standards are requested by issuers in response to challenges identified by issuers and include the need to develop and implement more rigorous ESG standards as well as to increase investor awareness and education on green bonds.

However, the literature in the field emphasizes that there are significant opportunities for the continued growth of the green bond market, particularly in the context of the increasingly emphasized global climate change commitments and initiatives (Tolliver et al., 2020; Deschryver and de Mariz, 2020; Tolliver et al., 2019).

3. Research Methods

The research aims to analyze the impact and evolution of green bonds in the European Union, looking at the most relevant players participating in this market: financial institutions, governments, companies, and non-governmental organizations. It describes the role of these entities in promoting and developing such financial instruments and evaluates how the regulatory framework has influenced their evolution over time. It contributes to the literature by pointing out new novelties

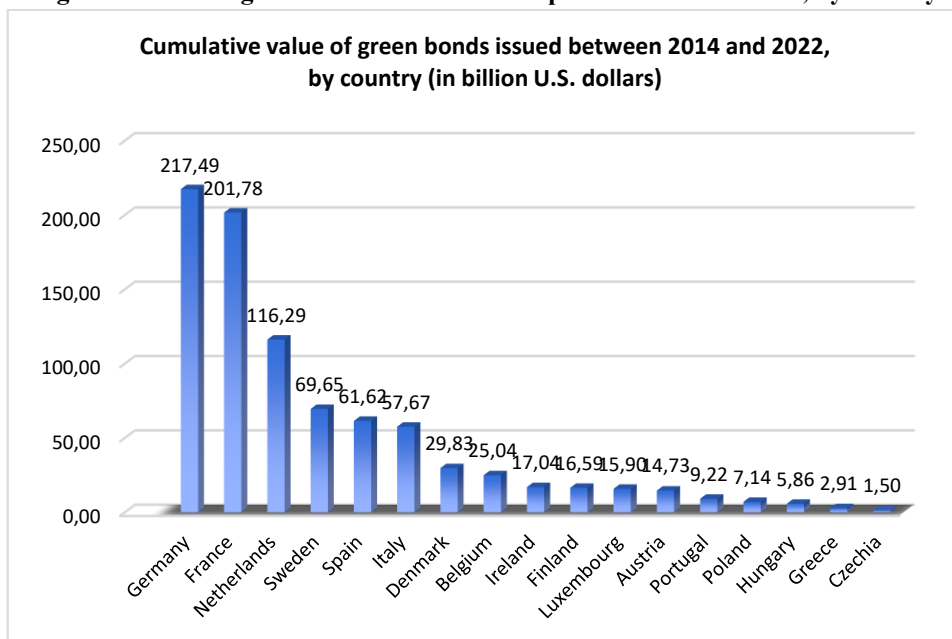
and challenges not addressed by the literature review in an attempt to increase current understanding of the role that green bonds could play in promoting financial sustainability and a low-carbon economy in the EU. The research is undertaken with the objective of providing useful insights for investors, financial institutions, and government authorities to understand the dynamics and direction of the EU green bond market.

4. Findings

4.1 Growing interest in green bonds in the European Union

The focus of the European Union on sustainability and environmental protection further quickens the pace of the impending surge of interest in green bonds. This was a trend underpinning Europe's low-carbon economies, evidenced by the targets specified in both the Paris Agreement and the European Green Deal. National government initiatives, such as tax incentives and regulatory standards, have further boosted the green bond market (European Parliament, 2023; European Commission, 2021; Chygryn et al., 2018; Baldacci and Possamai, 2022; MacRae and Tozer, 2024; Fisch, 2019). Investors are aware of climate risks and are acting as atae by diversifying portfolios that incorporate environmental, social and governance (ESG) criteria into their decision-making (Agliardi and Agliardi, 2019). As a result, demand for green bonds in the EU has skyrocketed, with an annual growth rate of over 50% in recent years (Alamgir and Cheng, 2023).

Figure 1. Value of green bonds issued in European Union 2014-2022, by country



Source: Climate Bonds Initiative (2023).

Figure 1 presents the accumulative flow of the green bond issuance in the EU member states for the period under analysis, 2014-2022. It can be noted that Germany and France are leading forces in their commitment to financing green projects, with huge amounts over 200 billion dollars each. The Netherlands, Sweden, and Spain have a pretty reasonable green bond issuance as against the rest of the European countries, defining their ambition to finance projects with positive environmental impacts. Such countries may be taken as examples of best practice that other EU nations would consider as a benchmark in their commitment to sustainability and promotion of green investment. Their substantial issuance of green bonds will encourage other countries to do the same, invest more in projects with a positive environmental impact, and prioritize them.

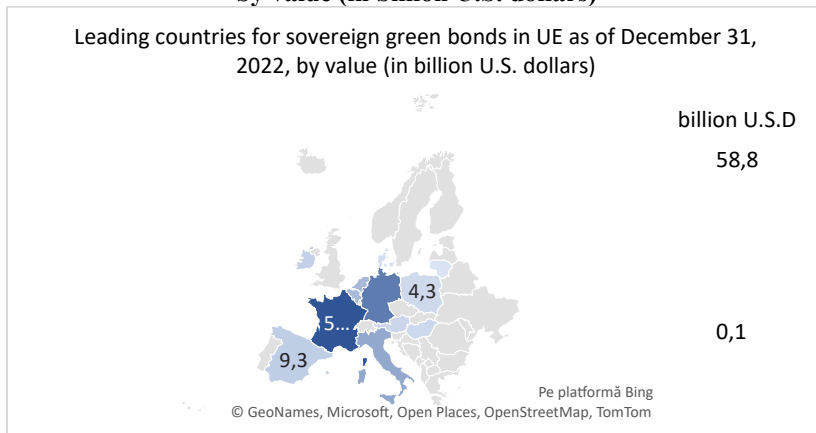
From 2014 to 2022, EU green bond issuance grew from 0.6% to 8.9% of total bond issuance, European legislative initiatives along the lines of the European Green Deal emphasize the EEA in 2023. International companies grew very fast, coming to rest at 11.0% in the year 2022 (EEA, 2023). The supranational bodies increased emissions to 8.6% in the same period. On the other hand, municipalities/agencies had considerable growth, but the issuance of sovereign government green bonds only showed a modest rise before it declined (EEA, 2023).

Looking forward into the future, however – with high demand and the targets forced by the EU Green Deal – green bonds will likely form a larger share of total issuance. In that line, the European Commission intends to issue more green bonds in order to finance its NextGenerationEU plan (European Commission, 2023). It is initiatives like the EU Action Plan for Financing Sustainable Growth and EU Taxonomy for Sustainable Activities that are timely, providing more incentives for sustainable investment and issuance of green bonds (European Commission, 2018; European Commission, 2021).

4.2 The Main Actors Involved in the Green Bond Market in the European Union

At the heart of the promotion of green bonds with respect to the creation of a legal and regulatory environment are national governments of EU member states. This may be achieved by way of tax exemption, state guarantees, or even standard setting in ESG reporting. Furthermore, the governments can even issue green bonds to finance national green projects. Demand for green bonds could be stimulated, and consequently low-carbon economies made easier to attain, by incorporating sustainable investments into fiscal policies and government programs. According to Figure 2, on 31 December 2022, France is the biggest sovereign issuer of green bonds, with an aggregate amount issued of approximately US\$58.8 billion.

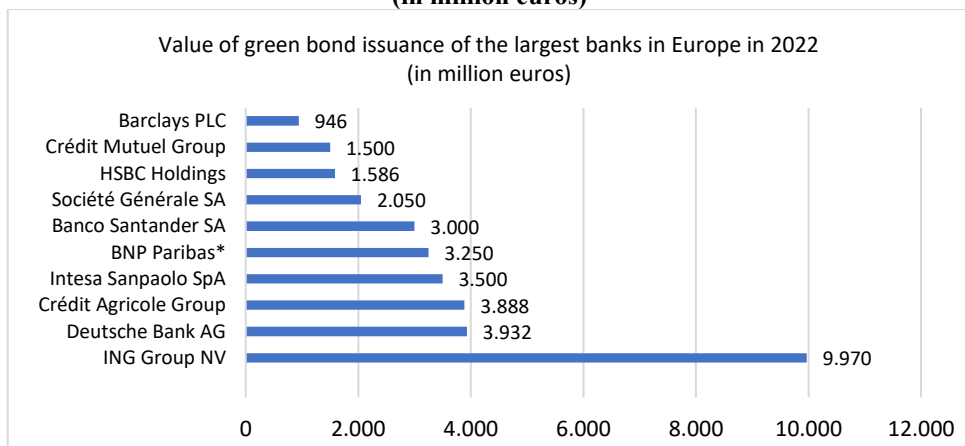
Figure 2. Leading countries for sovereign green bonds in UE as of December 31, 2022, by value (in billion U.S. dollars)



Source: Climate Bonds Initiative (2023).

Banks and investment funds are the two most influential financial institutions in the green bond market. They issue, underwrite and buy these bonds because of their operational expertise in identifying and financing green projects. They offer responsible investment by integrating ESG criteria, stimulating demand for green bonds and raising sustainability standards. They also create incentives for financial innovation in the development of new products, such as bonds with variable yield mechanisms linked to sustainable projects or securitization instruments covering green assets. As it is shown in Figure 3, in 2022, the Dutch ING Group led among the main European banks as the largest issuer of green bonds, with issuance totaling approximately €9.97 billion out of the 12 green bonds issued since 2018. Deutsche Bank takes the second position, having 11 green bonds totaling €3.93 bln in nominal face value.

Figure 3. Value of green bond issuance of the largest banks in Europe in 2022 (in million euros)



Source: Statista (2023).

Multinationals and corporates are increasingly tapping the green bond market for financing projects in sustainable initiatives such as energy efficiency and renewable energy initiatives. In this, they see the possibility of proclaiming to the world that they take serious regard for corporate social responsibility and protection of the environment, hence attracting investor and customer confidence and improving brand image. Such funds are aimed at stimulating innovation and sustainable development that would facilitate low-carbon economic shifts while meeting sustainable development goals.

The non-governmental and environmental organizations have a very key role in the green bond market through activities such as advocating, educating, and monitoring. They further influence policy and the law, promote standards of sustainability, and increase awareness through outreach. It, by overseeing the issuers and investors to ensure transparency and accountability, minimizes the possibility of green washing and promotes better ESG performance.

4.3 The Regulatory Framework for Green Bonds in the European Union

The European Union has stipulated strict rules to maximize efforts for growing green bonds and other sustainable financial instruments. The European rules do ensure transparency, compliance, and credibility in the issuance and investment of Green Bonds in EU Member States. Of importance in this case are transparency and compliance in the use of bond funds to ensure that they are used for projects that are of benefit to the environment. This should be ensured by the legislative framework that funds would clearly be reported and verified for use in supporting sustainable initiatives that have certain criteria.

Many of the Member States in the EU give tax incentives and subsidies to stimulate green bond issuance and investment. These range from exempting tax on interest or other income from such bonds, to offering subsidies for sustainable projects that make up the underlying assets of the green bonds, thereby lowering the cost and creating an enabling environment for investment in green projects within the EU.

EU Regulation 852/2020, the taxonomy of the EU, is a transparency tool to both companies and investors, underpinned by real scientific evidence. In addition, it shall also be used to set an EU Green Bond Standard and an EU Ecolabel for financial products.

According to the European Union's Green Bonds Regulation, applicable as of December 21, 2024, EU bond issuers will have to apply voluntary standards for the labelling of their bonds as either a "European Green Bond" or an "EuGB". The regulation defines strict criteria for investments in environmentally sustainable projects, requires pre- and post-issuance reporting and introduces external evaluation frameworks. The Regulation encourages transparency, comparability and investment in sustainable activities aligned with the EU Taxonomy Regulation (European Commission, 2024).

NextGenerationEU Green Bonds are expected to ensure Europe's commitment to sustainable finance at the EU and, accordingly, capital markets levels. These bonds

seem to be quite a strong signal about the commitment of the European Commission to sustainability and open up the possibility for a highly valuable and liquid green asset. They mobilize investment into sustainability through the ability to access a broader investor base and diversified portfolios, therefore supporting the green bond market. Such bonds provide for a robust framework, aligned with international standards, that ensure transparency in the use of funds, rigorous reporting, and increased credibility of the instruments, further strengthening the leadership of the EU in sustainable finance (European Commission, 2023). Under the NextGenerationEU, a big chunk of the funding from the Member States' recovery and resilience plans is dedicated to sustainable investments and reforms in green infrastructure and renewable energy. This includes at least 37% for green investment and reforms under NextGenerationEU (European Commission, 2023).

6. Conclusions

Interest in green bonds is building up within the EU as the feeling of financial sustainability and protection of the environment increases. The very strong position of the European Union and government policies to support such a green bond market's development have contributed immensely to such interest. These statistics show that there has been a significant increase in the issuance of green bonds in the EU, from 0.6% to 8.9% of the total bond issuance between 2014 and 2022, pointing out an escalating trend in the issuance of the bonds.

Governments, through their national and local levels, financial institutions, corporates, and NGOs, as well as other relevant agents, help promote green bonds in the EU, create friendly regulations, expertise and financing for sustainable projects that will spur development of a solid green bond market, and in turn spur sustainable investments towards realization of regional development goals.

The European Union is also a proponent for sound regulation in the development of green bonds and other sustainable financial instruments. The regulatory framework should define clear criteria and standards that will support the transition toward a low-carbon, resource-efficient, and sustainable economy in the EU.

In this section, it is also relevant to mention some of the critics, which regard both green bond issuance and those addressed to the study. Among such criticisms are the green washing issues, effective and consistent standards, and eligibility criteria for green bonds, which can or cannot totally matter in terms of assisting the environment.

Research gaps toward the full comprehension of the impacts of green bonds and how they can really make a contribution to long-term sustainable development need to be accepted. Further empirical analysis research, therefore, needs to be conducted in order to appropriately assess the outcomes and impacts of these financial instruments.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used Grammarly and Writefull in order to assist with language translation and to enhance the grammatical accuracy and overall quality of the manuscript. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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Exploring the Dynamics of Junk Bonds and Green Bonds in Financial Markets

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Abstract

The focus on junk bonds, which have an inferior credit rating and are associated with more risk, and green bonds which are intended to fund ecologically beneficial projects, has increased in recent years. The dynamics of these two bonds and their effects on financial markets are examined in this article. This work investigates the formation mechanism and determining factors of these two bond types by a thorough comparison analysis. Furthermore, it examines the ways in which certain characteristic of each class of financial instrument impact the nominal values and prices of these bonds.

Keywords: green bonds, sustainable financing, environmental policies.

JEL Classification: G18, Q56.

1. Introduction

There are two independent territories within the bond market: junk bonds and green bonds, with their own functions and characteristics. Green bonds are instruments of debt raised to finance projects that relate to environmental sustainability. Typically, they finance projects in clean transportation, sustainable water management, energy efficiency, and renewable energy. They are key instruments for the realization of goals set by global sustainability. Junk bonds are high-yield bonds with a reduced credit rating and increased risk of default. Thus, they offer higher returns to compensate the investors for their increased risk.

The study of green bonds is important because it indicates an emerging increased importance of ESG considerations in making investment decisions. Bonds will help to be able to have both practical and ethical aims avoiding climate change and

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promoting environmental sustainability. On the other hand, junk bonds help out the financial markets in that they open companies to cash they otherwise would not get. This ability to raise financing encourages economic activity, restructuring, and expansion of businesses despite a higher risk profile.

Green bonds represent the ingenuity of the market in finding ways to address environmental issues, while junk bonds exemplify the myriad options in financing available to firms across a wide array of industries.

2. Problem Statement

The European Investment Bank launched the green bond market in 2007; the World Bank followed in 2008. The market for green bonds grew substantially in the following years, thanks to these early issuances (World Bank, 2015; Climate Bonds Initiative, 2020).

Generating money for environmental sustainability-related projects is the main goal of green bonds. These programs usually focus on sustainable agriculture, pollution avoidance, energy efficiency, renewable energy and climate change adaptation (Ning et al., 2023; Azhgaliyeva, 2019). Green bonds give investors the chance to support eco-friendly initiatives and maybe receive a return on their investment (Baker et al., 2018).

The research into the performance of green bonds indicates that due to the strong demand from investors, it is often the case that they trade at a premium, referred to as the "greenium". There are studies by Zerbib (2019) and Ehlers & Packer (2017) indicating that the yields on green bonds were either marginally below those of comparable conventional bonds or very close in yield. According to Flammer (2021) issuing green bonds can improve the holistic corporate performance and green image of a firm. Green bonds have also been found to reduce the cost of capital for a firm (Gianfrate and Peri, 2019).

Junk bonds are fixed-income securities rated less than investment grade, that is BBB – by S&P or Baa3 by Moody's. In the 1970s and 1980s, the market for junk bonds expanded to a great extent due to Michael Milken at Drexel Burnham Lambert, who demonstrated that the capital markets are open to the funding of riskier companies through high-yield loans (Altman, 2000; Fraser-Sampson, 2011).

Compared to investment-grade bonds, junk bonds are more sensitive to economic cycles and have a higher chance of default. According to studies by Fridson and Garman (1998) and Altman (1998), junk bonds have higher default rates during recessions and higher return rates during an expansion in the economy. The trade-off between risk and reward is further re-emphasized by Campello et al. (2008). He stresses that even though junk bonds might offer sizeable rewards, careful assessment and management of risk is very important.

The historical context of junk bonds is marked by their crucial role during the leveraged buyout boom of the 1980s. In particular, junk bonds were able to alter corporate finance strategy by providing important funds for company acquisitions and restructurings (Kaplan and Stein, 1993; Hotchkiss and Jostova, 2007). These

studies highlight the pros and cons of high-yield debt and its relation to financial stability and corporate governance.

There is not much research that makes a comparison of junk bonds vs. green bonds. While these two types of bonds have different uses and tend to attract different investor bases, such a comparison may still be useful in shedding light on the two instruments' risk profiles, relative performances, and market dynamics. Early examples of comparative studies include those by Hachenberg and Schiereck, who, in 2018, compare the financial performance and volatility of green bonds with conventional bonds, particularly high-yield bonds.

Literature regarding the combined analysis of junk bonds and green bonds is rather scarce. Most of the works merely refer to their definitions, historical development, objectives, and achievements. Further research is required to be able to understand the potential trade-offs and synergies between the two bond market groupings.

3. Research Questions / Aims of the Research

The paper seeks to probe into the dynamics between junk bonds and green bonds in financial markets. This study will seek to compare junk bonds with green bonds and further proceed to examine what shapes their development, market behavior, and determinants. Besides an analysis of the pricing and nominal values of these bonds and the behavior of investors in them, it also tries to assess their impact on financial markets and attempts to identify the principal variables which may influence their nominal values and prices. It will, further, try to observe their risk-return profiles, market dynamics, and participation of these bonds in global sustainability programs.

4. Findings

4.1 Influences on Prices and Nominal Values of Green Bonds and Junk Bonds

Hence, environmental laws and policies have strong connections to nominal values and the price of green bonds. Tightening environmental regulation and policy would incentivize more investment in green projects, thereby lengthening the market for green bonds. The concern – increasingly taken by governments and companies toward sustainability – has a positive effect on the pricing of the green bond.

Two of the most critical variables are demand and investor sentiment. Increased awareness and demand by investors for green investments have raised the price of the green bond because of the rising demand. It is not uncommon for investors to accept lower yields for financing ecologically beneficial initiatives.

Green bonds prices are similarly impacted by interest rates. The price of green bonds is negatively correlated with interest rates, much as other fixed-income instruments. Green bond prices usually decrease as interest rates rise and vice versa. Policies of central banks have a big influence on these rates.

As such, the nominal value of green bonds is affected by the reputation and credit ratings of an issuer. In that respect, because credible issuers with higher ratings attract more investors, which pushes the price higher and subsequently lowers the yields, credibility of the issuer is a factor.

Market liquidity has an impact on the prices of green bonds. Green bonds allow for liquidity in the secondary market, hence making them more attractive to investors. Higher liquidity bonds usually fetch better prices.

The two most critical factors that affect the nominal values and prices of junk bonds are credit risk and default rates. In essence, the price for a junk bond is significantly linked to its heightened credit risk and possibility of default. When the rate of default rises, there is a corresponding drop in the prices of bonds.

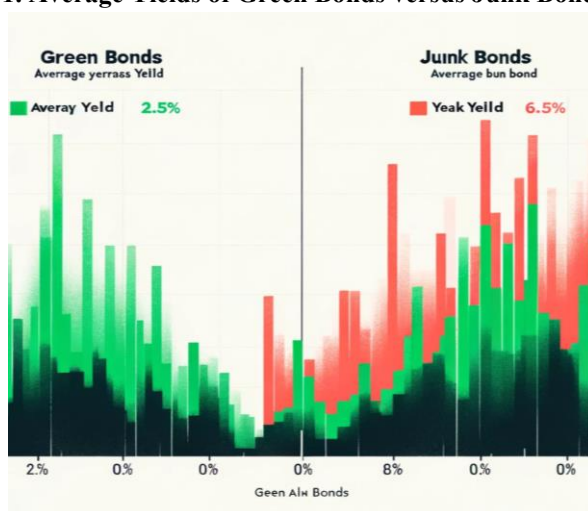
State of the economy also plays a part. The prices of junk bonds are dependent on the following macroeconomic factors: inflation, economic growth, and unemployment rates. The prices for junk bonds drop when the economy is not great and there is greater chance of default.

In the case of junk bonds, like green bonds, interest rates have an impact on their pricing. The prices of junk bonds move inversely to interest rates; however, due to a higher yield in the case of junk bonds, this trend may be more prominent.

Prices for junk bonds are largely determined by market sentiment and risk appetite. The attitude of investors and their willingness to take risks often play a huge role in determining junk bond prices. As the market becomes optimistic, investors become more ready to take on more risks, hence driving up the prices for junk bonds.

The prices of junk bonds are also determined by factors specific to an issuer. More importantly, the financial standing of the company issuing the instrument should be considered, together with its business prospects and industrial circumstances. In general, bonds issued by businesses in a collapsing sector or with unstable finances are usually lower in price.

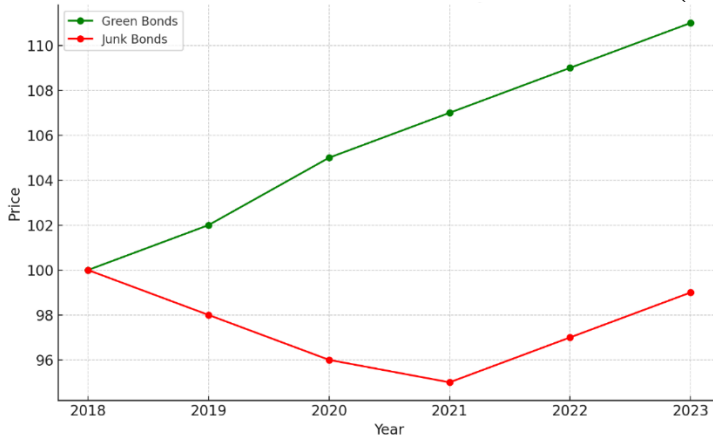
Figure 1. Average Yields of Green Bonds versus Junk Bonds (2023)



Source: Climate Bonds Initiative, 2023, and Moody's Investors Service, 2023a.

Figure 1: The yield on junk bonds far outweighs that on green bonds, thus showing varying degree of risk tolerance and investor needs. In 2023, the market had \$500 billion in volume of green bonds with an average yield of 2.5% and an average credit grade of A. For junk bonds, there were a total of \$1.2 trillion in issuance, an average yield of 6.5%, and a credit rating of BB.

Figure 2. Historical Price Trends of Green Bonds and Junk Bonds (2018-2023)



Source: Bloomberg, 2023b.

Figure 2: Green Bonds Steadily Rise from 100 in 2018 to 111 in 2023. From the graph, the steady price rise is noticed for green bonds from 100 in 2018 to 111 in 2023. This means there was a high demand for sustainable investments at lower risk. Junk bonds exhibit increased volatility. Their values denoted a higher risk and even greater vulnerability to the ups and downs of the economy, ranging from 100 in the year 2018 to as low as 95 in 2021 before reverting back to 99 in 2023. Therefore, this smoothness of green bonds comes in contrast to the risk-return trade-off depicted by junk bonds, thereby giving evidence of different investor preference and market dynamics.

Factors Impacting Junk Bonds and Green Bonds The investors and the governments have to understand various factors impacting the junk bond and green bond nominal values and their pricing. The major factors impacting the green bond are the market liquidity, interest rate, credit rating, investor sentiment, and the environmental regulations. While the price of the junk bonds is impacted by market sentiment, issuer-specific factors, interest rate factors, credit risk, and economic factors. It is in this regard that by considering these variables, investors will make very informed selections, balancing return-risk trade-offs in their bond portfolios.

4.2 Determinants of Green and Junk Bond Prices

Below is a feature comparison table between green bonds and junk bonds. The summary is in respect to what holders and potential investors can make out of

these two types of bonds in regard to their purpose, issuers, credit ratings, and as investment instruments.

Table 1 compares green bonds with junk bonds on the basis of their principal characteristics. It summarizes, in crystal form, major differences between these two kinds of bonds so that stakeholders and potential investors may understand the difference in terms of goals, issuers, credit ratings, and investment attractiveness.

Table 1. Comparative Characteristics of Green Bonds and Junk Bonds

Characteristics	Green Bonds	Junk Bonds
Purpose	Financing environmental projects (renewable energy, clean water, pollution control).	General corporate financing, often for companies with lower credit ratings.
Issuer	Governments, corporations, financial institutions.	Corporations with higher default risk.
Credit Rating	Typically high, often investment-grade.	Below investment-grade (BB+ or lower).
Investor Appeal	Ethical investment, lower volatility, potential for lower returns.	Higher yields, higher volatility, greater default risk.

Source: personal computation.

Because they are supported by companies and projects with steady cash flows, green bonds have been associated with lower credit risk. This stability reduces the volatility of green bonds, giving them appeal for long-term investors who value sustainability. However, it is probable that the still-developing green bond market may cause problems with liquidity.

On the other hand, junk bonds are issued by businesses with somewhat less stable finances, raising the default risk. Since these bonds are more prone to changes in the market and in the performance of the company, they become more volatile. Junk bonds, though more established, are equally susceptible to shortages of liquidity in low markets. In return for being investments that are prone to a higher amount of risk, junk bonds must have higher yields in order to attract investors who are ready to take on these risks.

Table 2. Default Rates Data & Yield Comparison Data

Bond type	Default Rate (%)	Yield (%)
Green Bonds	0.5	2.5
Junk Bonds	3.5	6.5

Source: Moody's Investors Service, 2023b; Bloomberg, 2023a; Reuters, 2023.

To that extent, green bonds are of very high credit quality and backed by credible institutions, such as government programs or financially sound corporations that value sustainability. They will remain attractive to investors who value sustainability and are willing to take a lower return in exchange for environmentally friendly measures, given their average yield of 2.5%, which reflects their stable and low-risk characteristics.

The default rate for junk bonds is much higher, at 3.5%, because the companies that issue them have less solid finances and worse credit ratings. A considerably higher average yield of 6.5% offsets the increased risk of junk bonds and appeals to investors ready to take on higher levels of risk in return for greater yields.

Table 3. Performance During Economic Downturns Data

Year	Green Bonds Index (2019=100)	Junk Bonds Index (2019 = 100)
2019	100	100
2020	98	85
2021	101	95
2022	102	98

Source: MSCI, 2023; The Economist, 2023; Morningstar, 2023.

Table 3: Green bonds performance relative to junk bonds over the last few years. It indicates how stable green bonds are in terms of performance, compared to the volatility of junk bonds, especially at times of downturns like the COVID-19 epidemic.

Green bonds have been rather resistant to recessionary pressures. After a slight decline to 98 in 2020 due to the COVID-19 pandemic, the index resumed its positive growth trajectory to 101 in 2021 and then 102 in 2022, reflecting strong performance and investor confidence.

Junk bonds were very volatile. In 2020, their index dropped from 100 in 2019 to 85 in 2020, reflecting increasing default rates and volatile markets. Underlining the enhanced risk of junk bonds is the fact that the index did not return to 2019 levels, even if it did rebound to 95 in 2021 and 98 in 2022.

4.3 Motivations Driving Corporate Utilization of Green Bonds

Four broad categories of incentives – financial, reputational, regulatory, and strategic – may drive companies to issue green bonds.

Financially, this green bond connects investors to a broader source of potential buyers who are highly sensitive to environmental, social, and governance (ESG) factors. Costs of borrowing can be reduced due to the rise in demand. They also help in diversifying the investor base by bringing in long-term, institutional investors interested in sustainable initiatives.

By issuing green bonds, companies can establish their brand and enhance public perception of them as leaders in sustainability. This could increase clients' loyalty and regional authorities' and communities' collaboration. Moreover, it goes in line with the CSR strategy and demonstrates an organization's concern for the environment.

The regulatory incentives include awards and a possible decrease in the penalty risk, and they finally resonate with the current governmental and regulatory attitudes towards sustainable and climate change. To advance sustainable investment, local authorities can award the issuers of their green bonds with tax breaks or other benefits.

From a strategic point of view, the green bond enables the realization of a firm's strategic environmental objectives, such as carbon emission reduction or the improvement of energy efficiency. The bonds therefore play a role in long-term risk management through the reduction of environmental risks brought about by climate changes, which may, in turn, affect a firm's supply chain and operation. The green bond investment may also encourage innovation toward green technology and sustainable practices to keep the firms competitive in the constantly changing business environment.

Conversely, businesses must keep reporting and certification requirements in mind because they are required to ensure they reach standards established for green bonds, to give investors guarantees of transparency and accountability. The green bond market is relatively young, so the market trend, investor expectation, and regulatory landscape need consideration. Overall, green bonds create powerful incentives for business through monetary benefits, improved reputation, regulatory fit, and strategic benefits on environmental projects and corporate objectives.

5. Conclusions

The risk and return profiles of junk bonds and green bonds are radically different for investors because of the differences in their goals and issuer characteristics. Most green bonds finance initiatives with a beneficial environmental impact, are normally issued by reliable entities, and have generated steady revenues, instilling low credit risk and volatility. These bonds appeal to the long-term investor dedicated to making ethical investments, as they offer modest returns in line with their lower risk. On the other hand, liquidity concerns may be an issue in a developing green bond market. Junk bonds are issued by firms having lower credit ratings and underlying financial instability, increasing the chances of default and market volatility. Since such bonds pay higher yields to compensate for the higher risk, they are mostly attractive to investors who can take on more risk in hopes of large returns. Indeed, the junk bond market is a more mature industry, but it can still have problems with liquidity when the economy is down.

It is important to acknowledge the several constraints of this research. This study may not be representative, considering that only historical, publicly available data is used. It does not describe the current situation of the junk bond market or the process of green bond market development. Also, this study does not take into account the respective return and risk characteristics of those two types of bonds, nor some macroeconomic conditions and regulatory changes. Since large marketplace data is the focus of the study, local variations that may impact the generality of the findings are dismissed. The risk and performance profiles are assessed in a very short period, rendering the ability to consider long-term trends and the impact of economic events on the horizon impossible.

Further research could address these limitations and perhaps provide a more comprehensive understanding of green and junk bonds. It would be stronger research if the data sets increased to include more thorough information, up-to-date in other regions and other economic situations. A deeper analysis of investor behavior and

preferences might shed a light on what drives junk bond and green bond investment decisions. Comparing green and junk bonds to other categories of bonds or financial products can shed more light on their relative performance for the investor.

Further research in these areas can contribute to increased understanding of market dynamics with regard to green and junk bonds and, therefore, help investors and policymakers to make better decisions.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used Grammarly and Writefull in order to assist with language translation and to enhance the grammatical accuracy and overall quality of the manuscript. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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**Mega Events and Their Impact on Country Image:
A Comprehensive Bibliometric Analysis**

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Abstract

This bibliometric research reflects the literature available to date on the themes of mega-events – such as sporting events, cultural festivals, and world expos – in creating a country image. For that, a base dataset was set up with 137 papers from Web of Science written from 2000 to 2024 as input for the bibliometric analysis. Analysis demonstrates that the streams of literature focus mostly on sports, tourism, and cultural events. This reveals the fashion of looking for the impact the international mega-events, such as the Olympics, the FIFA World Cup, famous music festivals, and expositions, have on shaping the image of the country. Temporal analysis illustrates an increasing trend in the data publications. The most cited works in the field show the power of media coverage in changing the attitude toward tourist destinations and the intentions to visit them. It means that the research contributions are from all the continents; however, with regard to citations, the United States, Australia, and Austria come at the top. The present research takes stock of the current state of academic research and identifies areas important for further research, specifically that are relatively less researched with regard to economic effects and long-term effects associated with hosting international mega events on country image.

Keywords: mega events, country image, bibliometric analysis, media coverage, national rebranding

JEL Classification: Z32, F59, M31, O57.

1. Introduction

The bibliometric analysis investigates the relationship between mega events and the creation of country image by employing a dataset of 137 articles from the Web of Science database.

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The study found that most articles have as main topic sports, tourism, and cultural events. Mega events such as the Olympics, FIFA World Cup, music festivals, and expositions all have a significant impact on a country's image. According to Hahm et al. (2019), hosting the 2018 Olympic Games improved South Korea's global image and led to a change in its perception, while showing its resilience and opposite evolution compared to its neighbouring country, North Korea. Similarly, Dubinsky (2022) underlined that, despite several challenges, the Tokyo 2020 Olympics considerably improved Japan's national branding and public diplomacy initiatives. An examination of the data over time reveals a growing trend in the number of publications, indicating an increasing level of academic interest.

Research papers that are frequently referenced emphasise the crucial significance of media coverage in altering perceptions of travel destinations and impacting the intents of potential visitors. This research shows the worldwide range of research input, with the US, Australia, and Austria among the most commonly referenced. It also indicates important gaps for future research, notably in terms of the economic impact and lasting effects of mega events on the image of the country. Hamelin et al. (2012) pointed out that winning the bid to host a big sporting event such as the FIFA World Cup could convey an impression of national prestige, attracting international attention and investment.

2. Literature Review

Mega events were shown to have a number of transforming effects on the host site (Wolfe et al., 2021). Expecting the beneficial changes that mega-events bring, nations and cities have been driven to host them, and the results of these changes have been extensively investigated (Mair et al., 2021). Researchers focused on the lasting effects of mega events in relation to tourism because of their opportunity of developing infrastructure associated to tourism and draw the media's attention (Vrondou, 2023; Lu, 2021). Mega events can be distinguished by their tourism influence, media coverage, and economic impact on the host community (Duan et al., 2021).

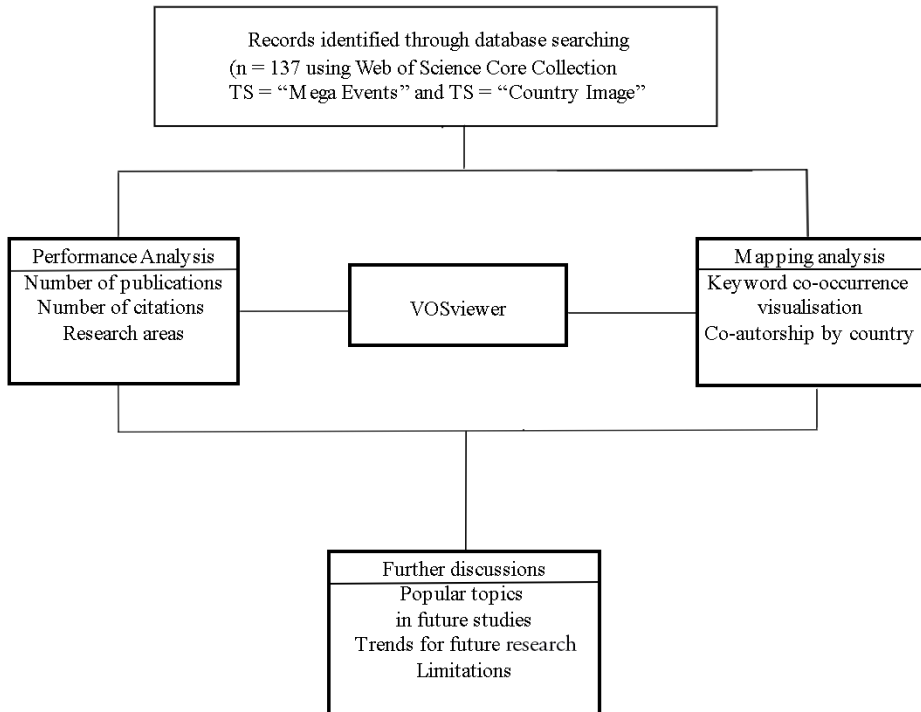
Since they can foster cooperation and offer incentive to tackle challenges, they become essential tools in urban policy (Smith and McGillivray, 2020). The growing number of cities from various socioeconomic backgrounds competing for mega-events confirms their importance in the urban agenda (Ponzini et al., 2022). Typically, these events are cultural or sports focused. Examples of such events are the World Cups in sports, the Olympic Games, or cultural festivals such as the UNTOLD festival in Cluj Napoca, Romania. So a hosted event can have a great impact on how attendees perceive the country that hosts it (Kim et al., 2019). Organising a mega event gives the opportunity to showcase the nation to a broad audience, and hence create a favorable perception, especially for relatively unknown developing regions. Through the organisation of an international mega event, the host nation may both associate its image with positive implications and contribute to influencing the perception of the visitors.

3. Methodology

This article seeks to provide a comprehensive bibliometric analysis of studies on mega events and their impact on country image. First, relevant studies are collected from the Web of Science database using an established retrieval methodology (Gusenbauer & Haddaway, 2020). After that, an analysis is conducted on the key features of these publications, including their yearly distribution, publication types, research focus, and work that has received a high number of citations. In addition to the data collection and preliminary analysis, this study will employ VOSviewer for further bibliometric analysis. VOSviewer is a specialised software tool designed for constructing and visualising bibliometric networks. These networks will enable the visualisation of various relationships such as and keyword occurrences and country co-authorship among the collected documents (van Eck & Waltman, 2009).

Finally, current issues, future trends, challenges, and limitations will be discussed. The methodology framework of this paper is shown in Figure 1.

Figure 1. Methodology framework



Source: authors’ creation adapted from the PRISMA statement (Moher et al., 2009).

3.1 Retrieval Process of the Data

Web of Science (WoS) is the oldest database (created in 1964 by Eugene Garfield from the Institute of Scientific Information (ISI) and is currently owned by Clarivate Analytics). Currently, it is the most comprehensive and selective academic research

resource worldwide (Singh et al., 2021). To retrieve and collect reliable literature, the WoS core collection is used as the data source in this paper. The retrieval settings are as follows: TS = “Mega Events” and TS = “Country Image”, Database = Web of Science Core Collection. On April 7th 2024, 137 publications were retrieved from the Web of Science database. Data including titles, abstracts, and keywords was exported in a .csv format for further analysis. The first article, “Analysis of the safety factors for event visitors: '99 Hanam Environmental Expo in Korea” (Kwon and Park, 2000), was published in *Ergonomics and Safety for Global Business Quality and Productivity* in 2000.

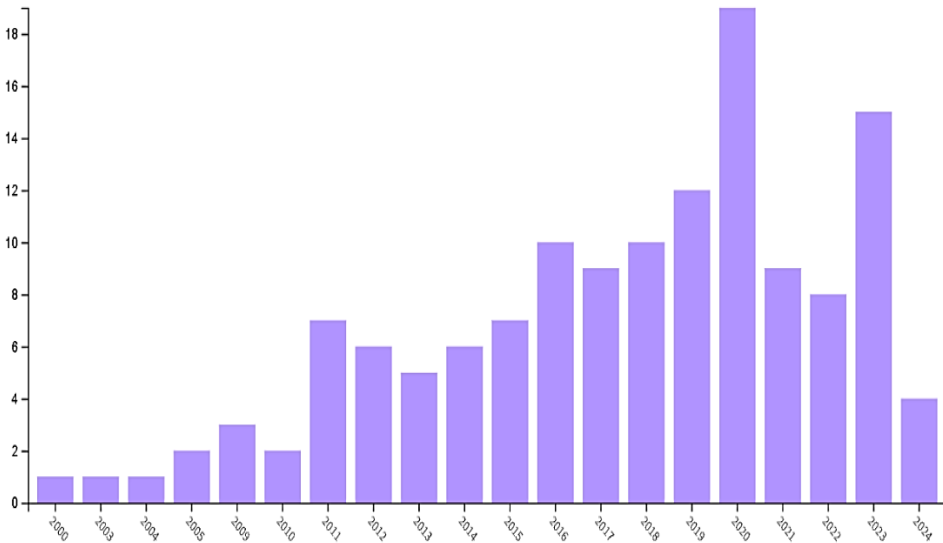
4. Results

Based on the retrieved data and the methodologies and tools presented, some results on the bibliometric analysis of the effects of hosting mega events on country image can be obtained. This can be demonstrated through the following four conditions, as first employed by Zhang et al. (2022) – Performance analysis, Annual indicators of publications, Types and research areas of publications, highly cited publications.

4.1 Performance Analysis

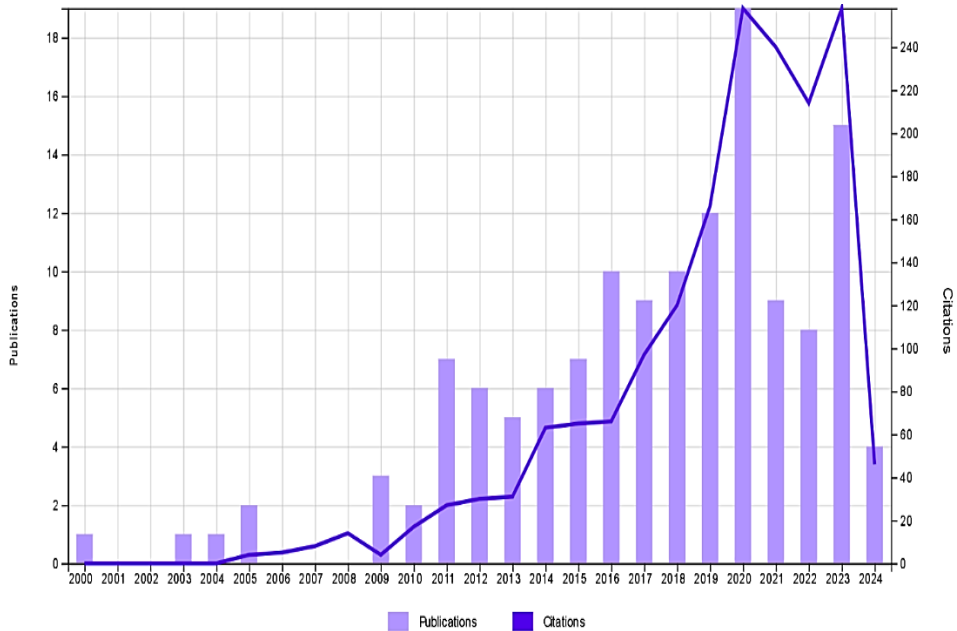
This section provides a performance analysis of publications regarding annual indicators, types, and research areas, as well as highly cited publications.

Figure 2. The tendency of the number of publications



Source: WoS based on author's input.

Figure 3. Times cited and publications over time



Source: WoS based on author’s input.

Figure 2 illustrates the trend in the number of scholarly publications from 2000 to 2024 on the topic of mega events and their impact on the national image. As shown in Figure 1, the first related publication, Analysis of the safety factors for event visitors: '99 Hanam Environmental Expo in Korea, was published in 2000, and the second one was published in 2003. Post-2010, there is a noticeable increase in publications, especially from 2012 onward, where the annual publication rate starts to stabilise between 5 to 10 publications per year.

The highest number of publications appears in 2020, with 19 publications, representing about 13.87% of the total, indicating a peak of interest that might have been caused by events such as the Russia 2018 FIFA World Cup and the nearing when Qatar would host the World Cup (in 2022). The increased level of activity in the following years (2021 with 9 publications and 2023 with 15 publications) indicates a strong development of this research area among the academic community, possibly shaped by the immediate effects of recent mega events (2024 Summer Olympics Paris, 2022 Winter Olympics Beijing, 2021 Summer Olympics Tokyo, 2018 Winter Olympics Pyeongchang, etc.). Four publications have been written so far in 2024.

As shown in Figure 3, the first citations appeared in 2005, with a total of 4 citations in 2 publications. This initial point suggests a modest initial level of attention, possibly triggered by special events such as the 2002 FIFA World Cup Korea Japan. An increasing trend is visible through the high number of citations recorded in 2020 (258 citations) and 2023 (259 citations).

4.2 Types and Research Areas of Publications

Table 1. Distribution of document types

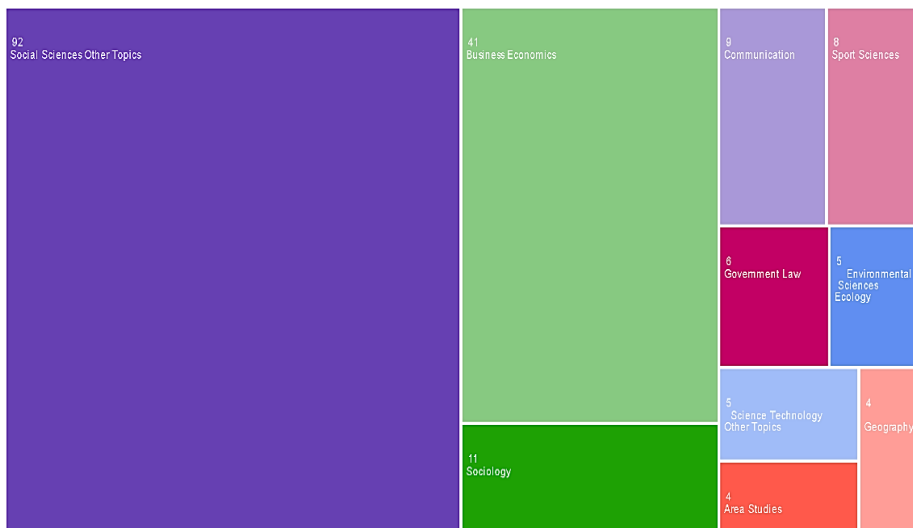
Document Type	Record Count	Percentage
Article	126	91.971%
Proceeding Paper	8	5.839%
Early Access	7	5.109%
Book Chapters	2	1.460%
Review Article	2	1.460%
Editorial Material	1	0.730%

Source: authors' creation.

The focus is on journal papers, which were 91.971%, or 126 entries. This means the high prevalence of the topic within academic research that has gone through the peer-review process. The 8 papers represent 5.839% of the total entries. This also includes articles comprising preliminary research results published at some of the academic conferences. Other, less frequent document types, are preliminary Communications, with a 5.109% share (7 documents), book chapters, and review documents with a share of 1.460% (2 documents) each, as well as editorial document types, with a share of 0.730% (1 document). All these document types allow for a comprehensive scientific debate about mega events and their impacts on the image of a country.

On the Web of Science (WoS), publications are categorised by different types. It is important to note that some documents are classified under multiple categories, which is why the total count per document type exceeds the total number of retrieved documents. Each publication focusses on at least one specific research domain. The top ten research areas are presented in Figure 4.

Figure 4. Types and research areas of publications



Source: WoS based on authors' input.

The treemap shows the top 10 research areas in 137 publications. Social Sciences Other Topics has 92 records, followed by Business Economics with 41. Sociology has 11 publications. Communication and Sport Sciences each have 9 and 8 records, respectively. Government Law includes 6 publications. Both Environmental Sciences Ecology and Science Technology Other Topics have 5 publications each, and Area Studies and Geography each have 4 publications.

4.3 Highly Cited Publications

The majority of the articles deal with how such sports events affect destination image, visitor intentions, economic impacts, and the wider implications for national branding. It emerges in the citation analysis that the publication "Effects of sport event media on destination image and intention to visit", which was published in the Journal of Sport Management in 2003, has had considerable impacts on the area's discussions. This has been confirmed by the fact that it has been cited 211 times. The presence of several global institutional affiliations tells of broad international collaboration and wide ranging academic perspectives, helping to deepen and broaden the scope of findings in this area of study significantly.

The affiliations listed in the Appendix for the top 10 highly cited articles indicate a high representation of some of the world's leading research universities within the social sciences, business and economics.

Table 2. Top 10 journals which published the most articles

Names of journals	Number of articles	Times cited (without self-citations)
Sport in society	6	64
International journal of sport policy and politics	5	20
Journal of vacation marketing	5	51
Communication sport	4	59
Journal of sport management	4	265
Sport marketing quarterly	4	75
Journal of destination marketing management	3	94
Journal of travel tourism marketing	3	65
Place branding and public diplomacy	3	8
Tourism economics	3	23

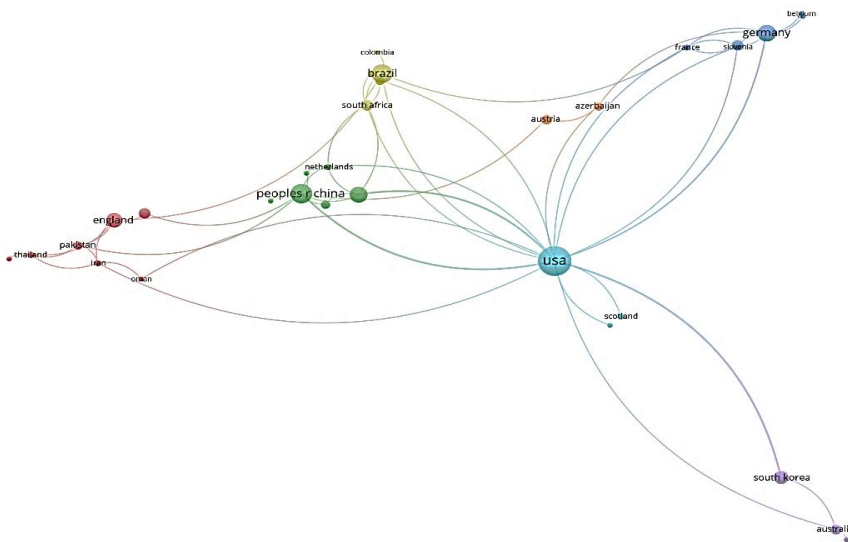
Source: authors' creation.

The data in Table 2 shows that the "Journal of Sport Management" has the highest number of citations, 265. This suggests that the journal plays a great role in sharing results on the effects of mega sports events on the country image. It is notable that journals like "Sport in Society" and "Communication Sport" have a considerable presence in the subject, with 64 and 59 citations, respectively.

The publications in "Sport Marketing Quarterly" and "Journal of Destination Marketing Management" mostly examine the marketing and tourism effects of sports. The former has received 75 citations, while the latter has received 94 citations. The comparatively lower citation counts in "Place Branding and Public

The 53 keywords are categorised into 5 groups, each coloured distinctly. The network map shows the link between “country image” and “mega events” in research. Keywords such as “Olympic games”, “World Cup”, and “mega-events” correspond to the biggest nodes, suggesting that these events are frequently examined together. The nodes of “economic impact” and “tourism” indicate that attention is placed on the physical advantages of hosting such events. Moreover, “sports diplomacy” and “soft power” underscore the importance of mega events in international relations. Furthermore, the five most often occurring keywords are “destination image”, “olympic games”, “mega events”, “tourism”, and “country image”.

Figure 6. Co-authorship by country



Source: VOSviewer based on authors' input.

The United States and China are identified as central nodes, reflecting their dominant position in international research collaborations. The significant co-occurrence between these countries indicates a strong academic interest and, potentially, common research objectives.

Alongside these, there are nodes depicting Germany, France, and other countries, with a less dense presence, indicating ongoing, although more cautious, international collaborations. The different sizes of the nodes represent the equivalent frequency of each country's presence in the literature. The bigger nodes for the United States and China highlight the higher frequency of co-occurrence.

The network's structure, indicated by the width of the connections, also indicates the strength of research collaborations. The thin links that connect nations such as Iran, Pakistan, and Thailand suggest less significant collaborations.

5. Discussions and Conclusions

The bibliometric analysis based on 137 publications in the Web of Science database has returned some important insights related to the association between mega-events and country image. Strong academic writing on sports tourism and cultural events touts the huge effects of the Olympics, FIFA World Cup, music festivals, and international expos. This is substantiated by the fact that high citation rates accrue to articles which, for example, analyze the impact of the 2018 Winter Olympics on South Korea or the impact of the 2020 Tokyo Olympics on Japan.

A temporal analysis expressed growing academic interest over the past two decades, while peaks matched the timing of international mega-events. It was therefore confirmed that international mega events could do not only light the spark of public attention but also further stimulate research interest. Contributions from the USA, Australia, and Austria are dominant, underlining the international value given to this topic of research.

However, there are still remarkable gaps, especially in the number of articles that have studied the long-term economic impact and durable implications on the image of the country. Most of these studies focus on the immediate impacts resulting from hosting the mega event and normally explore media attention and visitor intentions. In that respect, what is lacking is longitudinal work that would show a way to maximize the gains from hosting such an event over a longer period.

Keyword co-occurrence and country co-authorship plotted using VOSviewer, which describes in general the collaborative nature of this topic of study. The high frequency of keywords like "Olympic Games", "World Cup" and "mega events" occurring together with "economic impact" and "tourism" shows their interrelation. Strong scientific collaboration between countries can be observed, especially between the United States and China, indicating mutual interest at the academic level in studying the impact of mega events.

In summary, this study emphasizes the growing interest that scholars are showing in the study of international mega events and their impact on the image of a country. While the literature is currently focused mainly on sport tourism and cultural events, further research should be conducted on long-term economic implications and country image impacts.

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Appendix

Top 10 highly cited publications

Rank	Article Title	Source Title	Document Type	Publication Year	Times Cited, All Databases	Affiliations
1	Effects of sport event media on destination image and intention to visit	Journal of Sport Management	Article	2003	211	University of Texas System; University of Texas Austin; Griffith University; Griffith University - Gold Coast Campus
2	The Beijing Games in the Western Imagination of China: The Weak Power of Soft Power	Journal of Sport & Social Issues	Article	2010	139	University of Vienna
3	Economic and destination image impacts of mega-events in emerging tourist destinations	Journal of Destination Marketing & Management	Article	2016	74	University of Vienna

Rank	Article Title	Source Title	Document Type	Publication Year	Times Cited, All Databases	Affiliations
4	The Economic Benefits of Mega Events: A Myth or a Reality? A Longitudinal Study on the Olympic Games	Journal of Sport Management	Article	2011	76	National Taiwan Normal University; Yuan Ze University; National Taiwan University
5	Branding national images: The 2008 Beijing Summer Olympics, 2010 Shanghai World Expo, and 2010 Guangzhou Asian Games	Public Relations Review	Article	2012	62	City University of Hong Kong
6	Impact of Mega Sport Events on Destination Image and Country Image	Sport Marketing Quarterly	Article	2014	52	State University System of Florida; Florida State University; Seoul National University (SNU); Seoul National University (SNU)
7	Bringing the world to Canada: 'the periphery of the centre'	Third World Quarterly	Article	2004	62	University of Alberta
8	Festivalisation and urban renewal in the Global South: socio-spatial consequences of the 2010 FIFA World Cup	South African Geographical Journal	Article	2011	56	University Osnabruck; University of Erlangen Nuremberg; Technical University of Berlin

Rank	Article Title	Source Title	Document Type	Publication Year	Times Cited, All Databases	Affiliations
9	China and the Olympics: views of insiders and outsiders	International Marketing Review	Article	2010	56	Carleton University; Nipissing University; Syracuse University
10	The Impact of a Sport Mega-Event on Destination Image: The Case of the 2002 FIFA World Cup Korea/Japan	International Journal of Hospitality & Tourism Administration	Article	2005	48	Kyung Hee University; University of Technology Sydney; Dong-Eui University

Source: authors' creation.

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The Evolution of Business Communication in the Digital Age

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Abstract

The business world has been revolutionized by the digital age. It has left the traditional methods of communication – like memos and face-to-face meetings – in favour of digital platforms that make it possible for people to connect through instant messaging or video conferencing. This shift is an indication of a monumental change that is taking place among organizations in how they carry out their operations, collaborate among themselves and even deal with stakeholders – all made possible because technology has found its way into every corner of economy, facilitating a quick, efficient, and increasingly complex communication. To attain supplementary knowledge concerning the perspective of research over the consequences that digital communications exert on organisations, an in-depth analysis of specialty literature was conducted. By employing this approach, we can better trace the advancements obtained by various researchers when establishing these suppositions, on one hand, while on the other hand we can better understand the procedures in this field, that highlight the areas that require further study. The research shows that the emergence of digital platforms calls for more robust approaches in cybersecurity and ushers a need for organizations to develop a strong capacity of digital literacy among their employees. The work enriches the scientific world by combining a large amount of bibliometric data, through which it visualizes the changes in various historical periods and predicts future trends. It emphasizes that business needs to continuously adapt to changes if they are to survive competition in a market where most aspects are dominated by digital technology – this paper acts as both scholarly work and practical guide for professionals seeking insight into digital business communication landscapes that help them navigate through ease.

Keywords: business communication, digitisation, social innovation, digital platforms.

JEL Classification: O32, O33, O35, M21, M31.

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1. Introduction

Communication represents a vital component for achieving success in any business and professional setting and it has always been an essential part of human interaction. In the last decades, the development of technology and the expansion of artificial intelligence have extensively changed the way people and companies interact and communicate with each other, progressively facilitating the way through which the exchange of ideas is carried out and new connections are formed, inaugurating, at the same time, an era of transparency and speed (Defleur and Ball-Rokeach, 1982).

Although the entire technological advance was born thirty-three years ago, the tools we use today in business communication are dramatically contrasting from those of the 2000s. Back then, the activities, policies and organization of a company were still distributed on paper. Now, however, outdated communication techniques have gone through a strategic change, being replaced, and updated, by modern solutions based on cloud computing which are able to cope with the fast pace and extremely interconnected society, this being due to the rapid progress of digital platforms. Understanding the concept of digital communication and knowing its strategic impact is thus a necessity for decision-makers responsible for the success of a business (Roggeveen and Sethuraman, 2020).

The modern business landscape, stemmed from the power of developed technologies and the efficiency of AI, reflects the growing evolution of administrative tasks, embracing an appreciably more structured work, that chooses automation as a vital pillar in business communication, offering a better connection between companies, customers and organization, while also increasing the involvement of interested parties. The development of business communication in the digital age will solidify, through intelligent and personalized interactions, the perception that each interested party is valued and understood. Virtual reality (VR), augmented reality (AR), Blockchain technology, they will increase the adaptability of companies by stimulating transparency but also security, reaching a wider audience and promoting more meaningful connections for increased competitive advantages. This will affect the economy by: revolutionizing the job application process, lowering prices, increasing productivity and restructuring industries (Brynjolfsson and Mitchell, 2017).

Accordingly, besides an easier collaboration between employees and an increased flexibility of work, the digital age brings a series of other advantages in the business environment such as: increased speed and expanded capacity in terms of access to information and services, effortlessly access to the public from all over the world, extensive marketing, automation of tasks, and implicitly of businesses, reduced infrastructure costs for companies, all these things being possible through the development of concepts such as cloud computing, electronic commerce, or VoIP.

Managing communication in business is crucial for the smooth and successful coordination of the company. Therefore, the implementation of the latest technologies in business communication is mandatory (Schramm, 1954).

In this context, the main purpose of our research is to exhaustively analyse how business communication affects the work environment, in order to acknowledge how we can manage the business activity as correctly, safely and efficiently as possible, how we can provide an extensive and easily accessible digital literacy framework among the employees, as well as what risks, but also opportunities, are expected to proliferate in the future through this openness and transparency of digital practices.

However, the objectives of the research are to analyse the changes brought by digital communication in traditional methods, to assess the impact of digital communication on organisational efficiency and employee collaboration, to identify which countries are the most developed in this regard, and to examine the role of digital literacy in the effective implementation of digital communication strategies.

Through a comparative analysis, we are seeking to illustrate how digitisation is currently shaping the labour market, together with economic development and sustainability, and to find a balance between the judicious use of these technologies and the avoidance of information overload.

2. Problem Statement

The evolution of business communication in the digital age plays a leading role in the modernisation process of all economies, offering new perspectives regarding the planning and implementation of public policies, where the speed of information dissemination is more important than ever. The increasingly digitised communication already represents a faithful barometer of social, economic, and demographic changes that underpin strategic decisions in fields such as politics, health, education, economy, or infrastructure. When integrating the most recent technologies, countries from all around the globe bring their efforts to national calibration and the inclusion in continental systems, while allowing their adequate depiction within the state block.

According to Brown (1973), "communication is the transmission and interchange of facts, ideas, feelings or course of action", while Allen (1958) considers that "communication is the sum of all the things a person does, when he wants to create understanding in the mind of another. It is a bridge of meaning, involving systematic process of telling, listening, and understanding". Which is tremendously correct. Communication is the basis of all our social and economic activity; it stimulates the company's development processes, and it helps us create strong and productive relationships. In "Theories of Mass Communication", De Fleur & Ball-Rokeach (1982) analysed the main stages of the development of human communication, considering that "each of them had profound consequences for both individual collective social life".

When it comes to business communication, Barnard (1958) believes that "in the exhaustive theory of organisation, communication would occupy a central place because the structure, extensiveness and scope of organizations are almost entirely determined by communication techniques". Business communication can be characterised by the predominant pragmatic character, its concern for efficiency,

being the very essence of the social system and affecting change throughout the organization (Santhosh, 2018).

However, consumer behaviour is constantly developing and changing according to new innovations, interactions, and shifts in the market environment (Zhang et al., 2020), which is why communication has thoroughly developed with the entry of new technologies into the international landscape.

New innovations have unfolded new perspectives for understanding and anticipating economic-social trends, facilitating a quick and informed reaction of governments regarding societal changes. The new communication channels have optimised internal processes and they have increased the degree of transparency and accessibility of data for the general public, facilitating the process of adopting international reporting standards, thus contributing to increasing the reputation of countries as proactive and responsible member states within the international community, proving enormously beneficial for retailers, manufacturers, and service firms (Dekimpe, 2020).

Communication in the digital age stimulates the dissemination of innovative research and facilitates the exchange of knowledge between researchers at a global level, playing an essential role in understanding the complexities of a modern society with its economical dynamics (Prasad, 2023). Through rigorous analysis and interpretation of data, communication in business contributes to the foundation and evaluation of the effectiveness of a business activity. In the context of globalisation and rapid change, the ability to respond promptly and accurately is crucial (Archen & Yuan, 2000). New methods of communication, with the help of the new digital technologies, help us navigate effectively through the challenges and opportunities of the 21st century, facilitating strategic planning while adapting to people's needs.

Currently, in the context of the advance of artificial intelligence, new methods of communication are vital to evaluate the readiness and compatibility of enterprises increasing profit and expanding the enterprise (Grewal et al., 2022). Through its constructive and dynamic nature, business communication represents an essential criterion for the qualitative measurement of economic and social evolution, and its role in any modern state transcends the simple collection of data, becoming a crucial tool for interconnection, efficiency, and development.

Therefore, by continually improving methods and by adopting the latest standards, business communication in the digital age facilitates an informed dialogue between interested parties, stimulating the success of the business. At the same time, by embracing correct and ethical principles, the strengthening of inter-institutional ties is supported, contributing to a robust statistical system, organised on solid principles that ensure quality and promptness in responding to society's informational needs. This process of continuous evolution reflects the commitment of economic operators for excellence and precision in business, and in the context of globalisation and the emergence of the information society, new methods of communication become essential for identifying and addressing major phenomena, such as sustainable development and the millennium goals, by approaching real-time updates and exchanges (Roggeveen & Sethuraman, 2020).

As we look to the future, it is clear that continued investment in technology will play a critical role in shaping the evolution of business communication strategies. Becoming accustomed to these modifications will constitute a key point for the organisations that wish to meet success in the long run within a persistently linked environment. In light of this matter, we wish to draw attention, in the most comprehensive way, to the advantages and the threats imposed by digital communication, to foster the inclusion of these points on the greatest scale.

A current gap exists regarding the understanding of the particular processes permitting digital communication to change standardized communication means in business, to influence teamwork and efficiency in an organization, and the influence posed by digital literacy in this process, despite the notable literature which approaches the progress of business communication in the digital era.

A noteworthy element that is missing from literature is the integrated assessment of the advantages and the drawbacks digital communication in the business context and the effects it can trigger on strategic planning and policy application in a worldwide interlinked realm.

3. Aims of the Research

The objective of this research is to close the knowledge gap through an inclusive bibliometric analysis of the manner in which business communication evolved in the digital era. More exactly, the paper studies how traditional business communication means were altered by digital communication, pinpoints the primary advantages and drawbacks posed by digital communication in business settings, and ultimately determine the influence it has on organisational efficiency and the cooperation between employees. The research also focuses on the part played by digital literacy in the application of digital communication strategies, thus displaying an integrative image of the advantages and disadvantages that characterise digital communication in the current business environment.

The goal of the research is the familiarisation with the changing influence of digital communication on business procedures. The aim is to analyse how the emergence of digital platforms shaped the communication strategies of organisations, which affected the efficiency of their operations, the involvement of interest groups and the general competitiveness of the market. The research focusses on identifying both the benefits and challenges of digital communication, thus providing a comprehensive understanding of its effects on today's business environments (Archer et. al., 2000).

To achieve the main objectives of the research, the following key questions will be investigated: How has digital communication changed traditional methods of business communication? What are the main advantages and disadvantages of digital communication in business environments? How does digital communication affect organisational effectiveness and employee collaboration? Which are the major players in the evolution of digital transformation and business communication? What role does digital literacy play in the effective implementation of digital communication strategies?

The purpose of these questions is to identify specific ways in which digital tools and platforms have replaced or enhanced traditional forms of communication such as notes, face-to-face meetings, and phone calls, to evaluate the benefits, such as increased speed, flexibility, and accessibility, and the challenges, such as cyber security threats, digital literacy gaps, and information overload, while exploring the role of digital communication in streamlining workflows, improving productivity, and improving collaboration between employees.

Therefore, the main objective of this study is to provide a detailed analysis of the development of business communication in the digital age and to highlight the most important trends, advantages, and challenges, examining the importance of digital literacy among employees and how it affects the successful adoption and use of digital communication tools. The specific objectives consist in highlighting how countries manage to embrace digitisation in a way that gives them great competitive advantages, the most important milestones in the transition from traditional methods to digital methods are identified, the current state of digital communication in businesses, focussing on exploring the role of digital communication in improving organisational effectiveness, employee collaboration, and stakeholder engagement for providing recommendations for companies to address the challenges of digital communication and leverage its benefits to achieve a sustainable competitive advantage.

4. Research Methods

This study will use bibliometric analysis to find the most productive authors, source titles, documents, and organisations regarding the digital transformation and business communication. We used a total of 2035 scientific publications collected from the Web of Science database that were published between 2015 and 2024 for our analysis using the VOS viewer software. Content analysis was employed as a method for bibliometric analysis through the VOS viewer software which helped in achieving research goals; bibliometric analysis being a quantitative approach that evaluates article similarity within a bibliographic database which has been widely used over recent years (Almajali et al., 2022).

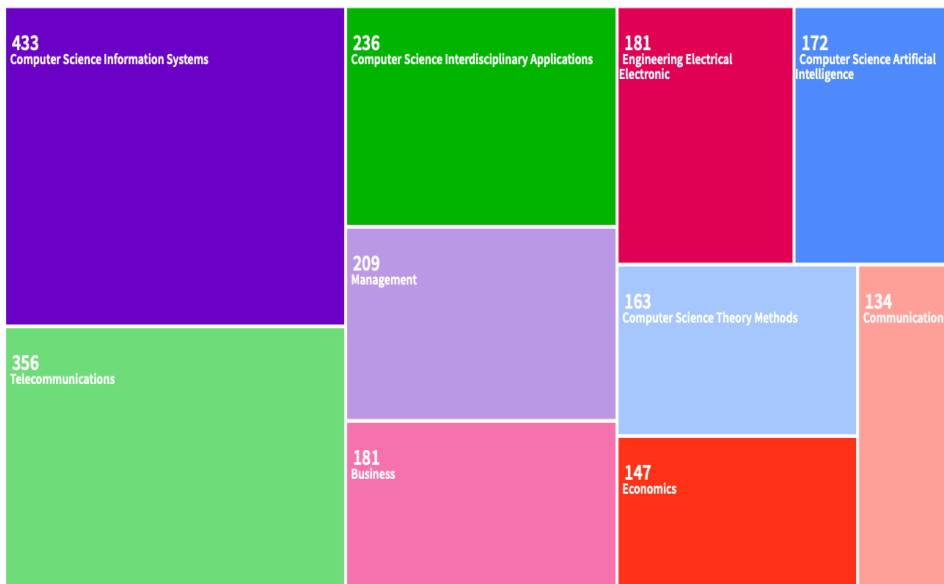
In the field of digital transformation and business communication, a sum of 2035 articles were examined through an integration of analytical evaluation and bibliometric technique. This helped us identify the most relevant papers, documents, and authors in the studied area. To make the visual representation possible, the software employed was VOS viewer, which can highlight bibliometric networks. Integrating in eth software several wordings obtained from journals, a detailed image of facts regarding the digital revolution in the marketing field were obtained. In the first place, the software classifies data by co-citation and co-authoring relationships, groups them based on bibliographic linkages. Additionally, it provides map support to make sure the most relevant elements are appropriately addressed.

5. Findings

As an innovative process, digitisation operated considerable modifications to the contemporary society. It provided a positive flow to day-to-day activities, reshaped work processes, and helped organisations increase their productivity. Moreover, it was persistently integrated in human life and displayed further innovative aspects. Despite the advantages and drawbacks that it implies, organisations are required by digitisation to know the latest changes within the digital field. For such a transformation to be viable and functional, an organisation must shed old habits, step outside its comfort zone, and be receptive to technological progress. The new digital media are dialogic, interactive, relational, and global, making them extremely suitable for a strategic paradigm of public relations.

Therefore, in the first phase of our research, we tried to identify the most relevant articles according to our problem statements. To select the articles, we accessed the Web of Science database and came across 2,035 articles that were considered relevant. During our research process, we applied certain filters for precision; therefore, we highlighted keywords that had to be present in the titles of the articles: “digital transformation”, “business”, and “communication”.

Figure 1. Structure of articles analysed by field of interest

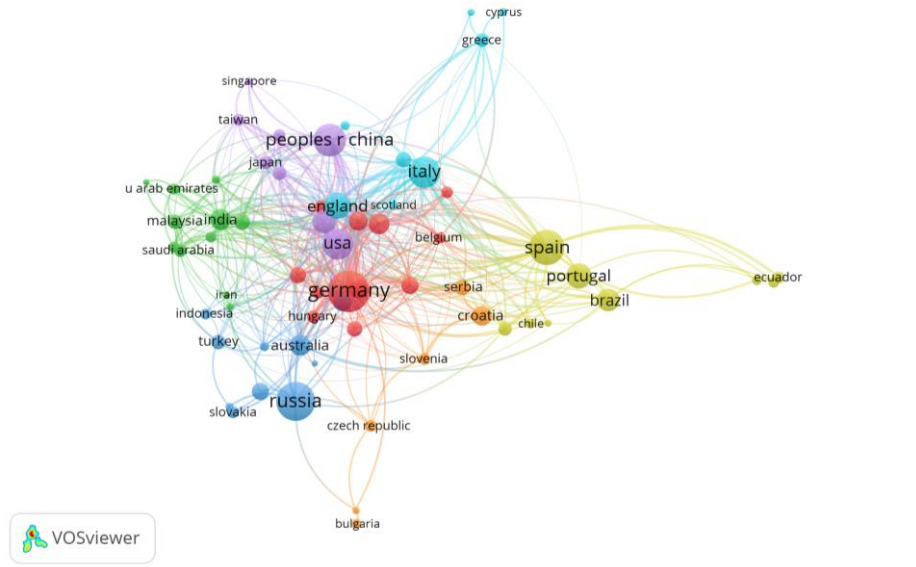


Source: Web of Science database.

Using the tools provided by the Web of Science database, we have classified the articles according to the areas of interest. As we can see in the Figure 1, the categories that are mentioned also represent the areas that have suffered a colossal impact due to the digital transformation. On the other hand, precisely these areas represent both

the engines and the bases that lead to the development of communication in business due to the phenomenon of digital transformation.

Figure 2. The most important scientific research centres in the field of digital transformation and business communication



Source: Web of Science database.

Therefore, as we can see in Figure 2, Germany, the USA, Portugal, Belgium, and Italy are identified as a major player in the evolution of digital transformation and business communication. The prestige of these countries resides in their persistent basis of academic and research activities, which are specific to the countries that own famous universities and research entities. These programmes involve both technology and business, since they attract eminent scholars in a context that can generate valuable research and holds interest from global academics, based on considerable financing.

The contribution of Government and EU funding to these nations is considerable, and it is notably high in Germany, Portugal, Belgium, and Italy. The aim of such financial infusions is twofold: fostering innovation and creating a supportive environment for research activities in the advanced tech and communication sectors. Additionally, these countries establish international collaborative networks involving academia, industry, and governmental officials – where knowledge as well as resources are shared reciprocally. The ties between leading technology firms (mainly based in the USA and Germany) and academia are symbiotic; leading to cutting-edge research findings that drive practical industry applications.

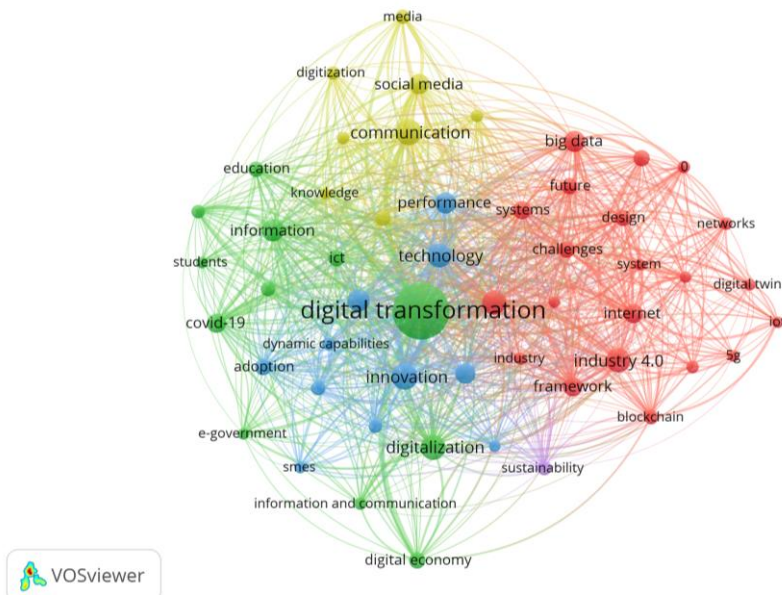
Countries such as Germany, Portugal, Belgium, and Italy reflect a great degree of contribution of governmental and EU financing to such countries of great potential. The financial assistance has a double aim, namely to encourage innovation

and generate a nurturing context for research actions in the tech and communication field, as well as to set global cooperation networks, that include the academia, organisations, and government executives. These networks split knowledge and resources. There exist reciprocal linkages between top technology companies, affiliated primarily in the USA and Germany, and the academic environment, that generate innovative findings that can practically assist the industry.

Another defining component, besides the economic circumstances, is culture. An example of a country with a strong entrepreneurial culture which enables innovation in business and technology, and that propelled itself on this basis, is the United States.

On the other hand, Italy and Belgium look towards their cultural richness – especially in design and communication, for cues on how they can infuse digital evolution into these areas. In light of strategic imperatives, efforts aimed at enhancing digital competence are given high priority within these nations that seek to boost their levels of economic competitiveness and adapt to global market dynamics, a directive echoed through national research agendas and allocation priorities of funds.

Figure 3. Key directions of digital transformation in business communication



Source: Web of Science database.

As we can see in Figure 3, according to the key-word identified, the major direction of evolution for digital transformation and business communication are dynamic capabilities, big data, sustainability, e-government and future. These elements play an important role as they highlight the wide-reaching and constantly evolving effects of digital technologies on business operations and communication.

When it comes to dynamic capabilities, it means that the company has the ability to adapt itself to changing environment by integrating both building and reconfiguring internal competencies with external competencies. In terms of digital transformation, these capabilities allow organisations to easily adapt their strategies regarding communication, along with tools – towards technology developments and market needs quickly.

Enhancing performance by way of digital metamorphosis means refining the art of business communication; that it be both efficient and effective would lead to swifter response time, pinpointed communication, and data-based decision-making processes. These concerns intend to improve productivity and to achieve the desired goals in an accurate way.

Organisations can access at the moment great volumes of information and unrevealed tendencies due to big data technologies, that allow decision making processes based on informed facts. In terms of communication, this matter supposes the adjustment of messages, together with streamlining the manner in which they are transferred through different channels and the personalisation of stakeholder communications to attain improved reach and effect.

In the realm of e-government, digital transformation is also instrumental in supporting this cause. It means that government institutions can use digital tools to better serve their stakeholders and reach out to the public easily. As for businesses, it implies improved accessibility to government services and information via electronic means; reduced redundancy during enforcement through online filing; and a faster feedback loop from governmental organisations thanks to electronic communication.

Regarding the advantages, they can be summarised as: smoother and faster communication and contact with colleagues, as well as with distant partners, improved data transparency and increased accessibility, easier tracking from different locations, increased work efficiency and enterprise performance, reduced administrative time, quick transaction processing, reduced operating costs, more efficient strategy, and simpler navigation.

However, despite the numerous advantages and opportunities offered by digitisation, several cross-cutting challenges persist in the media and content industries. In the supply sector, the main challenges lie in the fact that other players in the value chain often benefit from the advantages of digitisation rather than those investing in digital content, which generates some resistance to fully adopting it. Additionally, digitised goods are threatened by copyright infringement. Specifically, the main political and regulatory challenge for media and content in the EU should be a simple and effective framework for multiterritorial licensing, accompanied by an intellectual property regime capable of promoting innovation and creation and addressing society's new perspectives on media and content. Alongside funding, European policies should also be aimed at enhancing coordination and creating economies of scale in the use of technical infrastructures.

The final set of recommendations is oriented towards increasing user awareness and educating highly qualified professionals; by raising user awareness regarding

European heritage or creating public sector positions that require a certain level of digital knowledge.

Looking forward to future communication requirements demands anticipation of the future technological trends as well as readiness to adapt new technologies into business processes and operations. Remaining informed concerning AI, machine learning, and other technologies integrating innovation represents a central element in this structure, that further shapes both the internal and the external communication conducted by organisations.

Businesses must place emphasis on these fields to alter their communication through digital transformation, which can further increase the urgency of strategic growth. By conducting such efforts, organisations become able to stay competitive in a continuously changing digital framework.

6. Conclusions

The development of the digital age is perceived as a notable evolutionary process in business communication, standing as the main element which brings its contribution to the social and economic progress of the modern-world economies. In addition, the manner in which business departments conduct communication was changed by the evolutionary rhythm of digital technologies. At its turn, this process determined consistent alleviations in the operational efficiency that created ramifications and allowed organisations to materialise socioeconomic goals.

To truly begin the journey toward digital transformation, companies need to review their business processes. The main obstacle to digitisation for companies is not related to money or time but to operational processes, such as the processes for negotiating and approve contracts or managing payment processes to suppliers. These enterprises should find partners who can help them in the journey toward digital transformation, which always starts with the review of internal and external processes and then the adaptation of digital resources such as automation. These processes are absolutely necessary to provide a complete picture of any company's activities.

Important steps that should be followed for improvement in the digital area include: creating economies of scale in both technical infrastructures and management units for the production and distribution of media and digital content, researching and reducing transaction costs in the supply of media and digital content, combating insufficient media and digital content delivery caused by trade barriers, adopting a harmonised framework and a package of measures – promoting legal offers, raising user awareness, collaborating among players involved in content and media transactions, and specific legal measures – with the aim of combating online copyright infringements.

Major observations from top industry players stress on the criticality of communication as an institution's backbone alongside economic activity; this means effective utilization of digital innovations should be injected into developing organizational capabilities that will facilitate easy adaptability due to changing market dynamics along with strategic requirements.

Germany, the USA, Portugal, Belgium, and Italy are the leading nations in this wave of digital metamorphosis. They have led the way not simply by governmental or EU funding but because of their academically and research-oriented environments that are highly fortified. Innovation is promoted through these nations' supportive research climates while they also take advantage of their cultural uniqueness in the way they adopt digital advancements – contributing to their global competitiveness in unexampled ways.

From this point of view, the digital era has ushered in new paradigms such as e-government, big data and sustainability – these will define future communication strategies. The adaptability of governments and businesses to these advancements ensures transparency and stakeholder needs are met, thus driving organisations towards more data-driven decision-making processes that address both immediate and long-term objectives. As a result of this technological shift – from business functions towards government operations – being driven by data, digital technologies need to be continuously invested in. Also, flexible communication strategies should be adopted so that growth competitiveness can be sustained in today's highly interconnected world. The digital revolution provides not only better insight into responding economic changes, but also allows pre-dots on forthcoming technological waves: An industry-leading impact is what this holistic adoption approach for digital communication strategies will definitely have globally on industries and economies worldwide.

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Digital Assets: Emerging Opportunities and Challenges

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Abstract

As more people and organisations acknowledge the potential advantages and opportunities of digital assets, their use is increasing. Digital assets are gaining popularity due to increasing interest in blockchain technology, which is characterised as decentralised, efficient, and safe, and offers a transparent and immutable record of transactions. The introduction of new clearing techniques, including central bank digital currencies, is expected to increase the credibility and stability of the digital assets market, so attracting more participants. In the cryptocurrency field, the Bitcoin halving represented a noteworthy and an increasingly expected event, its effects being the halving of the reward for new bitcoin mining, the admittance of spot Bitcoin exchange-traded funds (ETFs) in the US and the initiation of spot Bitcoin and Ethereum ETFs in Hong Kong standing as happenings which are able to shape the global trust in cryptocurrencies, in their capacity as exchange and value storage instruments.

Despite these matters, there is no harmonisation at worldwide level regarding the jurisdictional landscape, and the utilisation of digital assets is, at times, slowed down or propelled by the regulatory structures. In addition, regulatory and surveillance systems have been launched by some jurisdictions, for example MiCA in the European Union, whereas other jurisdictions conduct fewer steps in this sense. The research aims to assess the manner in which market capitalisation is shaped by funds' inflow coming from private and institutional investors in the novel Bitcoin ETFs at the US scale and how consumer behaviour is altered by these market participants.

Keywords: digital assets, cryptocurrencies, bitcoin.

JEL Classification: E42, 58, F31.

1. Introduction

The evolving environment of cryptocurrency banking, combining digital currencies with traditional money, contributes to Bitcoin's rise in value, which

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reached 70,000 US dollars in March 2024. Bitcoin spot ETFs were allowed in the United States in January 2024, further diversifying the investor pool.

In the last 15 years, there has been an upward attention allocated to digital assets, this type of assets also reflecting altered volume and typology. Factors such as the technological progress and innovation, consumer attention, and novel financial structures determined the growth process.

Cryptocurrency banking, as a changing environment that links digital currencies and the usual form of money, plays its role in the value rise of Bitcoin, that amounted to USD 70,000 in March 2024. In January 2024, Bitcoin spot ETFs were permitted in the United States, and thus developed the investor pool. Major banks and financial institutions are integrating stablecoins and researching tokenisation using blockchain technology and decentralised finance solutions in order to improve consumer happiness and cost effectiveness.

In March 2024, the entire market capitalisation is 2.6 trillion USD based on the Trading View index TotalCryptoMarketCap. There were 700 exchanges and more than 2.2 million cryptocurrencies, with a daily volume exceeding 50 billion USD, and Bitcoin holding a dominance around 50%. However, Bitcoin's market capitalisation of 1.4 trillion USD was only half that of Microsoft Corporation, which was standing at 3.1 trillion USD.

The growth of the cryptocurrency market has also been influenced by factors such as the increasing adoption of technology, the attraction of cryptocurrencies global and decentralised features, and the attraction of promising financial opportunities in mainstream society (Meister & Price, 2022).

Studies suggest that investor attitudes, macroeconomic concerns, and technological and financial considerations influence the cryptocurrency market. One study highlights how investors emotions play a role in the cryptocurrency field during times of extreme market conditions. This emotional aspect can lead to fluctuations in assets values, irregularities, and speculative behaviours (Lin et al., 2023).

Stablecoins represent a solution that combines the benefits of the cryptocurrencies with the stability tied to currencies or other assets. Moving forward, these digital assets could offer a ground for investors seeking to leverage blockchain and distributed ledger technologies while mitigating volatility.

Some of the capabilities posed by stablecoins are transaction development, liquidity management enhancement, and border settlement simplification. Despite these aspects, stablecoins face processes of evaluation and risk management. Furthermore, users' trust in stablecoins decreased along with the non-achievements of stablecoins, for instance Unified Stablecoin USTC in 2022 and 2023.

2. Problem Statement

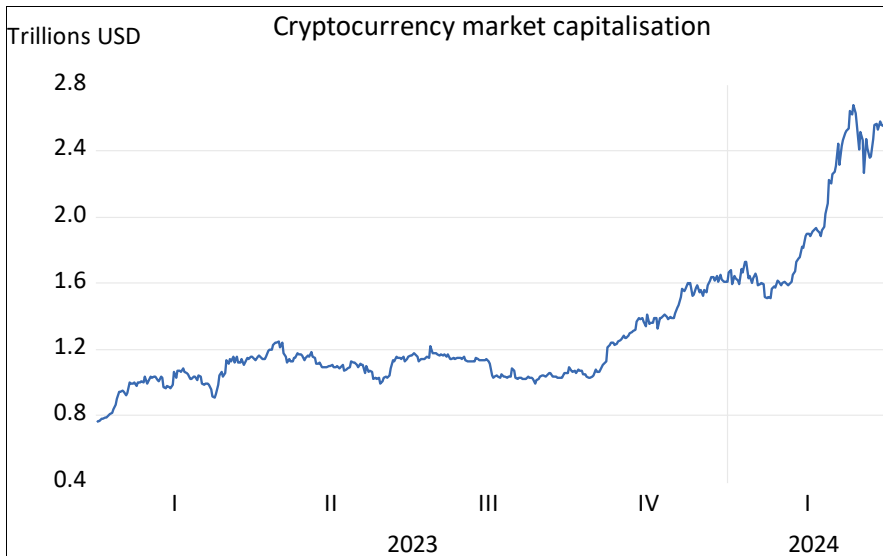
In 2024, there was a net increase of approximately 1 billion USD in the cryptocurrency market, indicating significant changes in the structure that could impact existing relationships on the market.

The year 2024 brought a net increase of approximately 1 billion USD in the cryptocurrency market, pointing out to major structural modifications which could influence market interactions. Around 62 billion USD flowed into the market solely from new Bitcoin ETFs (statista.com, 2024). However, the rise in cryptocurrency prices may also affect the market index.

Early 2024 saw two significant events with an important expected impact on the market: the approval of the Bitcoin ETFs in the US in early January and the Bitcoin halving event in April.

The Bitcoin halving takes place in every four years, as it is scheduled, and generated a 50% decrease in the mining rewards per block, which are reduced to 3.125 Bitcoins per block from a value of 6.25. Bitcoin is intrinsically defined by scarcity, the total volume being capped at 21 million coins. Given their reduced availability, it is highly possible for the value of Bitcoins and the demand for them to become augmented.

Figure 1. The capitalisation of the cryptocurrency market



Source: tradingview.com, TotalCryptoMarketCap 1Dindex.

The upturn taking place in the capitalisation of the cryptocurrency market can also be explained by incoming investments, for instance gold, stocks, or commodities, from other markets. In addition, the cryptocurrency trading price underwent a raise, this process being correlated with a bull cycle.

The approval of regulatory authorities regarding Bitcoin exchange-traded funds generated a strong impact on the cryptocurrency industry. For investors, this process ensured an enhanced and monitored manner of retrieving and investing in the digital asset market. Along with the presence of these investment instruments, investors started to prove interest to become involved in the Bitcoin market.

3. Research Questions / Aims of the Research

The paper aims to study the factors which shape the increase of the cryptocurrency market capitalisation, placing emphasis on the first quarter of 2024, as well as the primary events which determined its development. Whether we are talking about technological advancements, innovation, increased consumer interest, or changes in the legislation of the ETFs in the US allowing Bitcoin investments, all these factors have contributed to the spike in the market capitalisation. In early 2024, it reached 2.53 trillion USD, while the all-time high was 3 trillion USD in November 2021.

Research question 1: Is the rise in market capitalisation related to the inflow of funds from institutional investors in the cryptocurrency market, which in turn have been generated by the approval in the US of the new Bitcoin ETFs?

Research question 2: How does the entrance of new players into the cryptocurrency market impact investor behaviour?

4. Research Methods

We performed an examination of recent academic literature regarding cryptocurrency, maintaining the emphasis on keywords such as bitcoin, cryptocurrency, consumer habits, market volatility, and market liquidity. These terms were selected for their impact on the value of the market and the volume of transactions in the cryptocurrency industry.

Our review of literature sought to showcase an array of perspectives discoveries from recent research, on different facets of cryptocurrency markets. Focusing on Bitcoin and cryptocurrency as topics, we made sure to incorporate a range of virtual currencies and their market behaviours. By examining consumer actions our goal was to delve into how user acceptance, choices, and psychological aspects influence market activity.

We also investigated volatility to gain an understanding of the reasons behind the frequent and notable price fluctuations in the cryptocurrency markets.

This aspect is particularly meaningful for investors and policymakers, given that it directs investment strategies and regulatory procedures. In addition, we conducted a study on liquidity with the aim to determine the degree of ease with which asset trading can be operated without triggering major changes in prices, an element that is essential to maintain the steadiness of markets and the trust of investors.

Afterwards, we performed an assessment through the help of EViews software and data obtained from tradingview.com. The focus points of the analysis were the price and the trading volume posed by the cryptocurrencies Bitcoin (BTC), Ethereum (ETC), and Solana (SOL), in the timeframe January 2023-March 2024, namely 15 months.

Additionally, the paper performs an evaluation of the volume of new Bitcoin investments conducted through top exchange-traded funds (ETFs) in the United States, based on data retrieved from statista.com. The analysis is based on the first three months after the moment when the ETFs were brought to the market, the purpose being the identification of the timely market response as well as the behaviour depicted by institutional and retail investors concerning investments.

The paper also delves into the adoption rates and investment flows while determining the manner in which the novel Bitcoin ETFs influence the market. By placing the lens on this phase, we are able to find trends that otherwise may not present clarity in data for the long-run, such as the early adopters’ joy and the starting liquidity generated by these investment alternatives.

The limitations of the paper reside in the fact that the analysis ensures a snapshot of market dynamics on a term of three months, and thus not all the factors shaping investment levels may be identified.

Conducting an extended assessment encompassing a greater timeframe represents a strategy that can unveil supplementary attributes such as the modified interest of investors regarding regulations and the enhanced economic conditions and technological innovations within the cryptocurrency field.

Moreover, enlarging the timeframe of the study to over three months can bring about trends such as the steadiness of investment volumes, the market progression, and the amplitude of the influence posed by economic cycles on Bitcoin ETFs. This broader examination offers a view of how Bitcoin ETFs contribute to and impact the overall cryptocurrency market landscape offering valuable insights for investors, policymakers and researchers.

5. Findings

In 2024 the global market saw the emergence of Bitcoin ETFs after eagerly awaited approvals in the US. This led to a 57% increase in the market capitalisation from 1.6 trillion USD on January 1st, 2024 to 2.6 trillion USD on March 31st, 2024 as per the Trading View daily index for TotalMarketCap.

Bitcoin ETFs could appeal more to investors compared to directly purchasing cryptocurrencies due to lower fees and the familiarity of traditional investment avenues. There ETFs have the potential to change how individual investors engage with Bitcoin by providing a relatively stable investment option. Ultimately choosing between them depends on preferences, attitude towards risk, and financial objectives.

Figure 2. Bitcoin holdings of the ETFs

	Exchange Traded Funds	Country of incorporation	# of BTC	Value of BTC (billion USD)
1	Grayscale Bitcoin Trust (GBTC)	United States	304.970	20,14
2	iShares Bitcoin Trust (IBIT)	United States	273.140	18,03
3	Fidelity Wise Origin Bitcoin Fund (FBTC)	United States	152.465	10,07
4	ARK 21Shares Bitcoin ETF (ARKB)	United States	42.981	2,84
5	Bitwise Bitcoin ETF (BITB)	United States	33.659	2,22
6	Purpose Bitcoin ETF (BTCC)	Canada	27.928	1,84
7	ETC Group Physical Bitcoin (BTCE)	Germany	22.178	1,46
8	CoinShares Physical Bitcoin ETP (BITC)	Jersey	14.127	0,93
9	Bitwise 10 Crypto Index Fund (BITW)	United States	11.315	0,75
10	21Shares Bitcoin ETP (ABTC)	Switzerland	10.931	0,72
11	VanEck Bitcoin Trust (HODL)	United States	9.220	0,61
12	WisdomTree Physical Bitcoin (BTCW)	United Kingdom	8.510	0,56
13	CI Galaxy Bitcoin Fund (CAD) (BTCX-B)	Canada	8.364	0,55
14	Valkyrie Bitcoin Fund (BRRR)	United States	7.927	0,52
15	Hashdex Nasdaq Crypto Index Fundo De Indice (HASH11)	Brazil	6.898	0,46
	TOTAL		934.613	61,71

Source: statista.com/statistics.

Behavioural finance has influenced investor interest in the cryptocurrency market. In times of market downturns, the short-term focus of investors plays a significant role in influencing players in the cryptocurrency space to turn to media and online sources for information highlighting how investor attention can influence the crypto market briefly (Koutmos, 2018).

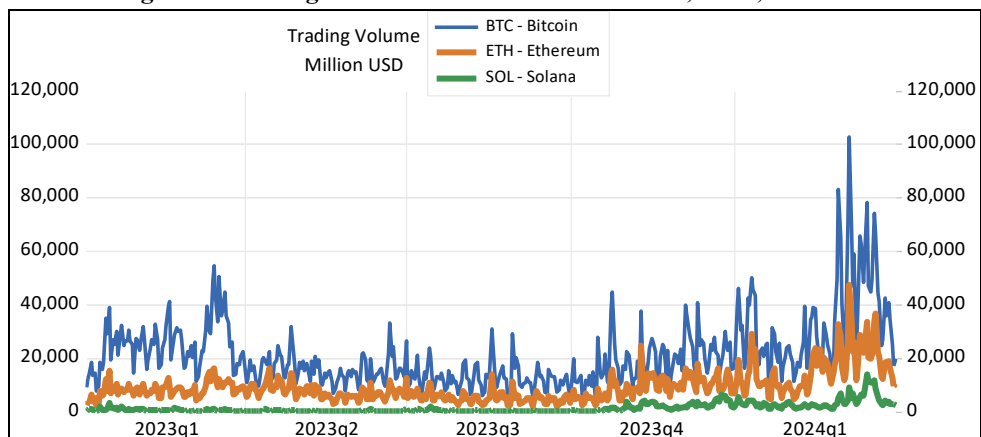
The general tendency indicated by the cryptocurrency market involves a momentum degree and regarding investor interest, size and momentum present a consistent influence (Liua et al., 2020).

The results of the research display that cryptocurrency markets function in an independent manner from other asset kinds. There are signs that the bitcoin market operates independently from macroeconomic conditions, and cryptocurrency markets show no correlation with the regular market (Glas, 2019). Consequently, producing parameters for cryptocurrencies using external data from other financial sectors poses a considerable challenge (Corbet et al., 2018).

The liquidity of the cryptocurrency market is primarily affected by factors unique to cryptocurrencies, such as the volatility of returns, the volume of dollar trading, and the transactions volume rather than by stock and exchange markets (Brauneis et al., 2021). However, data indicates that Bitcoin liquidity is impacted by the opening of the stock markets in London, Tokyo, and New York, peaking when both London and New York markets are active (Aleti & Mizrah, 2020).

Cryptocurrencies can serve as a good hedge against fiat currencies, topping diversified currency portfolios and gold, especially due to gold’s vulnerability to political instability and the global economy (Cheong, 2019).

Figure 3. Trading volume in million USD for BTC, ETH, and SOL



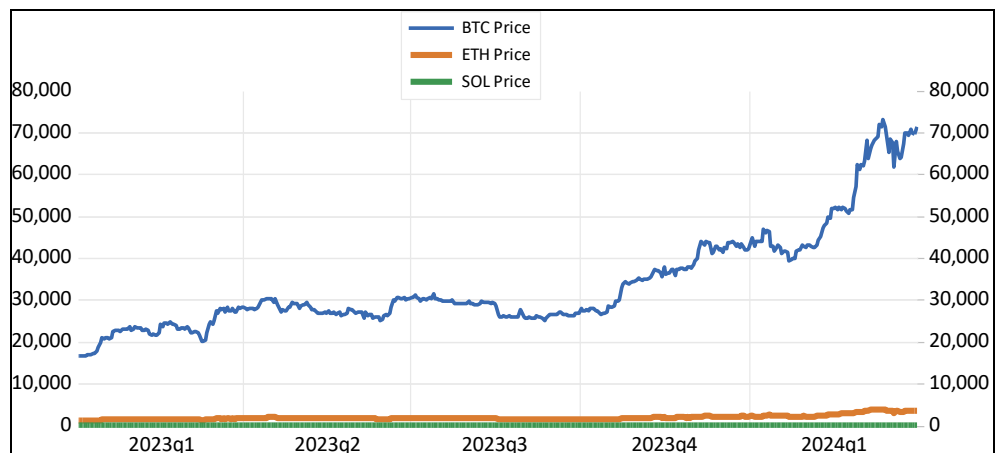
Source: EViews graphs based on the data retrieved from coinmarketcap.com.

Based on our econometric analysis which used regression analysis for the period January 1 to March 1, 2024, a strong correlation exists between the cryptocurrency market capitalisation, defined as the dependent variable, and the Bitcoin volume, as the independent variable. The coefficient is 1.19, and the p-value is 0.00, indicating that variations in the independent variable are associated with changes in the

dependent variable. However, the R-squared and adjusted R-squared are 0.30, indicating that the independent factors are associated with the dependent variable, but not explaining a significant change in the dependent variable, and leading to increased variability around the regression line.

Crypto investors view the introduction of regulations in the cryptocurrency market as adverse news leading to a negative response. Investors exhibit negative sentiments when exploring less liquid cryptocurrencies with higher levels of information asymmetry risk (Chokor & Alfieri, 2021).

Figure 4. Closing daily trading price for BTC, ETH and SOL



Source: EViews graphs based on the data retrieved from coinmarketcap.com.

In July 2023 the Financial Stability Board (FSB), an organisation responsible for overseeing and advising on the global financial system, released its regulatory framework for crypto assets activities. The framework covers aspects such as crypto assets regulations, supervision, and oversight along with updated stablecoin principles. The recommendations are based on market trends and the practical experiences of national authorities. These are grounded in the principle “same activity, same risk, same regulation” focusing on being broad based, adaptable, and neutral towards technology. The FSB cooperates with entities to ensure that efforts aimed at monitoring and regulating cryptocurrencies assets activities and markets are harmonised, mutually beneficial, and supportive of each other. By the end of 2025, FSB aims to assess how these proposals have been implemented while continuing to explore policy implications for decentralised finance.

In September 2023, both the International Monetary Fund (IMF) and the Financial Stability Board (FSB) jointly issued a policy recommendation document. The paper delves into the advantages and disadvantages of cryptocurrencies focusing on how it impacts the larger economy and the financial stability. The IMF-FSB suggests putting in place rules and oversight practices for crypto assets to tackle potential risks to macroeconomics and financial stability. By regulating and monitoring authorised or registered crypto assets issuers and service providers it may

be possible to maintain measures related to capital flows, fiscal policies, tax laws, and financial integrity standards. To prevent fluctuations in capital movements, nations should protect the control over their currency systems and fortify their monetary policy frameworks.

6. Conclusions

The introduction of Bitcoin exchange-traded funds impacted the cryptocurrency market, but it did not lead to significant changes in the market capitalisation.

As a result of factors such as reduced transaction fees and the familiarity posed by traditional investment options, some individual investors might choose ETFs instead of cryptocurrency purchasing. In line with this, Bitcoin investments can become easily attainable, more monitored from the legislative perspective, and stable. Nevertheless, given that the research relies on data from the first three months after the introduction, novel perspectives can be provided by an extended analysis in a greater timeframe.

Taking into account the conducted analysis, a proactive approach needs to be employed in regards to cryptoassets. Among the advantages of cryptocurrencies, we may name the lowered transaction expenses, the quick international payments, and the developed financial inclusion through payment technologies and trends. The potential held by Bitcoin is manifested in the direction of expanding portfolio performance, mitigating risks, and leveraging on innovative changes pertaining to digital assets. On the other hand, it is important to acknowledge that an evolutionary pattern is reflected by the technology that sustains cryptocurrencies and the viability of this method has not been fully proven yet. Due to this, the individual investor must be careful and map volatility risks, uncertainty regarding the regulatory framework, and problems associated with security.

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**The Impact of Fiscal Transfer from the EU Budget
on Economic Growth in CEE Countries**

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Abstract

Fiscal transfer is defined as the allocation of funds from the European Union's budget to its member states or regions for various purposes. This transfer constitutes an essential aspect of the European Union cohesion policy that aims to reduce the economic and social disparities among member states and to promote economic development and integration across the Union. The purpose of this paper was to determine the impact that these fiscal transfers from the union budget had on the economic performance in the Central and Eastern European countries. To achieve this, I used a panel data fixed effect model, taking into account the effects of the cohesion policy, but also other relevant variables. The paper focused on the period 2009 - 2022, being aimed at the member countries of the Central and Eastern European Union because they have a similar economic path. The results of the research demonstrated the fact that the expenses from the union budget had a positive impact on the economic performance in this region during the analysed period.

Keywords: EU budget, EU expenditure, CEE countries, panel model.

JEL Classification: C21, H87, O11, O47.

1. Introduction

The conclusion of the Cold War and the collapse of the Eastern Bloc resulted in the formation of a new political and economic environment in Eastern Europe. With the beginning of the new millennium, the process of Eastern European countries' integration into the European Union (EU) was brought on the EU agenda. Year 2004 brought the greatest expansion wave of the European Union, as 10 countries that are part of the Central and Eastern region attached to it. In the

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following years, specifically in 2007 and 2013, Bulgaria, Romania, and Croatia also joined the union.

In order to reduce the economic and social disparities between European countries, the main function of the community budget is that of allocation. As a consequence, it may be stated that the Cohesion Policy held an utmost role for the European territory across time.

The objectives of the Cohesion Policy, as a program, include environmental betterment, welfare, the EU sustainable development, and employment opportunities, together with the enhancement of regional economies' integration. Therefore, the program aims to make it possible for every citizen of the EU, no matter where, to participate and celebrate the benefits that actions intended to protect the development of the European territory bring into their lives.

Estimations find that the EU mobilized investments of EUR 392 billion in the period of 2021-2027 for the cohesion policy. In addition, program financing in the EU Member States and their regions shall be ensured via funding of around EUR 500 million, brought by national co-financing.

According to the European Commission, 2023, the Cohesion Policy is being implemented through the following funds:

- The European Regional Development Fund (ERDF) will allocate investments to the regions and cities of the EU;
- Cohesion Fund CF will provide transportation and environmental programs targeted to the EU member states that are of a weaker degree of development;
- European Social Fund Plus (ESF+) developed to help EU countries build a society that is inclusively-minded through the employment-promotion agenda;
- The Just Transition Fund (JTF) shall support this area hardest hit by the consequences of the transition to carbon neutrality.

In other words, the aim of the Cohesion Policy is to safeguard development and convergence in the long term, a goal that has also been stressed in the past.

The study assessed the influence that has been generated by Cohesion Policy towards economic performance on CEE countries using a panel data fixed effect model examining the influence of EU expenditure and other critical variables, and addressing for example, education, investment, and population growth.

2. Literature Review

This research approaching economic development and convergence in the European Union presents steadiness. Numerous authors have examined how European regional policy impacts the economic growth and convergence of European countries (e.g., Ederveen et al., 2006; Mohl & Hagen, 2010; Montresor et al., 2011). For their analyses, all of these writers chose the panel data method.

An important author who studied the impact of the EU budget on the process of economic convergence of EU member states is Výrostová (2016). Her work is relevant for the specialised literature because it takes into consideration the EU budget contribution and additional fiscal transfers from the EU as explanatory

variables in a panel econometric model of conditional of conditional β -convergence, as well as accounting for the effects of the cohesion policy.

Convergence can be understood and analysed using a variety of methods. Islam (2003) emphasised in his research that this method has an advantage over s -convergence in that it provides information about the structural parameters of the growth model. The assessment of β -convergence is based in the neoclassical growth theory, for instance Solow's 1956 exogenous growth model. The examination of β -convergence originates from neoclassical growth theory, such as Solow's 1956 exogenous growth model.

According to these theories, there exists an inverse linkage between the starting amount of income per labour unit and the economic growth rate per labour unit. Based on the theory of absolute (unconditional) convergence, all countries and regions coincide on the same stable rate due to the decreasing returns on capital.

Consequently, economies with a lower development level grow with a faster speed than the developed economies. In order to explain the differences across economies with different structural features, a number of additional explanatory variables are included in the growth-initial level regression, as conditional β -convergence predicts that these economies will eventually converge to different steady states.

For most empirical studies, neoclassical growth theories like Romer and Weil's (1992) serve as the basis. But by adding endogenous technological improvement, the concept of endogenous growth expands the paradigm. Human capital is given priority since it boosts the output of other inputs.

Some studies extend the *Solow model* to include the accumulation of human capital, showing a relationship between savings and population increase, as well as the accumulation of human capital. Before studies employed education-related variables (e.g., average years of schooling or tertiary education) or innovation-related variables (e.g., Mohl & Hagen, 2010, used the number of patents per million people) since measuring human capital is challenging.

This research contributes to the relevant literature due to the fact that it does not consider all the member countries of the union and the paper was concentrated on CEE member states of the EU because this region has a similar economic path and joined the Union at the same time or in close years.

3. Aims of the Research

Determining the impact of European funds in Central and Eastern European countries is important to ensure a more efficient use of them in these countries, as well as an improvement of public policies. Nowadays, when the trust in the European Union is put to the test, a positive evaluation of the impact of the European funds can lead to a better consolidation of the trust of the beneficiary countries in the Union, but also in their institutions.

4. Methodology

In this research, the impact of the EU budget on economic performance is studied and the method used was the cross-sectional panel data fixed effect.

This approach allows for the consideration of individual (country) effects, or technical differences between countries, perhaps mitigating the issue of the omitted variable bias. The model incorporates human capital accumulation as an explanatory variable, enhancing the neoclassical *Solow-type* growth model.

Starting from the models developed by other authors, such as Mohl and Hagen (2010) and Výrostová (2016), the regression function estimated in my analysis is:

$$\ln(\text{GDP-per capita})_{i,t} = \beta_0 + \beta_1 \cdot \ln(Y)_{i,t-1} + \beta_2 \cdot \ln(\text{Inv})_{i,t-1} + \beta_3 \cdot \ln(N_{i,t-1} + \delta + g) + \beta_4 \cdot \ln(\text{Educ})_{i,t-1} + \beta_5 \cdot \ln(\text{Spen})_{i,t-1} + u_i + \varepsilon_{i,t} \quad (1)$$

Where $I = 1, 2, 3, \dots, 11$ represent the countries from Central and Eastern Europe that are part of the European Union (Croatia, Czech Republic, Romania, Slovakia, Bulgaria, Hungary, Poland, Slovenia, Estonia, Latvia, Lithuania), and $T = 1, 2, \dots$, represent the time (period 2009-2022). β_i are the parameters of the model.

Table 1. Variables of the model

Variables	Description of the variables	Source
Real GDP per capita	The dependent variable. Is often used as a proxy for the standard of living.	Eurostat
$Y_{i,t-1}$ = Real GDP per capita in <i>Purchasing Power Standards</i> (PPS)	The explanatory variable. As initial income	Eurostat
$INV_{i,t-1}$ = Investment Share in GDP	The explanatory variable. It's a key economic indicator that measures the proportion of a country's GDP that is accounted for by investment spending	Eurostat
$N_{i,t-1}$ = Annual population growth rate	The explanatory variable	This variable is determined using the data of the total population on January 1 st for country i (Eurostat, 2024)

Variables	Description of the variables	Source
g = Rate of technical progress	The explanatory variable	Many empirical papers have used the assumption that g and δ are constant across countries and time, as well as $g + \delta = 0.05$
δ =ate of depreciation	The explanatory variable	
Educ _{<i>i,t-1</i>} = Population with tertiary education (levels 5-8) as a percentage of the total population.	Our proxy for the growth of human capital is this variable. Primarily because it aligns with one of the objectives of the "Europe 2020" plan for intelligent, sustainable, and equitable growth.	Eurostat
μ_i = fixed national effects		
$\varepsilon_{i,t}$ = error term for the country and time		

Source: authors' own data processing.

The data I used to calculate this variable were figures on *EU spending and revenue for 2021–2027* from European Commission (2024).

- $Sp_{i,t-1}$ represents the EU budget spending per capita for country i in the previous year in million EUR. This variable takes into account all of the spending that countries get from the EU budget, not just the structural and cohesion fund expenditures, which are typically examined in research of this kind.

From 2021 onwards, there will be a new trailblazing temporary recovery tool to help the economic recovery of Europe from the coronavirus pandemic, called NextGenerationEU. This expenditure also covers the new fund and pre-accession funding for Croatia, which became a member during the examination period.

5. Results and Discussions

The empirical results showed that the initial value of GDP per capita is positive and highly statistically significant, so an increase in initial value contributed to greater economic performance in the period 2009-2022. Therefore, the countries that have a good start from an economic point of view develop it even more throughout the period.

Table 2. Fixed effects panel data model results

Variables	Coefficient	Std. Error	T-Statistic	Prob.
C	3.096	0.245	12.625	0.000***
$\ln(y)_{i,t-1}$	1.058	0.063	16.814	0.000***
$\ln(inv)_{i,t-1}$	0.170	0.032	5.344	0.000***
$\ln(educ)_{i,t-1}$	0.190	0.034	5.600	0.000***
$\ln(n_{i,t-1} + g + \delta)$	-0.017	0.015	-1.152	0.252
$\ln(spen)_{i,t-1}$	0.059	0.017	3.421	0.049*

Notes: In this model, R-squared = 0.988, adjusted R-squared = 0.986 and Durbin-Watson = 0.74, The *, ***, denote statistical significance at 5% and 1% levels, respectively.

Source: authors' own data processing in EViews 12, based on the data from Table 1.

Also, the investment share in GDP is positive and statistically significant. A variety of factors, such as: the effectiveness of investment allocation, the calibre of institutions, governmental policies, worldwide economic circumstances, and the business cycle, can affect how investments affect real GDP growth.

I used as a proxy for human capital accumulation the population with tertiary education (levels 5-8), and in this model has a positive and statistically significant result that follows the *Endogenous Growth Theory*.

The *Endogenous Growth Theory* provides a framework for understanding sustainable economic growth that is centred on the internal dynamics of the economy, more especially the accumulation of knowledge, innovation, and human capital. It offers details on the potential effects of institutional and policy factors on long-term economic growth and development

The population growth rate is negative and it does not indicate statistical significance, this fact being coherent with estimations of the *Solow Growth model*. According to the *Solow growth model*, population growth rate shapes the long-run equilibrium level of the output per capita as well as the economic growth rate. In this acceptance, higher population growth rates are correlated with decreased levels of output per capita in the long term.

Most of the CEE countries are net beneficiaries of the EU budget, and in our model, the coefficient corresponding to the EU budget, spending per capita is positive and statistically significant. EU spending, particularly through various funding mechanisms such as structural and cohesion funds, has had significant impacts on the economies of CEE countries since their accession to the EU.

EU spending as a whole has played a crucial role in supporting their economic development, enhancing competitiveness, and fostering integration within the European Union.

Therefore, the expansion of the European Union had a positive impact on economic growth, and this can be linked both to the redistribution of resources among its members, but also to other advantages created with its expansion (free trade, economies of scale, increased competition, specialisation) especially since 2004.

6. Conclusions

In this article, I analysed the impact of fiscal transfers from the EU budget on economic performance in Central and Eastern European countries using a panel econometric model, taking into consideration the effects of EU spending and other relevant variables, such as education, investment, and population growth. The data collected covered the period 2009-2022.

This research contributes to the relevant literature because it does not take into account all the member countries of the union, and the paper was concentrated on CEE member states of the EU because this region has a similar economic path and joined the Union at the same time or in close years. Determining the impact of European funds in Central and Eastern European countries is important to ensure a more efficient use of them in these countries, as well as an improvement of public policies.

Over time, many academic papers have analysed the economic effects of EU cohesion policy, but this topic still remains an open empirical issue. Although the results of the specialised literature have proven to be inconclusive and uneven, the recent literature identifies a positive impact.

The results of this article align with the recent results from the specialised literature, namely with the works that identified a positive impact of European funds on economic development.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author used AI Service in the introduction of the paper in order to correct the language and ensure clarity, coherence, and precision in communication. After using this service, the author reviewed and edited the content as needed and takes full responsibility for the content of the publication.

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Digitalisation's Vital Role in Sustainable Circular Economy

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Abstract

The circular economy has emerged as a concept in the pursuit of achieving sustainable development goals, representing a pivotal paradigm shift toward resource efficiency and environmental sustainability. Current research examines the transformative potential of digitalisation, as a core factor of shifting to an economic environment, shaped by the characteristics of circular economy, therefore fostering the increase in sustainability. By leveraging emerging digital technologies, businesses can optimise resource utilization, minimize waste generation, and enhance their transition to practices with positive outcome over the environment. The current article aims to review and explore the relationship between digitalisation and circular economy, both of the concepts understood by connected variables, such as the DESI score, the investment in adopting and implementing multiple digital technologies, the recycling packaging rate, and WEEE collection. Through data analysis, centred on correlations and two statistical regressions, the present study provides insight of digitalization's role in recycling and reusing the main resources integrated in adopting and implementing the latest digital technologies in business activities and operations. It concludes by providing a structured answer to the research question. Is digitalisation impacting the circular economy?

Keywords: digitalisation, circular economy, business environment, sustainable development.

JEL Classification: O33.

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1. Introduction

During recent years, the sustainable circular economy has emerged as a concept based on a crucial framework to address the powerful environmental challenges our planet faces. With the ongoing increased recognition of the limited natural resources and the urgent need to minimise waste and maximize recycling and reusing resources, a concrete global effort has been presented to transition toward more sustainable economic business models (Trevisan et al., 2021).

Meanwhile, since the paradigm of the economic and business environment has shifted as well, currently at the heart of this transition lies the transformative power of digitalisation. Therefore, the integration of emerging digital technologies into various sectors and business activities has widely reshaped the perspective in which individuals and organisations produce, consume, and manage resources (Gil-Lamata et al., 2024).

Furthermore, from the Internet of Things (IoT) devices and advanced data analytics, to blockchain and Artificial Intelligence (AI) applications, the phenomenon of digitalisation offered unprecedented opportunities to optimise the usage of resources, to improve supply chain efficiency, and to promote the foundations of circular economy (Strev, 2023).

This paper explores the vital role that digitalisation plays in driving the transition towards a sustainable circular economy, a global trend that is developing simultaneously with the current digital economy paradigm.

2. Problem Statement

Digital technologies and therefore, digitalization, play an important role in enabling the transition from the classical linear economy to the circular economy, and there is no evidence against it. However, operationalising this transition remains a challenge for the business environment, as the understanding process of how digital technologies directly support the circular economy is still ongoing for many businesses and organisations (Cagno et al., 2021).

Meanwhile, digitalisation through digital technologies, has the power to enable real-time monitoring and tracking of resources throughout their entire lifecycle. Using that power, businesses can facilitate more efficient resource management and reduce waste reduction, especially the waste from electrical and electronic equipment (WEEE). Harnessing the power of digital tools, such as Big Data analytics, businesses through digitalisation, can gain valuable insights into consumption pattern. At the same time, opportunities for resource recovery and recycling can be identified, and businesses can also optimise production processes to minimize their environmental impact (Kurniawan, 2022).

Furthermore, digital platforms and sharing economy models enable the exchange and reuse of products and materials, fostering a culture of resource conservation and circularity. At the same time, the digitalised infrastructure of circular economy has the potential to facilitate and achieve the structural conditions for business models and production operations that are based on sustainability.

The high level of digitalisation that is present in the current circular economy is based on tangible technological innovations blended with softer intangible innovations that once combined, it can create the environment for improved business performance, efficient resource usage, and smart business models development (Allen and Sarkis, 2021).

At the same time, scholars have been strongly debating whether the framework provided by the characteristics of the circular economy will be adopted as the new economic paradigm. For example, the study conducted by Bressanelli et al. (2022) aimed that the economic environment should be transitioning to the *smart circular economy paradigm* that emphasises the role in achieving the goals of the circular economy. In their perspective, digitalisation involves a combination of various techniques, not just specific technologies. Their results show that the latest digital technologies represent smart tools in establishing product redesign, business models, and smart supply chains. Meanwhile, their study argues that digitalisation alone does not ensure higher sustainability, although the waste resulting from the linear consumption, combined with the data provided by adopting and implementing the emergent technologies, represents the adaptation of the classical circular economy principle for the digital age.

Digitalisation's vital role in sustainable economy has not yet been decided or accepted as a general statement by the scientific community. This leads to a gap in the literature that can only be fulfilled or abandoned when all the research possibilities and research perspectives have been explored.

Hence, current research represent one more approach in the process of determining the role in enhancing the circular economy.

3. Research Questions / Aims of the Research

There is no reason in denying that the transition towards a circular economy has been constantly supported by the adoption and implementation of the latest digital technologies into business models and business activities. Therefore, digitalisation and its tools are permanently involved in achieving the sustainability goals that the member states of the European Union have aimed to achieve.

At the same time, it is mandatory to understand the correlation between the DESI score, the basic level of digital infrastructure, the investments in multiple digital technologies, the collection of WEEE and the Recycling rate of packaging. In other words, the relationship between digitalisation and circular economy, as businesses operating in the current digital economic environment should be aware of the importance of recycling and reusing the available resources.

Hence, the main goal of the current study is to identify and provide an explanation for the correlations that could be acquired between digitalization and circular economy, in the current context of the digital economy as a main economic paradigm.

Therefore, as a research question for the current paper, the following can be formulated: *Is digitalisation impacting the circular economy?* At first glance, the research question is broad, although it will be narrowed, explained, and exposed in the study conceptualised by the authors.

4. Research Methods

As the authors aimed to provide a brief but comprehensive overview, the data were collected from various sources. The authors have decided to divide the data into two groups, one regarding **digitalisation** and the second group regarding the main aspects of the **circular economy**.

Regarding digitalisation, the following data has been collected: DESI score (European Commission, 2022); Basic level of digital infrastructure – basic level of digital infrastructure (European Investment Bank, 2023); and Multi-technology investments – the percentage of firms that have invested in multiple digital technologies (European Investment Bank, 2023).

Regarding the circular economy, the following data has been collected: Recycling rate of packaging waste – in percentage (Eurostat, 2023a); and WEEE collected – in kilogrammes per inhabitant (Eurostat, 2023b).

All data collected is representative of the member states of the European Union and has been summarized in Table 1.

Table 1. Data summary

EU State	DESI score	Basic level of digital infrastructure	Multiple technology investment	Recycling rate of packaging waste	WEEE collected
AT	54.70	67.3	54.77	65.8	15.46
BE	50.30	77.1	56.21	80.4	14.63
BG	37.70	47.2	22.91	61.2	13.56
CY	48.40	70	33.01	63.5	3.96
CZ	49.10	68	60.16	69.1	12.7
DE	52.90	77.3	40.81	67.9	12.1
DK	69.30	88.8	50.68	64.0	13.1
EE	56.50	66.9	40.24	70.4	9.0
EL	38.90	41.2	36.04	60.1	5.98
ES	60.80	67.5	53.75	70.1	8.72
EU27	52.30	69.1	41.29	64.0	10.97
FI	69.60	89.5	52.55	72.5	14.68
FR	53.30	63.5	22.26	61.8	14.67
HR	47.50	57.8	31.88	50.8	8.98
HU	43.80	51.7	28.50	52.4	8.71
IE	62.70	84.5	44.77	58.1	14.27
IT	49.30	69.9	39.54	72.9	8.5
LT	52.70	63.7	34.20	61.8	7.05
LU	58.90	66.2	33.53	73.7	10.4
LV	49.70	52.3	36.64	61.0	8.53
MT	60.90	77.9	45.13	38.4	6.85
NL	67.40	80.1	55.10	76.8	11.75
PL	40.50	61.0	31.75	55.5	11.24
PT	50.80	70.3	32.37	63.1	5.18
RO	30.60	52.5	34.62	39.9	4.75
SE	65.20	86.9	54.06	59.6	12.98
SI	53.40	67.1	54.99	55.1	7.37
SK	43.40	60.2	34.47	70.8	9.57

Source: data collected by the authors.

At the same time, in order to answer the research question, a simple correlation between the variables and two regressions have been conducted using the Data Analysis Tools provided by Microsoft Excel. The analyses are explored and extended in the next chapter of the paper.

5. Findings

The first step in formulating a statement for the research question is to run a correlation between the variables selected for the current study. Therefore, using the correlation tool, the results presented in Table 2 have been provided.

Table 2. Correlations between the analysed data

Correlation results	DESI Score	Basic level of digital infrastructure	Multiple technology investment	Recycling rate of packaging waste	WEEE collected
DESI Score	1				
Basic level of digital infrastructure	0.84	1			
Multiple technology investments	0.58	0.62	1		
Recycling rate of packaging waste	0.34	0.30	0.32	1	
WEEE collected	0.41	0.42	0.33	0.42	1

Source: authors' contribution.

The results provided by the correlation show that there are only direct correlations between the selected variables; therefore, the models constructed for the two regressions are empirically valid. As expected, the strongest correlation (0.84) is between the DESI score and the basic level of digital infrastructure, but this is not a new result, as the level of digitalization could be assimilated as a major element in determining the DESI score of a country.

The most notable result of the correlation summary is that both the Recycling rate and WEEE collected possess a moderate correlation with the remaining variables, which represents the reason why both regressions are required for more details of the impact over the environmental aspects of the circular economy. Therefore, it is observable that the Basic level of digital infrastructure is stronger correlated with the WEEE collected than with the Recycling rate of packaging waste, since the electrical and electronic equipment can be assimilate as the standard physical resources used in adopting and implementing the latest digital technologies into business models or economic activities.

In Table 3, the summary of Regression 1 is presented. The model has been proposed to determine the influence of digitalisation over the WEEE collected. For this instance, the dependent variable (Y) has been considered to be the

WEEE collected, while the independent variable (X) has been the digitalisation, represented by: DESI score, basic level of digital infrastructure, and multiple technology investment.

Regarding statistical hypotheses, the null hypothesis (H0) has been defined as *Digitalisation is not impacting the WEEE collected*, while the alternative hypothesis (H1) states that *Digitalization does impact the WEEE collected*, if at least one of the variables associated with the independent variable is impacting the WEEE collected.

Table 3. Regression 1: Digitalisation – WEEE Collected

Regression Statistics	df	SS	MS	F	Significance F
Regression	3	59.39417	19.79806	1.978677	0.144072
Residual	24	240.1369	10.0057		
Total	27	299.5311			
Multiple R	R Square	Adjusted R	Standard Error	Observations	Intercept P-value
0.445298	0.198291	0.098077	3.163179	28	0.605596

Source: contributions of authors.

Regarding the summary of the regression, the model returned a value of R Square of 0.19, which indicates that the model is not the strongest in explaining the relationship between digitalisation and WEEE collected.

Hence, only 19% of the variability of the model is attributed to the considered variables used in constructing the regression, highlighting the fact that 81% of the influence over the WEEE collected is determined by other variables, not integrated in the presented model. However, the output suggests that 19% of the total WEEE collected is influenced by digitalisation as understood through the three independent variables.

The output generated by the regression also highlights the Significance F valued at 0.144072. It should be noted that this generated value is substantially greater than the reference value of 0.05 used as a threshold.

This result suggests that the model as an overall output cannot be significant from a statistical point of view. Therefore, it should be agreed that the independent variables chosen for the model do not have a significant impact on the dependent variable.

Regarding the intercept p-value, the outcome of 0.605596 follows the Significance F and indicates that it is not statistically significant. Hence, there is no sufficient evidence to conclude that the intercept is different from zero, which is why, at the same time, it can be confirmed that there is no sufficient evidence to reject the null hypothesis.

Therefore, the regression analysis is in favour of the null hypothesis (H0), which confirms that the level of WEEE collected is not strongly and directly impacted

by digitalization, as understood by the DESI score, the basic level of digital infrastructure, and the percentage of firms that invest in multiple digital technologies.

Table 4. Regression 2: Digitalisation – Recycling rate of packaging waste

Regression Statistics	df	SS	MS	F	Significance F
Regression	3	381.4944	127.1648	1.372204	0.275155
Residual	24	2224.127	92.67195		
Total	27	2605.621			
Multiple R	R Square	Adjusted R	Standard Error	Observations	Intercept P-value
0.382638	0.146412	0.039714	9.626627	28	0.000448

Source: authors' contribution.

The summary of Regression 2 is presented in Table 4. The model proposed in the second regression aims to determine and to discover the influence of digitalisation over the Recycling rate of packaging waste. Therefore, digitalisation, as understood like in Regression 1, represents the independent variable (X), while the recycling rate of packaging waste represents the dependent variable (Y). At the same time, the statistical hypotheses are the null hypothesis (H0), which states that the recycling rate of packaging waste is not impacted by digitalisation, and the alternative hypothesis (H1) which states that the Recycling rate of packaging waste is impacted by the current trend of digitalization towards the digital economy and circular economy.

Regarding the output of the regression, the value of R Square returned by the model is 0.14, suggesting that the model has a weak explanatory power. Therefore, only 14% of the total recycling rate of packaging waste is impacted by digitalisation, the remaining 86% being influenced by other variables that have not been included in the model proposed.

At the same time, Significance F valued at 0.275155 highlights a higher critical value compared with the 0.05 accepted value. This aspect leads to understanding the fact that the overall model can not be significant for statistical purpose, taking into consideration that there is not enough evidence to reject the null hypothesis. At least, the intercept P-value of 0.00048 suggests the statistical relevance of the intercept variable.

Considering the outcome of the regression regarding significance F, the independent variables selected for the model are not significant for the dependent variable chosen to be analysed. Therefore, the results suggest that the null hypothesis (H0) has been validated. Taking this into account, we can conclude that the recycling rate of packaging waste is not directly impacted by digitalisation, as understood through the three composing variables: DESI score, Basic level of digital infrastructure, and investment in multiple digital technologies.

Regardless of the analyses of different variables, the models examined provide valuable insight into how digitalization through digital infrastructure and firms' investments in multiple digital technologies interact with the factors attributed to the circular economy. The two regression analyses help address the research question: *Is digitalisation impacting the circular economy?*

Understanding the relationships between the selected variables represents a critical point in determining whether the digital advancements drive the effectiveness of circular economy and, therefore, plays a vital role in promoting the sustainability goal aimed by the circular economy. Therefore, beside the correlation, the two regressions proposed in the current scientific study have the major role in defending the research hypothesis that digitalization is impacting the circular economy.

Hence, examining both regressions, it can be determined if digitalisation plays a vital role regarding its direct and indirect effects on environmental outcomes, providing a comprehensive answer to the stated research question, taking into account the selected variables.

6. Conclusions

Despite analysing variables that do not have a strong impact in the implementation and development of circular economy, as highlighted by the correlation and the two regression analyses proposed by the study, the models present valuable insights into how digitalisation, as represented by the three independent variables, interacts with two of the main aspects of circular economy: recycling and collecting waste in ways that sustain the environmental policies.

The correlation has shown the strong relationship between the DESI score and the Basic level of digital infrastructure, both major elements of digitalisation, highlighting at the same time the moderate relationship between digitalization and the circular economy, the results providing a direct medium correlation between the variables considered for digitalization, and the variables taken into account for circular economy.

Meanwhile, in the first regression, the data collected for digitalisation is not strongly impacting the aspect of circular economy, as the significance F has been valued at 0.14, which compared to 0.05 is a higher value. At the same time, the explanatory power of the square model, determined by the R valued at 0.19 confirms that the DESI score, the basic level of digital infrastructure, and multiple technology investments do influence just a small fraction of the total of WEEE collected.

Simultaneously, the second regression reveals that digitalisation, as understood by the same three independent variables, explains only a limited fraction of the variability of recycling rate of packaging waste, as suggested by the low R Square valued at 0.14. At the same time, the significance F value (0.27), compared with the threshold value, is significantly greater, aspect that suggests that the impact of digitalization over the Recycling rate of packaging waste is not directly throughout the three variables used in the model.

In general, these findings illustrate a nuanced relationship between digitalisation, understood by the DESI score, the basic level of digital infrastructure, and the

multiple investments in technology of firms, and circular economy, understood by the WEEE collected and Recycling rate of packaging waste. While digital readiness significantly drives firms' investments in digital technologies, these investments do not necessarily lead to improved environmental results, such as increased WEEE collection or a higher Recycling rate of packaging waste, even if electrical and electronic equipment is the main resource consumed in adopting and implementing the latest digital technologies and that the equipment is provided most of the time in a package that can be either recycled or reused. Therefore, those aspects are not sufficient to demonstrate the positive impact of digitalisation over the effective advancement of circular economy toward its sustainability goals.

The correlation between the two regressions with respect to the main components of digitalisation and circular economy, underscores the complexity of leveraging digitalization for sustainable circular economy goals. Digital advancements encourage investments, and investments encourage the usage of resource, but at the same time also encourage the increasement of WEEE. Therefore, the main gap of the vital role in sustainable circular economy is to find the requirements needed to encourage the reuse of electric and electronic equipment, the collection of WEEE and the recycling if possible, and the increase in the Recycling rate of packaging waste.

In conclusion, the present study highlighted that digitalisation do play a major role in circular economy, especially in achieving the sustainability goals aimed, but it is not the only variable that can impact the main aspects of the circular economy, such as the WEEE collection rate or the recycling rate of packaging waste, even if those two represent the main operations promoted by the circular economy: reusing and recycling resources.

Hence, taking into account the awareness regarding research limitations, a deeper holistic approach is required to align digitalization and firms' investments in digital technologies with environmental objectives, while fostering a more effective and proactive circular economy, at the same time.

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Building Digital Skills through Digitalisation of Education

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Abstract

Under the impact of today's digitally driven world, digital skills integration into education becomes essential for equipping learners with the competencies mandatory for success in the 21st century. This paper investigates the transformative capability of digitalisation in education and intends to explain its impact on the development of digital literacy and digital skills among Gen Z. The current scientific literature highlights the crucial role of digital skills in fostering employability, promoting innovation, and driving social progress. However, there remains a significant gap in understanding how digitalisation proposals within education affect skill acquisition, educational equity, and broader societal implications. This research paper applies a powerful mixed-method research technique and blends qualitative analysis - through study and analysis of field literature and European-level reports - with quantitative analysis of statistical data. The research question that governs this investigation aims at examining discrepancies in access and use of digital resources across various demographic groups. The main results of this investigation uncover a complicated relationship between digitalisation and skills development across EU-27. While cyber technologies provide many opportunities for customised learning and collaboration, gaps still persist and exacerbate already existing inequalities. Additionally, this paper identifies the need for extensive educational methodologies that ensure a harmonious incorporation of digital tools into educational curricula. Consequently, this paper is instrumental to the field of knowledge because it provides a broad analysis of the digitalisation of education and links theoretical judgements with empirical evidence. Finally, this research is disclosing the challenges and opportunities inherent in the development of digital skills, which present eloquent insights for policymakers, professors, and researchers determined to channel the full potential of digital technologies in education.

Keywords: digitalisation, education, digital skills, digital literacy, Gen Z.

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JEL Classification: I24, I25, J24, O33.

1. Introduction

In order to adapt the public education sector to the growing demands of the labour market, structured and coherent digital competencies acquisition becomes mandatory no matter the age or the demographic area. Moreover, the progressive shift of the majority of economic activities to virtual platforms mainly integrating artificial intelligence solutions has become fundamental for increasing productivity, which only highlights the growing emphasis on developing skills fundamental to human nature, abilities that autonomous systems cannot fully replicate (Kolade & Owoseni, 2022).

Recent findings in the field of educational sciences (Cropley, 2019; Sipică & Toma, 2022; Akimov et al., 2023) have led to a better understanding of critical elements of the foundational skills necessary for students to become adequately equipped for Industry 5.0. These elements include critical thinking, the ability to generate pertinent and original content, collaborative teamwork, effective communication, innovation, and flexibility in integrating web-based tools into educational practices.

Furthermore, the global closure of educational institutions forced public education systems all over the world to suddenly embrace and make use of e-learning platforms (Michigan, 2020; Tam & El-Azar, 2020), while students, despite being digital natives, have had to adapt to utilising digital tools for learning instead of just socialising (Botnariuc et al., 2020). Consequently, the recent pandemic generated the main objective to quickly transition all learning activities to online environments, with digital technologies having accelerated a fundamental restructuring of the traditional educational landscape, forcing educators to adopt individualised methodologies and strategies (Ceobanu et al., 2022).

Taking into consideration all recent technological advancements, it becomes obvious that the incorporation of Internet-based technologies into education is not simply advantageous but also imperative for guaranteeing the relevance and effectiveness of educational practices in the digital era. Failure to adopt digitalisation might leave both educators and learners poorly prepared for the rising demands of Industry 5.0, thus compromising the education's ability to facilitate meaningful labour force integration and societal evolution.

2. Problem Statement

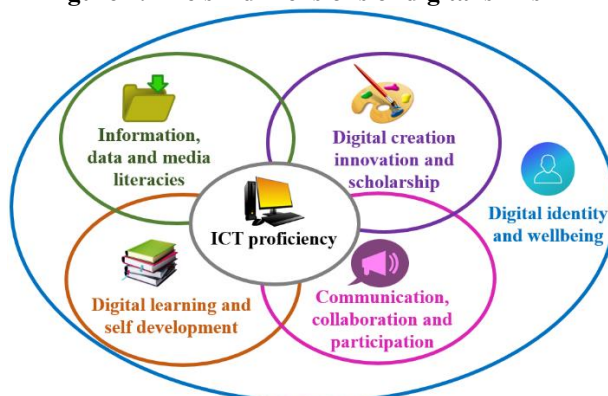
Literature review shows that most research on digital education has focused on the effects of online learning on both teachers and students. Early findings of Prensky (2001) led to the classification of students born after 1994 as digital natives, mainly because these persons are surrounded from a very early age by a plethora of electronic devices such as computers, tablets, video game consoles, and mobile phones. According to this definition, on the opposite end are those individuals who

have acquired the competencies necessary to use electronic devices later in their lives, referred to as digital immigrants.

The work of several authors (Taylor & Ferrari, 2012; Schwab, 2016; Werfhorst et al., 2022) focused on conceptualising digital competencies, and they all agreed on a three-dimensional profile of these abilities that encompass ICT, information, and media literacy. The rapid advancement of digital education led to a more comprehensive perspective on the concept of digital skills, characterised by other scholars (Cropley, 2019; Sipică & Toma, 2022; Akimov et al., 2023) as having five dimensions more clearly defined: analytical reasoning, cooperative teamwork, proficient communication, inventive thinking, and adaptability with online tools.

According to the European Commission's Digital Education Action Plan 2021-2027, the digital skills are characterised by six dimensions: ICT proficiency; information, data, and media literacies; digital learning and self-development; communication, collaboration, and participation; digital creation, innovation, and scholarship; and digital identity and well-being (Figure 1).

Figure 1. The six dimensions of digital skills



Source: adapted from European Commission's Digital Education Action Plan 2021-2027 (2020).

The focus of the European Commission's attention is on two strategic priorities: fostering the development of a high-performing digital education ecosystem and enhancing digital skills and competencies for digital transformation (European Commission, 2020).

Moreover, increased efficiency in teaching all disciplines through incorporating technology has already been highlighted in previous studies within the field of educational sciences (Drăgan, 2019; Țițan et al., 2020). Other authors (Gui et al., 2023) emphasise the importance of integrating digital skills into instructional activities, which have the potential to positively influence students' behaviour by fostering healthy digital content consumption habits.

Furthermore, other recent studies on the integration of artificial intelligence (AI) systems into the instructional process note the significant contribution of these artificial language models to the enhancement of deep cognitive processes,

metacognitive processes, and collaborative learning skills (Gennari et al., 2023; Iku-Silan et al., 2023).

Although numerous previous studies determined the positive correlation between digital technologies use and the level of digital skills acquired, the findings of Sailer et al. (2021) and Fütterer et al. (2023) conclude that the main factor that determines the use of electronic equipment in the classroom is the level of digital competencies manifested by the educators. Therefore, the integration of digital resources into teaching can only be achieved by providing teachers with training courses and formal instruction in order to acquire both digital skills and practical solutions for implementing digital applications under optimal conditions (Botnariuc et al., 2020; Zhang et al., 2023).

3. Research Questions / Aims of the Research

The main aim of this paper is to thoroughly investigate the associated disparities in the access and use of digital technologies among diverse demographic groups, with an accent on Gen Z. The methodology involves a complex mixed-method approach with the purpose of accomplishing its primary objective. Consequently, this research aims to identify and analyse the extent of inequalities in access and use of digital resources among different European countries. In order to operationalise the research problem, the following research question govern the present endeavour:

RQ 1: What are the disparities in accessing and using digital resources across various demographic groups?

The answer to this research question will shed light on the disparities in digital skills development and offer the opportunity for personalised strategies to be implemented in order to address not only the lack of access to digital resource accessibility but also the absence of digital skill acquisition by vulnerable demographic segments.

4. Research Methods

The methodological approach used by this research encompasses both qualitative and quantitative methods in order to provide a comprehensive understanding of the phenomena of the digitalisation of education. From a qualitative point of view, this paper scrutinises the scientific literature in the field of digitalisation of education and examines scholarly articles and books, but also the legislative framework, having the goal of gaining a clear picture of the complexities of digitalisation strategies and their impact on digital skill acquisition. Additionally, the qualitative dimension of this study is based on the analysis of documents and reports published at the European level, offering key insights on digitalisation trends and policies across the EU member states.

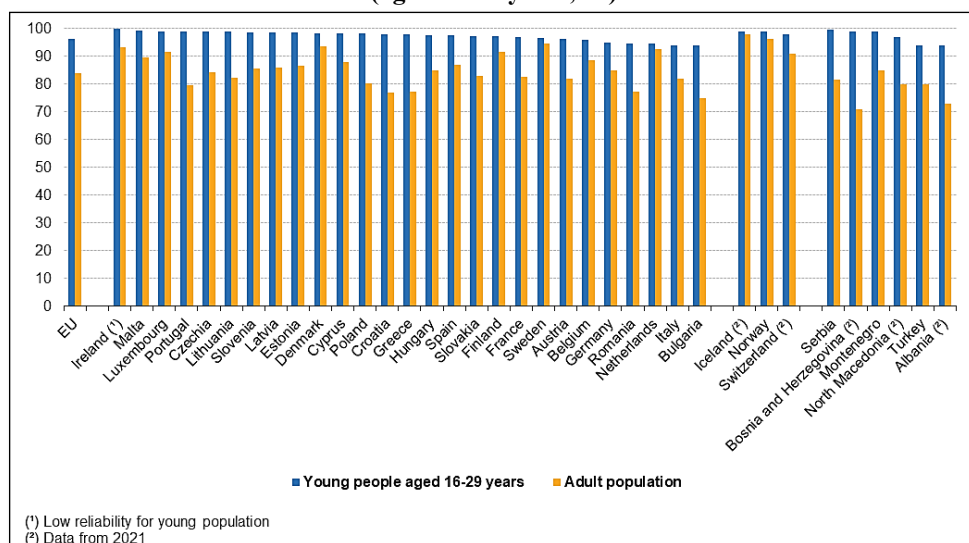
Next, the research methodology uses a quantitative perspective based on rigorous statistical analysis, which helps providing valuable empirical evidence to support its findings. With the means of systematic data collection and processing, this study aims to quantify the effectiveness of digitalisation strategies in promoting digital

skill acquisition across different demographic areas and groups. Furthermore, the use of the quantitative analysis enables the quantification of disparities in the access to and use of online equipment.

5. Findings: How Digitalised are the Digital Natives?

Figure 2 shows that the average percentage of adults who reported using the Internet on a daily basis was 84%, while the share of young people increased to 96%. Furthermore, the percentage of young people (aged 16 to 29 years) from all the EU 27 countries who reported using the Internet every day started at 94% and many countries almost reached 100%.

Figure 2. Young people who used the Internet on a daily basis in 2022 (aged 16-29 years, %)



Source: Eurostat database.

Not surprisingly, the share of adult population that reported using the Internet on a daily basis is lower than the share of young people, but still jumps over 70% (Bosnia and Herzegovina). If the average difference between these two groups is 12% among EU member states, the highest gap (21%) is in Croatia and Greece, followed by Portugal and Bulgaria with a difference of 19 pp., and by Poland and Romania with 18 pp.

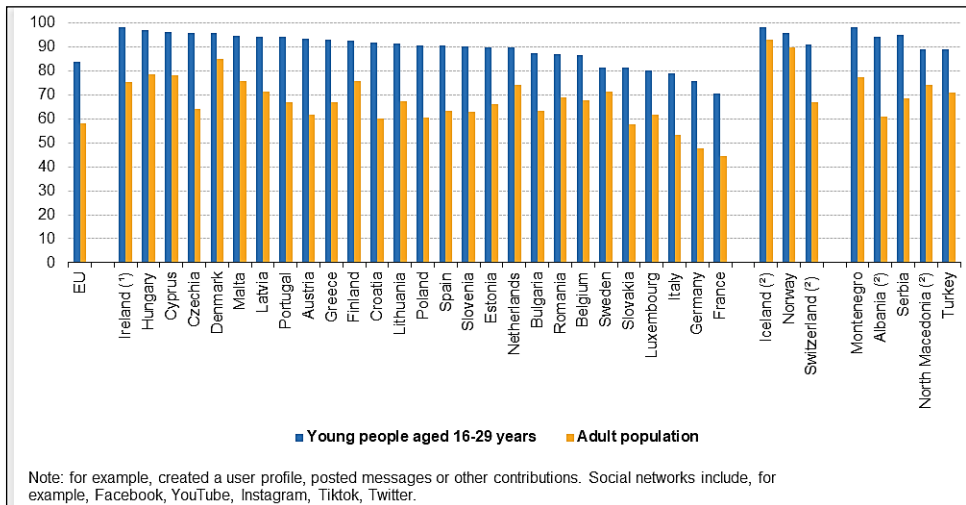
Nonetheless, data from Figure 2 demonstrates that the most digitalised countries with the lowest digital gap are the Netherlands (2pp) and Sweden (2pp), followed by Denmark (5pp) and Finland (5pp).

Taking into consideration that young people's favourite online activity was participation in social networking in 2022, it is noteworthy to mention that on average 84% of youngsters from EU-27 preferred to create a social media profile and engage in chatting activities. Figure 3 provides an overview of the data from all

EU-27 countries with regards to the share of young people versus adult population accessing social networking sites in 2022.

On one hand, Figure 3 illustrates that the lowest social media participation among both young people (70%) and the adult population (44%) is scored by France. For this reason, the digital gap from France is slightly higher (26pp) than the European average of 25 percentage points. In Eastern Europe, Romania surpasses the average EU level for both groups, with 88% of the young people using social networking platforms compared to 83%, and 68% of the adult population using social media sites compared to 58%. Consequently, the digital gap in Romania (20pp) was lower than the EU average (25pp), suggesting a decreasing trend in the digital divide from Romania.

Figure 3. Young people who accessed social networking sites in 2022 (aged 16-29 years, %)

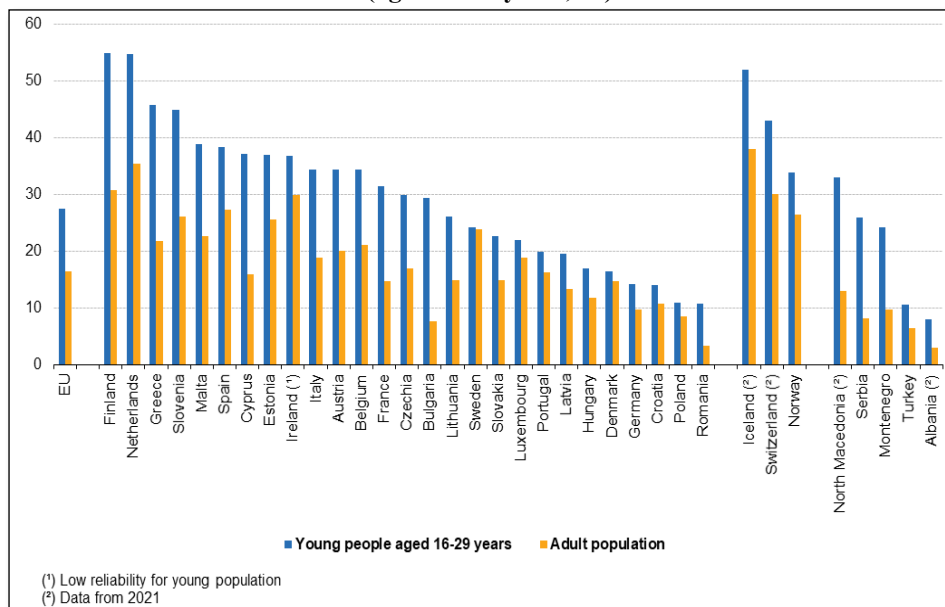


Source: Eurostat database.

On the other hand, Figure 3 shows that Denmark has the lowest level of digital divide (11%) among EU-27, while other Schengen area countries such as Norway and Iceland have almost eradicated their level of digital gap.

Next, Figure 4 illustrates the profound impact of the Internet and associated digital competencies on our daily lives. Hence, the increasing trend of educational activities that have transitioned to online environments in 2022 represents an evident proof of the relevance of digitalisation of education nowadays. Throughout all EU member states, the younger population reveals a higher likelihood for enrolling to online courses compared to the adult age group. This gap is predominantly pronounced with intervals as wide as 24 pp in Finland and Greece, followed by Bulgaria with 22 pp, and Cyprus with 21 pp. In contrast, Sweden shows no discernible gap between age groups, while Denmark and Poland mark a gap of 2 pp.

Figure 4. Young people who used the Internet for doing an online course in 2022 (aged 16-29 years, %)



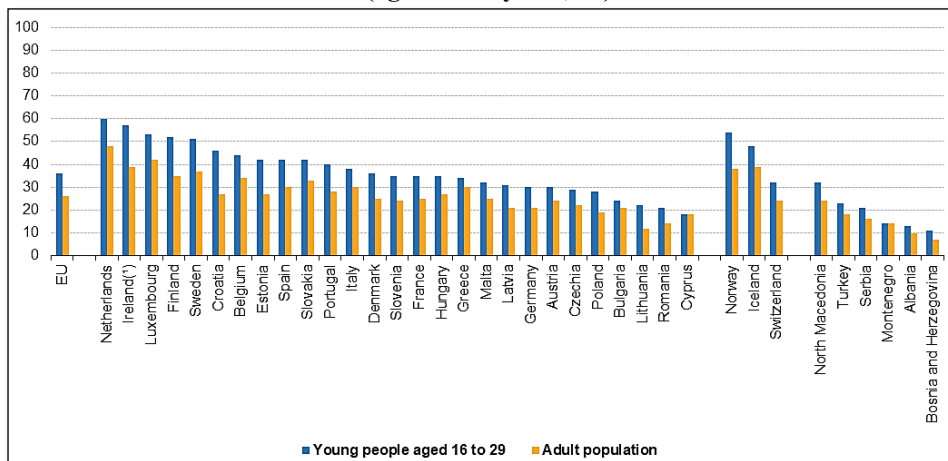
Source: Eurostat database.

As it can be observed in Figure 4, the biggest share of young people who used the Internet for educational purposes in 2022 is scored by Finland and the Netherlands (both 55%). On the other hand, in Romania and Poland only 11% of the individuals aged 16-29 years old made use of the Internet for taking an online course, compared to the EU average of 28%. While benefiting from the online environment advantages, it is extremely important to take into account and address online safety concerns, but also to critically assess the reliability and integrity of sites, information, and content.

Irrespective of the major Internet usage statistics within young persons, Figure 5 proves that just one third (36%) of the European youngest population directly engaged in validating online information in 2021 (latest data availability). Remarkably, Figure 5 demonstrates that only five European countries indicated rates above 50% for young persons aged 16-29 years that engaged in truth verification of digital media content: the Netherlands, Ireland, Luxembourg, Finland, and Sweden.

Conversely, the lowest rates were recorded in Cyprus (18%), followed by Romania (21%), and Lithuania (22%). In addition, Romania (14%) and Lithuania (12%) stated the lowest share of adults who verified online information.

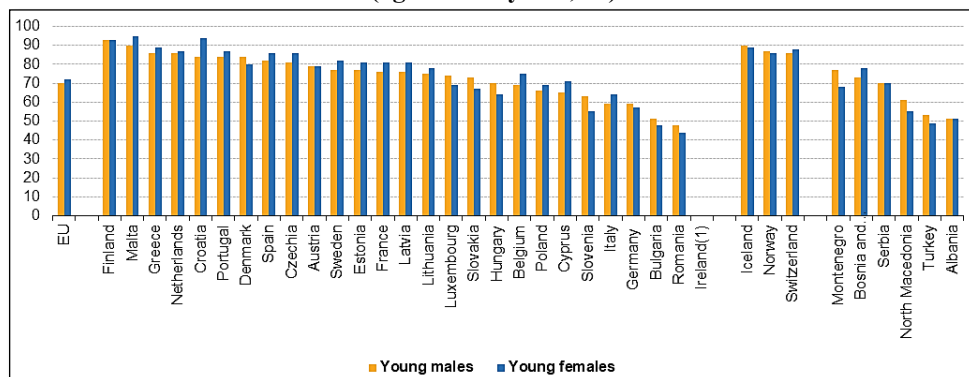
Figure 5. Young people who have verified the information found online in 2021 (aged 16-29 years, %)



Source: Eurostat database.

Nevertheless, young people exhibit an average 10% higher tendency than adults to verify the accuracy of information or content encountered online (Figure 5). The difference increased to 19% in Croatia and 18% in Ireland. On the other hand, Norwegian and Icelandic young people adult populations exceeded EU averages in evaluating their Internet sources. The essential role of information and communication technology competencies in the prosperity of knowledge-based economies and societies is widely acknowledged, and most young people regularly engage in computer and Internet use when they complete their compulsory education in the EU. As a result, it is necessary for young people to cultivate digital citizens that are self-sufficient and conscientious, but also equipped with basic digital skills.

Figure 6. Young people with at least basic digital skills by gender in 2021 (aged 16-29 years, %)

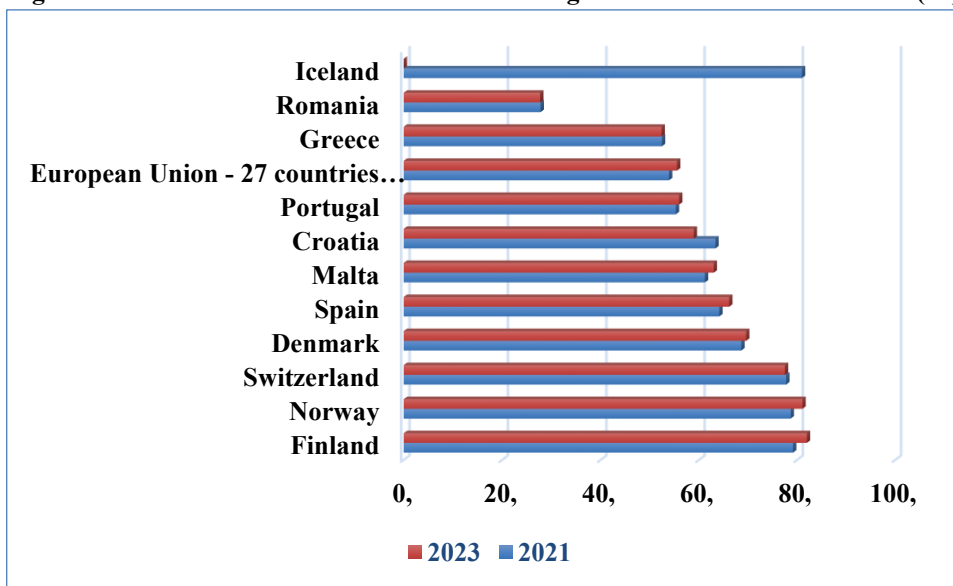


Source: Eurostat database.

Also, the rate of young individuals having basic or above basic overall skills in 2021 ranges from 46% in Bulgaria and Romania, to 92% in Malta and 93% in Finland, while the average EU level was 71%. Figure 6 shows that in 2021 there was no significant gender-based disparity in the reported digital skills manifested by young people at the EU level.

However, the situation varies when examining individual member states with the percentage of young females possessing at least basic digital skills exceeding that of young males by at least 5 percentage points in nine countries (Figure 6). For example, Croatia had the largest difference in favour of young women (94%), while the proportion of young men with at least basic digital skills (84%) was 10 percentage points lower. In Romania, there is a significant gender difference of 4% between young men (48%) and young women (44%) with at least basic digital competencies. Furthermore, the percentage of young men with at least basic digital skills exceeds the percentage of young women in in four other European countries: Slovenia, Hungary, Slovakia, and Luxembourg by more than 5 percentage points. In addition, Figure 6 shows that both young men and women have a significant share of at least 80% of young people with basic digital skills from ten EU-27 countries, including Finland, Malta, Greece, Croatia, Portugal, Denmark, Spain, Iceland, Norway, and Switzerland.

Figure 7. Individuals with basic or above basic digital skills in 2023 versus 2021 (%)



Source: authors' contribution using Eurostat database.

Given that by 2021 the percentage of young people between the ages of 16 and 29 with at least basic digital skills is the highest in these ten countries, it is easy to assume that their percentage of people with basic or above basic digital skills is also higher than the EU average. As a result, the data analysis of Figure 7 illustrates

a trend towards acquiring basic digital skills or more, with ten countries having the highest proportion of young people with at least basic digital skills (Finland, Malta, Greece, Croatia, Portugal, Denmark, Spain, Iceland, Norway, and Switzerland) in 2023 compared to 2021, while Romania has the lowest proportion.

It is noteworthy that nine of these countries (Iceland, Portugal, Croatia, Malta, Spain, Denmark, Switzerland, Norway, and Finland) have exceeded the EU average of people with basic or advanced digital skills (54% in 2021, 55% in 2023). Still, it must be mentioned that there is no data available for Iceland in 2023 (Figure 7).

On the other hand, the share of individuals from Greece and Romania with basic or above basic digital skills remains slightly below the EU average for both years, with Romania scoring the lowest share among all EU-27 countries.

6. Conclusions

Under the digital age umbrella, digital connectivity represents a global landscape for digital native people born in a world surrounded by technology. However, the scope of their digital competence and its impact on future progress remain the subject of discussion. This study analyses data from the official Eurostat reports on young European digital habits, highlighting their use of the Internet, the involvement and the acquisition of digital skills.

Findings present a very incoherent image of the digital landscape among young Europeans, who all present a daily habit of Internet usage (Figure 2), but seem to lack fact-checking behaviour while consuming online content. On the one hand, social networking activities are the main reason because the majority of young people use the Internet, but they also show higher online course enrolment rates than adults, emphasising the transition of Gen Z to Education 4.0 paradigm. On the other hand, the results indicate that young Europeans lack adequate fact checking behaviour, with only a few countries (such as the Netherlands and Sweden) taking the lead by example and actively checking online information and data sources.

Furthermore, the level of digital competence of young people remains far from the EU 2030 target, with only ten European countries with higher digital skills than the EU average. In addition, Figure 7 shows the gender difference between women and men in attaining digital skills in a number of countries (Malta, Croatia, Portugal, the Czech Republic, Spain, Sweden, France, Estonia, Latvia, Belgium, Poland, and Cyprus). Conversely, countries such as Greece and Romania are confronted with persistent obstacles in bridging the digital divide, and their digital literacy rates are lower than the EU average.

A very curious case is presented by the Romanian education system which is the only European system to assess students' digital skills through national tests for all pupil, but fails to deliver measurable competencies with only 48% of young males and 44% of young females possessing at least basic digital competencies. These rates place Romania in the last position in the hierarchy of minimal digital skills reported by European young individuals from 36 countries, followed closely by Bulgaria (Figure 7).

Overall, this paper explains the complex technological dimension of young Europeans aged 16 to 29, showing promising progress and concerning disparities. Although the use of the Internet and online learning show a transition to Education 4.0, the inadequacy of fact-checking behaviours and the continuing gender difference in digital skills improvement emphasise the need for targeted interventions. The results of this research also highlight the vital role of quality education for digital skills promotion, with countries that give priority to early digital competence acquisition with higher success rates than the other countries.

As a result, this research article provides a detailed picture of the complex digital landscape of European citizens, but it is critical to recognise certain limitations that affect the interpretation and generalisation of these conclusions. First, the study's focus mainly on young Europeans can potentially limit the extrapolation of results to a wider demographic group or geographical region. Secondly, the findings demonstrate the importance of quality education to promote digital competence, but the study does not offer a more detailed image of specific educational interventions or strategies used by different countries. Finally, even if the study identified dissimilarities in the development of digital skills and testing practices, it did not offer detailed recommendations to address these differences or develop assessment strategies. Future research should try to overcome these limitations by applying more diverse and representative research methods that address digital skills differences effectively.

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**From Roads to Riches: Infrastructure Development
as a Method of Driving Growth in Romania National Economy**

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Abstract

Currently the European Union is making significant efforts for the homogenisation of economic policies at the European level in order to reduce the level of development discrepancy between the members. State differences occur in these processes, represented by the road infrastructure which plays a complementary role in reducing transport costs and facilitating mobility in this context the concept of E-Road as a turn point by the United Nation Economic Commission for Europe (UNECE), a central element of the Trans European Transport Network (TEN-T). These forms of roads are built and maintained according to strict equality and safety standards and are designed to improve connectivity between EU member states and other European countries. In addition, they play a crucial role in regional integration as they support the increase of the level of urban connectivity by connecting less developed regions with large economic centres. The current paper observed the impact of an economic development using an economic analysis that was carried out with data extracted from the Eurostat international database and the data used for the realisation of the case study are at the level of Romania, the variable including analyses the GDP (grow domestic product aggregate), aggregate final consumption and the length of state, provincial, and municipal roads. The econometric analysis revealed the high degree of correlation that is significant between the road infrastructure development and economic growth, underlying the importance of continued investment in E-Road to support economic progress within the European Union. Road infrastructure is a central component in the European Union's efforts to create a more even and competitive economy. Investments in road infrastructure not only improve accessibility and mobility, but also help reduce transport cost and simulate economic activity, the use of the best technologies, and the most appropriate forms of road maintenance, so along with the modern forms of asphaltting and intelligence monitoring of structures, facilitate economic growth and the regional development.

Keywords: roads, transportation policy, EU, development, infrastructure.

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1. Introduction

The European Union employs efforts aimed to minimise progress differences between member states, the bystander procedures, and the extent of the economic community. Implementing this requires establishing a sustainable working environment and standardising development principles in reducing corporal cost.

In addition, the European Union must use a variety of cost cutting policies to maintain a competitive advantage, competitiveness being most commonly measured financially, as it is in this case the transport among the most common categories that must be constantly optimised and reduced by economic actors separating at European level, although it is not the only one. Government representatives must pay a lot of attention to transport activities, especially in regards to logistics (that is, the infrastructure that individuals must use to operate in the market) to support the private activity team steer the economy's direction. At the moment, E-Roads are one of the most representative strategies launched by the EU (Zuo et al., 2023).

This process associated with the European network project set out by the European Union is titled „E-ROADS”, or Europe international road network (E-Roads), and it stands as a network of interconnected roads that can connect European interest points. TEN-T, the Trans European Transport Network, stands as the logistics structure which integrates these access rates, whose numbers are antedated by the letter „E”. Connectivity and mobility within the member states of the European Union and other European nations are primary purposes of these roads covering long distances, facilitated by and for drivers by the uniform and simplistic numbering and signing of all E-roads in Europe. In addition, in the construction and maintenance of E-Roads, strict standards regarding the safety of participation in traffic are respected. The entire project as well as the necessary set of rules contribute to safer and more efficient journeys, including the wideness of the roads, the quality of the materials they are made of and the implementation of rest areas for the recovering of the main, direct beneficiaries of the project, namely the drivers (Ishamali, 2023). The transport of people and goods between the member states of European Union is achievable by implementing these road systems that also develop Europe's and the international economy as a whole (Pradhan & Bagchi, 2013). These firms of system help facilitate international trading stimulate tourist and economic growth factors as a whole. The economy of each area largest depends on the reduction of all possible cost, and those related to transport represent a large share of total cost. Moreover, considering the degree of recurrence of these costs, the reduction of operating times will have beneficial effect with high degree of propagating. European rules have the great advantage of connecting economically disadvantaged areas, but with a high degree of economic potential, with areas that are already mature, that are already developed and that can, through social cohesion, standardise these benefits at the level of the whole Europe (Bennett, 2019).

Deficiency in connecting all EU member states as well as other participating economies at the regional financial level is the main benefit regarding the

infrastructure and also the main reason for the project. Projects of this type can save travel times and transport costs for all economic agents that use the specific infrastructure. The proposed infrastructure model allows the ramping movement of people, goods, and other types of services. Well, these industrialised regions of the EU economically support less developed regions through social assistance and three investments that come from the economic activities in the developed areas that represent the main contributors to the local economy, the connectivity that is promised by these projects promises to unite these areas, reducing social disparity and increasing the degree of homogenisation in order to have sustained, consistent, and logical growth, as a result of which resources are used in the most optimal way. Highways that are accessible to reduce market forces promote private and trial activity. As a result, an increase in original competition makes Europe larger and more efficient as a whole. These kinds of infrastructure are good reflections of the efforts made to nurture sustainability based on actual actions (Stănică & Stănică, 2024). Additionally, the utilisation of modern ecological, economic, and technological instruments which indicate economic progress and that shelter the creation of biomass, is included in the growth of electronic networks. One relevant example in this respect is the utilisation of ecological construction materials and electrifying roads to assist electric vehicles' functioning. They mention the above line with the European strategy that aims to reduce the polluting effect of greenhouse emissions of transport, also making it possible to incorporate cutting-edge technologies such as automated cars and integrated transportation systems (ITS) into the infrastructure industry. Within transport processes, the new infrastructure allows timely analysis of the transport-related activities by using advanced digital systems.

The possibility of measuring these parameters improves road efficiency, decreases the level of congestion in certain locations and at certain times, and increases the degree of safety of traffic participants, the development of comprehensive transportation systems such as this being facilitated by continuous innovation (Zuo et al., 2023). This measure in question is intended to support the transport policy at the European Union level. The stability that an integrated and efficient transport network can provide is a factor of economic growth. The extent of effectiveness posed by these types of investment is delineated by the sustainability of the network. For this reason, it is also the game of the European Union to develop this type of infrastructure as much as possible in order to connect the economic group polls and it balances the profitability of the coasts born by the disadvantaged royal territories. Another very important aspect is the activities related to the environment, mainly the reduction of carbon nations and those with the greenhouse effect, the reduction of material waste and the improvement of environmental damage caused by a large structure such as highway or road. The Trans Europe Transport Network (TEN-T) is a complex system that includes natal infrastructure at democratic economic level, but also at the European one, and local roads. From this perspective, the management of such a system cannot be done certainly and internationally only by a single organisation, but must be managed by local authorities, even if there is a higher authorised body that analyses and manages

the necessary bureaucracy processes. The development of a plan that includes modern means of transport for people in good another (secondary) objective of the policy to be achieved by the TEN-T project, which aims to connect all road systems at the European level. To meet these needs, together with the environmental biomass protection strategy, the solution of electronic road seems to be the ideal compromise between the ratio of the impact and effort, between the level of investment required and the possible results (Liang & Liu, 2020). In order to facilitate the transfer of the value resulting from the economic activities, the creation of such a route system contributes to the expansion of the network. A system that is better at resource optimisation has the potential to promote steady economic growth, especially when the level of cost optimisation determines the competitiveness of the system at the European level. Policies targeting a particular objective and do not depict any linkage with these end results have to be employed. In addition, they need to be brief and clear.

The governmental spending pertaining to the alleviation of the local economies of underprivileged areas and jobs will be permitted by the transport policy. Additionally, the inclusion of those areas that find themselves at the periphery of economies in the central flow, especially by extending the real network, seems to stand as a sustainability objective whose realisation can be conducted through current resources. Conversely, the electronic growth of an alternative framework for entrepreneurs who want to benefit from a homogenous logistic system and the standardised work system, regardless of the access area in the available resources, potentially promoting regional development banking access to markets in weak areas. It is possible to facilitate international trade, resource mobility, job security, and investment sustainability by reducing social inequality and limiting factors such as conscious, additional cost, or resources access through shared access (Bethany et al., 2023).

2. Problem Statement

This paper analyses the relationship between various factors of economic development using European road railways, particularly in the scope of this relationship, namely growth supported by logistic infrastructure. Highlighting the advantages that such a project would have underlined the impact of a process of homogenising the quality of mobility of production factors, even if the relationship between the efforts made and the results achieved is no longer determinable at a given moment due to the international course of the project and from the perspective of multi sourcing funding and monitoring the potential benefits such as the great importance at the local level, but also the European Union level. The basis of the studies is based on the direction of public policy that supports such projects. Due to the fact that they enable greater efficiency and connect much of the key development areas with minimal impact, road vehicles are considered development solutions. This makes them able to facilitate the rapid movement of people and goods (Crescenzi et al., 2016).

The building and maintenance of E-Roads is governed by strict safety quality standards, intended to safeguard steady performance and safety levels on the European continent, emphasising road safety and standards. Travel conditions have been enhanced by quality standards for all the users of roads, thus minimising traffic accidents. This type of standardisation can be seen on the E18 route, when running through Norway, Sweden and Russia and using sophisticated road sign and advanced traffic control systems. Improved traffic flows and cheaper transportation cost are due two ways in which the standardised road restructuring helps minimise negative all sourcing and promote economic efficiency.

The predictability and the improvement in investment expense transparency are two more advantages of these kinds of systems. By utilising green technologies and encouraging electric vehicles, the electronic route supports the European Union's sustainability goal and helps the use of greenhouse gas emissions in accordance with the country sustainable development policy. The European Union's commitments to cleaner and more energy efficient transportation is exemplified by the pilot programs like Germany's E-highway which permit electric trucks to refuel while driving (Crunțeanu et al., 2023).

An example of an active project that uses inductively charged battery technology to fuel electric vehicles while they are in motion is the Swedish Arlanda electronic road venture. Transportation plays a crucial role, the overall value of the items being decreased without compromising their quality, which result in road transportation costs. Neglected regional areas that produced little operating revenue can be included into the commerce mechanism by coordinating operations with the transportation procedure. For locals, employment opportunities may arise from the provision of logistical and storage services. Then, instead of depending on government funding, the local economy would grow organically as a consequence of consistent economic activity. Better connectivity also makes it possible to move around more.

At the macroeconomic and microeconomic levels, this point of view will be advantaged. Travelling for businesses or pleasure can both result in cost saving for individuals. With greater access to the family budget in either case, the person's general health would be significantly improved. Eventually, as mobility increases, firms will have greater access to the lab pool, improving macroeconomic efficiency. By lowering transportation costs, these liber market barriers with simultaneously less socially inequality and great benefits for a more competitive market (Bennett, 2019).

The basic concept is that the cost of operating a worker in the market is represented by the transportation costs. As a result, competitive advantage is limited to proximity because people who cannot afford these costs cannot find employment. Improving transportation and communication infrastructure with reducing equality are benefits involved (Anwar et al., 2024).

Nevertheless, the global electronic rule structure has some disadvantages and difficulties. In the first place, strains are generated through the implementation and maintenance costs posed by electronic road networks. In this sense, cost allocation is a point of concern and it is necessary to establish, knowing the involved benefits, the amount that should be spent by every economy in accordance with the

great immediate cost that the project involves. To find an ordinary denominator, there are several approaches. Most often, countries expressing rest in thinking part only in those portions that cross their borders. The project fails to meet its objectives, and the richer regions continue to prop growth even faster, severally disadvantageously impacting economies that cannot afford to participate in these initiatives (Stanică & Stănică, 2024).

Finding a middle ground in creating an unfair atmosphere that could increase social inequalities if a solution cannot not be found. As a result, conscious member states, particularly those with less developed economies, may find the price of improving current roads to bring them up to the European standards excessively costly, hence it is necessary to build a resilient banking system to ensure the continuity of the systems as well as sound governance, since this cost includes not only the initial construction but also regular maintenance, the modernisation of existing infrastructure, and introduction of new technologies (Otovescu & Otovescu, 2023).

For example, the modernisation of the E85 route in both Bulgaria and Romania poses significant financial and logistical challenges, highlighting the obstacles that poor member states of the European Union faced in providing funding for large construction projects. Opportunity cost economics says that huge spending is required to bring up to EU standards, they can divert funds from other urgent needs that help both private and microeconomic levels, for example the visible character of interest in developing educated public policies in order to extend the national infrastructure (Crescenzi et al., 2016).

Another problem is the gap in quality standards that exist between individual countries. There are many European standards for the development of road constructions, but nevertheless differences in the way the standards are implemented at the national level can lead to quality and operability difficulties as countries do not accept the same standard as their neighbours do. Therefore, it is only logical and natural for the states that want to start a project as big as developing an electronic road or a specific road that would connect well developed economic polls, to establish certain standards and to be sure that the bureaucracy process they are going to specifies very clearly which country is going to be responsible for what actions. Also, they have to determine the weight of the financial involvement that they are going to occur into (Liang & Liu, 2020).

Road quality varies and different definitions and approaches for different route. The types may impact the consistency of the electronic road network. Inaccuracy in the quality of infrastructure can lead to interruptions in customer service and make driving difficult. To do this, generally accepted methods must be established, recognised by both participating economies, and applied as a national standard of excellence. The issue that comes up again with the first topic, financial performance, is the growing economies which need to meet the same standard, when it comes to assets with higher quality expectation (Eaves et al., 2024).

In some countries, the roads can be kept up-to-date and to insure a high-quality, while in other countries, this cannot be achieved. This can cause travel to become

even riskier for users. They asserted that deviation can pose a drastic impact on traffic speed and the efficiency of global transport. In this situation, two factors need to be carefully considered. Firstly, to ensure that the first stations in the road construction are carried out in a monitored, transportation, and certified manner, and that resources are preserved to the maximum extent possible throughout the project, it is necessary to ensure that no adverse, environmental effect occurs. Similarly, the entire construction process needs to be configured to guarantee that every method of work complies with the emission standards and environmental laws (Geng & Lo, 2023).

In the recent years, several types of previously unavailable manufactured goods have become available throughout discrete, sustainable techniques. Technological advances make this particularly possible. Moreover, car exhaust and other chemicals can be generated, thus triggering pollens and the damaging of local wildlife (Crunțeanu et al., 2023).

Ongoing maintenance and expansion operations have to be performed on highways to assure the safety and efficiency of any e-road. Nevertheless, this process may impose costs and complexity. Constant interaction between different member states. Road infrastructure must adapt to climate changes and increases cost as it must respond to severe weather, such as floods and temperature fluctuations (Ishamali, 2023).

The development of weatherproof roads is one of the new problems that thermal dynamic and climate change bring to the infrastructure. For instance, the roads that belong to areas with extreme temperatures or that are facing flood risk need to be optimised to properly face disasters, steps that raise the efforts needed maintenance and modernisation, designing, financing, and implementing an electronic road project, that also needs interstate cooperation, that may reflect difficulty or efficiency. Furthermore, due to certain objectives or financial difficulties, the implementation of the project may reflect a slow or uneven pace.

Cross border initiatives require the cooperation between member states, but political, economic, and bureaucratic obstacles can act as downgrading points and can slow down their application and increase costs. Apart from the advantages that they trigger for mobility and accessibility within Europe, electronic roads also bring some significant disadvantages. Several variables, including the high prices, bearing standards, the negative environmental impact, and the need for ongoing maintenance and coordination problems, must be taken into account to permit the continuous functioning of an electronic road network. To mitigate these issues in an efficient way, European policies must supply an adequate amount of funding, define roofing techniques, promote sustainable construction practices, and foster the partnerships between member countries (Nguyen et al., 2023).

3. Research Questions / Aims of the Research

The article aims to establish how the infrastructure of countries is able to influence their financial growth. In more detailed terms, the research scrutinises the probability of the existence of a linkage between a country's infrastructure and its general level

of economic growth. Romanian statistical data was used in the analysis and data collection. In order to carry out the analysis using the econometric application EViews, a set of three relevant variables were collected, and all of which have a direct relationship with the level of infrastructure in Romania. Indicators include GDP and its main component (production, expenditure, and revenue), final consumption aggregates by the ability and road length at the national, provincial and municipal levels. The first indicator, GDP, is chosen as the dependent variable, with total consumption and infrastructure size serving as the explanatory variables. The data comes exclusively from the Eurostat database and only the data available for Romania were taken into account for the analysis.

The GDP and final consumption value are calculated in countless euros, while the length of highways is measured in thousands of kilometres. To arrive at the same unit of measurement, the % change from year-to-year formula was used to each of the given inquiries. The time periods provided from the database were selected, ranging from 1995 to 2022. The analysis began in 1996 due to the application of the formula $(\Delta T1 - \Delta T0) / \Delta T0 = \% \Delta$, which allowed for absolute value variations. As a result, the study includes a series of 28 queries, which is a little smaller than the 32 data points evaluated suitable for analysis.

The GDP development indicator is calculated by Eurostat by the sum of the gross value added of all resident production units plus taxes on products and less subsidies on products. The second indicator, the one related to the value of aggregate final consumption, is often calculated, as in this case, in terms of durability, which also includes in its analysis durable, semi-durable goods, and non-durable goods. Durable goods are products that have a long period of use, such as cars or household appliances. Expenditure is quantified by the sum of the value of purchases of durable goods by households. Durable goods are those that have an average useful life, such as clothes or shoes, and these expenses are similarly calculated by the sum of values purchased directly. The last element consists of nondurable goods that have the largest share, the least cycle of use, but as a result also have the highest consumption rate, namely goods that have a short life span are food or fuel. They are often associated with recurring consumption of products, that is, with those elements of strict necessity. The last indicator, called Length of state, provincial, and communal roads, represents the number of kilometres that has been completed from one period to another for each of the three categories of roads. State roads are administered nationwide and are the main transport arteries. The length is calculated by the sum of all sections of road that are classified by the state as national roads.

These segments have the largest printer because they significantly help reduce transportation costs by reducing reaction times, reducing transport costs, reducing consumption, and better mobility that allows companies to display their products at competitive costs in a wider geographical area. Provincial roads, the second element taken into account for the formation of the indicator, are roads administered at regional or provincial level. The length of these is calculated the same as the first. Communal roads are the segments of roads that are under the local or communal administration of governing bodies. This segment is also calculated as the length of

all road segments classified as such. The importance of the last two elements lies in the risky access that areas would have to the economic circuit. Reducing the length of transport routes and people's access to a well-developed infrastructure interconnected with several development points is an essential condition for local economic growth, which translates into economic growth at national level and automatically increases the standard of living of individuals.

Table 1. Eviews processing data

Dependent Variable: Length of state, provincial and communal roads				
Method: Least Squares				
Date: 26/05/24 Time: 16:25				
Sample: 1 28				
Included observations: 28				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.957816	0.709819	1.349382	0.1893
Length of state, provincial and communal roads	0.466871	0.198502	2.351965	0.0269
Final consumption aggregates	0.903410	0.049029	18.42601	0.0000
R-squared	0.932359	Mean dependent lime		9.546429
Adjusted R-squared	0.926948	S.D. dependent lime		10.31441
S.E. of regression	2.787801	Akaike info criterion		4.989340
Sum squared resid	194.2958	Schwarz criterion		5.132076
Log Likelihood	-66.85076	Hannan-Quinn criter.		5.032976
F-statistic	172.2987	Durbin-Watson State		1.761598
Prob(F-statistical)	0.000000			

Source: authors' own processing of data using Eviews software.

The first time, it is observed that the indicators of relevance meet the criteria. Thus, an adjusted violation of R squared of 92.69% shows that the two elements contribute to explaining changes in GDP to a large extent. As such, we need to analyse these variables. The intercept coefficient is 0.95781, but it is not significant due to a too high probability. The 95% confidence model indicates that when the other two variables are zero, the dependent variable has an estimated value of 9.95, but the value is not significantly different from zero. On the other hand, the other two variables are representative. The length of national, provincial, and communal roads has a coefficient of 0.466871, so an increase in this indicator by one unit of measurement, ceteris paribus, will lead to an increase of 0.46687 units in GDP. In addition, the aggregate final consumption will lead by increasing by one unit to an increase of 0.93034 unit of the dependent variable.

Given the high values of Log Likelihood, as well as the Akaike, Schwarz and Hannan-Quinn criteria, more appropriate matching patterns can be identified for explanations of changes in GDP. If the ample nature of the aggregate is taken into account, it is difficult to identify the best explanatory model, but the model

suggests the need to assimilate these variables as well for a more complete picture. However, the analysis passes the significance tests as will be observed. The regression model indicates that the two dependent variables are significant in explaining GDP variability. It is mentioned that the percentage of 92.69% does not represent the extent to which the variable factor is explained by the two elements, but rather the fact that infrastructure and aggregate consumption contribute to explaining GDP to a large extent.

After verification of the relevance tests, tests of normality of distributions were carried out. As a result, it is found that at 28 observations and two elements, according to the critical value tables at a confidence degree of 5%, a value of d_l of 1.35 and d_u of 1.54 is observed. The Durbin Watson test value of 1.7615 is in the range ($d_u < DW < 4 - d_u$), indicating that there is no significant autocorrelation of the reconstructions. The asymmetry with slightly negative value indicates a slight asymmetry towards the left area of the graphical representation of the reconstructions. In addition, Kurtosis has a tangential value of three, i.e. the optimal threshold, which suggests a normal, bell-shaped distribution. In addition, the model can be considered correctly specified because the average value is close to zero (described in the table as a scientific value, not nominal), a phenomenon that occurs within the model that has correctly specified and outlined parameters.

The Breusch-Godfrey test was used to test autocorrelation. The procedure was used to reinforce the Durbin Watson test values on the lack of autocorrelation and to obtain additional data on the dependence of indicators on residual values.

Note the high probability value of the F-statistical indicator of 0.004268 indicating the possibility of obtaining an equally high value under the condition of null hypothesis, i.e., if there is no autocorrelation. The value much higher than the threshold of means c_p cannot refute the null hypothesis, so in other words, there is insufficient evidence to assert that there is a phenomenon of serial self-correlation within the reconstructions of the model. The high probability value of $Obs \cdot R$ -squared reinforces the rule. The values of the two variables are not significant, so they do not contribute significantly to the reconstruction model. Because the time series is annual, two LAG variables were used to run the analysis. The two values are large enough to state that neither the $t-1$ nor $t-2$ values of the same indicator have the property of influencing the present value of rewalls, at a residue probability level of (-1) in value of 0.9018 and for (-2) a probability value of 0.9824.

The next step towards completing the analysis and affirming that infrastructure is a vital element in the process of economic development is to test the phenomenon of heteroscedasticity, that is, to observe whether within the model there are variations of errors that are not constant over time. For this, the Breusch-Pagan-Godfrey test was run, being the most used and appropriate test where previous elements of the analysis did not raise suspicions about the character of the data.

All three representative results, namely those of F-statistical (0.494398), $Obs \cdot R$ -squared (1.065316), Scaled explained (0.871791) have a probability level higher than the reference level of 0.05, and as a result it is observed that there is not enough evidence to accept the heteroscedasticity phenomenon within the model, so the null

hypothesis cannot be rejected. The probability associated with the two explanatory factors suggests that they are not significant, indicating that the two variables do not explain the volatility of the rebuilding squares. In the current context, a small adjusted square R value is preferable because it suggests that adding variables to the model does not improve the explanation of redivision variability.

The last element in analysing the model is the multicollinearity check, which was done using the VIF (Variance Inflation Factor) test. For interpretation, Centered VIF was analysed, which is calculated using the coefficient of determination R² obtained from the regression of each explanatory variable based on the other variables in the analysis model. According to the data, the values in both cases are very close to 1 and 2 respectively, suggesting the lack of problematic multicollinearity in the regression model, namely a value for Length of state, provincial and communal roads of 1.1023 and a value for Final consumption aggregates of 2.098, both for Centered VIF. As a result, each of the variables in the model adds unique information within the model and is not strongly correlated with each other. The reduced multicollinearity in the model assumes that the estimates of the coefficients in the regression model are reliable and do not distort the strong relationships between the explanatory variables.

5. Findings

The examination passes all model quality checks. Although there are not enough time periods to improve the accuracy of the models, the model is considered functional due to the high value of the agreement. Indicators result, architecture plays a role in generating gross value, added for the gross domestic product is directly and strongly related to the level of economic development. The quality of the indicator is defined in particular by the analysis of specific types of infrastructure that connect disadvantaged areas with developed areas. The creation of infrastructure has a significant impact on economic group. And increasing length is associated with an increase in the growth, domestic product of the country, highlighting the importance of infrastructure for the Romanian economy.

The importance of household consumption is fostering economic growth, and it is demonstrated by the large impact that aggregate final consumption, which includes the spending on durable, semi durable, and non-durable product, has on the gross domestic product of the country. The shows that the two explanatory variables (aggregated consumption length) play a significant part in explaining change, increasing consumption and infrastructure, support, economic growth, according to the positive and significant coefficient. The validity of the model confirmed by the economic test, which showed no significant autocorrelation in residues or regarding heteroscedasticity.

Findings shows that improving grow infrastructure increasing aggregated final consumption have a broad and beneficial impact on Romania's GDP growth. Investment structure increases access and connectivity, low transportation cost, and boosts economic activity. Aggregate final consumption, meaning household expenditures on durable, semi durable, and brittle product, is crucial for increasing

demand and for economic growth. The analysis discloses that both determinants have a considerable impact on the growth, domestic product growth, emphasising the importance of infrastructure consumption for Romania's prosperity.

6. Discussion

At European level, smart pavement, digital monitoring, automation, and green technologies are some examples of innovative technologies used in roads, construction, and maintenance. Some of the advantages of using new materials and smart paving processes are the minimisation of wear and the enabling of maintenance. Additionally, employing a digital monitoring system allows the timely identification and repairment of damages. Enabling an infrastructure project to have a lowered carbon impact can be achieved by the utilisation of recycled materials and other environmentally friendly instruments. Infrastructure is being built more sustainably thanks to automation and rotation, which also increase productivity and reduce its cost overtime. By addressing these issues and using modern technologies, Romania devises the modernisation of its road, infrastructure, thereby strengthening the economic expansion and improving the well-being of its population.

More focused and efficient forms of infrastructure imaging improve technology and higher quality processes with accelerated development, as the role of infrastructure in the process of economic growth has been demonstrated thus, it would be advantageous for developing economies to take up new technologies as soon as visible in order to surpass more established and financially stable societies. Innovative and state of the art approaches, including electronic roads systems, and all the technology that goes along with them, electrical infrastructure projects like the electronic highway in Germany, which was developed by Siemens technologies, and inductively charged project for electric trucks, expansion of the economy and in treatment of public welfare. Although electric trucks can travel on E-Roads just like any other vehicles, the process of fuelling them while they are moving is still being worked on. Pilot programs and other initiatives are researching at the moment the capability of checking certain road segments in order to allow electric trucks charging while they are in movement. This project includes the usage of inductive charging and the installation of overhead powerlines.

As one of the most cutting-edge projects in the sector, Siemens's German e-Highway serves as both a model of best practice and a cutting-edge project. Parts of the freeway have overheard electrical lines that enable pantograph equipped electric tracks to connect and charge in real time the potential of technologies currently being evaluated throughout pilot project that are being carried out in strategic freeway areas. With the exception of being transmitted from coils embedded in the road to receivers on the motor vehicles, inductive charging is a type of current infrastructure that, in its most basic form, combines regular highways with electrification lines used by trams and trolley buses.

Currently undergoing testing, this technology makes it possible to charge cars without requiring physical connections. A road statement in Stockholm was electrified with overheard wires for automobiles as part of a test project conducted

by Sweden. The study illustrates the use of pantographs by track to link the power lines and self-charge while in motion, in the long term, the union and its member states are examining the expansion of technologies in order to create a sustainable transport system. Modernising the electric trucks high has the potential to dramatically reduce carbon emissions and the dependence on fossil fuels, helping the united Europe to meet its sustainability goals. However, until these technologies come more widespread, electric cars will largely have to rely on the existing battery, charging infrastructure, such as fast charging station on and near highways and major traffic routes.

Conclusions

Romanian logistics development is a long-term process faced with a number of challenges and obstacles. The latter include deficiencies, such as an efficient or inefficient financing of project cost, a high-level of bureaucracy, corruption, and limited administrative capacity of the responsible institutions. Technical problems associated with complex geographical conditions, such as the mountain road project, lead to even higher costs, and problems associated with the equipment required to realise the project. There is a strong, high probability correlation between GDP growth and the aggregate final cost at the economy level. Road infrastructure constantly contributes to improving access to the free market and high mobility, reducing operating cost and travel time, elements that stimulate economic activity and increase the growth rate of gross domestic product. Equitable development between urban and rural development contribute to balanced growth.

The integration of intelligent road signals, such as the traffic light based on traffic levels, data, flow, automation, digital infrastructure, monitoring for maintenance procedures, and intelligent paving are some of the contemporary working techniques utilised in the construction industry. Utilising sustainable resources and technological work processes extends the infrastructure useful and improves the return on investment by reducing wear and tear overtime. Additionally, it permits the quick identification of destructions, whose rapid repairment can be performed to counteract harms to the infrastructure. In addition, the usage of rework processes, for instance recycled materials can minimise the carbon footprint of infrastructural projects. Operations such as repairs, periodic technical evaluations intended to maintain works in optimal parameters, automatization, and rotation processes in the construction and maintenance industries trigger improved efficiency and reduced costs in the long run.

Such an approach with the neighbour Romania expedites the infrastructure modernisation process, towards creating a more environmentally, friendly, and energy efficient system. Examples of such integrated projects are the German electronic highway in the infrastructure design for electronic trucks, inductive charging as it is the project from Sweden.

The European project, E-Roads, holds major advantages. On one hand, it leads to greater mobility and more logical and coherent road connections. In addition, such project aims to reduce social inequality. Roads are necessary for international

trade and to promote economic group factors such as tourist or the mobility of production factors through fast, safe, and efficient transport, both locally and at the European level. Reducing waiting and operating time reduces cost at the microeconomic level, increases competitiveness, and increases individuals' financial resources by maintaining a higher disposable income. However, developing such a project also comes with its challenges. Investments for such projects are high and quality standards vary from country to country, for the European Union member states. This means that the results cannot be homogenised (through various compromises) and the quality cannot be the same for every participating country. The large investments assumed to modernise such infrastructure may result in funds being diverted from others, more important needs that would have a greater impact in the short term. Therefore, it is a long-term investment that requires sustained effort. Therefore, the infrastructure plays a crucial role in boosting the economy of Romania and the EU. The use of modern technologies and available financial resources represents the main starting point for the implementation of some supporting measures for a row development. Romania can be a direct beneficiary of these processes, both in terms of local investments and with the help of economic policies at the European Union level.

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**Analysing Consumer Behaviour:
The Pathway to Sustainable Food Consumption**

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Abstract

This article aims to analyse the relationship between consumer behaviour and sustainable food choices. It will investigate factors influencing consumer behaviour. Understanding these factors is crucial to guide efforts to promote sustainable food consumption. The connections analysed between consumer behaviour and sustainability will provide a good opportunity to understand clearer and better the role of the environment in our lives. The research will be based on the examination of specialised scientific articles, as well as the utilisation of field data accessed through databases and specialised websites. Subsequently, the collected data will be used and interpreted to better understand consumer behaviour regarding sustainable food consumption and to offer suggestions for improving sustainability within the food industry.

Keywords: consumer behaviour, sustainability, agrifood, sustainable food consumption, nutrition.

JEL Classification: Q01, Q56, O10, M20.

1. Introduction

In terms of the level of sustainability of food, it is considered an increasingly present problem today. Furthermore, the environmental footprint of households is influenced by food production and consumption. The fact that people are not actively involved and have trouble truly understanding the concept of food sustainability leads to the fact that those measures that are supposed to improve the situation cannot be applied and analysed effectively. These measures are based on internal factors, such as the level of awareness of food sustainability issues among consumers, shopping in an environmentally friendly manner, the reuse of food waste, and also external factors such as sustainable sales (Hansen, 2022).

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An important aspect to achieve sustainable food systems and processes consists of examining food habits. How individuals choose to consume products actually influences the entire production and distribution process of that product. However, today there is an increasing emphasis on sustainable diets that are friendly to the environment and that are closely related to social and economic norms. All these things underline the fact that there is a growing requirement to improve consumption behavioural patterns in the area of food sustainability (Panatsa & Malandrakis, 2024).

Taking into account that today food sustainability has become an extremely important topic at the global level, it is necessary to analyse the consumption patterns of individuals to be able to better identify the way in which their actions affect the environment and what impact there is on it. The role of the article is to identify the factors that influence consumers to make certain food decisions, but also how food sustainability can be improved by adopting certain eating habits in a sustainable manner.

In order to understand how a sustainable food system can be achieved, it is very important to understand what are the reasons behind consumer choice, what makes them choose, for example, food waste over sustainable consumption at certain time, and also what are the obstacles they face in this process. The purpose of these analyses is to better understand the behaviour of consumers in certain situations and implicitly to offer solutions, so that we can integrate sustainability in the food field.

2. Problem Statement

Sustainability at a global level has become an increasingly studied aspect and, at the same time, consumers, seeing the impact that their consumption decisions have on the environment, have begun to be more attentive to them. An example of this is India, where consumers have understood that a sustainable consumption model is also based on decisions and habits that benefit it, from simple recycling to efficient use of food resources (Sharma et al., 2022).

Among the factors that influence consumers' food choices are those related to supply and technology. More specifically, it is well known that for a consumer, it is essential that the products purchased to be found in the vicinity of his home and the range to be varied, with a well-made stock. It has been observed that technology can help in this regard by the fact that if you opt for an online order, then the products do not necessarily have to be in the consumer area but simply have to exist in the stock of the stores. Thus, more and more companies have started to invest considerably in online stores, helped by technology, in order to have as many customers as possible, but looking at it from another perspective, many consumers who do not have much time available have made the transition to online shopping, and the choices related to sustainable products can be analysed in much more detail, not being pressured by the time allocated for physical shopping activity (Panatsa & Malandrakis, 2024).

Studies have also shown that many consumers find it difficult to trace the origin of the food they eat. Specifically, if a food product is considered organic or sustainably sourced, simply mentioning it is not enough, and product labels can often be misleading. For this reason, the best sources of information are those of accredited institutions that can offer certificates regarding these types of products (Dolfsma et al., 2021). At the national and international levels, specialised organisations have formulated a series of nutritional guidelines. However, implementing it is not easy as consumer habits are very difficult to change, especially if consumers have formed it over the years. However, it is necessary to promote nutritional guidelines among consumers to increase awareness about food sustainability (Irz et al., 2015).

However, greenhouse gas emissions, the damage to biodiversity, and also the excessive use of natural resources, such as water or the pollution of the seas and oceans, are directly related to the level of production of agri-food companies and to the consumption of individuals. For these reasons, recommendations have been made for people to focus more on eating whole foods, respectively to consume fish from sustainable sources. However, the implementation of these suggestions also depends a lot on how consumers perceive them and whether they are biased toward them (Ford et al., 2023).

3. Research Questions / Aims of the Research

- Q1: What are the main reasons behind consumers' choice to purchase sustainable food?
- Q2: What are the main barriers consumers face in adopting a sustainable food consumption behaviour?
- Q3: What are the social and ecological consequences of adopting a sustainable food consumption behaviour?

4. Research Methods

The research methodology is based on VOSviewer analyses and data collection. Initially, a search was conducted in the academic literature to identify relevant articles on consumer behaviour in the context of sustainable food consumption. This search was based on the use of academic databases such as Science Direct and Scopus, accessed through the database provided by the University of Economic Studies. A relevant number of articles, totalling 723, were downloaded for bibliometric analysis using VOSviewer.

This software identified the visualisation of keyword networks and their co-occurrence in the academic literature. It is important to note that the 723 downloaded articles were not used directly in the drafting of the literature review. For this purpose, a smaller subset of relevant and significant articles was selected. These served as the basis for reviewing and synthesising the literature within the article.

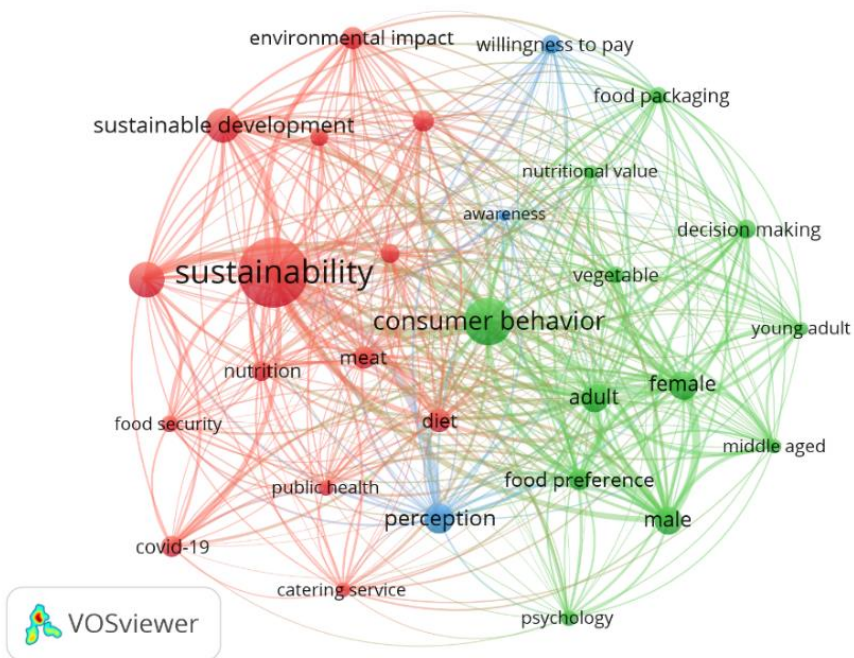
5. Findings

As stated previously, VosViewer software was used for bibliometric analysis. It processed 723 downloaded articles, focussing on their keywords. VOSViewer suggested a minimum frequency of 5 appearances for a keyword, which was adhered to. Out of the initial 4086 keywords, 374 met this requirement. Then a more specific set of 60 keywords was extracted and 29 keywords were chosen as relevant for the study. Generic terms such as "article," "study," and "survey" were removed.

The nodes represent keywords or ideas, and their size reflects how often they appear. VOSViewer uses unique colours for each group of keywords or ideas (Cruz-Cárdenas et al., 2021). Thus, 3 clusters, 394 links, and a total link strength of 3913 were recorded.

The main node of cluster 1 (red) is formed around the keyword ‘sustainability’, which continues to contribute to the appearance of other groups such as ‘food waste’ and ‘environmental impact’. This red node has a very strong connection with a green node, named ‘consumer behaviour’, which represents the main node of cluster 2 (green). It contains groups such as ‘food preference’, ‘nutritional value’, ‘food packaging’, ‘decision making’. On the other hand, compared to cluster 1, which has 14 keywords, cluster 2 has only 12. Finally, group 3 (blue) includes only 3 keywords, but one of them is a node name ‘perception’ and the other 2 groups are ‘awareness’ and “willingness to pay”.

Figure 1. Co-occurrence network of articles - Keywords



Source: VOSviewer software.

In the figure above, it can be seen that the main link between the 3 clusters is given by the term sustainability. Thus, consumer behaviour is analysed from several points of view, such as whether or not they emphasise food safety or how much they are willing to pay to buy sustainable agri-food products. Studies have shown that during the COVID-19 pandemic, people used home ordering a lot, but there were also many people who began to learn to cook and even to do it in a sustainable way, reusing food scraps. At the same time, it was found that many consumers began to pay attention to the nutritional values of the products purchased, this being done by analysing the product labels. However, it is known that these labels are not always made for the benefit of consumers and are difficult to understand. On the other hand, consumers' food preferences are also related to the taste and price of the products. Sustainable products have been observed to not always taste as pleasant as traditional ones, making consumers slightly reluctant to buy them, and most of them are much higher in price.

Thus, in order to achieve sustainable purchasing and consumption systems among individuals, it is necessary for each person to become more aware of the fact that their actions affect the environment, and better meal planning is a smart way to combat food waste, which is a factor that affects the population globally.

Table 1. Trend of food sustainability in 2021 for Romania

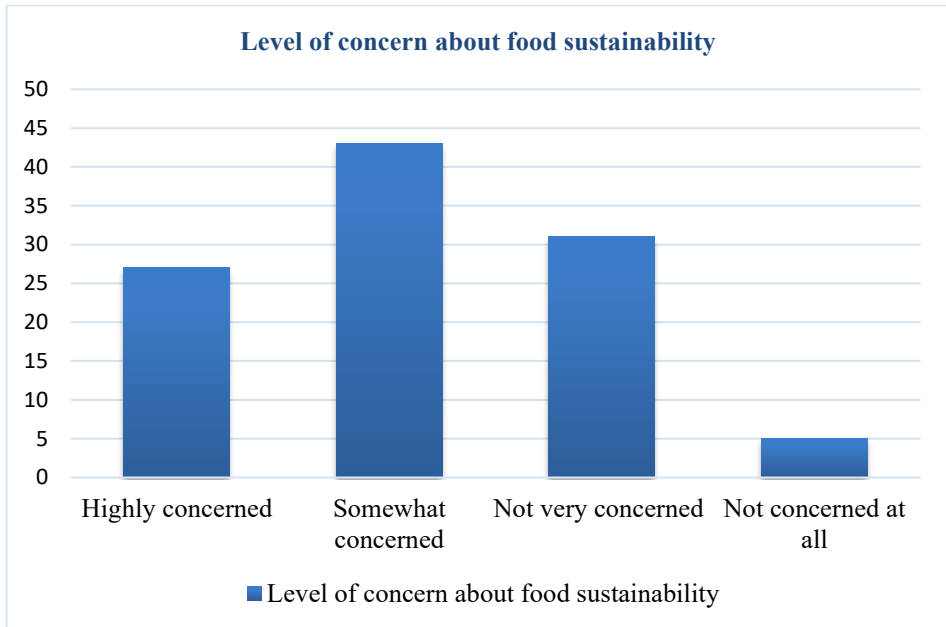
Romania		
Trend	Score	Rank
Food loss and waste	55	45/78
Sustainable agriculture	63	49/78
Nutritional challenges	65	45/78

Source: The Economist

<https://impact.economist.com/projects/foodsustainability/interactive-world-map/>.

In Table 1 it can be seen that Romania is among the countries that do not excel in terms of food sustainability, this sustainability index was achieved in 2021, from which it can conclude that things have improved now, but not significantly. Food waste is the main problem and one that persists. Although sustainable agriculture leaves much to be desired in Romania, because first of all, the infrastructure does not help farmers so that they consider opting for sustainable cultivation and production methods, but also because drought and the lack of professional irrigation systems contribute to smaller harvests. For this reason, many farmers resort to various ways to force the growth of agricultural products. However, consumers are starting to emphasise more and more nutritional values because they are directly related to quality of life, better eating habits, and implicitly this can ultimately lead to better sustainable agri-food systems for both people and the environment.

Figure 1. The level of concern about food sustainability in the UK in 2023 (%)



Source: Statista <https://www.statista.com/statistics/1402751/level-of-concern-among-consumers-about-sustainable-food-production-in-the-uk/>.

On the other hand, in graph 1 it can be seen that the level of concern for food sustainability is not high in the UK either, but compared to Romania, these consumers are more concerned about this aspect than those in Romania. The main reasons can be a better awareness of the problem, but also higher income, which allow these consumers to allocate a larger budget for sustainable food products.

6. Conclusions

In order to achieve sustainable food systems, collaboration between consumers and producers is essential. Profit is the main goal of a company from an economic point of view, but it must be obtained in a way that respects the environment and its resources. On the other hand, consumers must understand that natural resources are not unlimited, quite the opposite, with their main characteristic being scarcity. This means that a consumer should think twice before wasting food.

At the same time, good involvement of specialized institutions and the promotion of nutritional guidelines can help in time create new healthy eating habits, both for humans and the environment.

Following the bibliometric analysis, it was found that there is a strong link between sustainability and consumer behaviour, the latter being influenced by various factors, such as the price of products, their availability, and also the contribution they bring to their own health.

Globally, there are improvements related to food sustainability, but for things to progress even further, it is necessary for individuals to understand that rational and sustainable consumption is a benefit for both their own health and the environment.

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**Increase of Production Capacities and Investments
in Enterprises Depending on the Perspective
of Regional Development**

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Eleni VANGJELI³, Anila MANÇKA⁴

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Abstract

Through this study, regional producing potential was identified based on investments and increase of capacities in order to determine their impact on increase in employment, mainly qualified and university graduate employees.

A few questions that arise along the study are: Does the production capacity affect the number of employees? Does the investment amount affect the number of employees? Does the increase of production capacity affect the increase of incomes? Does the increase of incomes affect the employment levels?

In conducting the study, we used secondary data published by INSTAT, the Regional Tax Office, municipalities in the Korca region, and primary data obtained through questionnaires filled out by regional enterprises.

Data processing revealed that 33% of respondents' businesses invested in the last 5 years in expanding their activities. As results of the investments made in 40% of businesses, the number of employees has increased by over 20. Despite the internal sources and credit, 30% of businesses chose the government subsidies as an investment method. Due to investments, business incomes increased by 20%. About 33% of businesses plan to increase their investments in the future. The production capacity, investment amount, and increase of income have statistically affected the employment levels greatly. Increase of production capacities has a statistically important effect on incomes. This study will open the doors to other processes in the area. The results achieved will serve as data for the regional institutions, the university, etc.

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Keywords: production capacity, employment, investment, financing, increase in incomes.

JEL Classification: D25.

1. Introduction

In the last period, Albania has been affected by a wide wave of emigration. Emigration has particularly affected young people, who immigrate for reasons of employment and higher income. As a result of the youth and qualified class drain, Albania is thus losing its human capital, i.e. the labour force with high productivity. Under these conditions, increasing the level of employment, income from labour, and standard of living can be methods for improving the current situation. An important source of economic growth and job creation are the manufacturing enterprises, which contribute directly to regional and national economic development. The increase of the capacity and income of the manufacturing firms through the increase in investments, will have a positive impact on the economic development, affecting the curbing of the emigration of young people. The focus of our study is the identification of the production potential of the Korca region based on the increase in production capacity and business investments, which affect sustainable regional development. Also, the study identifies the effects of increasing production capacity, employment, and income.

2. Problem Statement

In order to meet the objectives of the study, we analysed such variables as production capacity, investments, number of employees, income from investment, etc. Also, we studied the effects of such variables on businesses outcomes, which in turn affect the regional economic development. Our research in this field of study concluded that the literature on this aspect is too limited. Some of the outcomes achieved by studies conducted in this area are listed below:

Manufacturing has traditionally played a key role in the economic growth of developing countries. On the basis of this fact, the research (Nobuya Haraguchi et al., 2016) in their study has explored whether the low levels of industrialisation in developing countries are attributable to long-term changes in the development characteristics of manufacturing or to the manufacturing sector's general global prospects. Lastly, its findings have resulted in a concentration of manufacturing activities in developing countries.

K. Fedorowicza and A. Łopatka (2022) have stressed the importance of investment in the development of enterprises in Poland. They have confirmed the theory that investment is a principal factor for companies to make profits. The results of their study show that investment is an important factor in economic growth because it leads to a better use of resources for which economic entities compete in the free market.

Montolio and Sole-Olle (2009) and Bottasso et al. (2014). argue that the rate of acquisition and adaptation of new equipment and machines are manifested in

investments by firms. Furthermore, investment in infrastructure and fundamental industries by states induces the adaptation of better technologies by firms.

Hongh Chen et al. (2018) in their study investigate the impacts that investments have on technological progress, particularly from a developing country perspective. Their findings complement the empirical literature by showing that private domestic investment has a consistent and positive impact on technological progress.

Dommari Anjaneyul et al. (2023) have found a very strong positive Association between Number of employees and Annual Revenue of the company. The results of their study show that when Employees of the Company increases during the years, in the same way Annual Revenue also increased.

(Heshmati & Löf, 2008) provide an empirical analysis of the two-way causal relationship between investment and performance indicators at the firm level. The performance variables include sales, value added, profit, cash flow, capital structure, and employment. The results show evidence of a strong and significant relationship between R&D and productivity. R&D is found to be a good predictor of future growth in profit and employment.

Oluchukwu et al. (2019) have estimated a dynamic model with error correction using data from Nigeria between 1980 and 2017. Their finding results that investment is capable of creating opportunities for employment thus reducing the level of unemployment in a developing economy.

Mutunga& Owino (2017) have studied the relation between production capacity and financial performance of manufacturing firms in Kenya. They have collected data using a self-administered questionnaire, from a population of 180 manufacturing firms in Kenya. The study concluded that there is a positive relationship between production capacity and financial performance of manufacturing firm.

Abu Jadayil et al. (2017), determine the main factors affecting its production capacity, and study their influence to improve the production capacity to reach the optimum. Different aspects were investigated, including the speed of the running machines, the number of workers running each machine, the operating shifts, the machine utilisation, and the working environment. It was found that all these factors have significant effect on improving the production capacity.

Jamaliah (2016) demonstrated in his study that private investment had a significant effect on production added value, with a positive relation; private investment had a significant effect on employment absorption, with a positive relation; production added value had a significant effect on employment absorption, with a positive relation.

Our study is only the beginning of studies to identify producing potentials regarding increased capacity and employment as basis for regional development. Since the paper aimed to study only a few affecting variables, future studies could complete the results by extending the assessment to other affecting variables to increase the levels of explainability of used models and improving the assessment techniques.

3. Research Questions

The main objective of the study is to identify the region's producing potentials based on increasing capacities aiming at a sustainable regional development.

The following specific objectives are the focus of the study:

- To assess the actual situation of the region's producing sector related to the amount of total production provided and the employment levels;
- To assess the actual investments and those planned in the future related to increase of capacities, incomes and employment.

To meet the above objectives, a few research questions come up:

Research question 1: Does the amount of investment affect the increasing number of employed people?

Research question 2: Does the increase of production capacity affect the increase of incomes?

Research question 3: Do the increase of production capacity and incomes affect employability?

Research question 4: Do the increase of investments and production capacity affect the increase of incomes?

4. Research Methods

In conducting the study, primary and secondary data sources were used.

The secondary data were obtained by: INSTAT, local institutions such as the Tax Office, municipalities of the Korca Region, providing the list of all businesses operating in the Korca Region. Only active businesses making up the study population were selected from the list (1550 companies). It is important to determine the sample, since it should be most representing for the population being studied. Keeping that in mind, the formula processed by Yamane (1967) was selected:

$$n = \frac{N}{1 + N(e)^2} \quad (1)$$

In this present study, since the population is made up of 1550 companies, the size of the sample is:

$$n = \frac{1550}{1 + 1550(0.1)^2} = 92$$

There were 105 producing companies involved in the study, since were considered that a lower return rate than 100% could exist. Business selection was done randomly from the list (1 in every 15 businesses).

The primary data obtained by questionnaires addressed to production companies from the Korca region. The questionnaires were physically distributed in selected businesses and the return rate was 100%. The data were collected during the period May-June 2023.

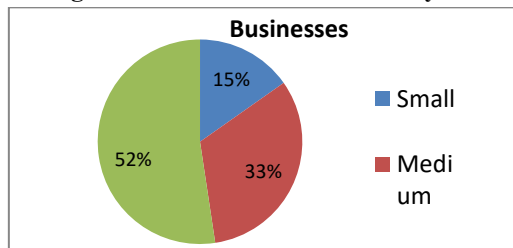
All data were analysed with Software EView 13. Primary data was displayed on tables and graphics through descriptive analyses. To test whether the independent variables included in the study statistically predict the dependent variables, simple regression and multiple linear multiple models were used.

5. Findings

5.1 Results of Questionnaire Processing

The study produced the following findings, after having processed and analysed primary and secondary data.

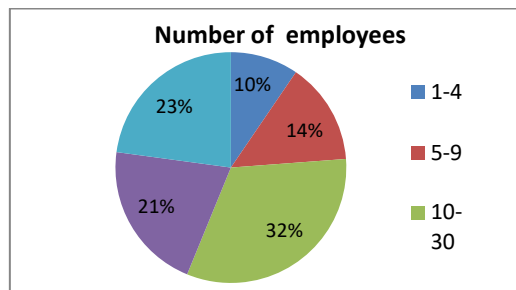
Figure 1. Number of businesses by size



Source: authors.

From the responses of the surveyed businesses, it appears that 52% of them are large businesses, 33% are medium-sized businesses and the remaining 15% are small businesses. The sample selected for the survey intentionally includes a high number of large businesses, with many employees, for the purpose of the survey and the implemented project.

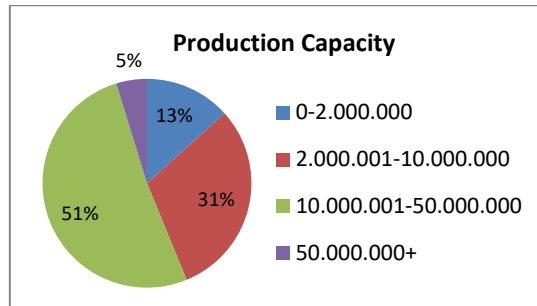
Figure 2. Classification of businesses based on the number of employees



Source: authors.

Regarding the number of employees in the surveyed businesses, it turns out that 10% of them have 1-4 employees, 14% have 5-9 employees, 32% of them have 10-30 employees, 21% of them have 31-50 employees and 23% have over 50 employees. The performance of businesses will affect directly the well-being of their employees, the increase of employees' numbers, as well as the improvement of employment and economic growth indicators in the Korca region.

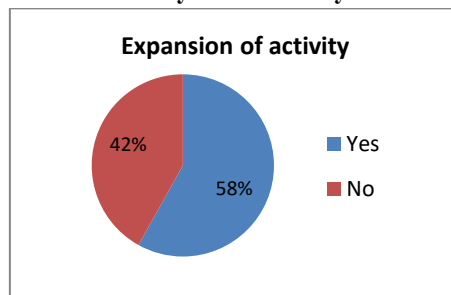
Figure 3. Classification of businesses based on annual turnover



Source: authors.

Regarding production capacity, most of the businesses asked (51%) have an annual turnover of 10,000,001-50,000,000 ALL, 31% have an annual turnover of 2,000,001-10,000,000, 13% an annual turnover 0-2,000,000 and only 5% have an annual turnover of 50,000,000+.

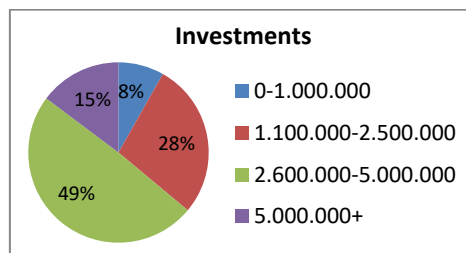
Figure 4. Classification of businesses based on the expansion of activity in the last 5 years



Source: authors.

Out of 105 businesses surveyed, 58% of businesses responded positively to the expansion of activity, while 42% do not want to increase their activity.

Figure 5. Classification of businesses based on the amount of the investments

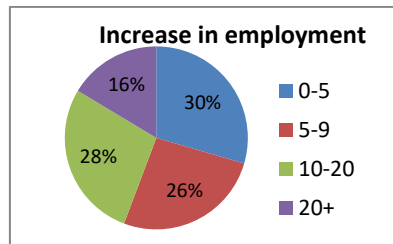


Source: authors.

The analysis of the questionnaires shows that 8% of businesses have invested up to 1,000,000 ALL, 28% of businesses have invested from 1,100,000 to

2,500,000 ALL, 49% of businesses have invested worth from 2,600,000 to 5,000,000, while 15% of businesses have invested in the amount of over 5,000,000 ALL. It turns out that most of the businesses in the Korca region have invested 2,600,000-5,000,000 ALL for expanding their activity.

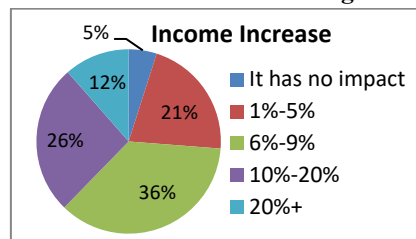
Figure 6. Classification of businesses based on the increase of employment levels



Source: authors.

Our study shows that 30% of businesses have increased the level of employment with 1-5 employees, 26% of businesses with 5-9 employees, 28% of businesses with 10-20 employees, and 16% of businesses with over 20 new employees, due to their investments.

Figure 7. Classification of businesses based on the growth of investment income



Source: authors.

Our study shows that investments had no impact on income increase for 5% of businesses, it had an increase up to 5% in income as a result of the investments for 21% of businesses, it had an increase up to 6%-9% in income for 36% of businesses, it had an increase up to 10%-20% in income for 26% of businesses and it had an increase in income by over 20% for 12% of businesses.

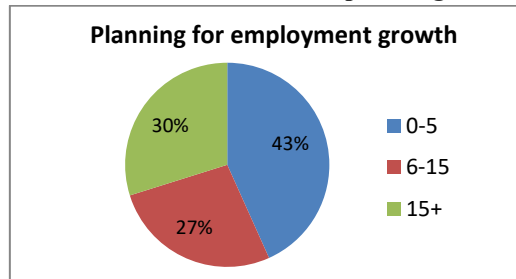
Figure 8. Classification of businesses based on future investments



Source: authors.

One of our study findings was how businesses will invest for technology in the future. As shown in Figure 8 there are: 34% of businesses will invest in new capacity-raising technologies, 40% of businesses will invest in new technologies to increase product quality, 23% of businesses will invest in technology for the production of a new product, and only 3% of businesses will make no investment for technology in the future.

Figure 9. Classification of businesses based on planning for employment growth



Source: authors.

One of the purposes of making investments is to increase employment. According to data from questionnaires, businesses have different plans for employment growth as a result of their investments. As it shows in Figure 9: 43% of businesses plan to increase the level of employment by 1-5 employees, 27% of businesses plan to increase the level of employment by 6-15 employees and 30% of businesses plan an increase by more than 15 employees as a result of the investment.

5.2 Regression Analysis

Some of the variables being analysed in the study are: investments, number of employees, production capacity, incomes. To analyse the relations between variables, we used the simple regression multiple linear analyses.

- Ho: The amount of investment affects the increasing number of people employed.

This hypothesis is proven.

Such model of simple linear regression presents the connection between the increase of employees' numbers and the investment. $Y = -0.0817 + 0.9065X_1$.

The model appears statistically important ($t=32.25$; $p<0.05$) with an explanatory strength of 90% ($R^2=0.9$). The investments made in businesses have very important effects on the increasing numbers of employees.

- Ho: Increase of production capacities has statistically important effect on increase of incomes.

This hypothesis is proven.

Such model of simple linear regression presents the connection between the increase of incomes and the production capacity $Y = 0.78 + 0.76 X_1$.

The model appears to be important ($t=7.48$; $p<0.05$) with an explanatory strength 35% ($R^2=0.35$).

The increase of production capacity affects the increase of incomes by explaining 35% of the measure of their change.

- Ho: The increase in capacity and the increase in income affect the increase of employment.

Thus, the hypothesis is proven.

Such model of multiple regression presents the connection between the increase of employment, capacity and incomes $Y = -0.018 + 0.63 X_1 + 0.17 X_2$.

The model appears to be statistically important ($F = 615$; $p < 0.05$) with an explanatory strength of 92% ($R^2 = 0.92$).

Increase of capacity and incomes explain 92% of change in increase of employment.

The increase in capacity appears to have an important effect on employment ($t = 22.7$; $p < 0.05$); similarly, the increase in incomes results to have an important effect on employment ($t = 8.06$, $p < 0.05$).

- Ho: Increase of investment and increase of capacity affect the increase of incomes.

This hypothesis is proven.

Such a multiple regression provides the connection between increase in incomes, increase of investments and increase of capacity $Y = -0.012 + 1.14 X_1 + 0.04 X_2$.

This model appears to be statistically important ($F = 1112$; $p < 0.05$) with an explanatory strength of 95% ($R^2 = 0.95$).

Increase of investment appears to have an important effect on increase of incomes ($t = 37.5$; $p < 0.05$), whereas the increase of capacity does not show an important effect on the increase of incomes ($t = 1.28$; $p > 0.05$).

6. Conclusions

The study was conducted for the producing companies in the Korca region, because businesses contribute directly to the economic regional and national development and increase in employment. Large businesses make up almost 50% of the companies under study. These businesses also have a higher number of employees and greater opportunities to create new jobs in the future. About 33% of the participating businesses have invested in expanding their activities over the last five years. As a result of investments done in 40% of businesses, the number of employees has increased with more than 20 employees. A considerable part of businesses – 33% of them – plan to increase their investments in the future. As a result of future investments, the producing capacity for 40% of businesses is expected to increase by over 50%. Also, future investments are expected to increase the employment levels with over 15 employees and have more influence on the production quality for 50% of businesses. One of the reasons why other businesses have not invested and do not plan to do so in the future is the high interest rates on the loans. Therefore, government policies should aim at creating a favourable business environment whether new or existing ones, through subsidizing or facilities in order to encourage them towards investments.

As by the statistical analyses of variables under study, it was concluded that: investments done in businesses have an important effect on the increase of the employees' number. Similar results gave the studies from Jamaliah (2016), and Oluchukwu et al. (2019).

The increase in production capacity and the increase in income have a statistically important effect on increase in employment. Same findings obtained in their studies Mutunga & Owino (2017) as well as Dommari Anjaneyul et al. (2023).

The increase of investments and the increase of capacity have a statistically important effect on increase of business incomes. Such a finding is partially proved in the studies by. Fedorowicza and Łopatka (2022) that investment is a principal factor for companies to make profits.

Increase of production capacity has a statistically important effect on increase in income. This finding is supported by Mutunga & Owino (2017) stating that there is a positive relationship between production capacity and financial performance of manufacturing firm.

We think that these outcomes are a contribution in the research field, leaving it open for researchers to continue their studies. This study should be extended in the future in a wider range of time in order to ensure the sustainability of the outcomes. The study served as a database for those people who are interested, such as company managers, regional institution directors, policy makers on local and central levels, and it would be worth it to deepen the study further in the future involving a wider business sample on national levels. Since the paper aimed to study only a few affecting variables, future studies could complete the results by extending the assessment to other affecting variables to increase the levels of explainability of used models and improving the assessment techniques.

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**Innovation Spillovers, Economic Growth,
and the Role of Absorptive Ability**

Muhammad USMAN^{1*}, Lal Khan ALMAS², Shoaib HASSAN³

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Abstract

Research and Development (R&D) based economic sustainability is the current debate in endogenous growth framework to solve the problem of production inefficiency to achieve economic stability. The high Total Factor Productivity (TFP) growth can be attained through technological innovation, reverse engineering, 'learning by doing', artificial intelligence, and interaction of the researchers around the world. The adoption of foreign and domestic R&D innovation and its spillovers are relying on the willingness to opt, financial capital, and knowledge capital. The rationale of this study is to examine the importance of R&D spillovers for stable economic growth (EG) through the channel of knowledge diffusion in Pakistan. This research theme has been designed to investigate the proficiency of R&D diffusions in the absorptive capacity of the Pakistani labour force and the efficiency to progenitive utilization of R&D innovation. Quantitative analysis is carried out through the yearly time series data covering the period of 1972 to 2022. The Translog and Cobb Douglas production functions were employed to measure the TFP growth and Autoregressive Distributive Lagged (ARDL) Model was applied for empirical analysis. The quantitative analysis provided evidence of the presence of foreign and domestic R&D innovation spillovers and adoption in Pakistan with poor absorptive capacity. The study has indicated that foreign R&D spillovers have an affirmative role in TFP growth compared to domestic R&D. A great deal of policy wisdom has been generated, which directs that government should focus on sustainable policies related to local R&D, R&D spillovers with sufficient and sustainable R&D expenditures, their availability, and accessibility of innovation to boost the resource efficacy for higher TFP growth. The government should emphasise the implementation of extension services to educate workers by demonstrating the effectiveness of early adoption of innovation, innovative technology, and artificial intelligence (AI) to achieve sustainable productivity.

Keywords: research and development spending, spillovers, knowledge capital, absorptive ability, TFP growth, time series analysis.

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JEL Classification: O32, O34, O30, L2, C33, C22.

1. Introduction

Research and Development (R&D) provides pivotal mechanism to transition the economy from resource-based to knowledge-based. In globalisation era, R&D becomes necessary for the achievement of sustainable economic growth, as only a knowledge-based economy can magnificently compete in the international market and achieve comparative advantages. Resource efficiency relies on level of R&D spending, internal knowledge, and labour capacity to absorb the innovation spillovers from across the world. The R&D spillover shocks are a long-term phenomenon that infiltrates the economy through various channels such as labour migration, international trade links, foreign direct investment (FDI), networking, international collaborations, and extension services. These channels are crucial in innovation diffusion, which is generated through R&D activities across borders, states, sectors, and industries. Once an economy achieved steady-state economic growth, further long-term economic growth potential can be fostered through continued engagement in R&D-based activities and its spillovers. This involves the dissemination of innovation across the state provinces, and industries and early adoption of innovative practices are as essential as spending in R&D based activities. Such initiatives contribute to attaining the potential level of output and competitiveness of a nation in the global market.

The economic growth measurement was initially introduced by Solow (1957), who adopted exogenous growth determinants. Subsequently, Jorgenson and Griliches (1967) elaborated the growth model and switched the conventional growth measurement process by incorporating labour and capital efficiency (quality) as crucial factors for higher economic output. Jorgenson and Griliches (1967) argued that the advancement of a country is not solely dependent on the quantity of physical capital, labour, and land, the quality of these inputs is equally essential in the production process to achieve the resource efficiency. In later developments, Griliches (1992) and Romer (1991) concluded that economic output hinges on R&D innovation, knowledge spillovers, and the ability to absorb innovation, reflecting labor efficiency or knowledge capital. For improving absorptive capacity, talent is an essential factor, as young researchers with innovative knowledge will endorse the exchange of ideas and collaboration that increased the R&D spillover process (Wang, 2015). On the foreign talent spillover may cause the crowding-out effect for internal/ existing talent, which is harmful to the internal innovation process (Agrawal et al., 2019) and inclusive growth process.

Initially, economists established fundamental connections between R&D spillovers and productivity by treating technological innovation as an exogenous variable. The importance of R&D gained as Griliches (1973) incorporated the R&D spillovers as an endogenous determinant of economic output. Within the framework of production function, the significance of R&D innovation has grown over time through novel-orientated studies on endogenous growth theories that positioned the R&D innovation as influential determinants of economic output (Aghion & Howitt,

1990). Furthermore, Griliches (1992) emphasised on R&D spillovers as a primary driver of economic output, fostering innovation and spillover shocks to cost-efficient and market-compatible products that enables firm or economy to secure comparative advantages. New growth theories heighten the role of R&D spillovers as catalysts for technological progress and innovation adoption in economic growth (Romer, 1990; Grossman & Helpman, 1991).

1.1 R&D Spillovers and Economic Growth

Technological innovation facilitates the mapping of inputs to outputs by improving product efficiency. R&D contributes distinctive and first innovative knowledge, which often entails strong complementary inputs, such as AI, tools, materials, and energy sources. Technological spillover is the utilisation of R&D generated knowledge spillover to gain the higher productivity with fewer resources. Empirical and theoretical studies that examine R&D models consistently indicate that R&D spillovers exert a substantial influence on the production performance of the manufacturing, agriculture and service sectors, minimizing the environmental damage both in developed and developing countries (Coe & Helpman, 1995; Lee, 2013; Liu et al., 2015; Maria & Smulders, 2017). Innovation spillovers are fundamental drivers for enhancing productivity, catalysing innovation, facilitating the ‘learning-by-doing’ process, and enhancing the value addition process both in agriculture and manufacturing sectors. Furthermore, R&D spillovers worked as an instrument to achieve the potential level of output to sustain long-term economic development. International trade emerges as a key factor for knowledge spillovers and innovation adoption, which is helpful in introducing efficient product varieties across borders. International trade in technological products increase market size through innovative commodity varieties and trade openness in R&D based products, which plays a fundamental role for introducing novel products, providing ways to access technical knowledge and mitigates the cost of innovation (Rivera & Romer, 1991; Usman et al., 2021).

R&D spending provides an imperative for obsolescence, surviving competition, and navigating waves of disruption. Engaging in R&D activities provides distinct advantages in terms of innovation spillovers and absorptive capacity, weather at national level, corporate level, or individual researcher dedicated to exceptional efforts in unique knowledge and product development. The economic impact of R&D spending manifests in progressive ways through the manufacturing and agriculture sector, which improves the knowledge efficiency of the labour force (Coe et al., 2009; Usman et al., 2021). Raza and Siddiqui (2014) hypothesise that spending on R&D enhance the production process in the economy, brings innovative technology and techniques in production, and provides efficient goods and services, allowing the economy to produce the higher value goods and services. In the context of economic development, innovative technologies generated through R&D initiatives are characterised by increased durability, capability, and power in high-intensity production of market-compatible products, which improve the living standard in the economy and the economic development process. Moreover, the

positive spillover of R&D generates innovative knowledge; benefits can emanate from imported goods and services, which developed by trade partners, also enhance the productivity growth of the host country. In addition, Ho et al. (2009) argued that more open countries gain greater productivity from external R&D expenditure compared to economies with lower level of openness, demonstrating the significance of R&D spending that transcends national borders, fostering innovation, improving productivity, and contributing to overall economic development.

The empirical results of Liu et al. (2016) suggests that the contribution of R&D spillover, both from foreign and domestic sources, significantly influences economic growth, which is directed to enhance the development and living standard of the economy. In addition, Gorkey (2014) delves into the long-term repercussions of technological spillover on economic and environmental conditions, and the findings revealed that R&D spillovers play a pivotal role in improving domestic output while minimizing environmental damages. The interdependence of a host country's R&D spillover and innovation capacity is dependent on various factors, such as innovative thinking, knowledge capital, "learning by doing", learning through experiences, and the absorptive capacity for foreign knowledge (Castle et al., 2014; Richard et al., 2023). Furthermore, comparative advantage and profit margin through investment in R&D spillover improve the strategic partnership between research institute and domestic firms, which accelerates the way of innovative thinking and domestic R&D spillovers process. Such collaborations contribute to the creation of unique new products in competitive markets, subsequently leading to increased customer satisfaction, improved performance, and a comparative advantage in the sale of products globally.

Inclusive and exclusive R&D spillover-driven growth plays a pivotal role in shaping modernisation and societal development. However, it is important to note that not all forms of growth can be attributed to technological advancement, improved allocation, and scale economies. Economic development resulting from R&D spillovers brings knowledge acquisition about significant improvement in living standards, life expectancy, quality of essential services and mitigate adverse poverty shocks. R&D spillovers benefitted a selected group of original, driven, and skilled individuals who push technological progress. Successive technology creates new demands, and thus generates further interest in endogenous R&D activities (Sulehri et al., 2023). On the contrary, the development of novel practices can be spearheaded by highly skilled engineers, scientists, and researchers who have immediate access to pertinent propositional knowledge; ingenuity serves as a driving force behind continuous progress (Xu & Khan, 2023).

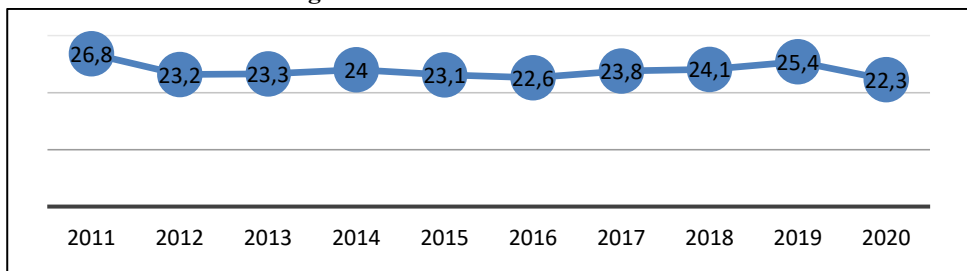
Economic theories propose two primary drivers of economic growth in the current situation, such as accumulation of R&D and human capital development (Asim & Sorooshian, 2021). Both human capital and R&D play an incremental role in productivity in all sector of the economy. Research fosters knowledge creation, while R&D serves as the mechanism through which researchers generate new knowledge, formula, technology, technique, products or services both nationally or internationally (Usman et al., 2021; Stads et al., 2015). R&D based innovation

is utilised individually or offered at the marketplace to produce efficient and market-orientated goods and services to earn higher profits. Innovative technology allows producers to maintain output with fewer resources or increase output with the available resource (cost minimisation or profit maximization process). Undoubtedly, reliable research and timely adoption have dynamically contributed to the economy generate tangible benefits, promoting stable economic growth, and coping risks aimed at rapid economic integration. The R&D process at the firm or country level typically encompasses seven fundamental stages: knowledge generation, idea screening, development and testing (including patenting), strategy formulation, product development implementation, market testing based on practical applications, and finally, commercialisation or the sale of innovative patents (Sulehri et al., 2023).

1.2 Pakistan's Innovation Index

The innovation index captured national elements that measured the domestic innovation activities, consists of five input pillars and two output pillars. The input elements are human capital and research, research institutions, infrastructure, sophisticated business, and market, while the output pillars are unique new product and knowledge-based outputs (Global Innovation Index, 2020). The average value of Pakistan's innovation index from 2011 to 2020 is 23.85 points, the maximum value of the innovation index is 26.8 during 2011, and the minimum value is 22.3 during 2020 (Figure 1). In the global innovation index ranking, Pakistan is ranked 108 among 131 countries (Global Innovation Index, 2020).

Figure 1. Pakistan Innovation Index



Source: Global Innovation Index, 2020.

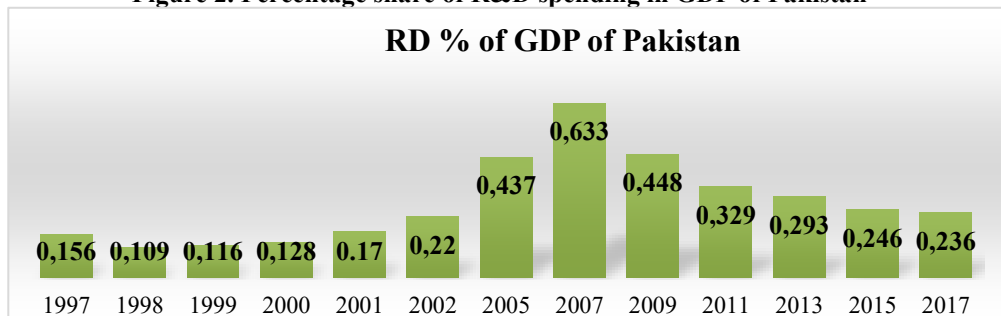
1.3 R&D Expenditures of Pakistan

In Pakistan, the public sector has the utmost proportion of expenditures allocated to R&D through investments in higher education, while universities are considered the main research institutions. Higher education R&D expenditures in Pakistan do not produce significant effects on the creation of new knowledge (Khan & Khattak, 2014). R&D spendings and EG have a two-way relationship, as economic growth increases, it leads to increases the R&D expenditures. Conversely, the rise in R&D synthesis leads to enhanced EG. Similarly, Ildirar et al. (2016) found the bidirectional causality between economic growth and R&D spending. Spending on

R&D capital highlight the country's priority for science and technology, innovation, and knowledge spillover, which leads to economic development in the long run.

R&D spending of a country, firm or individual efforts to design, develop and enhances its unique services, products, technology, formula or processes. R&D spending as a proportion of GDP of Pakistan includes both current and capital expenditures, which comprises four main dimensions such as business enterprise expenditures for innovation, government expenditure on innovation, higher education spending, and contributions from private non-profit sector expenditures. In Pakistan, the percentage share of R&D spending is shown in Figure 2, which highlights that in 2007 the % share of R&D spending was high and was 0.63 percent of GDP of Pakistan. The government R&D spending as a percentage GDP is not satisfactory as much as required for the internal research and innovation process. In 2017, the percentage of R&D spending of GDP was 0.236 percent compared to 0.246 percent in the previous period. R&D expenditures as percentage GDP graph shape look like normality curve and R&D expenditures were at peak during 2007. The lowest R&D expenditures were during 1998, with a percentage share of GDP of 0.109 percent. The R&D structure in Pakistan is not well established and government, firms, individuals, or researchers are not familiar with the importance of R&D innovation to acquire competitive advantage in science and technology and positive shocks for country development.

Figure 2. Percentage share of R&D spending in GDP of Pakistan



Source: World Development Indicators, 2020.

1.4 Problem Statement

Drawing insights from both international and domestic literature, this study concludes that there remains ambiguity regarding the contribution of R&D innovation to the economic growth of a country. A comprehensive review of studies suggested that R&D diffusion produces positive externalities and technological transformation, labour migration, and knowledge shocks are the key determinants to achieve long-term economic growth (Griliches, 1992; Keller, 2021; Rismawan et al., 2021). On the contrary, many studies argue that R&D spillovers produce negative externalities, such as increased unemployment, increased comparative cost of the industry, increased income inequality, elevated water and air pollution, reduced availability of organic food, and decreased domestic productivity (Aitken &

Harrison, 1999; Ahmad et al., 2020; Lucking et al., 2018; Adetutu & Ajayi, 2020). Based on diverse literature, this study identifies key questions that have not been adequately addressed in the context of Pakistan. What is the quantitative narrative of the spillovers of R&D spillovers for the economic success of Pakistan? What role do R&D and its spillovers play in the economic growth of Pakistan? Does absorptive ability exist within the Pakistani labor force? Whether the human capital efficiency of innovation adoption contributes to innovation spillover across the country? Does domestic R&D spillover have a crucial influence in promoting EG compared to foreign R&D spillover? By addressing these questions, the study aims to increase the comprehension of the nuanced relationship between R&D spillovers, innovation, and productivity growth in the context of Pakistan.

This research significantly adds to the body of knowledge already available on R&D and its spillovers in Pakistan in several ways. First, it represents one of the initial efforts to systematically investigate R&D spillovers on economic success in Pakistan. Second, the study explores the mechanism through which R&D spillovers are evident, emphasising both domestic and foreign sources, such as trade and FDI as an important channel for R&D spillover dynamics. Third, the research employs robust methodologies to calculate the TFP adopting both the Translog and Cobb Douglas production functions. Fourth, the existing literature regarding R&D spillovers predominantly adopted cross-section or panel data, like cross-country or regions, this research pioneers a time-series analysis approach for a more nuanced and carried analysis for country specific. Additionally, the investigation not only focusses on R&D spillover tools, but also incorporates an assessment of laborer absorptive capacity in Pakistan. Fifth, the existing literature on the adoption of technology in Pakistan (Akhtar & Pirzada, 2014; Ali, 2013; Chavas & Nauges, 2020; Raza et al., 2017; Wang et al., 2020), a limited study focused on examining the impacts of manufacturing and agri-inputs through FDI. This research stands out as a unique contribution, systematically measuring TFP growth and investigating the intricate association between opting for R&D and absorptive capacity in influencing economic growth. By addressing these gaps, this study significantly advances our understanding of the complex dynamics surrounding R&D diffusions and its contribution to productivity growth in Pakistan.

1.5 Research Objectives

R&D innovation bring novel technologies, technique, formula, and knowledge to obtain higher development, efficient, unique, and market-orientated products, which significantly contribute to the steady state level of EG. Moreover, the adoption and absorption of new technology, knowledge, or research play an essential contribution to enrich the R&D spillovers for sustainable long-term economic growth. The primary focus of this research is to investigate the influence of the spillover of R&D spillover on EG in Pakistan to explore the absorptive capacity of the workforce in Pakistan. The key objectives of the research are as follows.

- Investigate the contribution of R&D spillovers in fostering stable TFP growth in Pakistan through the channels of innovation diffusion.

- Assess the absorptive capacity of the Pakistani workforce in relation to the adoption of innovation and the adaptation of new knowledge spillovers.
- Quantify the effect of both R&D spillovers from domestic and foreign R&D spillovers on the economic performance of Pakistan.

2 Materials and Methods

Research in technological innovation is an important driving force in economic success and economic integration across boundaries. Neoclassical economics focused on technological innovation as exogenous and focused on factor accumulation (such as labour, capital, and land) as a source of economic output (Solow, 1957; Cass, 1965; Koopmans, 1965). Standardised technology modernised the country and provided an alternative competing system for development, and coalitions with other stakeholders to innovate. Endogenous economic growth models integrate technological innovation and consider knowledge and R&D spillovers within the growth model (Romer, 1990; Grossman & Helpman, 1991). The total factor productivity and economic output are dependent on domestic R&D and its spillover shocks from foreign sources.

R&D spillovers have similar process that benefits trading partners (Griliches, 1998) While knowledge diffusion has causal roots in non-competitiveness and exclusive technology (Romer, 1991). Knowledge spillover extends up to 300 km (Bottazzi & Peri, 2007). However, today globalisation era, transportation advancement, communication, and IT have amplified spillover impacts across the globe if the host country is as efficient in absorptive ability of innovative knowledge. Typically, the knowledge generation process spreads through face-to-face interactions among researchers, policymakers, and field workers. Absorptive capacity creates hurdles in disseminating knowledge in distant areas, particularly for unskilled laborers. The effectiveness of knowledge spillover is reliant on country absorptive ability, reduces the innovation cost, and transmission cost, time horizon (Hauser et al., 2007). R&D spillovers are positive associated with the growth of TFP, the output elasticity was between 10 and 30% for firms operating within the same industry. Both government and company R&D spending contributes positively to TFP growth. The growth of TFP depends on the size and distribution of funds for R&D and innovation activities (Bronzini & Iachini, 2014). Furthermore, Guellec et al. (2001) have found an inverse synergy among defence related R&D compared to civilian R&D spending on TFP. Similarly, Ho et al. (2009) found a protracted elasticity of the R&D spending contribution to TFP growth to be 0.091 in the case of Singapore. Both R&D and TFP growth are complementary goods (Cin et al., 2017; Czarnitzki & Hussinger, 2018; Bye et al., 2019).

Table 1. Theoretical revolution in exogenous growth models and R&D innovation

Creative Destruction		
Schumpeter (1934)	“Process of industrial transformation that continuously revolutionises the economic structure, destroying the old one, continuously creating a new one”	
Revaluation in Exogenous Growth Model		
Harrod–Domar Model (1939, 1942)	Physical Labour	Additional labour with fixed capital ratio increases the productivity (increase in population rise the economic growth).
Solow and Swan (1956)	Physical Capital	The increase in physical capital accumulation increases the productivity (keeping fixed labour).
Porter's Diamond (1965)	Diamond Model	Government should act as catalysts and pursue the policy to achieve competitive advantages in international market. Advantages can be gained through factor proficiency, international demand, and firm strategy, structure, and rivalry.
Griliches (1967)	Quality of Input Resource	Highlights the efficiency and quality of labour and capital as a key to economic success.
Revaluation in Endogenous Growth Model		
Griliches (1973, 1992,1998), Grossman and Helpman (1991); Aghion and Howitt (1990);	R&D spending and Technological innovation	Considered the R&D capital and technological innovation in endogenous framework.
Romer (1990); Lucas-Uzawa (1988)	Human Capital Efficiency	Human capital is as important for economic success as physical capital and labour. Long-run economic growth as dependent on knowledge capital that creates innovation spillovers. The Lucas model focused on formal education rather than learning-by-doing.
Romer (1990); Romer (1991); Coe and Helpman (1995); Coe et al. (2009)	Efficiency of R&D capital with Human Capital	The efficiency of R&D spillovers from domestic and foreign sources is considered in the endogenous factors in growth model. Investment in human capital is key to technological innovation and accelerate the spillover process.
Aghion and Howitt (1996); Aghion and Caroli (1999); Howitt (2007)	Green R&D Innovation	Innovation competition and R&D based green growth based on R&D is needed for further economic output.
Modern Approach		
Solow (2007); Barro (2015); Nordhaus (2018); Pylypenko et al. (2023)	R&D Efficiency, Environmental Capital, and Institutional Framework, Social Capital	Institutional framework and policies provide protection to R&D, knowledge capital, environment sustainability, and social capital are important factor of economic growth. If one institution is not working efficiently, it affects all other integrated institutions and creates economic discrepancy.

Source: author’s own.

2.1 Data Framework

This research examined the time series analysis on R&D spillover effectiveness from both domestic and foreign spillovers shocks TFP growth in Pakistan. The spillover effects R&D is examined through different instruments by acquiring the yearly data covering 1972 to 2022. Data related to economic performance and R&D spillovers were gathered from various national and international sources, such as various issues of Pakistan Bureau of Statistics (PBS), Pakistan Economic Survey, State Bank of Pakistan, Pakistan Ministry of Finance, Penn World Table 10.01, and World Development Indicators (WDI).

2.2 Analytical Framework

The R&D expenditures and early adoption of innovation make a valuable contribution to economic production of the economy. R&D involves innovation, new technology, and unique product varieties to earn comparative advantages and global exchange export revenue. R&D play a vital role in influencing the education, knowledge, financial capacity, management skills, practical experience, readiness to choose novelty and capacity to absorb the new knowledge of firms, farmers, and individual's, thereby shaping their ability to adopt innovation earlier. The results indicated that R&D spending rate of return on R&D spending is higher and investment for innovative technology, product varieties, new seeds and fertilisers provide a significantly higher output both from manufacturing and agriculture (Chandio et al., 2021). List of methods are available for calculating the TFP growth, including indexing approach, Cobb Douglas production function, stochastic frontier, OLS, etc. Such methods are not relevant in this research because of data limitations (Sharif et al., 2021).

For Pakistan's economy, the TFP growth is calculated using the Cobb Douglas production function due to a constraint. Furthermore, the TFP growth is calculated at cumulative level through the Cobb-Douglas production function, which makes sense for estimating the TFP growth using traditional yearly time-series data that is dependent on capital and labour inputs. The assumption of constant return to scale was included in the Cobb Douglas production function in the respective of capital and labour (Coe & Helpman, 1995; Coe et al., 2009). The Translog and Cobb Douglas production functions were applied to measure TFP growth by adopting the Hicks neutral (Constantin et al., 2021).

$$Y_t = A_t K_t^\alpha L_t^\beta \quad (1)$$

In Model 1, output is denoted by Y_t , labour by L_t , capital stock by K_t , and A_t is the TFP (Salim & Islam, 2010). Whereas, 't' shows time series, while α and β are representing the elasticities of both the capital stock and labor force. Tanking logarithm on both in equation 1, and converting it into input-output model, equation 3 was used to calculate the TFP growth. By applying the properties of logarithm, the final equation for measurement of TFP growth is as follows:

$$TFP_t = \frac{Y_t}{K_t^\alpha L_t^\beta} \quad (2)$$

$$\ln TFP_t = \ln Y_t - (\alpha \ln K_t + \beta \ln L_t) \quad (3)$$

By adopting the 3 equations, TFP_t growth was calculated, where inputs are capital and labour. Furthermore, the net capital stock K_t was measured for the economy, and the perpetual inventory method was adopted as given in Equation 4 (Coe et al., 2009; Lapple et al., 2016).

2.3 Net Capital Stock

Gross capital formation, which is measured through the entire amount of capital expenditure made by the economy, is the increase in the stock of capital. Net investment in the economy is defined as gross capital formation after inflationary effects and depreciation are subtracted. The depreciation is referred as the difference between gross capital formation and fixed capital consumption, which is the net capital stock. The wear and tear costs incurred by fixed capital to keep capital stock in its initial state are referred to as the depreciation rate. According to Kuo and Yang (2008), the average life of machinery (capital equipment) is used to calculate depreciation.

The net capital stock is determined using the Perpetual Inventory Methodology (PIM) technique, which is based on Griliches (1979) and Barro & Sala-i-Martin (2004). This method includes an approximation of the growth rate, the depreciation, and the initial capital stock. The growth rate for the preceding period is taken to be the current capital growth rate (Sharif et al., 2021). The following are estimated formulations:

$$K_{t+1} = I_t + (1 - d)K_t \quad (4)$$

In equation 4, "t" stands for time, "K_{t+1}" for net capital stock, "d" for the depreciation rate, and I_t for gross capital stock. Although the initial capital formation was determined using gross fixed capital formation, the study's primary focus was on quantifying net capital stock. The following is the methodology for calculating the beginning capital:

$$I_0 = \frac{I_i}{g_i + d} \quad (5)$$

In equation 5, I₀ starting level gross capital stock and g_i is capital formation growth rate. To measure capital stock, GDP growth from the previous era was used as a proxy (Sharif et al., 2021) of growth in capital formation. To calculate the net capital stock, the depreciation data are taken from Penn World Table 10.01. It is necessary to interpret the growth of capital stock as "g" as an average growth of capital stock over the sample range.

2.4 Model for R&D Capital and Economic Growth

Comprehensive research has been conducted in the literature relevant to economic performance and the role of R&D spillover in the international forum. Würtenberger et al. (2012) highlights the issue related to R&D spillover and its role in economic growth and argued that technological spillover is key factor to boost the long-run economic growth. Available studies adopted various mechanisms for capacity to absorb innovation, whereas few studies have focused on educational expenditures and human capital (Criscuolo & Narula, 2008; Keller, 2004), while other focus on R&D investment and emphasized on new knowledge adoption (Wang et al., 2010), and technological infrastructure (Chuang & Hsu, 2004). The list of researches explained the ability in form of national social and innovative culture, infrastructure, orientation, and government inducement for the adoption of new knowledge. The production function in the form of Cobb-Douglas is as follows

$$Y_t = TFP_t L_t^\alpha K_t^\beta \quad (6)$$

In notation 6, Y_t is the productivity output, while TFP_t , L_t^α and K_t^β are total factor productivity, labor force and capital stock, respectively. Therefore, the TFP is dependent on the knowledge spillover (A_t) Human Capital Index (HC) and R&D activities (RD) both domestic and foreign.

$$TFP_t = A_t HC_t^\gamma RD_t^d RD_t^f \quad (7)$$

The knowledge spillover is dependent on technological changes (TC) and fixed technology (FT).

$$A_t = TC_t FT_t \quad (8)$$

For substituting the value of A_t and TFP_t the equations 6 and 7 become

$$Y_t = TC_t FE_t HC_t^\gamma RD_t^f RD_t^d L_t^\alpha K_t^\beta \quad (9)$$

$$TFP_t = TC_t FE_t HC_t^\gamma RD_t^f RD_t^d \quad (10)$$

To quantify the role of R&D spillover and its impact on economic growth, this research takes the log and adds the intercept and residual terms in Equations 9 and 10. This gives the final estimated model in the form of economic growth and TFP growth. The effects of FDI inflows are productivity-driven and dominant on the growth of the TFP per worker, so the FDI inflows privileges are subordinate to the host country's absorptive capacity. To sustain and long-run economic growth, countries require knowledge-driven, quality institutions and skilled-based human capital (Ahmed & Kialashaki, 2019; Le et al., 2021). The transformed growth is as follows.

$$\ln Y_t = \beta_0 + \beta_1 \ln TC_t + \beta_2 \ln FT_t + \beta_3 \ln HC_t + \beta_4 RD_t^f + \beta_5 RD_t^d + \beta_6 \ln L_t + \beta_7 \ln K_t + \beta_8 \ln HC_t * RD_t^f + \epsilon_t \quad (11)$$

Currently, researchers are more enthusiastic about multidisciplinary and multidimensional knowledge skills, which increase absorptive ability as well as converted economy from resource-based to knowledge-based. Collaboration among stakeholders (like universities, research institutions, and industries) can improve absorptive ability, which plays a mediating role in innovative capabilities and industrial performance (Asplund & Bengtsson, 2020; Zhai et al., 2018). The final estimated model is as follows

$$\ln TFP_t = \beta_0 + \beta_1 \ln TC_t + \beta_2 \ln FT_t + \beta_3 \ln HC_t + \beta_4 RD_t^f + \beta_5 RD_t^d + \beta_6 \ln L_t + \beta_7 \ln K_t + \beta_8 \ln HC_t * RD_t^f + \epsilon_t \quad (12)$$

The estimated model of R&D spillovers and impact of absorptive capacity on output growth in Pakistan in the form of ARDL is as follows.

$$\begin{aligned} \Delta \ln(TFP)_t = & \beta_0 + \sum_{t=1}^n \beta_1 \Delta \ln(EMP)_{t-1} + \sum_{t=1}^n \beta_2 \Delta \ln(HC)_{t-1} + \\ & \sum_{t=1}^n \beta_3 \Delta \ln(ECI)_{t-1} + \sum_{t=1}^n \beta_4 \Delta \ln(TOP)_{t-1} + \sum_{t=1}^n \beta_5 \Delta \ln(Tech_Imp)_{t-1} + \\ & \sum_{t=1}^n \beta_6 \Delta \ln(UT)_{t-1} + \sum_{t=1}^n \beta_7 \Delta \ln(Tech_Exp)_{t-1} + \sum_{t=1}^n \beta_8 \Delta \ln(Uni)_{t-1} + \\ & + \sum_{t=1}^n \beta_9 \Delta \ln(RD_OECD)_{t-1} + \sum_{t=1}^n \beta_{10} \Delta \ln(RD_USA)_{t-1} + \\ & \sum_{t=1}^n \beta_{11} \Delta \ln(RD_China)_{t-1} + \sum_{t=1}^n \beta_{12} \Delta \ln(R\&D_W)_{t-1} + \sum_{t=1}^n \gamma_1 \ln(EMP)_{t-1} + \\ & \sum_{t=1}^n \gamma_2 \ln(HC)_{t-1} + \sum_{t=1}^n \gamma_3 \ln(ECI)_{t-1} + \sum_{t=1}^n \gamma_4 \ln(TOP)_{t-1} + \\ & \sum_{t=1}^n \gamma_5 \ln(Tech_Imp)_{t-1} + \sum_{t=1}^n \gamma_6 \ln(UT)_{t-1} + \sum_{t=1}^n \gamma_7 \ln(Tech_Exp)_{t-1} + \\ & \sum_{t=1}^n \gamma_8 \ln(Uni)_{t-1} + \sum_{t=1}^n \gamma_9 \ln(RD_OECD)_{t-1} + \sum_{t=1}^n \gamma_{10} \ln(RD_USA)_{t-1} + \\ & \sum_{t=1}^n \gamma_{11} \ln(RD_China)_{t-1} + \sum_{t=1}^n \gamma_{12} \ln(R\&D_W)_{t-1} + \sum_{t=1}^n \delta_1 \ln(HC * FDI)_{t-1} + \\ & \delta_2 \ln(HC * TOP)_{t-1} + \delta_3 \ln(HC * RD_Tech_Imp)_{t-1} + \delta_4 \ln(HC * RD_OECD)_{t-1} + \\ & \delta_5 \ln(LRD * RD_USA)_{t-1} + \delta_6 \ln(HC * RD_China)_{t-1} + \delta_7 \ln(HC * RD_W)_{t-1} + \\ & \delta_8 \ln(HC * FDI)_{t-1} + \epsilon_t \end{aligned} \quad (13)$$

Equation 13 represents the short and long term dynamics of ARDL model, whereas $\beta_0, \beta_1, \dots, \beta_{12}$, are short run parameters, while parameters $\gamma_1, \gamma_2, \dots, \gamma_{12}$ are represent long term association and ϵ_t represent the error term. In addition, $\delta_1, \delta_2, \dots, \delta_8$ represents interactive terms to capture the absorptive capacity of the labour force in case of Pakistan.

Table 2. List of Variables and Abbreviation

Abbreviation	Operation Definition of Variables
LTFP_t	Total Factor Productivity Growth
LEMP_t	Employment Rate
LHC_t	Human Capital Index
LECI_t	Economic Complexity Index (As proxy of R&D Spillovers)
LFDI_t	Foreign Direct Index Inflow
LTOP_t	Trade Openness
LTech_Imp_t	Technological Imports as Percentage of Total Import
LUT_t	University Teachers as a proxy of researcher across Pakistan
LTech_Exp_t	Technological Exports as a percentage of merchandize exports
LUni_t	No of Universities as proxy of research institutions expenditures
LRD_OECD_t	Spending on R&D done by OECD Countries
LRD_USA_t	Expenditures on R&D done by USA

Abbreviation	Operation Definition of Variables
LRD_China _t	R&D Expenditures done by China
LRD_W _t	R&D Expenditures done across the Globe

Source: authors' own.

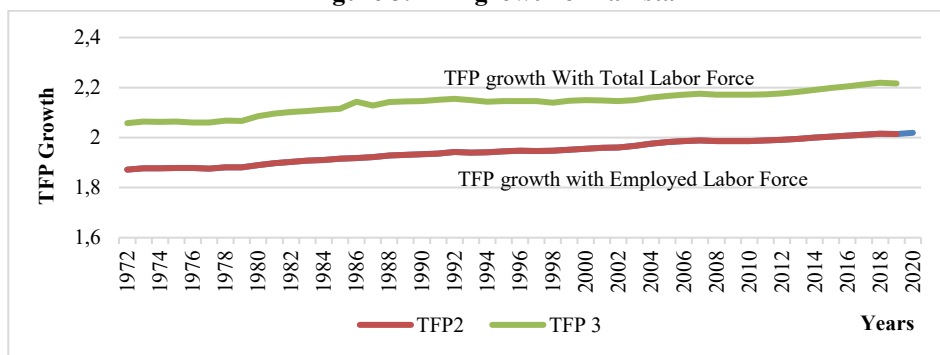
3 Results and Discussion

3.1 R&D spillovers and TFP growth

R&D diffusion performs an essential role in manufacturing, agricultural and services sectors through the channels of innovation adoption, technological transformation and knowledge capital. An economic R&D consists of factors including innovation expenditures either domestic or foreign, trade openness, FDI, technology imports and export. The noneconomic factors consist of R&D structures, incentive system, innovation environment, and factors related to absorptive ability. Analysis techniques are adopted according to the nature and limitation of the data, the requirement of the model, and the assumption of the study. Different data cleaning and screening tools are applied to avoid unbiased, spurious, and inconsistent analysis. For empirical analysis this research adopted the following techniques such as unit root test, ARDL model, Cobb-Douglas (CD) and Translog production function. For results, the accuracy and cleaning of several residual diagnostic and remedial tests are also applied. The CD production function is appropriate for measuring TFP growth using conventional time series data of aggregate inputs such as labour and capital.

Figure 3 shows the computed graph of the growth of TFP in Pakistan. The increase in TFP exhibits a favourable rising trend. In 2020, TFP growth was remained at 2.01%, which is less than the 2.90 percent global TFP growth (World Bank, 2021). To ensure the efficiency of the full-employment level, the calculated value of TFP with the total labour force is 2.21, while TFP growth with the employed labour force is 2.01. The gap in TFP growth shows that Pakistan has the potential to achieve higher productivity through reduction of unemployment. Higher TFP growth can achieve through spending in R&D and knowledge capital to improve innovation and human capital efficiency.

Figure 3. TFP growth of Pakistan



Source: author's own estimation.

3.2 Unit Root Test

The trending behaviour of the time series data analysis may cause a problem of spurious analysis. This problem can be resolved by examining the stationarity behaviour and adopting the suitable analysis techniques in light of the unit root results. The augmented Dickey-Fuller (ADF) technique is applied to identify the stationary level of the given variables, the results shown in Table 3. According to ADF outcomes, the explained variable is integrated at the first difference, while the independent variables have mixed stationarity behaviour, some variables are integrated at level and few variables are integrated at the first difference. This demonstrated that the adoption of R&D from earlier periods and skilled base knowledge capital is crucial for Pakistan's TFP growth. For optimal lag selection, the Akaike Information Criterion (AIC) provides robust results compared to the Schwarz-Bayes Criterion (SBC) and Hannan-Quinn Criterion (HQC), as the results emphasised that lag 2 is optimal lag and suitable for given sample size.

Table 3. Results of the ADF test for R&D spillovers and TFP growth

Variables	Level		First Difference	
	T-stat	P-Value	T-stat	P-Value
TFP_t			-5.12*	0.0001
EMP_t			-4.31*	0.0012
HC_t			-6.68*	0.0000
ECl_t			-5.47*	0.0002
FDI_t	-3.37*	0.0675		
TOP_t	-5.08*	0.0007		
Tech Imp_t			-6.92*	0.0000
UT_t			-5.91*	0.0000
Tech Exp_t			-7.10*	0.0000
Uni_t			-6.74*	0.0000
LRD_OECD_t	-6.31*	0.0000		
LRD_USA_t	-7.94*	0.0000		
LRD_China_t			-4.63*	0.0005
LRD_W_t			-6.86*	0.0000

Note: *Indicates the level of the stationarity of respective variable.

Source: author's own calculation.

3.3 Long-Term Coefficient of R&D Spillover on TFP Growth

The long-term analysis uses time-series data to figure out what is going on with trends and what might be wrong with an analysis. To avoid spurious analysis, the problem of multicollinearity is found during the data cleaning process. Due to interacting terms and tighter proxy of R&D spillovers, the problem of multicollinearity emerged. For this reason, many models' estimates include the addition of R&D adoption proxies. The ARDL method of cointegration is applicable for the final empirical results since the outcomes of the ADF test demonstrate that all the selected variables are integrated at the level or 1st difference (I(0) or I(1)). To prevent multicollinearity, seven models are estimated using the dynamic

autoregressive distributive lag (ARDL) technique. The analysis results of all estimated models are given in Table 4.

The estimated results of all models show that the penetration of R&D creates positive externalities for the growth of Pakistan. The results highlight that international R&D has greater magnitude with positive spillover shock compared to local R&D to enhance TFP growth. The calculated values of the absorptive capacity of R&D absorptive ability indicate negative and significant, which emphasised that Pakistani labor force has less knowledge capital and poor absorption capacity. The empirical results of R&D expenditures around the globe have positive spillover shocks in Pakistan's TFP growth, while R&D expenditure from OECD countries creates negative externalities for TFP growth. In all seven specifications, Human Capital (HC_t) and Employment (EMP_t) are considered control variables. The estimated value of HC_t in all estimated models shows mixed results, in three models, HC_t has positive and significant results, while in four models, HC_t has insignificant results.

In the first estimated model, the explained variable is TFP growth (TFP_t), while the predictor variables are employment (EMP_t), Human Capital (HC_t), Foreign Direct Investment (FDI_t), University Teachers (UT_t) and interaction term of HC with FDI ($HC*FDI$). EMP_t and HC_t are control variables, while FDI is a proxy of foreign R&D and UT_t is a proxy of domestic R&D. The calculated value of EMP_t has a significant impact on TFP_t with positive elasticity, the calculated value of EMP_t shows one percent increase in employment has 17 percent contribution in TFP growth of Pakistan. Further, Moreno-Galbis (2012) concluded that TFP growth accelerates the jobs markets, increase the trained, skilled, and intensive to update job specific technology.

The efficient and knowledgeable worker force has productive impact on TFP growth. The value of the coefficient value of HC_t demonstrated a positive and significant influence on the growth of Pakistan, this is due to the youth, energetic and abundant labor in the country. The coefficient of HC_t shows 34 percent share in the growth of TFP in Pakistan. The study finding aligned with the findings of Moreno-Galbis (2012) who argued that human capital magnifies impact on growth through heterogeneous skilled labour, trained workers and complementary association between skills and technological innovation.

In the first model, foreign R&D spillovers is captured through FDI_t , the analysis results of external R&D adoption produce a significant affirmative effect on TFP growth in Pakistan. The coefficient elasticity of FDI_t is 2.3 percent. Additionally, the advantages of FDI spillovers can be attained through effective human capital, skilled and efficient labour, and early adoption of foreign R&D innovation, for this, domestic factors, institutional development, and extension policies are crucial tools. Technology transfer from outside sources has made a significant contribution to TFP growth. Adopting innovation in R&D innovation is the first step toward increasing productivity, but for most developing nations, access to affordable new

technology is a key problem (Abdullahi et al., 2015). The results are aligned with the findings of Ahmed et al. (2017), who investigated the positive association between FDI inflow and TFP growth. Khan et al. (2017) and Lapple et al. (2016) argued that R&D spending on foreign R&D and innovative technology has a positive impact on TFP growth.

The variable of university teachers (UT_t) is used to measure the domestic R&D spillovers, as university faculty is considered a fundamental source of knowledge spillovers across the country. The calculated coefficient value of UT_t is insignificantly negative. The insignificant value of UT_t directed that domestic R&D spillover has not perform any fundamental contribution in TFP growth. The reason for the insignificant impact of UT_t is that the university faculty are not up to date and do not generate the knowledge and its spillovers shocks for the society to boost the TFP growth in the long term. In addition, Martin (1998) concluded that university research accelerates the TFP growth through development of new product, country support in favourable knowledge intensive product and innovative product competitive at market globally.

Through an interactive term of human capital (HC_t) with FDI_t , the researcher captured the absorptive capacity of the Pakistani workforce. The efficiency of R&D spillover is dependent on the absorbent ability of the host country, and knowledge-based labour can utilise foreign R&D efficiently (Coe et al., 2009). The interaction term's negative, significant result suggests that the labour force's absorptive capacity is lower. The Pakistani labour force is incapable of effectively using foreign technology. The results of the interaction term indicated that either educated labour is not readily available or that knowledge capital is insufficiently efficient to absorb foreign innovation. The findings are in line with those of Nadeem et al. (2013), Chandio et al. (2016) and Khan et al. (2017), who discovered that the lack of absorption ability makes human capital, experience, and training have little bearing on productivity. To achieve better TFP growth through spillover of technology, human capital investment is necessary to boost labour productivity.

In the second specification, the explained variable is the TFP growth (TFP_t), whereas the explanatory variables are employment (EMP_t), Human Capital (HC), trade openness (TOP_t), Technology Exports ($Tech_exp_t$), and the interaction term of HC with TOP_t ($HC*TOP$). The EMP_t and HC_t are control variables, while TOP_t is a proxy of international R&D and $Tech_exp_t$ is a proxy of domestic R&D. The calculated coefficient value of EMP_t has a significant impact in TFP_t with positive elasticity and has a similar impact as in the model first. However, the coefficient value of HC_t shows a positive and insignificant impact on the growth of TFP in second specification.

Table 4. Long-Run Results TFP Growth and R&D Spillovers Model
The dependent variable is TFP growth.

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
C	1.244*** (0.000)	1.356*** (0.000)	0.676*** (0.000)	0.171* (0.059)	0.237*** (0.001)	2.420*** (0.007)	1.255*** (0.000)
EMP _t	0.173*** (0.000)	0.140*** (0.000)	0.341 (0.125)	0.133*** (0.000)	0.140*** (0.000)	- 0.486*** (0.014)	0.130*** (0.000)
HC _t	0.343*** (0.001)	0.151 (0.235)	1.339** (0.018)	0.024*** (0.005)	0.001 (0.820)	0.185*** (0.013)	0.541 (0.245)
ECI _t			-0.012* (0.089)	-0.009** (0.025)	-0.017*** (0.000)	- 0.078*** (0.003)	-0.003 (0.441)
FDI _t	0.023*** (0.000)						
TOP _t		0.003** (0.014)		-0.002 (0.713)	0.009*** (0.008)	0.139*** (0.009)	-0.017 (0.209)
Tech_Imp _t			0.447*** (0.000)				
UT _t	-0.004 (0.199)						
Tech_Exp _t		0.003*** (0.001)					
Uni _t			0.183*** (0.000)				
LRD_OECD _t				-0.233*** (0.000)			
LRD_USA _t					0.055*** (0.000)		
LRD_China _t						0.235*** (0.003)	
LRD_W _t							0.529*** (0.000)
HC*FDI _t	- 0.015*** (0.000)						
HC*TOP _t		- 0.007*** (0.008)					
HC*Tech_Imp _t			- 0.965*** (0.005)				
HC*LRD_OECD _t				-0.229*** (0.000)			
HC*Lrd_USA _t					-0.261*** (0.000)		
HC*LRD_China _t						0.021 (0.134)	
HC*LRD_W _t							- 0.962*** (0.000)

Note: ***, **, * Indicates the level of significance of all respective variables at 1, 5 and 10%.

Source: author's calculation.

The foreign R&D spillovers is captured through TOP_t , the analysis results shows that TFP growth is positively affected by external R&D adoption in Pakistan. The coefficient elasticity of TOP_t is 0.3 percent. Furthermore, TOP_t has less foreign R&D spillover shocks as compared to FDI in the case of Pakistan. The TOP_t spillovers can boost through /+more open economy, especially trade liberalisation with the technological advanced countries and improvements of internal knowledge diffusion. The TOP_t benefits can be achieved through efficient human capital, skilled and efficient labour, and early adoption of foreign innovative technology, for this, domestic factors, institutions development and extension policies are important instruments to enhance long-term TFP growth. The adoption of R&D innovation is the initial step to enhance productivity; however, the affordability of new technology is a key issue for most of the developing economies (Abdullahi et al., 2015). The outcomes align with the findings of Lapple et al. (2016) and Khan et al. (2017) who argued that R&D spending on foreign technology and more open economies can achieve greater benefits from innovation spillovers.

The coefficient value of $Tech_exp_t$ shows a positive and significant contribution to TFP growth in Pakistan. $Tech_exp_t$ has a 0.3% contribution in TFP growth in Pakistan. The small coefficient value highlights that $Tech_exp_t$ has a small contribution in innovation exports. Export to technological products has a small share to GDP growth in Pakistan, which is a central reason of inadequate contribution of technological exports in TFP growth. The results are aligned with the findings of Bolosha et al. 2022 concluded that technology exports and innovation management have a productive impact on TFP growth.

The interaction term $(HC*TOP)_t$ yields a substantial negative result, indicating that the absorptive capacity is lower. The labour force in Pakistan lacks the skills necessary to use foreign technologies. According to interactive-term outcomes, either there is either a lack of trained workers or the knowledge capital is inefficient enough to absorb foreign innovation. The results are aligned with the outcomes of Nadeem et al. (2013), Chandio et al. (2016), and Khan et al. (2017) who found that human capital, experience, and training have an insignificant impact on productivity due to poor absorption capacity.

In third estimated model, the explained variable is TFP growth (TFP_t), whereas the predictor is Employment (EMP_t), Human Capital (HC), Economic Complexity Index (ECI_t), Technology Imports ($Tech_imp_t$), No of Universities ($Unit$), and interaction term of HC with $Tech_imp_t$ ($HC*Tech_Imp$). The EMP_t and HC_t are control variables, while $Tech_imp_t$ is a proxy of foreign R&D and Uni_t is a proxy of local R&D. The ECI_t is used to measure the current production capability and efficiency of the country. The estimated value of EMP_t has an insignificant impact in TFP_t with positive elasticity. The coefficient value of HC_t has a similar result with minor change in coefficient magnitude as given in the first specification.

The foreign R&D spillovers is captured through $Tech_impt$, and the analysis results of external R&D adoption shows significantly positive effect on TFP growth in Pakistan. The coefficient of elasticity of $Tech_impt$ is 44%. Additionally, the advantages of $Tech_impt$ spillovers can be attained through effective human capital, skilled and efficient labour, and early adoption of foreign R&D innovations; for this, domestic factors, institutional development, and extension policies are crucial tools. Technology imports from abroad have a noteworthy impact on TFP growth.

Adopting R&D based new R&D-based technology is the first step toward increasing productivity, but for most developing nations, access to affordable new technology is a major problem (Abdullahi et al., 2015). The results are aligned with the findings of Ahmed et al. (2017), who investigated the positive association between FDI inflow and TFP growth. Lapple et al. (2016) and Khan et al. (2017) argued that R&D spending on foreign R&D and innovative technology has an optimistic impact on TFP growth.

The calculated value of Uni_t shows a positive and significant contribution to enhance the TFP growth. The unit has 18 percent contribution in TFP growth. The coefficient value of Uni_t highlights the increasing number of universities playing a productive role in TFP growth and innovation spillovers across the county. Pakistan is in the early stages of development and a growing number of universities perform productive role in increasing the literacy rate and human capital development. The estimated results indicate that Pakistan has to focus on university development by ensuring quality education. In addition, Martin (1998) concluded that university research accelerates the TFP growth through development of new product, country support in favourable knowledge intensive product and innovative product competitive at market globally.

The estimated results highlighted that ECI_t has a significantly negative contribution to TFP growth. The estimated coefficient of ECI_t has a negative and significant contribution in TFP having coefficient value of -0.012. This specifies that the knowledge accumulated by the Pakistani population is not translated into the production process. Furthermore, innovative ideas and unique research activities are not appreciated in the inclusive research and production process. The ECI_t results indicate that knowledge generation system is very complex and not translated into innovative activities. The industrial production structure is not developed, producing the innovative products to compete at international market. The research results are aligned with Pazham and Salimifar (2016), who found the negative association between GDP growth and ECI_t of chosen panel countries. The results of the interactive term are consistent with the findings of the model first, which shows that the technology imported from foreign sources is not absorbed efficiently.

In fourth, fifth, sixth, and seventh models, the independent variables are Employment (EMP_t), Human Capital (HC), Trade Openness (TOP_t), ECI_t , R&D expenditures did by USA (RD_USA_t), R&D spending did by OECD economies (RD_OECD_t), R&D spending did by China (RD_China_t), and world R&D expenditures (RD_W_t) and their interactive terms with Human Capital (HC_t) of Pakistan. TOP_t is a proxy of foreign R&D and ECI_t is a proxy of local R&D, while the other countries' expenditures on R&D is utilized to capture the shocks from the spillover of innovation towards Pakistan. The estimated results of the control variables and the proxies of domestic and foreign RDs are consistent with previously estimated models. The results of different interactive terms with other countries R&D spending shows an adverse and notable effect on TFP growth of Pakistan. This shows that the knowledge generated by the developed countries is not absorbed in Pakistan. The Pakistani workforce does not have the efficiency and knowledge capital for the effective use of foreign innovation.

The results of proxies of foreign R&D shows positive spillover shocks and helpful in TFP growth of Pakistan. The estimated coefficient value of RD_USA_t ,

RD_Chinat, and RD_W_t shows a significantly positive contribution to enhance the TFP growth of Pakistan. The R&D expenditures done by the USA, China and World are creating the positive externalities for TFP growth in Pakistan, which is helpful in bringing the innovation and new production technique through positive spillover shocks. However, the R&D expenditures made by OECD countries (RD_OECD_t) show a significantly negative contribution to reduce the innovation process and the growth of Pakistan. This means that innovation expenditures of the OECD countries are creating the negative externalities for Pakistani TFP growth.

3.4 Cointegration and Diagnostic Estimates

The CUSUM and CUSUMQ tests are graphical analysis of the cointegration equation (called the ECM model) which is estimated in the ARDL model. The calculated values of CUSUM analysis and CUSUMQ tests lie within 5 percent bounds which is confirmation of the existence of a long-run association with selected variables and shows the stability in estimated coefficients (Alimi et al., 2014; Ali et al., 2019). To ascertain whether a relationship of cointegration exists, the bound test of ARDL is used (Pesaran et al., 2001). The calculated value of the ARDL bound test shows that F-stat values are greater than the upper bound in all estimated models, which indicated that the hypothesis of no long-run association is rejected significantly (Table 5). The estimates of ARDL model show that R&D spillover indicators have extended effect on TFP growth. The empirical results agree fairly well with the findings of (Liu et al., 2016).

Table 5. ARDL bound test and diagnostic estimates of TFP growth models

Bound Test	7.57	5.84	10.760	5.668	7.809	3.527	6.256
Heteroskedasticity	0.676 (0.816)	0.595 (0.854)	0.964 (0.536)	0.366 (0.984)	0.301 (0.993)	0.792 (0.711)	0.453 (0.562)
Serial Correlation	2.785 (0.109)	2.429 (0.107)	1.322 (0.290)	0.687 (0.414)	1.045 (0.366)	2.242 (0.121)	1.245 (0.346)

Source: author's own calculation.

3.5 Short Run Analysis and ECM Results

The estimates of the short-term coefficients are given in Table 6. Since the estimated models are time series multivariate, so, the error correction model (ECM) is used to determine how stochastic trends will behave and how quickly the dependent variable will converge to equilibrium. The error correction mechanism ECM (-1) coefficient has a significantly negative sign at the 1 percent level in all estimated models, which shows that variables in estimated models are cointegrated in the long run. The coefficient of ECM implies that deviation from steady-state position in R&D spillovers in estimated models is corrected with fast speed of adjustment (Shittu, 2012). Disequilibrium can be corrected through R&D spillovers, that shocks can be modified with faster speed, and R&D spillovers perform an important role in TFP growth to bring its steady state position (Shita et al., 2019; Ali et al., 2020).

Table 6. Short-run and ECM estimates of TFP growth models

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
D(LEMP)	-0.0126 (0.4861)	-0.0129 (0.4193)	-0.1348*** (0.0000)	-0.0740*** (0.0074)	0.0463 (0.1292)	-0.0233 (0.5633)	-0.1548*** (0.0054)
D(LEMP(-1))	-0.0719** (0.0259)	-0.0418 (0.2300)	-0.0053*** (0.0092)	-0.0976*** (0.0008)		0.0569 (0.2666)	0.1053*** (0.0000)
D(LHC)	0.1375*** (0.0045)	0.0277 (0.5982)	0.0520 (0.3719)	0.0152** (0.0182)	0.0296** (0.0166)	0.0292*** (0.0000)	0.0230 (0.1900)
D(LHC(-3))		0.2081** (0.0173)			0.0281** (0.0168)	0.0177* (0.0943)	
ECI			-0.0029 (0.1248)	-0.0174*** (0.0006)	-0.0050 (0.1630)	-0.0007 (0.7946)	-0.0015** (0.0160)
D(FDI)	0.0092*** (0.0000)						
D(TOP)			0.0011** (0.0104)	-0.0015 (0.7167)	0.0083** (0.0232)	-0.0085** (0.0471)	0.1892*** (0.0089)
D(LTECH_T)			0.0107** (0.0234)				
D(LUT)	0.0025** (0.0286)						
D(LUT(-1))	-0.0019* (0.0927)						
D(TECH_EX)		0.0004 (0.2114)					
D(TECH_EX(-1))		-0.0005 (0.2552)					
D(LUNI)			0.0077* (0.0915)				
D(LUNI(-1))			-0.0081** (0.0244)				
D(INT)	-0.0049*** (0.0001)	-0.0026*** (0.0063)	-0.0020 (0.8942)	-0.0885 (0.1246)	-0.0929*** (0.0000)	-0.0129** (0.0111)	-0.1214*** (0.0016)
D(INT(-1))	-0.0011*** (0.0087)			0.0513 (0.3369)	0.0289*** (0.0007)		
D(LRD_OECD)				0.0134 (0.6909)			
D(LRD_USA)					0.0480*** (0.0000)		
D(LRD_China)						-0.0031 (0.7521)	
D(LRD_W)							0.1295*** (0.0000)
ECM(-1)	-0.4005*** (0.0000)	-0.3565*** (0.0000)	-0.2437*** (0.0000)	-0.6226*** (0.0000)	-0.8625*** (0.0000)	-0.3937*** (0.0019)	-0.5815*** (0.0000)

Note: ***, **, * Indicates the level of significance of all respective variables at 1, 5 and 10%.

Source: author's calculation.

4 Conclusions and Policy Suggestions

This research was designed to investigate the proficiency of R&D spillovers and the capacity to absorb foreign knowledge is essential for the growth of TFP in Pakistan. It also investigates the efficiency of the labour force for progenitive utilization of R&D innovation. The quantitative analysis is carried out through the yearly time series information for the time frame of 1972 to 2022. The Translog and Cobb Douglas production functions were employed to measure the TFP growth, and Autoregressive Distributive Lagged (ARDL) model was applied for empirical

results. The estimated results of all models show that the penetration of R&D creates positive externalities for the growth of Pakistan. The results highlighted that global R&D spending has optimistic spillover shocks compared to internal R&D shocks to enhance TFP growth. The calculated values of R&D absorptive ability of R&D indicated negative and significant, highlighting that Pakistani labor force has less knowledge capital with poor absorption capacity. The empirical results of R&D expenditures around the globe have positive spillover shocks in Pakistan's TFP growth, while R&D expenditure from OECD countries creates negative externalities for TFP growth. On the basis of the quantitative analysis, it is concluded that global R&D is more appropriate for economic growth compared to domestic R&D, and the Pakistani labor force has less absorptive ability.

The innovation index highlights that Pakistan lacks good research institutions, knowledge capital, technological innovation and infrastructure, and an environment for research, which is extremely important for the socio-and-economic development of the economy. The statistical and graphical representation of internal and foreign R&D drivers highlight that Pakistan has the potential to acquire benefits from both sources, such as foreign and domestic spillovers shocks of R&D. In terms of global R&D spillovers, Pakistan has the potential to attract foreign innovation through FDI, trade openness, and technology imports, but the domestic knowledge capital has a significant problem in absorbing external innovation. Now, it is time to realise and move on the importance of R&D expenditures for both the private and public sectors. A combined strategy is required to focus on inclusive innovation and spillovers of foreign knowledge. Internal innovation can improve through an increase in domestic R&D expenditure, improve research culture, incentive system, collaboration, and networking. Based on quantitative analysis, this study has the following suggested workable policies:

- The government should focus on sustainable policies related to internal R&D, R&D spillovers with sufficient and sustainable R&D expenditures.
- The Pakistani government needs to develop an institutional structure and ecosystem for R&D spillovers.
- A combined strategy is required to focus on domestic and foreign R&D innovation spillovers both in the public and private sectors.
- Domestic knowledge spillovers can be enhanced through an increase in domestic R&D expenditure, research culture, incentive system, collaboration, and networking within and across sectors.
- Research alliances are required among research institutions and public and private corporations, which is desperately needed to design the incentive and protection mechanism for private sector innovation to encourage future R&D spillovers.
- Linkages among research institutions, industries, and extension agents are required to boost the adoptability and capacity to absorb (knowledge capital).
- The government should focus on the R&D spending, human capital development, and achieving a full employment rate to boost the TFP growth.

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**Influence of Organisational Climate
and Employee Desires on Managerial Drive**

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Abstract

In this study, we focus on the significant factors that influence managerial drive, analysing the relationship between employee desires, organisational climate, and managerial drive (organizational commitment). The aim of our study is to evaluate the validity of a well-known concept in the context of Pakistani: a combination of individual and situational factors influences human behaviour. In our study, the dependent variable is organisational commitment, and the independent variables are participation management, ethical practices, job security, empowerment, and Benevolent Management. Participative management, ethical practices, and Benevolent Management are used to assess the organisational environment. Aspects like the Need for Power and Job Security are considered as a measure of the variables Employee Desire and Organisational Commitment, and as a reflection of Managerial Drive. Primary investigations have pointed out that Organisational Commitment is a dimension of Managerial Drive, hence the term 'Organizational Commitment' is more in usage than 'Managerial Drive'. A pre-designed questionnaire was used to collect the primary information. The questionnaire was administered online through Google Docs and also by personally approaching the respondents. The sample size was 100 respondents. The sample includes engineers, HR personnels, and Business Development Executives of different organisations in Pakistan. The sampling technique used for drawing the sample would be simple random. We use SPSS software to analyse the data. We found that the environment in which employees work is more important than their requirements in terms of managerial drive. Taking this into account, the theory gains wide support in Pakistan. All hypotheses were accepted for this study, indicating the positive relationship of the independent variables with the dependent variable.

Keywords: employee desires, managerial drive, organisational climate, organisational commitment.

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1. Introduction

In case the workers in a company are satisfied, responsible, and can willingly do extra for the company, it is for its own good. Increased employees' inspiration, therefore, means increased dedication; proper work done at a higher level and improvement in terms of organisational efficiency. The motivation of managers and dedication of workers are therefore an important prerequisite for a business to have life. Through the implementation of such humanly inspired policies and practices into their employees, there can be financial gains by the companies at the present time and in the future, too. Generating high earnings and returns on investment can be achieved through the growth of the organisational growth, being very crucial, with any firm that designs its human resources policies purposefully, taking into consideration the demand and psychology of its labour force. This not only benefits corporations but also ensures effectiveness, which in turn reduces overall cost of production. A more prestigious, competent, and efficient workforce is required to meet this objective. The production increase and the opportunity costs decrease. A satisfied team is the secret to this great achievement. The employee will have a new perspective on his job and will be more reliable and dedicated when he is satisfied with his wage, the way his superiors treat him and his ability to do things his way. He will also trust that he has supportive colleagues and superiors in case he will face difficulties.

The primary engine behind this kind of growth is the managerial drive.

Individuals are sensitive enough to properly respond to external factors, such as attractive workplace culture or HR rules that are responsive to their demands. The employees will be the focus of our study. We need to examine how employee demands and organisational climate influence the motivation of managers. Taking into account various ideas about employee behaviour (Mowday et al., 1982; Cook & Wall, 1980) and the extensively accepted theory that states that an employee's performance is the result of a mix of individual and situational aspects (Sharma & Mohapatra, 2009), the nuanced and complicated issues of managerial motivation and staff commitment should be clarified.

Based on the literature, we identified that there are several facets of a specific characteristic in the management sciences. Some articles defined management inspiration as organisational commitment, while others defined it as work satisfaction, etc. It was noted that managerial motivation has several facets when measured. We do not draw conclusions about the exclusive premises that might move forward the concept of managerial motivation, based on the independent variables we chose for this investigation.

The literature review part of our study is based on the online articles accessible through the databases of "JSTOR", "Science Direct" and "Google Scholar". There are so many avenues in organizational development that a single study is difficult to carry on. With this, we mentioned only some of the topics that are more related in the present context. In the next section, we will present the theoretical

framework which identifies the dependent and independent variables we used in this study. We validated the theoretical framework to note both the critical and noncritical factors of organizational development. Furthermore, we identified parameters that can be tuned for various dimensions of organizational growth. The findings in our research are related to managers and people who should have a good knowledge of terms and concepts in organizational growth. In the case of our sample, we selected workers with different levels of experience in most fields of business in order for our questionnaire not to be biased by people's opinions from only one specific field.

2. Literature Review

Motivation is a complex phenomenon. It is possible that a worker is satisfied with his job, but dislikes the company for which he works. Or vice versa. A worker who is satisfied with the company may be dissatisfied with interpersonal and intergroup interactions or the other way around. The three components of work motivation explained in the literature include job satisfaction, organisational commitment, and social fulfilment.

Some authors (Hrebiniak & Alutto, 1972) considered that organizational commitment is the refusal to leave a position or group for a small personal gain. Other authors (Han & Northoff, 2008) considered that China is facing a declining degree of organisational commitment because of its limited internal growth possibilities.

Tao and his associates discovered that organisational commitment is greatly influenced by the organizational environment (Tao et al., 2002). Many studies conducted in India corroborate the favourable relationship between expressed organisational commitment and the organizational environment (Sharma & Mohapatra, 2009). It has been verified that mutually situational factors and personal attributes impact the level of managerial motivation.

Keeping in mind the fundamental motivation theories elaborated by various authors (Herzberg et al., 1959; Lawler, 1994; Rainey, 1997 & Rainey, 1983) it was recognised that motivation had two components: inner and external influences. Together, these two elements affect human behaviour in general and organisational commitment in particular.

According to (Mowday et al., 1982) managerial drive is the “comparative strength of an entity’s credentials with and participation in a specific organisation” (Choe et al., 2017). When we are discussing about their association with organisational commitment, ethical behaviour and benevolent management also score well (Sharma & Mohapatra, 2009).

Currently, identifying the complex relationship between organisational climate, employee desires, and managerial drive is highly important to increase productivity and support organisational success. Despite their importance, there is a lack of literature that observes how these aspects cooperate and persuade each other in the organisational setting. This study tries to close this gap by analysing the complex links between organisational climate, employee desires, and managerial

drive, providing constructive insight to improve managerial efficacy and organisational performance.

3. Aim of the Study

This research aims to evaluate the applicability, for Pakistan, of a widely accepted theory that considers that human behaviour is influenced by a mix of situational and individual factors.

The results of this study will be useful to HR consultants working in organisational development in monitoring, measuring, analysing, and evaluating dependent variables (organizational commitment) and independent factors (ethical practices, job security, empowerment, and participatory management) in various contexts. In addition, students will carefully examine what additional elements are important for organisational development and how to use them in practice to assess important management behaviours and attributes.

In addition, it is considered that investigation firms might utilise this study to develop audit techniques for the company and revitalise their organizational growth models. Increasing real labour output would not only help companies improve their internal processes, but also make it easier for them to increase their profitability.

3.1 Theoretical Framework

Figure 1. Theoretical Framework



Source: developed by author (Waqar, 2024).

3.2 Participative Management

Within the organisational climate, participative management addresses how employees participate in decision making, are encouraged to think creatively, are included in major company decisions, and receive the necessary support or

assistance from peers and superiors when needed. In this way, the employee gains a stronger sense of emotional connection and identification with the organisation and feels more a part of it. When an employee is having trouble, he or she always believes that their supervisors or coworkers will assist them in solving the issue. This feeling improves the worker's sense of belonging to the organisation (Benoliel & Somech, 2014). Taking into account these aspects, we propose the following hypothesis.

H1: Participative management is significantly related to organisational commitment.

3.3 Benevolent Management

Giving back is assured when acts and choices are made with the best interests of the largest number of individuals in mind (Choe et al., 2017). An environment that is generally caring encourages a sense of homeliness and fearlessness among employees because they know that they are constantly protected by the organisation is constantly protecting them and that it will always take care of their well-being. Employers are more likely to keep their commitment if management and HR implement policies that demonstrate empathy and concern for their workers (Karakas & Sarigollu, 2011). The following hypothesis is proposed:

H2: Benevolent management is significantly related to organisational commitment.

3.4 Ethical Practices

An organization that practices social responsibility is very likely to attract the affection of its employees. A company that exudes the highest level of morality and has a fair and just employee recruitment and promotion process is considered a beautiful place to work in. An organization in which leaders are candid and run business in a transparent way will pay in dividends in terms of long-term recruitment and retention of other employees. In this setup, every employee, regardless of their position in the hierarchy, receives the same benefits and penalties, all together, in a unit system (Turyakira, 2018). The following hypothesis has been drawn:

H3: Ethical practices are significantly related to organisational commitment.

3.5 Job Security

All staff want a stable job and do not want to be concerned about being fired or laid off. Probationary staff and those on short-term contracts usually worry about job security and do not feel a strong sense of belonging to the company they work for. On the contrary, a leader who has the assurance of his job security and who is not subject to accusations will be working with a sense of relief and will not be subject to such challenges. Government sector employees feel quite secure in their jobs (Clark & Postel-Vinay, 2009). The following hypothesis is developed from the above discussion:

H4: Job security is significantly related to organisational commitment.

3.6 Need for Power (Empowerment)

If individuals are valued, they will feel more in charge. Giving them some degree of power over certain facets of their position is one way to do this. On the job, each worker aspires to be in charge. They may realise their ideals in this way, which has positive psychological effects. They will be more responsible the more they believe they are in control of things. The organisation could gain from this in the form of greater dedication and effectiveness (MSW, 2008). This helps us develop the following hypothesis:

H5: Empowerment is significantly related to organizational commitment.

4. Research Methods

This research is based on quantitative data. In the response of this research, a detailed questionnaire is used. It was developed with the factors we chose to measure in mind. This survey has been pre-tested before any data are collected.

The questionnaire consists of 27 items all together. These items are formulated through the usage of multiple choice and Likert Scale questions (Sharma & Mohapatra, 2009).

The survey was conducted online with Google Forms.

This research has a sample size of 100 respondents. The random sampling technique was used in drawing the sample for this research.

The population studied is arbitrarily chosen from a variety of Pakistani companies, both private and public. Respondents are primarily engineers, HR personnels, and Business Development Executives from various organisations in Pakistan.

SPSS software that is a statistical software used for analysis. We used SPSS to analyse the data. Different statistical techniques were used to analyse the data and test the hypotheses. Demographic analysis was also done using SPSS.

5. Findings

5.1 Demographic Analysis

The findings of this study indicate that the questionnaire was filled out by 100 respondents, but of 100, 91 responses came while the remaining were left empty. The Demographic section contains various demographic variables such as age, gender, length of employment, type of organisation, level of education and position in the organization. The results show that out of 91 respondents, the majority of respondents were male (73.6%) and only 26.4% of them were female, as shown in figure 1. Most of them fall within the age bracket of 26-35 years old, 7% fall with the age bracket of 36-40 years, and the remaining 2.2% are above 40 years of age. This is also shown in Figure 2.

Figure 2. Gender

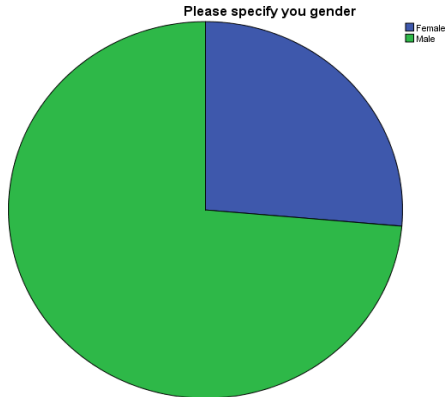
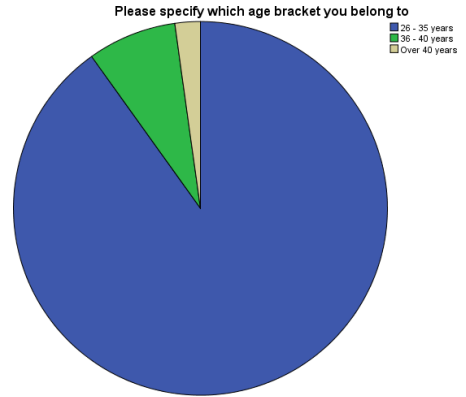


Figure 3. Age



Source: developed by author (Waqar, 2024). Source: developed by author (Waqar, 2024).

Moreover, there were 54.9% of the employees who have work experience of 1-5 years, 29.7% have experience of 6-10 years, and only 15.4% have experience above 10 years as shown in Figure 3 below. In addition, most of the employees worked in private companies (82.4%) compared to public companies (17.6%) in Pakistan. The main reason is the high salary and benefits. As the data were gathered from the employees with graduate and post-graduate degree, the results show 50% of them were graduates whereas 50% of them hold post graduate degrees. The last and most important demographic variable is the position of the employees and the results concluded were 36.3% were executives, 40.7% were middle managers, 17.6% senior managers and only 5.5% hold the position of GM and above in the organisation as shown in Figure 4.

Figure 4. Work Experience

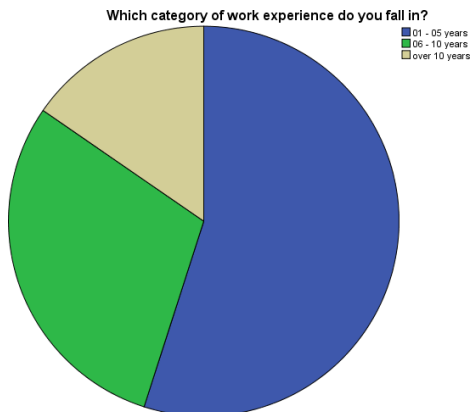
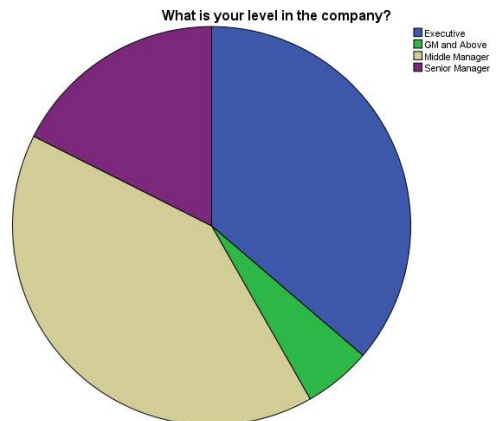


Figure 5. Position



Source: developed by author (Waqar, 2024). Source: developed by author (Waqar, 2024).

5.2 Hypotheses Testing

Hypothesis testing is one of the statistical methods used to test the reliability and validity of the study. This method is used to test specific predictions, called hypotheses. Five alternate hypotheses that were developed for this study from the literature. All independent variables (participative management, benevolent management, ethical practices, job security, and need for power {empowerment}) are positively correlated with the dependent variable managerial drive (organisational commitment). In other words, all independent variables have a significant relationship with the dependent variable.

The P-value is a number calculated by the statistical tests to describe whether to accept or reject the hypothesis. If the p-value is less than or equal to 0.05, it means that the null hypothesis is rejected and alternate hypothesis is accepted. If the p-value is greater than 0.05, this means that the null hypothesis is accepted and the alternate hypothesis.

All hypothesis of this study has a p-value lower than 0.05, which indicates that all hypothesis H1, H2, H3, H4 and H5 are accepted. All independent variables are positively correlated with managerial drive (organizational commitment). The results of all hypotheses along with the p values are also shown in Table 1 below:

Table 1. P-Values

Hypothesis	Variables	P-value	Result
H1	Participative management → Organisational commitment	0.000	Accepted
H2	Benevolent management → Organisational commitment	0.000	Accepted
H3	Ethical Practices → Organisational commitment	0.025	Accepted
H4	Job security → Organisational commitment	0.015	Accepted
H5	Need for power → Organisational Commitment	0.000	Accepted

Source: developed by the authors.

According to the study findings, participative management has a significant relationship with organisational commitment. This can also be proved by previous studies as it is a general awareness that participative management techniques provide several advantages for the organisation as well as for employees' mental health and job satisfaction (Benoliel & Somech, 2014). This increases the employee's commitment to the organization. Thus, if employees at all levels are involved in decision making, it can help the organization to perform better and to achieve goals in a short time; it is only possible if the employees are involved in the organisations (Benoliel & Somech, 2014). Secondly, H2 is accepted; also according to the literature benevolent management has a significant relationship with organisational commitment, as when the employees feel that they are protected in the organisation and their concern are fulfilled, they become more committed. It is very necessary to provide a safe and healthy work environment for employees and value peoples. This can increase your level of commitment. They want to remain committed to the organization (Karakas & Sarigollu, 2011). Third, H3 is accepted according to the results of this study. Furthermore, the literature suggests that there

is currently increasing pressure on business organisations to be ethical, in addition to running their operations in the most economical, efficient, and effective manner possible to increase performance (Turyakira, 2018). The authors believe that ethical misconduct can be harmful both the employees as well for the organisation. Unethical practices lead to business failures. So, all organisations strictly follow ethical practices, as it also increases organisational commitment. Employees believe that if the organizations can follow ethical practices, it leads to advancement, and they feel more committed to the organization. Moreover, in developed countries organisations gained their reputation by applying ethical practices. As it helps to retain employees (Turyakira, 2018). Last but not least, according to the study results, job security also has a positive relationship with organisational commitment. Job security increases productivity, loyalty to the organisation, and the ability to master new job skills. The presence or absence of a sense of job security in the workplace can have negative and positive effects on both employees and organisations (Toosi, Bakhtiary, & Salehi, 2020). Past research has shown that there is a significant positive relationship between the need for power and organizational commitment. In addition, a sense of empowerment can increase employee engagement in an organisation (Rawat, 2013).

6. Conclusions

This study gave us a clear image of the most essential aspects that influence managerial motivation, and respondents of this study are more concerned with the environment in which they operate than with their personal demands. That determines how motivated individuals are to work for their organisations. This result is useful for HR departments in many organisations because they can improve the work climate by setting up some guidelines and principles and creating a more relaxed to work in for the employees.

Participative management, benevolent management, ethical standards, job security, and empowerment are very important for organisational transformation and have implications for HR operations. All hypotheses were accepted in this study, as the p-value is less than 0.05. The variables being discussed have been adequately evidenced by the study that they have been practiced in organizations adhering to the principles of good governance in making decisions after giving powers, responsibilities, and roles in advance.

Participative management is indispensable for organizational commitment because the decisions based on mutual concerns and involving all members create the positive effects mentioned above. Apart from the benevolent management, job security has a pretty good effect on the organizational commitment. For example, if a person feels safer and more protected by the manager, he will put more efforts into the organization resulting in the high degree of commitment.

Ethical behaviors would empower employees to drive employers to offer reasonable wages and compensation, that could result in a social security system that ensures the right to education and freedom to express.

The ethical means also foster the adherence to lawful and legal responsibilities, contributing to alleviating social issues like the organization of work, victimization of work load, harassment, and an impartial appraisal system. Lastly, contemporary organizations depend on empowered and committed employees for efficient performance. Research indicates that a sense of empowerment may increase employee commitment to their organisation (Rawat, 2013).

Therefore, researchers were recommended to shape up this study and establish other factors that organizations in present-day arena.

6.1 Limitations and Future Research

This study has several limitations that suggest potential areas for future research. As a result of the lack of resources, simple random sampling was used to collect the data. Second, due to lack of time, the data were collected from only 100 respondents working in various organisations in Pakistan. The study was cross-sectional due to a limited time frame and the data was collected at a specific point in time in different organisations of Pakistan. This can lead to specific results. In addition to that, some variables were used to analyse the results and see the impact on organisational commitment (Rožman & Štrukelj, 2019), while according to literature, there are various other variables that can also be studied and incorporated to see the effect, which in turn leads to different results.

However, future research should explore this topic including different variables that impact organisational commitment (Rožman & Štrukelj, 2019). Moreover, different countries organisations can be studies in future, to make comparisons and to study different perspectives. Mostly importantly, the longitudinal study design can be used to study the impact of organisational climate and employee desires on the drive over time. Furthermore, the sample size can be increased in the future to obtain better results and improve study findings. Accordingly, to further advance our understanding of managerial drive, several other variable impact can be studies to expand research such as work engagement of applies etc.

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**The Influence of Corporate Social Responsibility
on Organisational Commitment among Employees
in Pakistan**

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Abstract

The potential effects of corporate social responsibility (CSR) on employee commitment levels towards their respective organisations represents a very important topic in the current business environment. The purpose of this study was to provide organisations in Pakistan with a means of reducing turnover rates as well as to teach them how to create a strong and reliable workforce that is motivated to serve the organisation's aims. Several CSR dimensions were studied to understand how they impact organisational commitment. The influence of independent variables (Legal CSR, Economic CSR, Ethical CSR and Philanthropic CSR) on dependent variables (organisational commitment) was studied for this study. The study used a combination of primary and secondary data collection tools to achieve the results. Secondary data sources include past studies in the form of journal articles retrieved from credible sources such as Jstor, Google Scholar, etc. The original data were collected through survey questionnaires distributed to the leading organizations. Our sample size was 220 employees, and we analysed the results using SPSS. The findings indicated that economic CSR, Legal CSR, Ethical CSR, and charitable CSR were the aspects that organisations could choose because they significantly improved employee motivation and determined them to remain with their organizations and had an impact on organisational commitment. This study focused exclusively on Pakistani organisations and their features. Hypotheses H1, H2 & H3 were accepted whereas hypothesis H4 was rejected. This indicates that Economic, Legal, and Ethical CSR have a positive impact on organisational commitment whereas philanthropic CSR has a negative impact on organizational commitment.

Keywords: corporate social responsibility, employees, organisational commitment, Pakistan.

JEL Classification: M1.

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1. Introduction

Corporate social responsibility (CSR) is a well-known and widely used concept. According to Crane et al. (2008), it allows organisations to address the demands and well-being of both societies and key stakeholders. CSR contributes to increased efficiency and improved company image (Crane et al., 2008). Since they are the ones who decide on the organisation's revenue, large corporations actually prioritise customer happiness. In this context, the recent research has turned firms' attention to identifying how to increase customer satisfaction. People are viewed as the most meaningful component of an organisation since they become the most powerful promoters of the organisation's concerns as well as a great impact of the entity's success or failure.

Every enterprise undergoes obstacles in their process of attaining a workforce which is committed to the organisations' interests, shows thorough motivation, and holds objectives and a motto that is the same as their targets.

This matter is of utmost importance for all organisations irrespective of their size, as it supplies encouragement to diligent employees who act towards the fulfilment of the organisational objectives and it minimises overall turnover rates. CSR is vital in such a setting because, even if it is costly to implement, it assists organisations in delineating circumstances that are appealing to everyone and provided employees the impression that the organisation is focused on their welfare, even when this is not applicable (Prasad & Holzinger, 2013).

The characteristics and scales of CSR developed in the current timeframe, its inception taking place in the previous decades (Carroll, 1991). It was categorised and described in four main areas that included all aspects of life: economic, legal, philanthropic, and ethical corporate social responsibility. Therefore, a company must be aware of and refer to all these characteristics in a way that is seen and felt by everyone to successfully inherit and incorporate CSR into the way it operates (Kim, Song & Lee, 2016). Significant advances in recent decades have further improved these characteristics in response to the demands of time. Therefore, it is critical for firms to determine whether combining these factors may increase employee dedication to the company, resulting in an efficient labour force that best supports the company's goals.

Contemporary human resource methodologies and internal marketing instruments are another important element which all successful companies inbuild into their commercial operations. Employee management is a modern tool for streamlining and accelerating corporate operations, and efficiency is how most businesses thrive (Huang & Rundle-Thiele, 2014). Since employees are the stakeholders who have the power to build or destroy a company, all businesses have a strong interest in ensuring their happiness.

The research investigates whether and how the elements of corporate social responsibility can influence how people work for their companies, the way of job approach, and the necessary work hard to achieve goals.

2. Literature Review

According to Porter and his colleagues, “Organisational commitment is defined as the degree to which employees are affiliated and attached to the organisations to which they belong” (Porter, Steers, Mowday, & Boulian, 1974).

CSR, corporate social responsibility, also referred to corporate responsibility, corporate accountability, corporate ethics, corporate citizenship, etc. According to the literature, "Corporate social responsibility" refers to an organisation's accountability for the effects of its choices and actions on the environment and society via morally and transparent behaviour that is compatible with long-term growth and societal well-being; the expectations of stakeholders, complies with relevant legal requirements, is in line with accepted worldwide standards of behaviour, and is integrated across the entire business (Hohnen, 2007). There are four basic forms of CSR which include Economic, Legal, Ethical, and Philanthropic CSR. According to the literature, they are defined as follows:

Economic CSR:

“Economic corporate social responsibility suggests that for the business cycle to remain smooth, all firms must battle to be successful in providing goods and services to their individual clients” (Carroll, 1991).

Legal CSR:

“Legal CSR executes the organisations with the belief that all commercial action is required in accordance with governmental laws and regulations and that laws-related practices must be scrupulously adhered to” (Carroll, 1991).

Philanthropic CSR:

“A firm must make the extra effort to fulfil philanthropic missions, which may be connected to advancing society and providing significant advantages for its stakeholders, once all other conditions have been met” (Carroll, 2003).

Ethical CSR:

Previous studies focused on how individuals perceive CSR and how it affects their organisational commitment (Brammer et al., 2007). The study used a sample of 4 712 workers from a major retail banking company. The tests were carried out using regression analysis, followed by an ANOVA test. The results indicated that CSR has a positive impact on the commitment to the organisation.

Lee et al. (2013) investigated how three components of corporate social responsibility influenced organisational trust. The study was carried out and validated using confirmatory factor analysis and structural equation modelling (SEM). The results showed that legal CSR improved employee perception regarding their level of employer and increased their job satisfaction (Lee, Seong-Yeon, & Jung, 2013).

Mahenthiran et al. intended to analyse how legal and ethical CSR components affected the levels of commitment to the organisation. To assess the results, a regression analysis was applied to a sample of 151 Malaysian companies. The findings revealed a strong association between employee participation and legal and ethical CSR activity (Mahenthiran, Tong, Terpstra, & Rachagan, 2015).

Another previous study has investigated the potential impact of corporate social responsibility efforts on employee organisational engagement in the gaming industry. The authors used the structural equation model to evaluate the results of a survey conducted among these employees. The results revealed that greater awareness of business social responsibility increased the engagement to their specific organisations. (Smith & Kumar, 2014).

An earlier study by Schnurbein and his colleagues tried to establish the link between corporate social responsibility and philanthropic CSR. The study, which combined the overall strategy with other components including the CSR pyramid, was based primarily based on a theoretical approach. They found that when done well, corporate giving can increase an organisation's drive and inventiveness (Schnurbein et al., 2016).

2.1 Problem Statement

The objective of this study is to classify the possible effect of the areas of corporate social responsibility on the way staff perceive their company. The goal is to determine how these practices might influence employee commitment and whether they are truly worth the time and money needed to implement them.

3. Research Questions

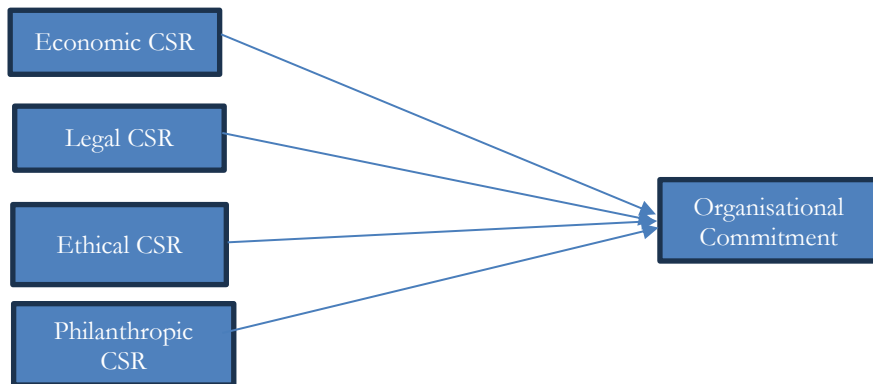
There are various research questions developed for this study. They are described below:

- To determine whether Economic CSR increases the organisational commitment of employees.
- To determine whether legal CSR raises employee commitment to the organisation.
- To determine whether employee organisational commitment is increased by Ethical CSR.
- To determine whether organisational dedication among workers is enhanced by philanthropic CSR.

3.1 Hypotheses

- H1: Economic CSR has a positive relationship with Organisational Commitment.
- H2: Legal CSR has a positive relationship with Organisational Commitment.
- H3: Ethical CSR has a positive relationship with Organisational Commitment.
- H4: Philanthropic CSR has a negative relationship with Organisational Commitment.

Figure 1. Theoretical Framework



Source: created by the authors.

4. Research Methods

Our study focusses on the widely used concept of "corporate social responsibility" and requires analytical data regarding employee behaviour.

It used a combination of primary data, which comes from questionnaires, and secondary data, which come from articles in journals indexed in different international databases. The questionnaire was developed to obtain the primary data necessary as part of this study. The questionnaire was developed in Google Docs and disseminated online to collect data. The questionnaire is developed on two sections. The first section includes questions related to all variables (dependent & independent). The questions were developed using a Likert scale ranging from 1= strongly disagree to 5= strongly agree. The second section contains demographic data of the employees. Data was gathered from employees of various organizations in Pakistan. Our sample size was 220 employees from different leading organisations in Pakistan. To obtain the data, we use the random sampling technique.

To analyse the data, SPSS software was used. Different statistical techniques were used to check the reliability of data and to test hypotheses, for acceptance or rejection.

5. Findings

5.1. Demographic Analysis

Demographic analysis was considered very important for each study. For this study, various demographic variables were included in the questionnaire such as gender, education status, income, and marital status. The data was collected of 220 employees from various organisations in Pakistan. Out of 220 employees, 72.3% of them were the males and 27.7% were the females working in various organisations in Pakistan. However, most of them were single (65.5%) and only (34.5%) were

married. However, analysing the educational status, it was seen that 62.7% of them had master's degree, 27.7% of them had bachelor's degree, 4.5% of them had only matriculation and only 5% of them had other degree/diplomas such as vocational diplomas, etc.

5.2. Reliability Analysis

Research must include reliability analysis as a critical component. It essentially functions as a verification of the legitimacy of a research questionnaire. It gives the research its quality as it attempts to establish the accuracy of data chosen for a study (Fink & Litwin, 1995). 0.6 or higher is the standard value for the Cronbach alpha. Any figure falling into this bracket is therefore regarded as legitimate and dependable.

The expectation is that the standard Cronbach's alpha will be greater than 0.6. The results in this study are higher than 0.6. As can be seen in Table 1 below, every parameter has Cronbach's alpha values greater than 0.6, indicating the reliability of each variable's instrument.

Table 1. Cronbach's Alpha

Variables	Cronbach's Alpha
Organisational Commitment	0.8132
Economic CSR	0.7341
Legal CSR	0.6423
Ethical CSR	0.7011
Philanthropic CSR	0.6372

Source: developed by the authors.

5.3. Hypothesis Testing

For this work, a structural equation modelling (SEM) was used as the method of hypothesis evaluation. It was presumable that a variable's p-value for the chi-square test would have to be under or equal to 0.05 in order for it to have a significant relationship with the dependent variable (organisational commitment). Conversely, factors with a value greater than 0.05 were deemed to have no meaningful relationship with the dependent variable, which is organisational commitment. The results of the hypotheses are displayed in Table 2 below, together with the p- and t-values.

H₁) According to the t-value of 4.208 and the p-value of 0.000, there was a very strong relationship between employees' organisational commitment and economic CSR adopted by the firms. Since both obtained values were well inside the benchmark range, the hypothesis had been accepted.

H₂) Based on its 0.000 p-value and 3.964 t-value, legal CSR that was integrated by organisations showed an extremely significant link with Organisational Commitment. The results achieved were well within the criterion; hence, the hypothesis was approved.

H₃) The organisational commitment of workers was significantly correlated with ethical CSR activities carried out by organisations; the t-value for this

association was 2.020 and the obtained data showed a p-value of 0.045, which is less than 0.05. These findings led to the hypothesis's acceptance.

H₄) With a p-value of 0.938, greater than the acceptable threshold level, and a negative t-value of -0.078, which led to the rejection of the hypothesis, corporate philanthropic CSR had a very insignificant negative connection with the dependent variable organisational commitment.

Table 2. P-Values and T-values

Name of Variables	P-value	t-value	Result
Economic CSR → Organisational commitment	0.000	4.208	Accepted
Legal CSR → Organisational commitment	0.000	3.964	Accepted
Ethical CSR → Organisational commitment	0.045	2.020	Accepted
Philanthropic CSR → Organisational commitment	0.938	-0.078	Rejected

Source: developed by the authors.

6. Conclusions

Employees are considered the most important factor in determining whether an organisation succeeds or fails. They communicate with existing customers and attract new ones and meet their demands to enlarge their commercial horizons. As a result, organisations are continuously and increasingly searching to develop strategies to retain employees who are loyal, motivated, and committed to achieving organizational goals. This is where this study comes in, as it provides organisations with tools and practices to build teams, to decide which approaches to use and how to use them to support a working labour force.

Our study mainly allows organizations to learn about the characteristics and importance of the four basic forms of CSR, and about the internal procedures that a firm can apply to stimulate employee commitment. The findings of this research are significant in the sense that they reflect the attitude and corporate climate of the Pakistani corporate sector. It explains the different landscapes and mentality of the Pakistani people, hence helping companies to decipher the type of personnel they employ. This research will help corporations understand the need and desire of their employees and best ways to satisfy them. Organisations should aim to understand their staff. Organizations capable of recognizing and collecting labour force needs and desires for the workforce will reduce turnover rates since satisfied employees are less likely to leave their employers.

The findings of the study are self-explanatory in pointing out that the effective implementation of CSR increases motivation to work with the organization. Businesses must continue

The CSR should, therefore, be actively promoted to all shareholders. The effective promotion must start within the organization so that all may believe in it.

In other words, although this study has certain limitations, it is of immense importance, more so for Pakistan. The topic can assist organisations and employees better understand corporate social responsibility. It can assist organisations in identifying strategies to reduce employee turnover. It can support them in opting for methods and strategies which can alter the motivation of employees while minimising or removing conduct that produces negative externalities. Conversely, employees are provided benefits through their understanding of these features as it permits them to properly negotiate with employers, to enhance their awareness on how they can safeguard themselves against exploitation, and to select to work for an organisation that best serves them.

Lastly, the hypotheses H1, H2 & H3 of the study were accepted except one, H4, as philanthropic CSR has an insignificant relationship with organisational commitment. Therefore, this hypothesis is rejected on the p-value. The other types of CSR have a more direct impact on organisational commitment compared to philanthropic CSR.

According to previous studies, economic CSR has a significant relationship with organisational commitment. According to the literature, a high level of organisational commitment can increase workplace productivity, which helps to run the organisations smoothly and to be profitable (Carroll, 1991). However, organizations who capitalize on training programs as part of their economic CSR, this helps the employees in the organization to grow competently and get hands-on experience. Therefore, this increases employee commitment towards the organization (Brammer, Millington, & Rayton, 2007). Secondly, H2 is accepted as legal corporate social responsibility and affects organizational commitment positively. Furthermore, previous studies also suggest that legal CSR has a positive relationship with organisational commitment as workers consider if their organisation is legally obedient and justly liable, they are more committed to it. If the employees believe that organisation follow the legal standards and have defined laws and rules, employees are more dedicated towards the organization, enhancing positive organizational culture and leading to high level of organizational commitment, thus in turn leading to lower level of employee turnover (Brammer, Millington, & Rayton, 2007). Third, there is a significant relationship between ethical corporate social responsibility and organisational commitment based on p-value which is significant (0.045) as less than 0.05. In addition to that according to previous studies, there is a positive relationship between ethical CSR and organisational commitment because if the organisations follow ethical laws and codes of conduct, employees are more committed towards organizations. If employees were given fair rights and respect, their attitude towards organisations increase. Thus, the ethical measure of corporate social responsibility was a robust predictor of organisational commitment than the economic and legal measures (Peterson, 2004). The last hypothesis H4 is rejected according to the results of this study. According to the literature, some studies show that corporate social responsibility has a strong relationship with organisational commitment, but some studies show the insignificant relationship. If the charitable practices in the

organisations are not beneficial for the employees and they are not unified into their roles, they are not committed towards that. Moreover, if they are not aware of the benefit, this is a low level of organisational commitment shown insignificant relationship between philanthropic CSR and organizational commitment (Margolis & Walsh, 2003). Between 1950 and 2000, firms' philanthropic contributions increased by more than fourfold in actual terms (Margolis & Walsh, 2003).

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**Emerging Trends and Impacts:
A Bibliographic Analysis of Generative AI in Marketing**

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Abstract

Artificial intelligence in marketing uses machine learning to create dynamic content and personalise consumer interactions. This development reflects a broader trend in the social sciences, where the transition of artificial intelligence from theory to practical application has transformed research and practice throughout the field. Generative AI is still a relatively new subject in the academic literature, having sparked interest for its groundbreaking applications and implications. This paper will focus on several key questions, namely identifying the main themes within the literature on generative AI in marketing, examining the key findings and trends reported across various studies, and determining the primary authors studying the implications of generative artificial intelligence, in this using the VOSViewer data visualiser.

Keywords: generative artificial intelligence, marketing, bibliographic analysis.

JEL Classification: M30, M31, O30, O33.

1. Introduction

In the present digital environment defined by dynamism, marketing developed its aim in order to include the influential powers posed by Generative Artificial Intelligence (GenAI). Since its inception in the early 1900s within the Industrial Revolution, marketing faced significant modifications, making the leap from the focus on mass production and distribution to the current era. The core of contemporary marketing, defined in a significant manner by pioneers Philip Kotler (Kotler & Keller, 2016) and Lester Wunderman (Wunderman, 1996), has shifted

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from basic product promotion to nurturing intricate connections with customers, based on understanding and adjusting to their developing requirements.

The emergence of the digital era changed in a dramatic manner the way that organisations conduct communication with prospective clients, mainly as a result of the upshift of digital marketing. Organisations become empowered to extend their aim and develop the interaction with consumers. The inclusion of GenAI into marketing tactics is a noteworthy achievement, as it provides instruments which can automate content issuance and ameliorate customer targeting through data-driven insights. Due to this transformative technology, marketers can now trigger highly customised experiences that respond to the distinct preferences of every customer, pointing out to more adaptive and efficient marketing techniques (Kumar et al., 2024).

This paper explores the consequences of GenAI on several marketing dimensions of marketing, with a special orientation towards content generation and customer interaction. The purpose of it is to give an overall explanation of the status and future prospects of GenAI in marketing with observations of recent developments and bibliometric methods. This will entail how it can power customer engagement and business success in the digital age.

2. Problem Statement

2.1 Introduction to Marketing

Marketing has been an integral aspect of human civilisation, as people have been selling goods and services since the earliest of times, and they understood early on that their success depended on how they promoted whatever they were selling. The field of marketing, as we understand it now, began to emerge in the 20th century, just as the rise of mass manufacturing during the Industrial Revolution was happening.

Marketing is a crucial component of a business that is constantly evolving. It entails understanding and anticipating the desires and requirements of clients; it encompasses the process of generating value for customers and establishing customer connections, which subsequently enables the acquisition of value from customers through sales, profit, and long-term loyalty (Kotler & Keller, 2016). According to the American Marketing Association (2017), marketing is the set of actions and procedures involved in generating, transmitting, providing, and trading products or services that are valuable to customers, clients, partners, and society.

The father of modern marketing, Philip Kotler, defines marketing as “the creative use of truth” (Kotler, n.d.). Among his contributions to the marketing philosophy lies the expansion of the aforementioned concepts outside conventional business contexts to include nonprofit, social, and political sectors. The broader concept of marketing emerged when experts in the industry acknowledged that the fundamental principles of marketing, which involve comprehending and fulfilling the requirements of distinct demographics, could be universally employed.

It is crucial to acknowledge the significant contributions made by other pioneers, like as David Ogilvy, who is generally referred to as the “Father of Advertising”. Ogilvy's marketing technique not only highlighted the significance of captivating and innovative content, but also stressed the need to base advertising on extensive research into customer preferences and behaviours (Ogilvy, 1963).

Lester Wunderman was another innovator who established the foundation for what is now recognised as direct marketing, by leveraging data and state-of-the-art technology. “Direct marketing was out there. I did not invent it. But it had no definition and no strategy.” (Wunderman, n.d.). His strategy relied on large amounts of consumer data, much like the owner of a small store who knows every customer and their preferences. Wunderman's teams may deliver personalised adverts straight to potential purchasers by using technologies like ZIP codes and extensive research databases. This technique changed the relationship between marketers and their target audiences, boosting the level of innovation.

2.2 The Digital Revolution of Marketing

Digitalisation in marketing radically changed the way companies interact with and communicate to their potential consumers, breaking all restrictions and barriers set by national and geographical boundaries. This transition has benefited small and medium-sized enterprises by making it economically viable for them to reach a much larger audience through advertisements. Compared to conventional marketing and advertising techniques, digital solutions are more cost effective and have a wider scope of influence. One advantage of digital transformation in marketing is that it allows immediate feedback from customers. Instant communication allows firms to respond to customer requirements at the earliest possible moment and adapt their strategy while keeping these requirements in mind. In addition, digital platforms allow organisations to have a constant online presence through their websites, which are operational 24/7. This means that customers can have services and information at their convenience anytime, which simply means more sales and profits (Chaffey & Ellis-Chadwick, 2019).

The interactive nature of social media enables a two-way communication between brands and customers. There is a chance for relation building with the brand; this creates a community that also pulls new customers but at the same time retains existing ones by keeping them loyal and provides continuous feedback.

Artificial intelligence (AI) has revolutionised the marketing industry. It changed how firms used to think about their marketing campaigns by adopting sophisticated algorithms and using complex machine learning techniques (Noble & Mende, 2023). This enables marketers to personalise their strategies according to the needs and preferences of customers in order to come up with highly engaging and effective strategies. The intelligence of AI is in self-managed learning and continuous improvement, making it more productive and effective with the iteration of the performed task (Kumar et al., 2024). AI allows marketers to come up with new ideas, formulate new strategies, and create lively interactions between themselves

and their customers in reaction to changing trends. GenAI makes all of this even easier to use (Rodrigue, 2023).

2.3 Generative AI in Marketing

Recently, content marketing has embraced the use of GenAI, most likely due to its ability to speed up the individual creative process, regardless of whether it refers to idea creation or just idea perfection (Hsu & Liou, 2021). In this scenario, GenAI uses machine learning algorithms to produce different marketing materials, such as blog articles, email marketing content, and social media postings. This automation helps marketers create content of various formats on a large scale, helping not only in time efficiency, but also by giving more scope for creativity. Industries such as insurance and banking leverage generative AI to transform their marketing strategies, which involves generating more relevant and captivating content for their customer base (Lin & Ruan, 2023). Through generative AI-driven storytelling, marketers can come up with stories that deeply connect with clients, hence customising and improving the customer experience on the whole (Vidrih & Mayahi, 2023). Additionally, it has a great effect on digital advertising by changing the way in which firms interact with clients by making use of AI-generated virtual influencers in the advertisement process (Baek, 2023).

Generative AI has a notable influence on data analysis in marketing; it can work through large datasets and come up with patterns and insights that humans may miss. By making use of this functionality, marketers can make informed assessments about their content and optimise it to have a better reach and broader impact. GenAI solutions have the ability to predict customer behaviour and market trends (Gozalo-Brizuela & Garrido-Merchán, 2023), enabling marketers to immediately adapt their tactics in real time to cash in on new possibilities.

Customer service is another essential component of marketing that is influenced by generative AI, through sophisticated chatbots and virtual assistants. AI-driven systems possess the capability to engage with customers at all times, delivering immediate responses and assistance. These AI assistants are capable of managing a wide range of duties, including providing answers to commonly asked queries and providing personalised recommendations based on client preferences and past interactions (Arviani et al., 2023).

3. Research Questions / Aims of the Research

This study was guided by questions that were designed to clarify the importance of the influence that generative artificial intelligence has on the field of marketing: What are the main recurring topics and important terms found in the literature on the use of artificial intelligence in marketing? Which authors and nations are the principal contributors and what is the nature of their collaborative activities? The research aimed at developing an in-depth understanding of conceptual structures, key contributors, and collaborative networks characterising this rapidly evolving field.

4. Research Methods

This paper aims to analyse and interpret the fast-growing literature of generative artificial intelligence in marketing using VOSviewer, a software programme used for building and visualising bibliometric networks. We first collected a large number of academic papers relating to generative AI in marketing available in the Scopus database. The selection criteria were, firstly, that the title or the abstract should include the term “marketing”, and either “generative” and “artificial intelligence” or “AI”, or “GenAI”, and secondly, the publishing date should be between 2004 and 2024, ranging a twenty-year time frame. From the downloaded publications, we extracted bibliometric data related to authors, publication years, citation count, and keywords. We conducted a keyword co-occurrence analysis in order to find out the main themes that run across the literature on generative AI in marketing. This type of analysis quantifies their frequency and the pattern of the keywords in such a way that the researcher can easily identify the central themes of research and their interlinkages, meaning how they are linked to one another. A citation analysis was used to identify the themes of the fundamental pieces of literature. In order to identify the network of cooperation and impact among academics in the field, we conducted an author co-citation analysis.

5. Findings

The data source for the bibliometric analysis is a Scopus database which includes academic papers spanning a 20-year period, from 2004 to 2024, that respect the conditions stated in the Research Methods section of this paper. This resulted in a database of 103 academic papers that deal with GenAI in marketing, written by 318 individual authors. This collection of literature displays a total of 757 keywords that reflect the research area's thematic and conceptual richness.

5.1 Relationship between Keywords

In the first section of the bibliometric analysis, a co-occurrence analysis using VOSviewer was performed, in order to showcase the relationships among the keywords from the selected literature. The counting method set all keywords as units of analysis, and the full counting method was applied to count every use of the keywords. A threshold of only including those keywords that appeared at least five times was set, in order to focus on the most common themes.

Table 1. Keyword overview

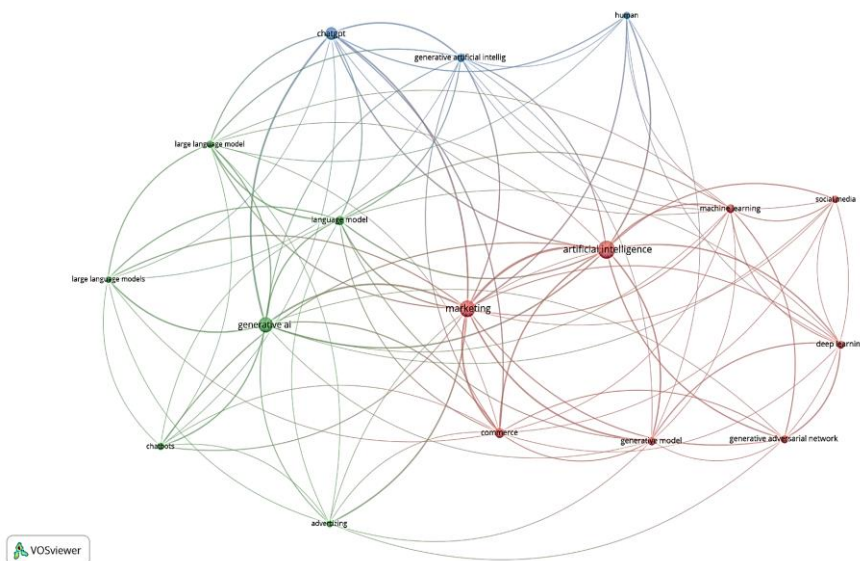
Keyword	Occurrences	Total link strength
marketing	31	75
artificial intelligence	36	64
generative ai	27	49
chatgpt	19	41
commerce	12	36
language model	10	35
generative artificial intelligence	9	27

Keyword	Occurrences	Total link strength
large language model	6	27
generative model	8	24
machine learning	9	22
generative adversarial networks	8	20
deep learning	7	19
large language models	5	19
human	6	17
advertising	5	15
chatbots	6	15
social media	6	11

Source: authors' own research, based on VOSviewer results.

Results from the co-occurrence analysis include several keywords that showcase some of the core topics and potential emerging trends in the domain of generative AI in marketing. “Artificial Intelligence” is the most frequent keyword since it contains 36 occurrences with a total link strength of 64, thus pointing toward its central role and extended connectivity in the research landscape. Other frequently occurring keywords, such as “marketing” and “generative AI,” appeared 31 and 27 times, respectively, which suggests their importance in the discourse concerning AI technologies in marketing strategies. Other terms, like “chatgpt,” “commerce,” and “language model,” bring out more specialised topics of interest, such as conversational AI and its relation to commerce and communication. The co-occurrence analysis is provided in the figure below:

Figure 1. Keyword co-occurrence analysis



Source: authors' own research, VOSviewer results.

The co-occurrence analysis grouped the most frequent 17 keywords into three clusters, as follows:

Cluster 1 includes eight keywords: “artificial intelligence”, “commerce”, “deep learning”, “generative adversarial networks”, “generative model”, “machine learning”, “marketing”, and “social media”. The focus of this cluster is on core AI technologies and their broad applications to marketing and social media.

Cluster 2 contains six terms: “advertising”, “chatbots”, “generative AI”, “language model”, “large language model”, and “large language models”. This cluster shows different communication aspects of AI, such as language processing or its usability in customer service.

The other three terms are encapsulated within cluster 3: “chatgpt”, “generative artificial intelligence”, and “human.” This smaller cluster refers to particular AI technologies and their relationships with humans.

These clusters indicate a clear thematic structure in the literature, where foundational AI technologies and their marketing applications are dominant in the discussion (Cluster 1), but there is also interest in how these technologies communicate and interact with humans (Clusters 2 and 3). This reflects a dynamic and rapidly evolving research landscape, in which the development of AI is centred around practical, communicative, and human marketing practices.

5.2 Co-authorship Analysis

The second step of the bibliometric analysis was the co-authorship analysis, which aimed to analyse the collaboration among researchers in the generative AI in the marketing field. In this phase, the focus was placed on the most notorious and frequent authors in this area of academic literature. The contributions of the literature were related to the authors.

A full counting method was used, and the parameters for this analysis were a maximum of 25 authors, each having to have written at least three documents. No minimum for citations was set in order to allow the inclusion of both established and young researchers. The weight was assigned based on the number of documents each issued author had.

Table 2. Author overview

Author	Documents	Citations	Total link strength
sands, sean	4	5	6
campbell, colin	3	4	5
ferraro, carla	4	4	5

Source: authors’ own research, based on VOSviewer results.

A compact network of three authors – Sean Sands, Colin Campbell, and Carla Ferraro – results from the analysis results, as summarised in Table 2. All three are contained within the same cluster. This indicates a possible close collaboration

among the aforementioned authors, when it comes to academic literature in the field of interest.

Between the three authors, Sands and Ferraro have the most published pieces of literature (four), with Sands having the highest number of citations (five). His total connection strength of six indicates that he has stronger collaborative links within this group, perhaps serving as an anchor for the collaborations.

Colin Campbell comes in with three documents and four citations, and an overall link strength of five. This places him as almost on par with Sean Sands in this network, contributing a great deal toward research output and collaboration.

5.3 National Level Analysis

The third and final part of the bibliometric analysis was focused on co-authorship trends at the national level, to help determine what the contributions of various countries toward research in Generative AI in marketing are. This analysis also applies a full counting method wherein the contribution of each country is considered if its researchers created at least three documents. There were no mandatory citation criteria for a paper to be included. The weight was determined by the number of documents created, which helped to identify the countries that are the most productive in generating research in this field.

Table 3. Country overview

Country	Documents	Citations	Total link strength
United States	31	981	29
India	15	871	27
United Kingdom	12	880	26
Norway	6	758	23
France	5	732	19
Taiwan	3	730	18
Australia	9	774	15
Hong-Kong	5	750	15
Germany	6	703	13
Singapore	3	721	13
Italy	4	717	12
United Arab Emirates	5	62	12
Poland	3	701	11
Romania	3	29	9
Malaysia	3	82	7
China	11	61	2
Russian Federation	3	6	1

Source: authors' own research, based on VOSviewer results.

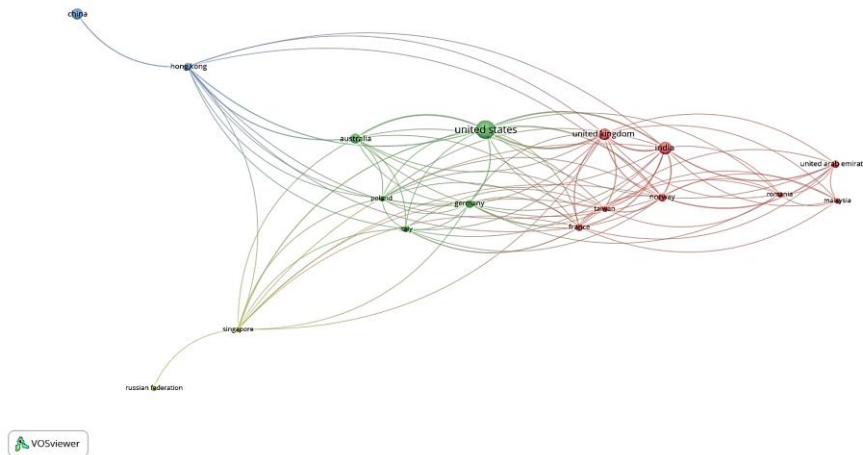
Table 3 depicts the results of the analysis. As depicted there, the United States is the “leader” among the 17 countries that met the selection criteria, having the largest number of academic papers published in the field of interest, and with the highest

number of citations. This country truly stands out among the rest, having had published over double the number of papers of India (31 and, respectively, 15), the country that has the second most published documents. The number of citations of the U.S. is also greater by over one hundred in comparison to India. The United Kingdom follows shortly, having 12 published documents, three less than India, but a higher number of citations. This goes to show that these three countries – the U.S., India, and the U.K. – show strong research and academic networks, as exemplified by their high link strength. The fact that the top three countries of this analysis are all in very different geographical positions, on three different continents, also marks the fact that the topic of Generative AI in marketing is an issue that is and has been of global interest.

Norway, France, and Taiwan, despite having fewer published papers, have high link strengths, meaning that their input is, nonetheless, essential to the overall network of research.

On the other end of the spectrum is China; the low link strength and the number of citations for the country's extensive volume of documents is surprising and shows newer and less coordinated research in the area of GenAI in marketing. This opposes Romania and Malaysia's position, having somewhat significant ties in the global academic community by the total links, despite authors from these countries having had published fewer articles on the topic of interest in the 20-year analysed time span.

Figure 2. Co-authorship analysis, country level



Source: authors' own research, VOSviewer results.

The countries were then grouped into four clusters based on their likeness, which revealed insights into the collaboration trends and dynamics:

Cluster 1 includes France, India, Malaysia, Norway, Romania, Taiwan, and the United Arab Emirates. At first glance, all of these countries are very different with

respect to their total documents number and citation number, but the link strengths among them are strong. This serves as an indicator for robust collaborative networks between these countries.

The second cluster encompasses Australia, Germany, Italy, Poland, and the United States. While within this cluster, the U.S. has very high output of academic papers and citations, the other countries included have a lesser output, but of equally good quality, based on the high number of citations of the pieces of literature produced.

Cluster 3, including China and Hong Kong, suggests a regional collaboration oriented towards GenAI in marketing unique to the Asian context.

The final cluster includes the Russian Federation and Singapore, and is characterised by a rather low document count and weak link strength. These characteristics may indicate that the research regarding the field of interest is only now emerging in these countries and can hence potentially become a growing field in the future.

6. Conclusions

Marketing professionals are changing how they engage with their audience and leverage their data, all by incorporating generative artificial intelligence into their practices. In this study, the bibliometric analysis performed highlights the high influence and wide span of innovative contributions that generative AI adds to the marketing domain.

This research traced the way in which this technology evolved, from its early stages to its current position as one of the pillars of modern marketing campaigns. In this regard, the keyword analysis revealed the complex discussion on the core technologies used in marketing and their practical applications, which fit within the trend of tailored, streamlined, and engaging marketing solutions. The patterns of co-authorship show a vibrant academic community, characterised by collaboration, and which reflects the rapid advancement of AI technologies.

The future holds endless possibilities for the development of GenAI in marketing. While the technology used gets perfected, its applications will also progress, challenging marketers to be more creative and interactive than ever before. The results obtained from this study aim to aid in understanding what the current academic landscape of generative artificial intelligence in marketing looks like, and also to open areas for future improvements that will continue to transform the way in which modern marketing operates.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used ChatGPT 4.0 in order to improve the readability of the paper and to correct any grammatical errors. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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Social Media and Online Shopping: Exploring Interactions and Implications in the Digital Environment

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Abstract

The advancement of technology and the widespread use of the Internet have significantly amplified the impact of media on individuals reshaping our lifestyles and social interactions. In light of the marketing strategies have swiftly transitioned to digital platforms proving to be more effective. Social media now plays a role in sparking competition, among businesses vying for consumer attention. The rapid evolution and intricacies of the landscape have posed challenges in pinpointing promotional tactics to maximise profits. This study delves into phenomena related to consumer behaviour and the sway of social media platforms on purchasing decisions. Despite studies exploring the impact of social media marketing on consumer behaviour, research remains limited within Romania's context. As such, there is a lack of understanding regarding the interconnectedness between social media engagement buying patterns and attitudes towards social media ads. To bridge this knowledge gap, this research investigates how social media influences consumer buying behaviour and preferences towards advertising on these platforms. These insights offer a foundation for fostering e-Commerce growth and enhancing revenue generation via social media advertising.

Keywords: Social Media, E-Commerce, Social commerce, Marketing communication strategies, Online promotional communication.

JEL Classification: M31.

1. Introduction

The new customer is known for being adaptable, always connected and dependent on channels when making buying choices. However, they also appreciate real-world interactions. They rely more on their connections than on big companies or brand names (Kotler et al., 2017).

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The widespread use of media over the years highlights its role in sharing information and advertising products. Based on the data from DataReportal (2024a) in January 2024 there were 5.35 billion people using the internet globally with a remarkable 5.04 billion actively participating in various social media platforms. This suggests that a large portion of internet users are also active on media. It is important to keep in mind that while these numbers show the popularity of social media usage, they may not necessarily reflect individuals due to factors like accounts.

Social media utilisation has faced a rising trend in Romania, the number of active users as of January 2024 being of 13.30 million, which represents 67.4 percent of the country's population. Moreover, in Romania there are 18.06 million internet users, which reflects an internet penetration rate of 91.6 percent. Mobile technology is also widely utilised in Romania, the country depicting a total number of connections of 28.00 million, which is above Romania's number of inhabitants (DataReportal, 2024b). These figures provide clues concerning Romania's standing and also acknowledge the meaningful effect that social media platforms have on the society of the present and the power that e-Commerce businesses have in this context to develop.

2. Literature Review

2.1 Social Media's Impact on Consumer Behaviour

Social media platforms, for instance Facebook, Twitter, and YouTube, are instruments which permit links and provide organisations a method that is cost-efficient and helps them interact in a direct way with customers, in line with Kaplan and Haenlein (2010). With the multitude of choices to consumers, the presence of marketing on media and the interaction between brands and customers have become essential in shaping organisational strategies according to Lindermann's insights from 2004 (Lindermann, 2004).

Wiktoria and Sanak Kosmowska's (2021) research reveals a link between online content communication and corporate competitiveness. They assert that nurturing the loyalty of customers and developing the competitive advantage of a brand on the market is influenced by effective content dissemination. Dwivedi et al. (2021) manifest the same concern and claim that online content communication shapes the competitiveness of an organisation by fortifying customer relationships and creating awareness. In addition, Momen et al. (2020) view online content communication, as a component of internet-based marketing, as being an integrative element in the establishment of brand value and the development of the organisational standing. Alvarado-Karste and Kidwell (2021) indicate that communication holds particular significance in encouraging the relationship between brands and consumers, to ultimately increase organisational competitiveness.

2.2 Impact of Social Media on E-Commerce

In the e-Commerce field, leveraging networks for marketing with the aim of boosting customer relationships. Small and medium sized enterprises (SMEs) are influential elements in national economies, proving their adaptability and their ability to generate income. Business support has been realised by technology, these entities receiving digital resources such as social media and online platforms to carry on customer relationships, expand market presence, and increase their operational efficiency. In the case of SMEs that wish to attain competitive advantage in the market landscape of today, the usage of advertising is a central topic. The impact of brands on consumer choices and the manner in which customers can influence the conduct of each other triggers a consequence that determines ongoing purchases, alleviated earnings, as well as consistent organisational success over time. SMEs' decision to adhere to social media marketing is determined to a great extent by elements such as competitors, industry experts, and customer feedback. Recent media studies have mainly approached the understanding of opinion leaders' importance in influencing the dynamics of communication.

The research of Arora et al. (2019) evaluated the usage of three social media platforms, Facebook, Twitter, and Instagram, thereby emphasising social media as a means to link with audiences.

Social media marketing (SMM) presents significant and positive influence on customer loyalty for e-Commerce (Yadav & Rahman, 2018). Another strong influence on online commerce is represented by influencer marketing (IM), which by using digital environment opinion leaders (influencers) and associating them with the brand image, encourages their followers to participate in co-creating the brand image on social networks (Vrontis, 2021). In times of social media influencers on platforms such as Instagram play a crucial role, in inspiring and impacting consumer purchasing choices (Brown et al., 2019). Many businesses use paid advertising on media to reach customers. Consumers see these ads as a source of information about products and services they are interested in (Chetioui et al., 2021). Medium-sized enterprises face difficulties in integrating media platforms and pinpointing the importance of business values (Abed et al., 2015).

In circles, there is an emphasis on social commerce as a distinct type of e-Commerce. This concept involves using media, online platforms, and various communication channels for interactions. Research by Wang and Xie (2020) explains that social commerce leverages social media technologies to enhance relationships, facilitate business information exchange and support buying and selling activities through user-generated content. It is observed that e-Commerce platforms have evolved to meet consumers desire for sharing opinions and reviews by integrating features, to those found on social media sites.

This progress is not extensive enough to label it as a type of trade. Instead, it indicates a growing understanding among businesses about the consumers' interest, in conversing about their buying decisions.

The rise in popularity of media platforms provides an avenue for expanding Business-to-Consumer (B2C) and Consumer-to-Consumer (C2C) e-Commerce

commonly referred to as social commerce. Take Facebook, the platform, for instance, with a whopping 3.049 billion users globally (DataReportal, 2024a). Recent usage data reveals that the average user now spends 2 hours and 23 minutes daily on media. It is necessary to understand the way in which users, technology, and social factors interconnect, in order to grasp opportunities pertaining to social commerce, even though the potential exists (Wang & Zhang, 2012). The research of Fitriani et al. (2023) underline the magnitude of progresses by taking advantage of social media platforms to attain sustainable competitive advantage and to boost general performance.

Since the outbreak of COVID 19 there has been a shift, from online shopping methods involving images and videos to the rising trend of livestream shopping. Consequently, numerous apps dedicated to livestream shopping have seen a surge in popularity, as noted by Wang and Oh in 2023 (Wang & Oh, 2023).

3. Research Questions / Aims of the Research

The widespread use of social media has opened the doors to digital marketing platforms. People spend more time on media; with increasing daily competition, it is getting fierce every day. Even though many researches tackled the effects of media on shopping behavior, discussing the preferences of promotional strategies on social apps in Romania was almost nonexistent. Accordingly, limited understanding exists on the link between media and buying behavior and consumer attitude towards companies' social media engagement. As such, this research examines the relationship between social media use and buying behavior, social media activity and psychological well-being, and purchasing behavior and promotional activities on platforms. Amidst the changing environment of e-commerce and

Electronic commerce: It is increasingly recognized that the role of understanding social media platforms and their effects on engaging with customers through marketing is paramount in the changing face of retail, shifting consumer behaviors, and fierce market competition. While doing this, and as businesses strive to differentiate and thrive in a fast-moving environment, the knowledge and implications that arise from this research provide valuable direction. By looking into media trends, analyzing the impact of social media marketing, identifying the factors of success, and analyzing consumer behavior, this research will identify valuable insights for companies and marketers looking for success in the digital age, while also giving recommendations. The research makes its contribution to knowledge in a more detailed understanding of how online shopping has evolved, more particularly regarding the contributions branding and social media marketing have had toward shaping the future of the retail landscape.

The importance of this study is that it provides both insight and practical values, even to the stakeholders in the commerce sector. In other words, this research will have implications, particularly on how shopping interacts with social media marketing. This research work is done primarily for companies operating in the domain. It can be a source of fine-tuning of strategies regarding social media marketing. The guidance and recommendations that can be drawn from the report

will help businesses raise their visibility, fine-tune customer engagements, drive up sales figures, and foster brand loyalty. For marketers and digital strategists, this research will help them by providing insight into trends and good practice in branding and social media marketing to underpin their decision-making. Inspire ideas for campaigns that engage consumers in the digital space. For the study, we categorised social media marketing methods into types such as Paid Advertising (PPC), Influencer Marketing (IM), Micro Influencer Marketing, Organic Promotion, Contests, Events, and Carousel Ads.

The analysis of the results is related to the research objectives set in this work. In the process of operationalisation, we put forward two research hypotheses:

Hypothesis 1.

Null Hypothesis (H0): There is no significant relationship between social media and online shopping through social media marketing in the context of revolutionising e-Commerce.

Alternative Hypothesis (H1): There is a significant relationship between social media and online shopping through social media marketing in the context of revolutionising online shopping.

Hypothesis 2:

Null Hypothesis (H0): Influencer Marketing strategies have no significant effect on customer engagement through social media marketing in the context of revolutionising online shopping.

Alternative Hypothesis (H1): Influencer Marketing has a significant effect on customer engagement through social media marketing in the context of revolutionising online shopping.

4. Research Design

The research employed an approach involving comprehensive data collection and analysis. A survey was conducted with 130 individuals who have experience in online shopping representing groups such as different age ranges, online shopping habits, and preferences.

The study employed both qualitative and quantitative research methods. The survey contained inquiries aimed at collecting information on participants' online shopping habits, preferences, and views on marketing tactics. Ended questions also enabled participants to offer insights that offer a profound insight into their motivations and emotions.

This study adopts a research methodology utilising an empirical case approach with an emphasis on testing hypotheses.

The study utilised data from sources such as DataReportal, Statista and other open sources. In terms of timing, the research followed a sectional design collecting data at a specific point in time, the beginning of 2024.

A five-point Likert Scale questionnaire was employed to measure all variables with the scale ranging from agree (1) to disagree (5). The questionnaire comprised two sections; the first covering the three variables under scrutiny and

the second focusing on details of respondents, like age, gender, occupation, and location of residence.

The information was gathered by sending surveys to the participants, through Google Forms and utilising platforms like WhatsApp, Facebook, and Instagram, which are seen as methods for gathering data from individuals amid the pandemic. To safeguard the confidentiality and anonymity of the participants, their personal information and responses were kept confidential. Not shared with any parties. The survey responses were then sorted in a spreadsheet. Transferred to SPSS.

The initial phase of data analysis involved assessing the characteristics of the participants, including age, gender, and location. This was followed by conducting an analysis using SPSS (e.g. mean maximum value, standard deviation) to verify accurate data input and explore the distribution pattern of the data

5. Result and Discussion

More than half of the respondents are female (56.2%) compared to male respondents (43.8%). Contrary to that over half of the survey participants (52.3%) fall within the 25-39 age bracket. This has reflected that the respondents are primarily young adults and have purchasing power. The majority of people spend between 1 to 3 hours on media, with 65 respondents or 50%. Most respondents are employed, making up 78.5% of the group and hold a bachelor's degree as their level of education at 56.9% followed by master's degrees at 18.5% and MBA/CFA at 16.9%.

Although Facebook is a better-known platform, WhatsApp takes the lead in a big way with a response rate of 73.8%. Facebook, YouTube, WhatsApp, and TikTok are all known platforms with rates above 90%.

Coming in next after WhatsApp is YouTube, at 69.2%, and then Facebook and Instagram, which tie at 64.6% each.

Interesting enough, 82.3% of the respondents indicated they had bought products promoted on media platforms, and the portion 83.1% discovered that they now often use many products and brands. These data raise questions about consumer preference in market segments. 42.3% of respondents indicated they shop online at least once a month, while 37.7% shop online weekly. In expenditure terms:

Also, 46.9% spend between 1001 lei and 2000 lei monthly. On the level of satisfaction in online shopping, 59.2% declared to be satisfied, and 33.1% that they are very satisfied.

When it comes to social media promotion preferences, both promoted ads and content from followed individuals (micro influencers) are equally favored at 54.6%. Giveaway contests follow with 38.5% with influencers at 32.3% and organic content from companies/brands at 27.7%. This research identifies how algorithms play part in finding out customer needs. For example, paid ads within the social media population remain the most utilized means of promotion. The influencers are at times not viewed positively, more so when promoting the products. This is an aspect that calls for more study to reflect this relationship. In this regard, it is evident that a

friend, who might be a non-influencer or a micro-influencer, can become brand promoters without negative comments.

Purchase behaviour is swift and dynamic with 33.3% of respondents making a purchase upon finding the desired product and up to 20% taking 1-2 days to decide. These findings underscore the importance for companies to pinpoint strategies for persuasion and targeting customers according to their needs in a competitive landscape with limited space.

Social media users engage for reasons such as entertainment connecting with friends or addressing work related matters.

The top platforms people use to connect with brands are Facebook, with a usage rate of 63.1% and Instagram, at 52.3%. Businesses should pay attention to this shift in consumer behaviour. It can be frustrating when advertisements interrupt your viewing pleasure, especially when you are fully immersed in a show. However, during browsing or while seeking entertainment ads might seem tolerable.

6. Conclusions

The current study opened up how e-commerce shopping environments must change while summing up the strategies for social media marketing. It indicates that media marketing is one of the most importance-infusing factors in establishing contact with clients. Online survey analysis, case studies, and consumer behaviour were used in exploring the driver for brand success in e-commerce. It also shows how proper use of social media strategies could mean more than sales but building of communities and loyalty among shoppers. While presenting the study results, it is still understood that it may have some level of bias and the volatile nature of marketing. The study results and recommendations therefore provide a direction to businesses and marketers in their efforts to fit in with the current digital space. As shopping trends change, these strategies from the study, provide a blueprint in constructing a customer online shopping journey that results into transformation. Respondents show a liking to promotion formats in social media, indicating that organizations should apply a strategy in different ways.

Though the promotion methods included the study, it did not focus on video, images, or text. The study of these is very important to understand. As discussed, the study of merchant case studies is important regarding strategies about social media marketing.

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**A Data-Driven Approach: Assessing the Relevance
of AI Algorithms in Tailoring Personalised Content
for Social Media Users**

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Abstract

In the rapidly evolving landscape of social media platforms, the delivery of personalised content has become crucial to engage users and foster meaningful interactions. Artificial Intelligence (AI) algorithms offer promising solutions to this challenge by leveraging vast amounts of user data to tailor content recommendations to individual preferences. This research presents a comprehensive quantitative analysis aimed at evaluating the effectiveness of AI algorithms in personalising content for social media users.

The key findings will provide valuable insights into the effectiveness of various AI algorithms in delivering personalised content across different social media contexts. We aim to see if AI-driven personalisation significantly enhances user engagement, with tailored content receiving higher interaction rates compared to non-personalised content.

Furthermore, this article study if exists factors that influence the success of AI-based personalisation efforts, including user demographics, content characteristics, and platform-specific features. The analysis highlights the importance of considering these factors when designing and implementing AI-driven content personalisation strategies.

The current state of the scientific literature reveals a growing interest in the use of AI for content personalisation in social media. While previous studies have highlighted the potential benefits of AI-driven personalisation, there remains a need for empirical evidence to quantify its effectiveness and understand its impact on user engagement and satisfaction. The research questions from the questionnaire focus on quantifying the impact of personalised content on user engagement, content relevance, and user satisfaction.

Overall, this study contributes to advancing our understanding of the role of AI in content personalisation and its impact on user experiences in social media environments. Through quantitative analysis, we provide empirical evidence to support the adoption of AI-powered

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personalisation techniques, ultimately leading to more engaging and satisfying user experiences on social media platforms.

Keywords: AI, content, Social Media, consumers, experience.

JEL Classification: M30, M31.

1. Introduction

Since artificial intelligence has started to be on everyone's lips, social media has become even more dynamic. Businesses and influencers started to use this for a variety of complex factors and reasons (Barnes & Rutter, 2019). Amongst them there are other stakeholders like governments, businesses, and NGOs.

In this research we want to evaluate how relevant the AI algorithms are in tailoring custom content for the social media users while discovering their behaviour on these platforms and other variables like: how much time they spend now that artificial intelligence has been widely implemented all over the internet, the degree of transparency of algorithms in the content personalisation process, user perception of control over content displayed by algorithms, personal data protection and privacy concerns, consistency of content recommendations over time, relevance and diversity of suggested content based on the user's past interests and activities, algorithms' ability to take into account context and the right time to display recommended content, the ability of the user to provide feedback and influence the subsequent recommendations of the algorithms, and others.

According to Saima et al. (2023), the algorithm on Instagram's platform tends to show their users customised content on their own preferences and interests. And since Facebook, Instagram, and other platforms merged into Meta, the base algorithm is used all over these platforms. The social media application uses multiple different factors when it personalises and shows content for a specific user. Some examples are: timeliness, relationship, and engagement (Saima et al., 2023). So, whenever someone engages with a post, they are channelling the powerful AI algorithm within the platform. That post has some specific hashtags, colours, images, elements, people who interacted with and other things which are then showed to the algorithm so that after Instagram could recommend you content similar to that. But there is also a downside for businesses who want to use the platform to the best: the algorithm is always updating, and it is the secret of the Meta, so there is limited information around its efficiency in marketing (Saima et al., 2023). Furthermore, there are also ways to cheat the algorithm into thinking something different and recommend you something wrong.

Now, regarding certain AI platforms used to create AI content, there are other specific advantages and disadvantages. We have ChatGPT which can create texts, realistic images, and also videos once OpenAI will release Sora application. If they are used in combination with ElevenLabs who can generate new voices based on the input of a text, some social media users can create a new kind of AI-generated content. The advantages consist of more efficient ways to create content, but there

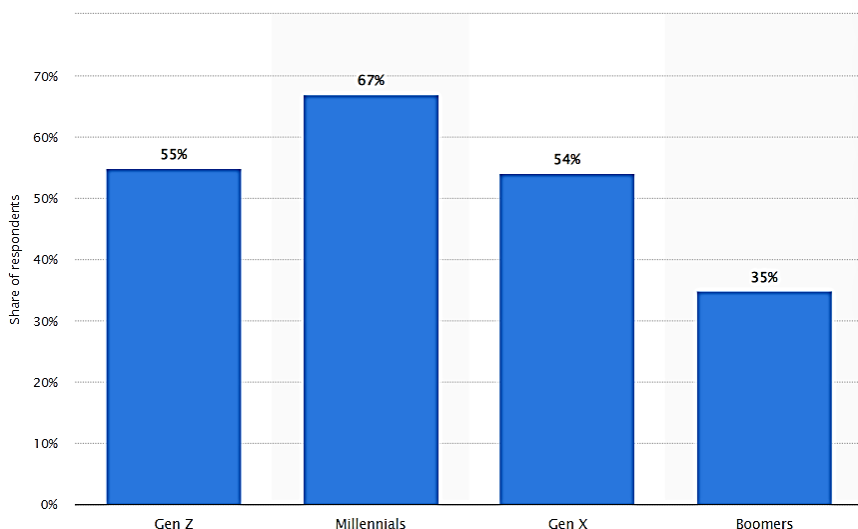
comes a big loophole of disadvantages like: misinformation (Mohamed et al., 2024), “filter bubbles” where AI algorithms reduce and limit the exposure for users to some content (Chen & Zhang, 2022), fake news, and others.

To conclude, this research will offer valuable information of how AI algorithms can tailor the content on social media to user interests and also what are the pitfalls of using it on a daily basis. Algorithmic transparency and ethical strategies can be used to mitigate the bias from the AI algorithms in the social media platforms (Das & Gupta, 2023).

2. Problem Statement

This study will not only be useful for businesses, but also consumers and social media users can take advantage of the information we obtain through this research. The relevance of AI algorithms in personalised content is yet to be one of the main factors that will keep users engaged with content on social media platforms. If we look at the US residents and their support towards the use of artificial intelligence for personalised recommendations (Navarro, 2024) we notice that only Boomers do not necessarily agree to this. Only 35% of boomers want AI for personalised content, while 55% of Gen Z, 67% of Millennials, and 54% of Gen X agree to custom content from brands with the help of AI, as it is shown in Figure 1.

Figure 1. Consumer support for brands using artificial intelligence (AI) to offer personalised recommendations in the United States as of March 2024, by generation



Source: <https://www.statista.com/statistics/1463198/consumer-support-brands-ai-personalized-recommendations-generation-united-states/>.

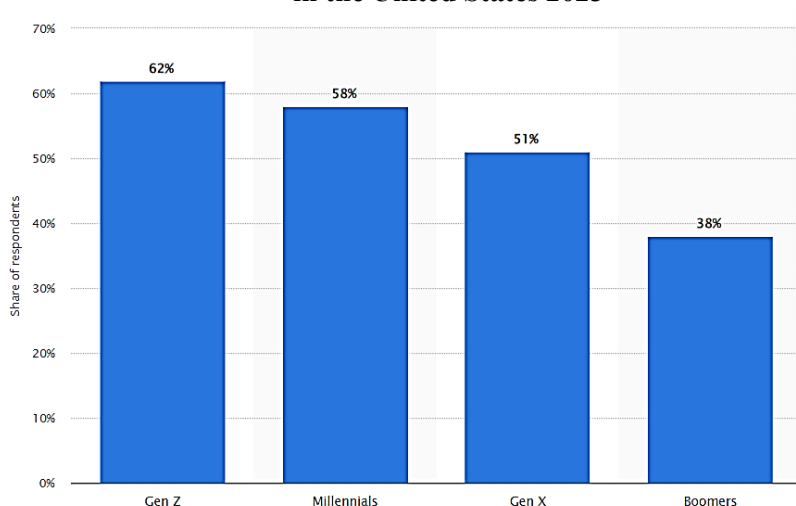
Of use, according to Imran et al. (2020), people tend to use social media even more in case of a disaster and emergencies. That's when AI comes in handy, because it can process, analyse and offer a lot of information in a short period of time. Some of the challenges it faces can be the summarisation and the verification of the visual and textual content. And in those times, the classic approaches, to understand the macro elements and to create a big picture, are consuming a lot of time and a lot of work (Imran et al., 2020). As an example, Wang et al. (2020) discovered that AI algorithms for filtration and processing of information on social media can be an efficient way to track and follow the flooding phase and the transitions of the flood for locating and helping incidents of emergency. Using a natural language processing model, they were able to recognise incidents from a few tweets on the social media application Twitter, now called X. Moreover, Ofli et al. (2020) saw that using data from past disasters can be of help to update new other models and different learning techniques based on online activities to adapt and learn so the existing models can predict more accurately.

Using a convolutional neural network (CNN) Inception V3, Barnes and Rutter (2019) analysed different products on social media posts from 226,801 pictures from top 75 social media influencers over a period of 1 year. What did they discover? Through the power of Big Data and AI algorithms, they managed to see what kind of influencers perform the best while comparing the efficiency of engagement from one product with the type of the influencer who promotes that category of product. The general influencers performed the best overall. But influencers who focused on travel content had a better engagement regardless of the product type and influencers who focused on a specific niche, industry or theme gained better engagement for specific types of products.

This is an example where businesses can use artificial intelligence and big data to filter and choose the best influencers for promoting different products to make sure they get the best return on investment. AI will make sure how a specific product will fit for an influencer and what kind of engagement it will generate. Moreover, influencers can use this technology to gather information for optimising their personal content. They can see what kind of products they like and want to promote and change their posts accordingly so that they can gain different sponsorships and also raise their revenue and increase or decrease their audience. But some might ask why would someone decrease the audience? In some cases, it might be more useful if they have a smaller audience which engages more with the posts.

Also big data and certain AI and machine learning algorithms can have an impact on analytics on LinkedIn. Soliman et al. (2019) could predict a job transition with 67% accuracy after they looked at the top 10 predictions on the social media platform. Moreover, the position at the beginning of the career did not contribute as much for the prediction of the end of a career (Soliman et al., 2019), after the research analysed over 9,5 million public profiles from the social media platform LinkedIn.

Figure 2. Concerns of AI tools replacing jobs per respondents in the United States 2023



Source: <https://www.statista.com/statistics/1449228/concerns-ai-tools-replace-jobs-united-states/>.

When questioned “How concerned are you, if at all, about the following related to AI offerings like chatbots, image generators, and facial recognition tools?” the younger generations manifested concerns regarding this subject. Over 50% of Gen X, Millennials and Gen Z think AI will replace their job.

In conclusion, there is evidence that people find that AI is relevant to customisation of content in social media and also in real life situations like jobs, disasters, and others, but they require further research, something that we will do in this study. Chen and Zhang (2022), Das and Gupta (2023), Lee et al. (2024), and Wang et al. (2024) explore the importance of ongoing research in this field as long as AI development continues.

3. Research Questions / Aims of the Research

The aim of the research entitled “A Data-Driven Approach: Assessing the Effectiveness of AI Algorithms in Tailoring Personalised Content for Social Media Users” is to explore and understand the efficiency and impact of artificial intelligence (AI) algorithms in customising content for users on social media platforms and also their satisfactions.

The main objective of the research is to thoroughly evaluate the effectiveness of artificial intelligence (AI) algorithms in tailoring personalised content for social media users. This involves a comprehensive examination of how AI-driven algorithms analyse user data and behaviour to customise the content displayed on social media platforms.

Along with the main objective, we highlighted a few secondary objectives:

1. Assessing how much users of Social Media are aware of the use of AI for the personalised content
2. Seeks to understand the impact of personalised content recommendations on the overall user experience, including user satisfaction, engagement levels, and perceived relevance of the content.
3. Examine the influence of personalised content on user satisfaction
4. Discover what ethical considerations finds consumers surrounding data privacy and transparency

4. Research Methods

The research seeks to investigate the impact of such new technologies used in social media on consumer behaviour, including their attitudes, perceptions, and actions towards them.

We carried out exploratory research in the first part of the study, which helped to establish a general framework for the problem investigated using primary data sources. After that, we prepared a quantitative research by using the survey method: a questionnaire with a total number of 19 questions was created, which was administered through the Google Forms platform to a number of 207 respondents between 1 May and 11 of May 2024.

5. Findings

The analysis of the data reveals that more than 90% of our respondents use social media daily, which means that the results of the survey will be valid and very meaningful for our research. For one of the key questions in this survey “how acquainted are you with the use of artificial intelligence algorithms to personalise content on social media platforms?”, it was surprising to find out that more than 70% of the respondents stated that they are aware of the use of AI.

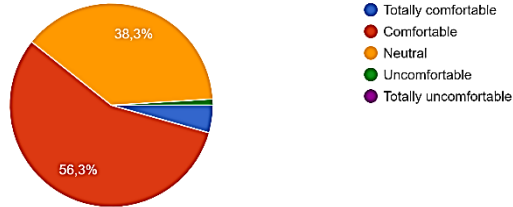
In consideration of the findings, the most significant for respondents when it comes to the difference perceived in “the content displayed based on your previous interactions on social media platforms” compared to what is currently happening on social media networks, more than 50% of the respondents said that they see an important difference.

Referring now to objective no. 4, one of the most discussed aspects when it comes to artificial intelligence, namely data collection, privacy and transparency, we also asked the respondents what their opinion is "Are you comfortable with collecting your personal data to personalise content on social media platforms?" and surprisingly or not, almost 60% of them feel comfortable with data collection if it is collected for the mentioned purpose.

Figure 3. Privacy

Are you comfortable with collecting your personal data to personalize content on social media platforms?

205 răspunsuri



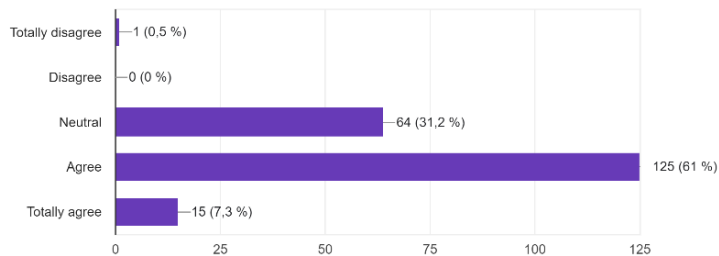
Source: author's own research.

However, over 60% of social media consumers want personalisation algorithms to be more transparent:

Figure 4. Transparency

Do you think AI algorithms should be more transparent about how they personalize content for users?

205 răspunsuri



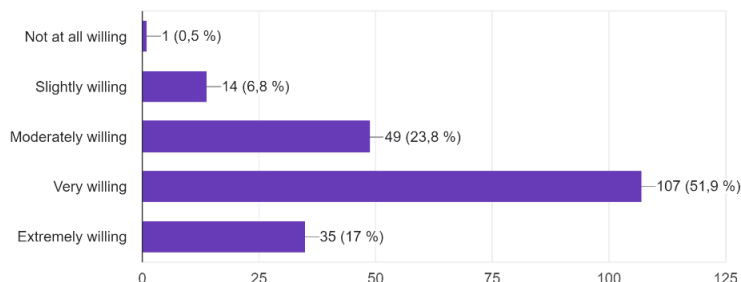
Source: author's own research.

Lastly, 107 respondents out of 207 admitted that they are “very willing” to engage more with the content displayed based on AI on social media rather than with the content displayed organically. This means that at least at this point in time when we carry out this research, consumers of social media understood that AI is transforming social media, making it more personalised, efficient, and engaging. AI algorithms can analyse user behaviour and preferences to deliver tailored content and recommendations which will become more and more attractive to consumers.

Figure 5. AI vs Organic content

How willing are you to pay attention and engage with content displayed based on AI algorithm recommendations on social media compared to content displayed organically?

206 răspunsuri



Source: author's own research.

6. Conclusions

The review of relevant literature and the undertaken research highlighted the positive impact of artificial intelligence on consumer experience on social media, considering as well the various ethical challenges associated with its use. Ethical practices, such as data protection and transparency, play a crucial role in ensuring an effective and fair use of any kind of new technologies used on social media. Future research should focus on developing and applying strong ethical guidelines to address these challenges and augment more the benefits of using personalised content on social media. However, even if the objectives of the study were attained, it is crucial to take into account the limitation of this research, more exactly of the limited number respondents of only 207, so it was not satisfactory for statistical measurements. For this reason, the research in order to ensure the accuracy of the study the interview should be further extended to more respondents and also focusing on qualitative research with an interview among social media and marketing experts.

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**Hedonic and Utilitarian Motivations
of Social AR Filters Usage**

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Mihai PRELIPCEAN³, Elena GOGA⁴, Mihai Cristian ORZAN⁵

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Abstract

This research paper studies whether social media users have both utilitarian and hedonic motivations to use AR filters. The Technology Acceptance Model extended with perceived enjoyment is used as the theoretical framework to analyse user acceptance and usage of AR technology on social media. The questionnaires were distributed to a sample of social media users (n=186) to acquire data regarding hedonic motivation and utilitarian motivation behind the usage of AR filters. More specifically, data about perceived usefulness, perceived ease of use, and perceived enjoyment were acquired. In the end, the data was analysed to understand what is the relationship between these concepts and what is their impact on actual usage. The results of this study provide insights into the motivations that lie behind the usage of social AR filters, which can be useful for AR filter developers and academic researchers who study the implications of emerging technologies on social media. It will also provide information for the advertisers who are interested in using AR filters as a marketing tool.

Keywords: technology acceptance model, AR filters, social media.

JEL Classification: M30, M31.

1. Introduction

Social augmented reality (AR) filters represent a feature of social media platforms such as Snapchat, Facebook, Instagram, and TikTok. This feature enables users to enhance photos and videos in real time with superimposed virtual elements over the real environment. Depending on the platform they are used on, AR filters

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are also commonly known as AR lenses or effects. As the number of available filters grows and their user base expands, the way people interact with them becomes more diversified as well. For some users, filters are primarily a handy content creation tool, whereas for others, they are a feature used mainly for fun and entertainment. Understanding users' motivations and behaviours regarding AR filters is increasingly important, yet studies often lack a unified view.

TAM is one of the most widely used models to study the usage of AR-based systems. Depending on the focus of their studies, researchers categorised different augmented reality technologies as either utilitarian or hedonic. The same applies in the case of social media AR filters. Although both motivations have been researched separately, there is a limited number of studies that integrate both views in a holistic approach.

The current article aims to research both the hedonic and utilitarian motivations behind the usage of social AR filters, therefore demonstrating they are actually what the academic literature calls dual technologies or dual systems (Ernst et al., 2015; Chesney, 2006).

2. Background Literature

2.1 Technology Acceptance Model

To understand the usage behaviour of AR filters on social media, the study is based on the Technology Acceptance Model (TAM), which is one of the most commonly used theoretical models for user acceptance and usage of technology systems (Davis, 1989). According to the TAM model, the Behavioural Intention to Use a technology is primarily predicted by two factors: Perceived Usefulness and Perceived Ease of Use, which are labelled as extrinsic motivations. The theory also states that there is a positive direct link between Behavioural Intention to Use and Actual System Usage. Furthermore, the Behavioural Intention to Use fully mediates the Actual System Use.

Many studies researching entertainment-oriented systems integrated Perceived Enjoyment in TAM. This extended version was proposed by van der Heijden (2004) and was replicated by other scholars on several hedonic systems, including on social network sites (Ernst et al., 2015) or AR-based mobile apps (Oyman et al., 2022). TAM was also used to investigate the motivations for using dual technologies. For example, Kim and Forsythe (2007) found that a virtual try-on, a technology very similar to AR filters, has both functional and hedonic roles for individuals, although a stronger relation between the hedonic motivation and the attitude towards using the virtualisation system was identified.

Similarly, another study investigated the acceptance of four AR apps (Rese et al., 2017). The results found that both Perceived Usefulness and Perceived Enjoyment are predictors of intention to use. Perceived Usefulness was determined by the fact that AR technology provided more information about the product's characteristics, which ultimately reduced confusion and helped in the process of making an informed choice. On the other hand, Perceived Enjoyment was associated mainly with self-expression.

2.2 Hedonic and Utilitarian Motivations to Use Social Media AR Filters

Different types of virtual elements can be employed in AR filters, depending on their purpose. Some are for beautification, others for comedic effects, while others can be used to test products, such as makeup or sunglasses. Some are even mixing these types, to appeal to a more general public. Previous research focused either on analysing AR filters as entertainment products, underlining their hedonic characteristics (Ibáñez-Sánchez et al., 2022) or as marketing tools, mainly highlighting their utilitarian characteristics (Yim et al., 2017; Flavián et al., 2021).

The role of AR in supporting customers in product evaluation and ultimately, in having a positive effect on purchase intentions (Hilken et al., 2017), comes from the intrinsic characteristics of AR, specifically real-time interactivity and visual nature. The interactivity of AR filters primarily determines their usefulness, while aesthetic qualities make them enjoyable to use.

The integration of AR filters into social media platforms aims to provide users with new expressive tools and enhance their online image and identity (Muntinga et al., 2011). They also facilitate social connectedness by enabling virtual sharing and communication. All these are examples of utilitarian characteristics that can have an impact on users' perceptions.

As for the hedonic side, numerous studies validated that entertainment and enjoyment are linked with AR-based systems, as they represent a strong predictor for the use of technology. Playfulness is one hedonic motivation that was found to be a strong predictor of social media usage (Barnett & Wood, 2012), and it is very likely transferred to social AR filters as well.

3. Research Questions

The TAM model postulates several determinants of a person's attitude toward technology use. The first determinant is perceived usefulness (PU), which refers to the degree to which using the technology will improve the user's performance or satisfy their needs. The second determinant is perceived ease of use (PEOU), which refers to the degree to which a technology is perceived as easy or difficult. A more recent addition to the TAM model is the perceived enjoyment construct (PE) (Davis et al., 1992), which refers to the extent to which the activity of using the technology is perceived to provide reinforcement in its own right, apart from any performance consequences that may be anticipated.

Overall, the determinants of the TAM model suggest that the actual use of a technology is influenced by their perceptions of its usefulness, ease of use, and enjoyment. In the case of social media AR filters, users may be motivated to use filters for utilitarian purposes, such as improving the appearance and quality of their content, as well as for hedonic purposes, such as expressing their creativity and having fun.

In his research, van der Heijden (2004) found a positive relation between perceived ease of use and perceived usefulness, as well as between perceived ease of use and perceived enjoyment. Another study (Sun & Zhang, 2006) focused on the causal direction between perceived enjoyment and perceived ease of use and found

that PE → PEOU is more significant than PEOU → PE. In this one, the hypothesis was tested for utilitarian systems, but we believe that for mixed (dual) technologies the causal direction might be different. By putting together all the information above, the following hypotheses were developed:

H1: Perceived ease of use has a positive influence over perceived usefulness.

H2: Perceived ease of use has a positive influence over perceived enjoyment.

The users' desire for entertainment can influence how useful the technology appears to be to them. Research conducted on AR-based technologies showed that the more the user values entertainment and emotional satisfaction, the more likely they are to engage in cognitive processing when using the technology, and the more useful they will perceive it to be (Holdack et al., 2020). Therefore, we also added the following hypothesis:

H3: Perceived enjoyment has a positive influence over perceived usefulness.

According to the Technology Acceptance Model (TAM) theoretical framework, perceived usefulness and perceived ease of use play a crucial role in shaping people's attitudes and intentions towards adopting and using technology. Ultimately, they determine whether individuals will embrace and actively engage with the technology or not, as they weigh the benefits and the perceived ease to incorporate it into their daily lives. Many other authors replicated the work of Davis with different types of technologies and came to the same findings. For example, Kim and Forsythe (2007) researched product virtualisation technologies and Ernst et al. (2015) tested the link between perceived usefulness, perceived ease of use, and actual system use in the context of social network sites. Taking this into consideration, the next two hypotheses are stated as follows:

H4: Perceived usefulness has a positive influence in determining the actual usage of social media AR filters.

H5: Perceived ease of use has a positive influence in determining the actual usage of social media AR filters.

Researching the hedonic and utilitarian motivations of social network sites, Ernst et al. (2015) found that perceived enjoyment directly influences the actual use of dual technologies. Similarly, Kim and Forsythe (2007) concluded that perceived enjoyment is a factor that ultimately determines the use of hedonic and dual systems, by researching virtualisation systems. For that, we hypothesise the following:

H6: Perceived enjoyment has a positive influence in determining the actual usage of social media AR filters.

4. Research Methods

Using a survey administered on the web, the TAM model extended with the construct of Perceived Enjoyment was tested. The participants were required to have had previous experience with social AR filters to be eligible for the study, regardless of the social media platform they use. All constructs and scales employed were adapted from previously validated scales in scholarly work to suit the specific context of social AR filters. These adaptations were necessary to capture the unique aspects of AR filter usage, and involved a rigorous process to ensure their validity and reliability. The statements used for Actual System Use, Perceived

Usefulness, Perceived Ease of Use and Perceived Enjoyment are included in the Appendix section.

For Perceived Usefulness, the scale from Venkatesh et al. (2002) was adapted by incorporating items specific to social media AR filters, as suggested by Bostănică et al. (2023). Seven items were included in the final survey for this construct. The items for Perceived Ease of Use were also adapted from Venkatesh et al. (2002). Many other researchers, including van der Heijden (2004), successfully tested the Perceived Usefulness scale for hedonic systems. Five items were included in the final research instrument. Similarly, six items were used to measure Perceived Enjoyment. Initially developed by Venkatesh et al. (2002) and tested by researchers such as Kim and Forsythe (2007) and Holdack et al. (2020), the six statements included underwent slight wording changes to match the topic of the study. A single item was employed to investigate the frequency with which individuals utilise AR filters on social media platforms to assess the construct of Actual System Use.

All the items of the scales were reviewed by experts to ensure that they accurately capture the usage behaviour of AR filters. This expert review process also verified that the wording of each item was clear and appropriate for the context of the study. Also, all items used 5-point Likert scales, ranging from 1 (Strongly disagree) to 5 (Strongly agree), except the item for Actual System Use, which was also a 5-point scale, but the scale labels ranged from 1 (Less than once a month) to 5 (Several times a day). The data collected was analysed in SPSS using descriptive statistics and structural equation modelling.

5. Findings

From an initial sample of 203 eligible participants recruited for this study, 186 remained after data cleaning. This sample is balanced by gender identity, with 99 female, 83 male, and 4 non-binary individuals. The age ranges were represented by young adults aged between 18 and 30 years who are native and represent the target publics of the social media platforms that have integrated

AR filters. The reliability of the scales for the composite constructs regarding perceived usefulness, perceived enjoyment, and perceived ease of use was computed. For this, the Cronbach's alpha coefficient was employed ($p = 0.05$). Cronbach's alpha reliability coefficients were 0.907 for perceived usefulness, 0.911 for enjoyment, and 0.900 for ease of use. Because all results are over 0.8 (Table 1), we conclude that all items in each scale are highly correlated, and the scales are reliable for measuring the constructs of interest.

Table 1. Cronbach alpha for PU, PE and PEOU

Scale	Cronbach's α
Perceived Usefulness	0.907
Perceived Ease of Use	0.900
Perceived Enjoyment	0.911

Source: data analysis conducted by the authors using IBM SPSS Statistics.

Then, exploratory factor analysis was performed on the three composite constructs using principal component analysis with the Promax rotation method. The results can be observed in Table 2. The factor loadings exceeding 0.40 for each construct indicate strong convergent validity, implying that the observed variables are closely related to their respective constructs. This suggests that items such as PU1, PU2, PU3, PU4, PU5, PU6, and PU7 (Factor 1), as well as PE1, PE2, PE3, PE4, PE5, and PE6 (Factor 2), and finally PEOU1, PEOU2, PEOU3, PEOU4, and PEOU5 (Factor 3), are highly correlated with their underlying factors, namely perceived usefulness, perceived enjoyment, and perceived ease of use, respectively. Although PEOU4 exhibits factor loadings across 2 factors (Factor 2 and Factor 3), the item was not removed from the scale, because the cross-construct loadings do not exceed 0.50, which indicates robust discriminant validity.

Table 2. Exploratory factor analysis (values below 0.4 eliminated)

	Factor 1	Factor 2	Factor 3
PU1	0.603		
PU2	0.902		
PU3	0.833		
PU4	0.636		
PU5	0.828		
PU6	0.579		
PU7	0.671		
PE1		0.564	
PE2		0.857	
PE3		0.595	
PE4		0.794	
PE5		0.522	
PE6		0.645	
PEOU1			0.758
PEOU2			0.818
PEOU3			0.804
PEOU4		0.423	0.465
PEOU5			0.868

Source: data analysis conducted by the authors using IBM SPSS Statistics.

Linear regression analyses were conducted to test the hypotheses of the study. The results of these tests are shown in Table 3.

Table 3. Testing hypothesis with linear regression

Regression tests	β	Hypothesis result
Perceived ease of use → Perceived usefulness	0.492	H1: Supported
Perceived ease of use → Perceived enjoyment	0.652	H2: Supported
Perceived enjoyment → Perceived usefulness	0.755	H3: Supported
Perceived usefulness → Actual system use	0.736	H4: Supported
Perceived ease of use → Actual system use	0.380	H5: Supported
Perceived enjoyment → Actual system use	0.530	H6: Supported

Source: data analysis conducted by the authors using IBM SPSS Statistics.

The perceived ease of use moderately influences both the perceived usefulness ($\beta=0.492$) and the perceived enjoyment ($\beta=0.652$), supporting H1 and H2, respectively. Similarly, we found that users who perceive social AR filters as easy to use are moderately likely to use them ($\beta=0.380$), supporting H5. Although the hypotheses are validated, ease of use is the weakest predictor in the model. These results do not necessarily mean that users do not value ease of use when using AR filters. For example, the findings can be explained by the fact that our study sample was constituted of young people under 30 years old who are usually highly technologically literate and familiar with internet-based technologies. This demographic profile creates a tendency for users to navigate and use digital interfaces (such as AR filters) more easily, and therefore, the perceived importance of ease of use is minimised. Also, the ease of use is a variable that usually has high importance in utilitarian systems, minimal importance in hedonic systems, and moderate in dual systems, which can be a strong argument for labelling social media AR filters as a dual technology as well.

Next, perceived enjoyment strongly predicts perceived usefulness ($\beta=0.755$), confirming H3. Users who find AR filters enjoyable are highly likely to also perceive them as useful tools, suggesting that hedonic experiences positively influence utilitarian perceptions.

The robust influence of perceived usefulness on actual usage ($\beta=0.736$) supports H4. This can be attributed to the pragmatic value proposition that these filters offer to users. Perceived usefulness encapsulates the extent to which individuals perceive AR filters as instrumental tools for enhancing their social media interactions, augmenting self-expression, or facilitating communication. Given the utility-driven nature of social media engagement, users are inherently predisposed to prioritise functionalities that contribute tangibly to their online experiences.

Conversely, the moderate influence of perceived enjoyment on actual usage, which confirms H6 ($\beta=0.530$), reflects the nuanced interplay between hedonic gratification and utilitarian considerations within the context of AR filter usage. While perceived enjoyment pertains to the subjective pleasure derived from using AR filters, its impact on actual usage is tempered by the pragmatic imperatives that underpin social media engagement.

6. Conclusions

By focusing on the interplay between the utilitarian and hedonic motivation behind AR filters, the study contributes insights into the social dynamics of AR filters usage and can explain a user's behavior on social media. The research is also a very strong theoretical contribution by extending TAM with perceived enjoyment.

The weak influence of perceived ease of use on both perceived usefulness and perceived enjoyment thus underscores the nuanced nature of relationships between user experience and technology adoption. The importance of ease of use prevails; however, this relatively weak impact may suggest that other factors, such as perceived enjoyment, exert a stronger influence on user perceptions and behaviors.

The demographic profile of the study sample, being mainly composed of digitally native individuals, gives ever more reason that regard be exercised for the characteristics of users and their technological literacy to estimate the role of perceived ease of use in the formation of user preferences and adoption decisions.

The strength of perceived enjoyment as a predictor for perceived usefulness points out that these hedonic experiences can strongly affect and enhance the perception of the utilitarian value of AR filters. At the same time, perceived enjoyment in itself only made a moderate contribution to actual usage. This means, although "enjoyable" hedonic experiences are important for user engagement and satisfaction, the influence on real use might well be moderated by real-world pragmatic considerations.

This spread is from performance to pertinence and applicability. The practical value proposition of AR filters is evinced by the powerful influence that perceived usefulness exerts on actual usage, emphasizing their role instrumentally in improving social media interaction and one's self-expression. This research emphasizes the importance of features for AR filters that can respond well to the real needs and practical goals set by the user—improving social interaction, boosting communication, or enhancing content production. Developers can provide more value to users by emphasizing the tangibility of the benefits brought by their AR filters and therefore they can make more robust the utility and then a deeper willingness to adopt and use the AR filters, increasing developers' engagement among the target audiences.

Further, the research should strive to considerably extend this TAM framework, by adding theoretical constructs that could lead to having a well prediction on the usage of social media AR filters, such as social influence or visual appeal.

The results of this study provide a start point for future research and development of user acceptance theories in the context of social media and augmented reality, as the field of digital interaction continues to change.

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Appendix

This appendix contains the statements of the scales used in the survey.

Table A1. Research items

Actual system use	How often do you use AR filters on social media?
Perceived usefulness	I use filters to increase the overall quality of my photos and videos.
	I use AR filters to create content for my social networks more efficiently.
	I use AR filters to create content more appealing to the people in my social networks.
	The content created with AR filters increases the engagement rate on my posts.
	AR filters help me better communicate what I want to my social networks.
	Using social media AR filters allows me to test and evaluate products. (e.g. make-up, sunglasses, travel destinations)
	I consider that AR filters are useful to me.
Perceived ease of use	My interaction with AR filters is clear and understandable.
	Interacting with AR filters does not require a lot of mental effort.
	It is easy for me to learn how to use new AR filters.
	I find it easy to share my photos and videos created with AR filters on my social networks.
	I find AR filters to be easy to use.
Perceived Enjoyment	I have fun using AR filters.
	I find the use of AR filters entertaining.
	I use AR filters to express my creativity.
	I find the use of AR filters enjoyable.
	I use AR filters to express my personal identity.
	Using AR filters is an agreeable way of passing time.

Source: Venkatesh et al. (2002); van der Heijden (2004); Bostănică et al. (2023); Kim & Forsythe (2007); Holdack et al. (2020).

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Understanding Consumer Behaviour in the Digital Era: A Literature Review

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Abstract

In the rapidly evolving digital age, it is crucial for marketers to understand consumer behaviour to develop effective strategies. This literature review explores the complex dynamics that shape consumer behaviour in the digital realm. Based on a comprehensive analysis of existing research, this article explores the key factors that influence the consumer decision-making process, including the impact of technology and artificial intelligence on personalised marketing strategies. Additionally, the role of trust, privacy concerns, and empowerment in shaping digital consumer behaviour is explored. The findings provide valuable insights for marketers seeking to adapt and thrive in an increasingly digital marketplace.

Keywords: artificial intelligence (AI), consumer behaviour, digital marketing, technology integration.

JEL Classification: M31, D11.

1. Introduction

In a timeframe defined by quickly developing technology, the comprehension of consumer conduct constitutes a requirement for the marketers aiming to draw action plans to attain business goals. The digital marketing landscape is significantly reshaped by the integration of novel technologies, for instance artificial intelligence (AI), consumers' interaction with brands and their acquisition decisions being impacted in this sense. In response to these matters, it is highly necessary to obtain a profound understanding of the factors which alter consumer behaviour in the digital space.

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The central goal of this research is to assess the intricate dynamics that decide the behaviour of consumers in the digital age, across the published research. Placing attention on aspects such as the inclusion of new technology in marketing activities, the role of AI in personalising marketing deliverables for consumers, and the impact of trust and privacy issues, this study seeks to offer actionable insights to marketers. Provided that organisations understand these factors, they can become accustomed and flourish in a persistently digital marketplace, as well as to conduct consumer interaction and fulfil their developing needs.

By performing literature review on this subject, the current study ensures an inclusive analysis of the matters, intending to emphasise the main items directing the consumer decision-making process in the digital era.

2. Problem Statement

The main problem of the marketers nowadays is the deeper understanding of the consumer needs in the digital era. Starting from this statement, this research specifically explores how digital interactions and the newest technologies influence consumers' decision-making process, preferences, and loyalty. The main challenge is to synthesise existing research to identify key trends, themes, and gaps in the current researched published until now, thereby laying the foundation for future studies and practical applications in digital marketing and consumer engagement.

3. Aims of the Research

How does the rise of new technologies influence consumer decision-making process regarding trust, privacy, and empowerment?

The purpose of this study is to review the existing literature published based on the digital consumer behaviour subject and to identify common themes and trends regarding the impact of technologies such as artificial intelligence, which are raising ethical problems.

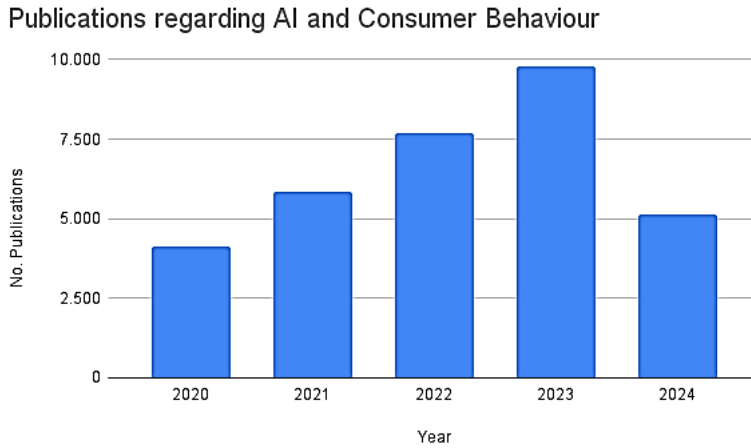
Furthermore, the goal of this literature review is to synthesise the findings into actionable insights for business and researchers.

4. Research Methods

For conducting this literature review, the search strategy included a systematic approach to ensure a comprehensive coverage of relevant studies. The databases used were Google Scholar and Science Direct, which were chosen for their extensive collection of peer-reviewed articles.

The main findings for the articles which describe the use of artificial intelligence on Google Scholar are: 17.600 articles published regarding this topic and its use in consumer behaviour during 2020-2024. From the figure listed below, it can be seen that the interest in the influence of this new technology has increased, especially during the launch of ChatGPT in November 2022 (Acres, 2023).

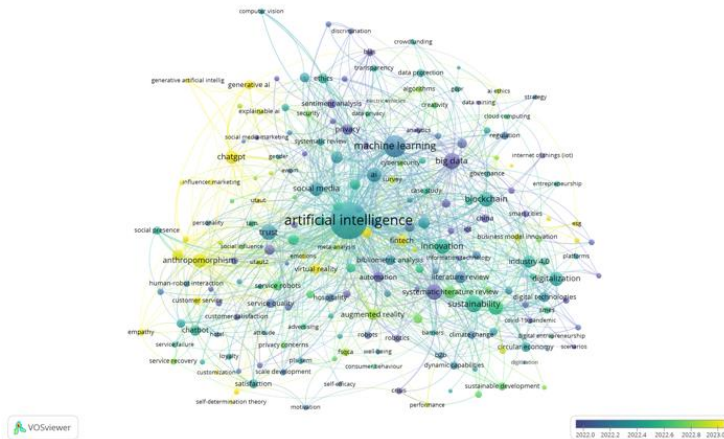
Figure 1. Publications regarding AI and Consumer Behaviour



Source: authors' own calculations based on Google Scholar Data Base.

The keywords were selected by analysing the researched studies found by the key phrase “AI consumer behaviour”, from Google Scholar and Science Direct data base, to determine the main studies and their keywords related to the topic as it can be seen in Figure 2, generated with VossViewer, listed above.

Figure 2. Articles correlation regarding AI and Consumer Behaviour



Source: Cloud Word generated with VossViewer (2024).

Furthermore, the keywords that were included such as “artificial intelligence” (AI), “consumer behaviour”, “digital marketing”, and “technology integration”, were selected. Specific key terms such as “consumer behaviour”, “consumer behaviour in digital era”, “AI in digital consumer” and “technological integration in marketing” were used to refine the search.

In order to focus on the latest developments in the field, only peer-reviewed articles and most of the publications from the past 10 years were used as inclusion criteria to ensure the relevance and quality of the studies examined. This ensured that the results were up-to-date and reflected the current trends.

The exclusion criteria were applied to filter out the non-English publications, articles without empirical data, and consumer behaviour studies on a single region to ensure a broad understanding of the consumer behaviour in the digital age. The purpose of this approach was to bring together a diverse and high-quality set of studies for analysis.

The articles, publications and books which were not excluded are written by relevant researchers in the consumer behaviour subject such as Daniel Kahneman and Jim Blythe.

5. Findings

Nowadays understanding the complexity of human beings is vital in order to survive as a specialist from various domains but also in the dynamics of economic.

The development of technology has grown rapidly starting with the beginnings of 2000 until now and in order to survive in the marketplace, businesses should adapt a strategy where the human is centred in all areas of the strategies developed. To understand the implications of nowadays technology, in the following paragraphs is presented an extended literature review based on consumer behaviour and the understanding of the implications of artificial intelligence in purchase decisions.

5.1 Consumer Behaviour and Cognitive Biases

The American Marketing Association (2024) is defining consumer behaviour as the study of how customers (individuals and organisations) choose, buy, use, and dispose of goods, ideas, and services to satisfy their needs and wants. Consumer behaviour helps marketers understand the factors that influence purchasing decisions. This knowledge can help marketers to identify the products and services which meet consumer needs, and starting from this statement, they can fill the gaps in the market.

The consumer is defined by “*someone who is enjoying the benefits of the product by obtaining it*” (Blythe, 2016). This may include all activities leading up to a purchase, including searching for information about products and services and evaluating alternatives.

The need of understanding the human behaviour behind the purchase decision have gained popularity among neuroscientist researchers by predicting consumer Decisions Empirical research in the field of consumer neuroscience and neuromarketing uses imaging technologies as biomarkers to assess responses to marketing stimuli such as brands, advertisements, and packaging, and to predict consumer decisions (Plassmann et al., 2012).

Based on how cognitive biases and consumer behaviour work, it is more likely that the usual rules and rational model might be ignored, because the conclusions

can be drawn from the similar situation using some logic. This happens from a simplified way of processing the information, influenced by various factors such as subjectivity, emotional, and moral motivations and social influence. In reality, people's biased way of thinking influences their decisions and judgments because it is neither logical nor objective (Hilbert, 2012). This decision-making process might be different from other alternatives. The Eurasian phenomena simplify the decisions by reducing the cognitive instability and its complexity. These Eurasian beliefs may include rules of thumb, educational requirements, intuition, or simple laws. This approach allows speeding up the decision-making process and increasing efficiency. It is easy, fast and convenient to provide information and highlight three important details.

The SOR (Stimulus-Organism-Response) model is used to understand how various external factors affect the internal states of the people and their subsequent behaviour. In the context of online reviews, different factors such as the quality of the information and how similar might seem the reviews, influence the thinking and emotional trust of the consumers. This kind of internal states has an impact of the consumer behaviour, especially on buying intentions and testimonials. Therefore, the SOR model helps to understand cognitive biases by illustrating how external information and context shape internal psychological states and lead to certain behaviours. The model emphasises the importance of building trust elements on online platforms to influence consumer decisions (Wang et al., 2023).

The anchoring effect influences consumer behaviour, because consumers are relying on the initial information (anchors) when they are making a decision. For example, when they need to evaluate the characteristic of a product, consumers are usually using typical values based on memories as anchors. This mental trick can lead to errors: if the real value is higher than the referral value, consumers tend to underestimate it, and if it is less, they overestimate it. This bias affects a variety of judgments, including product selection, willingness to pay, and perceptions of fairness in employee compensation. Therefore, marketing strategies and regulatory policies must take these biases into account to ensure fair and accurate consumer reviews (Ziano & Villanova, 2022).

Extensional neglect in consumer behaviour refers to the tendency not to pay enough attention to size or quantity when evaluating something. Instead, people base their judgments on a representative example or typical situation. This cognitive error exemplifies a situation whereby the number of elements or the length of an experience provokes sensitivity in people. In most situations, such as environmental estimations or painful scenarios, the responses of individuals rely mainly on their affective reactions to representative examples rather than the actual degree or magnitude of the group. This kind of error can lead to inconsistent and erratic decisions because people tend to underestimate larger quantities unless explicitly asked to consider the quantity. (Kahneman et al., 1999).

5.2 Consumer Behaviour in the Digital Era

In the digital age, the various factors which have an impact on consumer behaviour include easy access to online information, e-Commerce businesses, social media influencers, and personalised marketing. Although consumers focus on viral phenomena and general availability, with a more dynamic and complex buying process, consumers can quickly compare products, read reviews, and read comments (Cummins et al., 2014).

It is known that in marketing that product is bought from an impulse which is an unplanned behaviour, determined by a spontaneous and irresistible desire to purchase a product immediately after exposure to a stimulus. In the online environment, this behaviour is intensified by digital stimuli such as promotional offers and positive reviews. The variety and accessibility of the products along with fast payment facilities and digital marketing increases the frequency of impulse buying (Bhakat & Muruganatham, 2013).

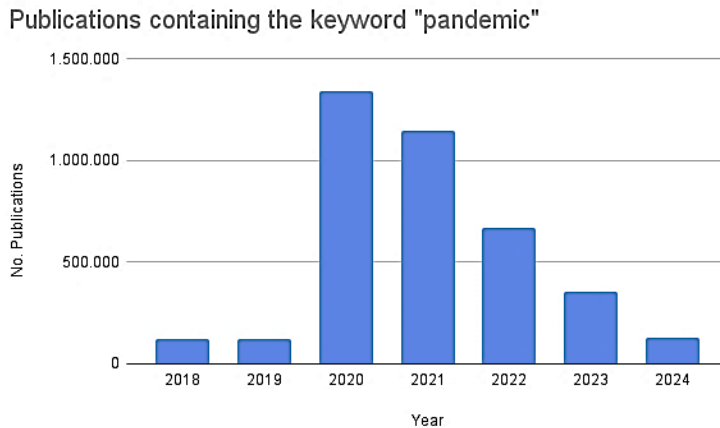
In this new era, the “digital consumer” can be defined as a new category of technological users who have a different mentality and behaviour compared to the traditional users. They are the early adopters, and they are integrating the technology in their daily life. The key factors that define digital consumers include the new skills and opportunities that the digital technology provides them, such as influencing other consumers by sharing opinions and broadcasting content on social media. This empowerment requires companies to reorganise around customer experience and continually create value paths to effectively engage these consumers. Digital consumers operate in a dynamic sociotechnological environment that requires companies to constantly adapt to evolving technology and consumer behaviour (Hafezieh & Pollock, 2023).

The main motivations for online shopping can be divided into two categories: utilitarian and hedonistic. Utilitarian motivations refer to functional, economic, and rational benefits such as convenience, control, availability of variety, economic utility, availability of information, personalisation, payment services, lack of social interaction, and anonymity. These factors greatly increase consumer satisfaction because they fulfil their practical needs and make the buying process more efficient and profitable. On the other hand, hedonic motivations refer to the emotional or experiential desire of customers who seek pleasure and personal satisfaction through the shopping experience. Both types of motivations are very important in shaping online buying behaviour. Utilitarian motivations usually lead to more frequent and better planned purchases (Pires da Silva et al., 2024).

Before 2019, the word “pandemic” was rarely used in scientific studies. However, COVID-19 drastically changed consumers’ behaviour. Despite the concerns and restrictions about the public health, people started looking for safer and convenable ways to buy. This accelerated digital transformation, integrating e-commerce into daily life and fundamentally changing market interactions, forced companies to adapt to new, digital-centric consumer habits. As it can be seen in the bar chart below, the interest in researching a possible pandemic outburst was low, about 240.000 articles were published during 2018-2019. But after the COVID-19

pandemic started, it was necessary to understand the implications of this medical crisis and in 2020 it was registered a boom, where 1.340.000 articles that contained the keyword “*pandemic*” were published. After 2020 the interest started to fade regarding this subject, but it is a clear fact that the human behaviour was affected by this crisis drastically.

Figure 3. Articles correlation regarding AI and Consumer Behaviour



Source: authors’ own calculations based on Google Scholar Data Base.

A new phenomenon has appeared and was classified by psychologists, after the global pandemic, and this is about digital burnout, which refers to the state of physical, psychological, and social exhaustion caused by excessive use of digital devices and platforms. This phenomenon affects consumer behaviour by changing the way individuals interact with online platforms. Despite the exhaustion and stress associated with digital burnout, affected consumers often continue to use digital consumer platforms. This behaviour can be viewed as a coping mechanism or a form of escapism to deal with negative emotions (Pires da Silva et al., 2024).

Another phenomenon that has increased in the last decade is the drive to purchase by impulse buying, without prior planning and considering long-term effects. Social media and digital platforms are enforcing this kind of behaviour through the targeted ads and personalised content. These online environments provide steady shopping opportunities, but encourage consumers to buy products on an impulsive basis. The existence of brands and influencers on social networks can determine consumers to make careless decisions. In addition, there is a direct linkage between low self-control and impulsive buying, namely individuals who have minimal self-control prove greater exposure to the instant gratification ensured by online shopping, this process determining to potential negative effects such as financial distress and buyer’s remorse (Nyrhinen et al., 2024).

Moreover, shifts have been made in consumer conduct as a result of COVID-19, boosting the development of online shopping. Individuals considered

online shopping as a safer and more appropriate option, given the restrictions and concerns associated with the pandemic. In response to these changes, digital commerce faced ongoing growth, even in the case of those individuals who were not frequent online shoppers prior to the pandemic. Certain key elements encouraged this process, for instance the convenient access to detailed product information, the easiness of price comparisons, together with the general convenience of making purchases while being home. Consumers' habits encountered digital transformations due to the pandemic, a primary point being the inclusion of e-Commerce in people's daily lives (Higueras-Castillo et al., 2023).

5.3 The Implications of Artificial Intelligence in Consumer Behaviour

For the better understanding of the Artificial Intelligence, it should be categorised in two major classes: predictive AI and generative AI (GenAI), where the first one focuses on improving decision-making through algorithms and machine learning, enhancing applications such as recommender systems and online advertising, where the second one focuses on the creation of new content, such as text, images, and videos, using advanced models like transformers. Compared to predictive AI, generative AI (GenAI) is different because of its advanced capabilities to create content and interact like a human. While predictive AI focuses on improving decisions based on predictions from data, GenAI can generate new content such as text, images, and videos that appear original. This technological leap has caused mixed reactions from consumers. On the one hand, GenAI's human-like performance and interactive behaviour can trigger positive reactions, including higher trust and perceived similarity. On the other hand, it can also cause negative reactions, such as weirdness, fear, and threats to human identity. The dual nature of these reactions highlights the complexity of consumer acceptance and the psychological impact of interacting with GenAI (Hermann & Puntoni, 2024).

In many industries, as within the beauty industry, AI has also been one of the major changes. This innovative technology has changed consumer behaviour.

and interact. This personalized strategies is a key element in this transformation

It attracts and engages consumers. Since the AI algorithms have the ability to analyze piles of data, it can take into consideration the personal tastes of an individual, their skin type and modern trends in beauty before recommending something for them. Also, during the virtual try-on experience, AI enables the buyers to visualize the products within their skin appearance, therefore boosting their confidence in selecting a product. Besides, artificial intelligence-powered chatbots and virtual assistants provide immediate support by responding to inquiries and providing product information. The optimisation of the customer's journey, coupled with the promotion of interactivity and engagement, serves to improve the overall purchasing experience (Roche et al., 2024).

Artificial intelligence can also be applied to many areas of daily life. Structurally, humans are mentally unable to process large amounts of data at once. The lack of processing skills leads to gaps and missing value in hidden information. Computers

can process data and provide reports that discover opportunities, trends, or potential threats (Gkikas & Theodoridis, 2022).

A common mistake is to believe that machines and technology are objectives and less unbiased. However, biases represent a major problem for AI, directly affecting the quality of AI software and the users' satisfaction. The issue of AI algorithm bias has received increasing attention in media, including concerns about biases in algorithms used in apps like Google Search, Facebook, and FaceApp. AI-driven products and services are based on machine learning, which uses large training data sets as input, based on which algorithms are developed. A major driver of AI bias is unbalanced and distorted training data. AI-driven products, especially those with high levels of interactivity, are increasing the amount and variety of consumer data collected, used, and transmitted, creating new challenges for consumer privacy (Du & Xie, 2020).

In order to understand better the consumers regarding the use of AI, consumers with higher certainty about their needs are more likely to accept AI chatbots. This acceptance is mediated by the perceived effectiveness of the chatbots. When consumers are certain about their needs, they perceive AI chatbots as more effective in providing relevant information and facilitating their decision-making. This effect is particularly pronounced for search products, where objective criteria can be evaluated before purchase. For experience products, the certainty of needs does not significantly impact AI chatbot acceptance due to the subjective nature of evaluation (Zhu et al., 2022).

Regarding the ethical impact on consumer decision making, it turns out that consumers are more likely to behave unethically when the AI identity is disclosed compared to when the AI is not disclosed. This trend is largely driven by perceived social judgment. Consumers feel less judged when interacting with public AI and therefore behave unethically (Li et al., 2024).

For the ethical principles of AI, the focus should be on ensuring that AI systems operate in a manner consistent with fundamental rights, democracy, and the rule of law. Respect for human autonomy means that AI should complement humans, rather than manipulate them, in order to preserve the right to self-determination. Harm prevention ensures that AI systems do not cause or exacerbate physical or mental harm and are protected from malicious use. Fairness requires that AI systems are free of bias and discrimination, ensuring equal opportunities and procedural fairness. Explainability requires that AI systems are transparent and that their decisions are understandable to those affected (Laine et al., 2024).

6. Conclusions

The development of technology and of the AI has deeply changed the way of how consumers behave in the digital era. A few of the central factors that work through the process of consumer decision-making are technology, AI, trust, privacy, and empowerment. Today's consumers have access to huge piles of information, and this information makes them capable of making smarter and more efficient decisions. Besides, AI-powered personalized marketing strategies engage and increase

customer satisfaction. Organizations need to competently manage ethical challenges related to trust and privacy issues through the integration of transparent and fair AI practices in a bid to retain consumer trust. This paper has emphasized that in making use of digital instruments, the requirement for constant adaptation and ethics arises with the end aim of satisfying the changing priorities and preferences of consumers. In view of these research findings, further studies should focus on some areas.

First, research into the long-term effects of AI and digital technologies on consumer trust and behaviour is needed, in particular within different cultural and demographic contexts. By doing that, one would be able to see what universal trends are and what are region-specific. Second, further study on the ethical setting for AI, involving bias and mitigation, is an important part of creating fair and transparent AI systems. It should also assess how well the numerous regulatory frameworks and industry standards in place facilitate ethical AI practices. One can further gauge the effect of new technologies—such as virtual or augmented reality—on consumer behavior. The last one is the longitudinal research in terms of changing consumer behavior that will give insight into the changing digital environment to help companies adapt to the future. The steps will help an individual to clearly understand the behavior of digital consumers and come up with strategies of effective and ethical engagement.

During the preparation of this work the author(s) used Chat GPT 4.0 in order to correct any misspellings and grammatical errors. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

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**Green Deal Era: Exploring Environmental Attitudes
and Ecological Behaviour**

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Abstract

Proposed by the European Commission in December 2019, the European Green Deal is a bold initiative aimed at transforming the European Union into a sustainable and carbon-neutral economy by 2050. To achieve this goal, it necessitates a collective approach and firm dedication from European institutions, member states, the private sector and civil society. This research assesses the factors which can influence the behaviour of consumers and delineates action plans aiming to encourage the realisation of sustainable choices. Specialty literature views the European Green Deal as a core, requisite stepping stone in the efforts taken by Europe toward creating a sustainable ecological revolution. Moreover, it triggered an assessment of environmental problems and fostered EU climate and economic objectives because of current and relevant events of an economic and political nature. In operating the research, information gathering concerning consumer behaviour and attitudes was conducted with the help of a survey, and it was analysed from the statistical point of view, foreseeing the realization of the European Green Deal. The European Green Deal will also ensure consumers are supplied with information on the environmental consequences of products and services, fostering transparency. The two goals are thus to encourage decision making based on knowledgeable facts and to increase responsible consumption. Furthermore, the implication of the European Green Deal brings along a series of disadvantages and opportunities that enable one to understand better the economic implications for consumers and to realize their desires and demands more clearly. There are important directions, according to the research, for example, including its ability to provide valuable knowledge about the impact of the European Green Deal on consumer behavior. It is through the reshaping of marketing strategies and approaches that organizations can plug into the changing trends posed by consumer preferences and become accustomed to the positively altered wish for sustainable products.

Keywords: Green Deal, Sustainability, Environmental Attitudes, Ecological Behaviour, Environmental Policies.

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1. Introduction

The European Green Deal was introduced in December 2019, and immediately became a big step toward sustainable development. The initiative is targeted at fighting climate change, preserving the environment, and providing economic growth together with social well-being. By putting the above goals together, the European Green Deal strives to protect the natural world and achieve a more sustainable future (European Commission, 2019).

The European Commission has in 2019 presented a detailed blueprint of the budget for this mega-project amounting to 1 trillion € which is to be spent over a decade. The European Union's budget for the years 2021-2027 is to be spent on the European Green Deal where it is estimated that, out of this, an overall budget of 30% is exclusively used for projects relating to fighting climate change. Not least among these, its primary objective is to support those regions and communities that will be most affected by the low-carbon transition process.

The European Commission prioritizes the welfare of consumers. Among the ambitious agreements is the European Green Deal, which focuses on sustainability and the fight against climate change. The agreement intends to bring about essential changes in a lot of sectors within the economy. We should, however, note that the policies of the European Green Deal may have different implications for different consumer groups. That is why it's very critical to know just how consumers' lives, finances, and well-being may be impacted by these changes. That understanding is key to a transition not burdening low-income or vulnerable consumers.

Environmental attitudes involve a person's perception, belief, and feelings towards the environment and environmental issues. They include a person's concern for the environment, values, and beliefs about conservation, responsibility to the future generation, and importance of protecting the environment. They also reflect willingness to participate in sustainable activities such as recycling and energy saving and views on environmental policies and regulation. Moreover, environmental attitudes integrate concern for the fact that personal actions can protect the environment and trust in environmental sources of information. People differ in this sense by their attitudes, shaped by such determinants as education, culture, upbringing, and social norms, and personal experiences.

2. Problem Statement

To see how effective Green Deal policies are, we need to look at how they affect consumers. If consumers experience negative effects or do not accept the changes, these policies may not work well. Conversely, if consumers benefit from the policies, this shows that they are successful.

This research seeks to understand the gap between what people think about the environment and what they actually do under the Green Deal. It focuses on obstacles to change, such as financial issues, lack of knowledge, and cultural opposition.

Moreover, it looks at how well the policies and incentives are working to promote sustainable behaviours.

To improve these policies, policy makers can study how consumers react to the Green Deal. Through detailed research, we can find out what motivates people to adopt a green behaviour. With this information, they can tailor incentives and information campaigns accordingly.

The Green Deal aims to ensure long-term climate and environmental sustainability. An important aspect of making these changes last and aligning consumer behaviour with environmental goals is consumer impact research.

The European Green Deal is a model for the other regions and countries facing climate change. By analysing the impact on consumers, we can learn valuable lessons applicable globally. As climate and environmental issues change, policies must be flexible and adaptable. Ongoing consumer impact research provides essential feedback, allowing policy makers to adjust policies in time.

The main aim of the European Green Deal is to encourage innovation and create new jobs and economic growth through the transition to a green economy (European Commission, 2019). Experts from different fields, such as environmental studies and public policy, approach the Green Deal from a different perspective, but all agree that it is an essential step for a sustainable ecological transition in Europe. Recent global events such as the Covid-19 pandemic and the war in Ukraine have provided a good context to analyse environmental issues and created an opportunity to strengthen both the climate and economic objectives of the European Green Deal (Skjærseth, 2021; Wolf et al., 2021).

A recent study by Gailhofer et al. (2021) shows that artificial intelligence (AI) has a great potential to help achieve desired goals. The research of Corrigan and Lucaj (2020) unveiled that AI has development potential by lowering greenhouse gas emissions in fields such as energy production, agriculture, land management, biodiversity conservation, transportation, and smart mobility. AI also ensures instruments that support the forecasting, adaptation, and management of the effects of climate change, and thus improves the resilience against hindrances. According to Nordgren (2022), the careful evaluation of probable obstacles and ethical dilemmas that can result are noteworthy for ensuring the responsible and ethical utilisation of AI. Supplementary research regarding AI usage in the shift towards a greener future will bring relevant insights and it is a direction that needs to be taken into account for further studies.

Establishing a fair, sustainable, and environmentally friendly food system in the European Union is a major objective of the Green Deal. To assess the impact of the main Green Deal strategies, such as reducing the use of chemicals in agriculture, minimising post-harvest food losses and promoting healthier diets with less meat, Guyomard et al. (2023) developed an economic model based on partial equilibrium. All the three strategies need to be put in practice together so that the climate, biodiversity, and nutritional performance of the European food system can be ameliorated to a great extent. Through this approach, the minimisation of greenhouse gas emissions from food consumption can take place by 20%, while biodiversity loss

can be lowered by 40-50%. Moreover, consumer food expenditure may meet a downward trend, while meat producers are exposed to difficulties as a result of reduced quantities and prices.

This study underlines the meaningfulness of sustainability and environmental defence, propositions that are reinforced by the European Green Deal. Through the performance of this research, people can comprehend in a better way how consumers, individually and collectively, shape environmental goals and more sustainable policies. In the view of Hainsch et al. (2022), the adherence to the European Green Deal can trigger major changes regarding consumer conduct, as their awareness on their environmental impact heightens and their choices are more sustainable, for instance the minimisation of energy consumption and the implementation of more efficient waste management strategies.

Based on Ajzen's (1985) theory of planned behaviour, intentions play an important role in influencing behaviours, being shaped by three key factors: attitudes, social norms, and perceived control over behaviour. To integrate all of these concepts into a single framework, it is necessary to include three essential components: knowledge about environment, social, and moral values related to the environment and ecological intentions. Both the theory of reasoned action and the theory of planned behaviours suggest that attitudes influence behaviours through intention (Hines et al., 1987; Kaiser et al., 1999).

However, the European Green Deal does not place enough emphasis on the impact of individual actions. The Green Deal relies on collaboration under the direction of the EU, rather than to stimulate citizens to alter their conduct in a complete manner. By employing this strategy, the EU becomes the leader and expert in terms of initiatives intended to deploy the industry, to lower emissions, and shelter the economic change, while also benefiting from an improved degree of authority. Questions arise from the part of some researchers regarding the possibility of technological progress and ecological solutions to substitute the need for collective determination, that can trigger drastic changes in people's and communities' conduct (Eckert & Kovalevska, 2021).

To successfully achieve the objectives of the European Green Deal, a joint effort and firm commitment is needed from various entities, including the European institutions, member states, the private sector, and civil society. Recognising the important role that consumers play in the transition to a green and sustainable economy, it is essential to understand how their decisions influence the demand for products and services.

Understanding consumer behaviour is very important because consumers are the ones who ultimately decide to buy products and services (Ajzen, 2005). By analysing consumer behaviour, companies and marketers can seize the opportunity to increase sales and revenues. This can be achieved by developing marketing, sales, and branding strategies based on a deep understanding of consumer behaviour.

Consumer behaviour is influenced when they make decisions and this behaviour can be analysed from two perspectives: micro and macro. From a micro perspective, understanding consumers is critical to helping companies or organisations achieve

their goals. Khan (2006) explains that the macro perspective is based on the idea that consumers together can shape the environmental and social conditions in society. Consumers have a significant impact on production, resource use and therefore on the market and living standards.

For a company to pursue environmental sustainability as part of its strategic plan, it must meet three key objectives: economic viability, social sustainability, and ecological sustainability (Dyllick & Hockerts, 2002). However, Vithessonthi (2009) points out that developing and implementing such a strategy can be challenging for employees within the organisation. To meet all three objectives, the company may need to make significant internal changes, such as changes in organisational structure, human, and capital resources, processes, or products. Despite being needed, these changes may face opposition from employees.

Variables that need to be taken into account in order to alter consumer conduct in a significant way are represented not only by the sales objectives of the organisation, but also by the circumstances that permit consumers to adjust the market. In line with Sikora (2020), changes operated to prices and taxes for some products and services can influence to a significant degree consumers' conduct, their decisions being determined to reflect more sustainable alternatives. On the other hand, particular consumer groups can find the upturn of prices and taxes as being discouraging, thereby lowering purchases.

Empowering consumers to make informed choices and be aware of the environmental impact of products and services are fundamental elements of the European Green Deal. This initiative, highlighted by Sanchez-Reaza et al. (2023), aims to provide consumers with the necessary knowledge to make informed decisions about their purchases and how they consume. Research in this area plays an important role in showing how the European Green Deal influences consumers. These data are essential for political decisions and the development of effective measures and policies.

The meaningfulness of data collection concerning the shifts in consumer behaviour as a result of the European Green Deal has been indicated by scientists. Its aim is defined by innovation nurturing and green technology development, allowing consumers to opt for green products and services. This initiative can improve living standards and meet consumer needs in a sustainable way (Bernstein et al., 2022).

Barry and Hoyne (2021) recently emphasised the importance of inclusivity, ensuring that every person and place receives equal attention and fair treatment in efforts to achieve climate justice. This will be with respect to the context of sustainable development, through which it can integrate all dimensions in a society in an ecological, cultural, social, and economic system in a harmonious way. The impact of climate change and actions of the society must be assessed, and appropriate indicators must be used to measure their sustainability and effectiveness toward the achievement of Green Deal Europe objectives (Dobbs et al., 2021).

Currently, key indicators are mainly about environment change pertaining to climate change. This incorporates factors such as changes in precipitation, temperature change, greenhouse gas emission, rise in sea levels, floodings, and land degradations (Gandini et al., 2021). The expansion of these indicators into other factors incorporates communities, regions, and countries into environmentally and socially sustainable areas.

It is very important to do research that can bring out challenges but also opportunities that the Green Deal presents to consumers. Understanding what prevents or helps people to adopt sustainable behaviors and assessing and understanding consumer preferences and needs throughout this transitional period.

While the impact of consumer action on the environment was complex, earlier research focused on single products or activities and did not allow consumers effectively to monitor their own behaviour. Ajzen et al. (1982), however, showed that such self-monitoring is a precondition if people are to adopt a more sustainable lifestyle. We must therefore look at new approaches. The sociology of consumption is a new and promising area in this respect.

Such actions to make a person's lifestyle greener may impinge on the way in which all aspects of his life dovetail and integrate with each other by asking individuals to re-examine each facet of their lives with an ecological perspective, by creating an "ecological profile" for each area of their life. It is explained that in this process, people want to find a balance between factors like economic, ecological, cultural, and social factors (Spaargaren & Van Vliet, 2000). Such influence of the European Green Deal on the environment in relation to carbon emissions, resource usage, and ecological sustainability can be confirmed by applying very famous environmental theories (Stern, 2000). For example, economic theories such as consumer choice theory and supply and demand analyses might also be applied to provide a better understanding of how such a Green Deal or other global changeovers can influence consumer spending, green product prices, and the general economic environment (Cassetti et al., 2023).

According to Hass and Sander (2020), increasing the number of routes, frequency of rides, and reliability of services will help popularize public transport. Attractive fares or subsidies can be offered so that more and more people travel using public transport. Establishing clear waste collection schedules and launching educational campaigns, together with other simple steps like recycling bin installation, will help people reduce waste and get involved in recycling. In addition, Krajnc et al. (2022) discuss electric vehicle (EV) adoption, promoting green products, educating and raising awareness among consumers (especially the youth), ensuring accessibility and inclusion, providing financial support to disadvantaged communities, and protecting consumer rights.

The importance of collective social systems becomes clear when people try to live more sustainability and consume responsibly at home. If people are very aware of the environment, but there is little ecological innovation in the systems that provide our needs, this leads to less environmentally friendly behaviour (Carolan, 2004). However, people are more likely to adopt energy and water saving devices if

they easily integrate into their daily routine and lifestyle. To understand how household organisation influences sustainability, we need to analyse two key aspects: how daily activities are structured and the cultural standards that accompany them (Rajala & Katko, 2004).

It is important to understand that green advances can reach consumers through different methods. Green taxes are usually implemented through public services, while organic food products are mainly provided through the private sector. Certain innovations, such as car sharing programs and neighbourhood composting, are facilitated informally. The transformation of household consumption towards and ecological upgrade is not limited to influences from production. In fact, many green innovations introduced by private and public organisations, such as organic food products, green energy initiatives, and water reuse systems, have come about because of consumer demand.

3. Research Questions / Aims of the Research

The key objectives of the research paper are to assess consumer knowledge regarding the European Green Deal, analysis of consumer behaviour, and purchasing habits in the context of the European Green Deal. We are also working to understand changes in consumer preference and choice, socioeconomic and cultural factors that influence consumer choice, and barriers to choosing sustainable behaviour, and evaluating the effectiveness of policies and incentives for adopting sustainable behaviour. This shall be to enthuse consumers toward a more sustainable lifestyle. The financials for the European Green Deal will be brought more into focus for consumers. In this regard, the costs and benefits of the transition will have to be assessed against how eco-friendly products and services are accessible and available to consumers, with special attention paid to different consumer segments.

First of all, while transitioning to a sustainable and green economy, consumers' needs and demands should be understood and addressed. Assessment of the consumer view with respect to the policies and measures taken through the European Green Deal shall be conducted to identify concerns, expectations, attitude, and opinions about the proposed initiatives.

Such objectives, if achieved, would give great insight into how the implementation of the European Green Deal would affect consumers and, hence, be very informative for the development of impactful policies and measures that could engage and empower consumers in the transition towards sustainable and responsible consumption.

4. Research Methods

In order to study environmental attitudes and ecological behaviour during the Green Deal Era, we applied a quantitative study using survey methods.

The sample was calculated according to the formula " $n = (t^2 \times p \times q) / e^2$ " (Cătoi et al., 2002): n , where " n " is the sample size, " t " is the coefficient associated with the probability of guaranteeing the results (confidence level) predetermined by the

researcher and “p” the non-percentage share of the sample components, which are characterised by a certain attribute, and “q” is the non-percentage share of the sample components that are not characterised by a certain attribute (calculated with the “1-p” relationship). We decided to work in the case of a probability of guaranteeing the results of 95% ($t = 1.96$), resulting in “ $n = (1.96^2 \times 0.5 \times 0.5) / 0.05^2 = 384$ ” (being the minimum number for the sample size).

A sample of 229 individuals is considered for this study due to limitations imposed by the process of data collection. The research was conducted during the period January-February 2024 and was distributed online. The utilisation of a small sample size in research presents challenges such as restricted scientific conclusions and potential barriers to scientific exploration.

Following the predetermined research schedule, the research phase commenced with the collection of data and information. Once the data was collected, it underwent processing to ensure it was ready for analysis and interpretation. After the completion of the encoding process, the data was entered into the SPSS software, where we analysed and interpreted it.

During the survey research we used 18 questions divided in four categories, such as environment protection, pollution, European Green Deal and eco-friendly products. For this research we analysed the data from only two categories, European Green Deal and environment protection.

The analysis of the variables is conducted in relation to important socio-demographic factors, such as gender, income level, and education.

5. Findings

Prior to delving into the primary findings of the research, the sociodemographic attributes of the participants were analysed, with emphasis on their gender, age, income level, occupation, and education. All of these attributes are very important for this study in order to test for relationships between two variables, such as ecological behaviour or the knowledge level of respondents about the objectives proposed by the European Green Deal (EGD).

At the start of the study, participants were asked to evaluate the level of knowledge of the European Green Deal objectives. The distribution of responses is shown in Table 1. Most respondents (32.3%) considered that they know the proposed objectives to little extent. Interestingly, just 0.9% answered that they know them to a very large extent, meanwhile 14.4% have never heard of them. This could be argued to the little media coverage, the lack of communication from the authorities, or the indifference from the population for this subject. Overall, 29.7% claimed that they know about these objectives to some extent or to a large extent. The use of the Internet, social media or participating in courses, conferences on this subject might have helped to achieve these results.

Table 1. Respondents' level of knowledge of the EGD objectives (N=220)

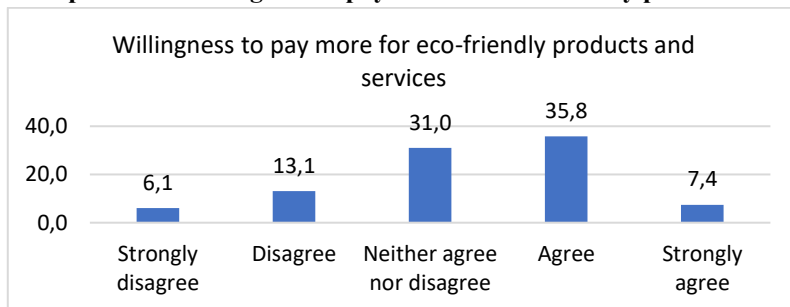
Category	Frequency	Percent
To a very large extent	2	0.9
To a large extent	28	12.2
To some extent	40	17.5
To little extent	74	32.3
To no extent	43	18.8
Not at all	33	14.4

Source: authors' own calculations.

When it comes to test for relationships between their knowledge level and sociodemographic aspects, we used Chi-Square tests. The results did not reveal a significant relationship between the variables ($p < 0.05$). This may be due to the fact that there is a small degree of knowledge of the EGD objectives, as well as a lack of information from the authorities or other competent institutions. In order to understand more on this topic, we asked the participants to mention if they agree with a series of affirmations about the implementation of the European Green Deal. 51.5% of the respondents think that the EU should invest more money in environmental protection programmes and projects. Moreover, 45.4% remarked an increase in the concern of companies regarding their impact on the environment. More than half of the respondents (53.3%) admitted that they changed their purchasing behaviour after seeing sustainable campaigns from companies. Nevertheless, 59% believe that advertising of a company's sustainability practices is often exaggerated or false.

As shown in Figure 1 below, 35.8% of the participants are willing to pay more for eco-friendly products and services. Thus, 31% cannot decide if they are willing to pay more. This requires more attention from the authorities and the scientific community in order to present the benefits of choosing more sustainable products and how to maintain a level of price which might be accessible for a larger part of the population.

Figure 1. Respondents' willingness to pay more for eco-friendly products and services



Source: authors' own calculations.

When it comes to a better implementation of the EGD objectives, respondents were asked to rate how significant are the following measures or initiatives (Table 2) for them on a 5-point scale (1 = lowest score, 5 = highest score). 42.8% of the respondents strongly agree with stronger regulations and penalties for noncompliance with environmental standards (with a mean score of 4). 69.9% believe that is necessary to increase the investment in sustainable technologies and innovations (with a mean score of 4.11).

Table 2. Respondents' level of knowledge of the EGD objectives (N=220)

	Increased education and awareness among consumers and businesses	Intensive promotion of ecological alternatives and responsible consumption	Monitoring and reporting progress transparently	Financial and tax incentives to companies and consumers who adopt sustainable options	Increasing investment in sustainable technologies and innovations	Tougher regulations and penalties for non-compliance with environmental standards
Mean	4.00	4.03	3.81	3.82	4.11	4.02

Source: authors' own calculations.

In one of the questions of the survey, the participants were asked how often do they approach an ecological behaviour in their daily lives. The collected results were analysed as shown in Table 3. We can note that 59.8% of the respondents answered that they avoid wasteful packaging for their groceries. Moreover, 37.5% are buying recycled products, but 32.3% are indifferent towards what kind of products are they buying, either recycled or not. It is important to take into account the good intention of the respondents to look for eco-friendly products while shopping (46.7%). In regard to which materials are recycled by the respondents, they frequently recycle glass (56.8%), plastic (59.8%), and paper (51.9%). When it comes to recycling metals, 46.3% affirmed that they rarely recycle this type of material. Studying these issues might be a relevant topic for future research.

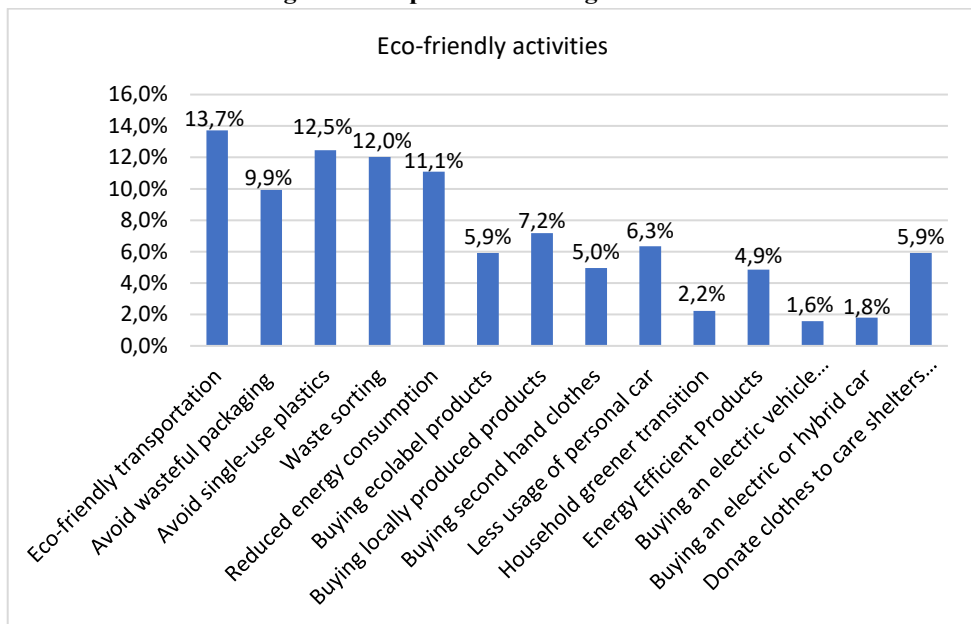
Table 3. Respondents' ecological behaviour (N=220)

	No need for extra packaging for groceries		Buying recycled products		Looking for eco-friendly products		Disposable packaging instead of returnable packaging		Recycle metals		Recycle glass		Recycle plastic		Recycle paper	
	Frequency/Percent															
Very Rarely	90	39.3	21	9.2	18	7.9	32	14.0	61	26.6	28	12.2	26	11.4	26	11.4
Rarely	47	20.5	48	21.0	30	13.1	45	19.7	45	19.7	29	12.7	26	11.4	35	15.3
Somewhat	50	21.8	74	32.3	74	32.3	65	28.4	57	24.9	42	18.3	40	17.5	49	21.4
Frequently	34	14.8	69	30.1	87	38.0	66	28.8	51	22.3	87	38.0	85	37.1	69	30.1
Very Frequently	8	3.5	17	7.4	20	8.7	21	9.2	15	6.6	43	18.8	52	22.7	50	21.8

Source: authors' own calculations.

In accordance with this subject, the respondents were asked the degree to which they agree with a series of statements regarding eco-friendly products and their attitude toward the environment. 80.8% of the respondents claimed that the price for ecological products is above average, but 61.7% think that the quality of these products is better. Unfortunately, 50.7% think that Romanian people do not care about environmental protection enough, but 46.7% claimed that they often talk with friends about environmental degradation. 70.3% of the respondents try to choose the products that pollute less, if they are available and 82.5% turn off the lights, air conditioners, computers, or other devices that consume electricity when they leave work. From the answers collected and analysed we can say that people tend to choose eco-friendly products, they are willing to change their behaviour for the good of the environment, but the authorities and institutions involved in this transition should approach the problem of higher prices and how to make this products and services more accessible to the population.

Figure 2. Respondents' ecological behaviour



Source: authors' own calculations.

For the last part of the research, as shown above in Figure 2, we did an analysis of the most common eco-friendly activities carried out by the respondents (out of 14 choices). The three most used ecological activities are ecological transportation (by walking, by bicycle, public transportation, or electric car) with 13.7% of the respondents, then the less usage of disposable tableware (12.5%) and waste sorting with 12%. During the last year, 63.3% of the respondents have had between one and four eco-friendly activities, while 7.4% had between nine and 12 activities. None of the respondents chose all 14 activities.

Table 4. Correlation analysis of respondents' sociodemographic characteristics with ecological practices

Category	Question	Pearson Chi-Square Asymptotic Significance (2-sided)
Gender	Buying a hybrid/ electric car	0.011 (N=224)
	Donate clothes	0.003 (N=224)
Age	Eco-friendly transportation	0.039 (N=229)
	Avoid wasteful packaging	0.016 (N=229)
Education	Buying a hybrid/ electric car	0.026 (N=224)
	Avoid wasteful packaging	0.008 (N=224)

Source: authors' own calculations.

In Table 4 we presented the correlation analysis of respondents' sociodemographic characteristics with ecological practices. The results revealed a significant relationship between the variables ($p < 0.05$). When it comes to gender, we found out that males are more likely to buy a hybrid or an electric car than females, but for donating clothes to care centres or second-hand stores females are more likely to do these activities. Regarding the age, the results show that younger people with ages between 18-45 tend to choose eco-friendly transportation more than the other categories and, at the same time, the respondents with ages between 18-55 are more likely to avoid wasteful packaging.

For their education level, we analysed variables such as ecological transportation or wasteful packaging. In this case, we found out that people with a higher level of education (university or high school graduates) tend to choose hybrid cars or electric cars and avoid wasteful packaging for the products they purchase. For the older generation, we should carry out more research in order to find out why they are reluctant to these practices and how we can convince them on adopting more sustainable decisions. More on this, we can confirm that the income level has a significant relationship with variables such as buying a new electric or hybrid vehicle. Moreover, we found out that the marital status also influences the decision of choosing a less polluting way of travel. The area or residence (urban/ rural) also influences the decision of choosing not to use the personal car at the expense of other modes of transport or just working from home. From the study, we can see that respondents from urban areas are more likely not to use their personal car that often. This may also be possible due to the greater presence of public transport in large cities. Also, the respondents from urban areas tend to donate the clothes more than the ones from rural areas.

6. Conclusions

Our sincere curiosity to understand and promote greener and more responsible consumption led us to analyse the impact of the European Green Deal on consumers. We are aware of the importance of protecting the environment and we should be actively involved in combating climate change and other environmental problems.

This is why it is essential to see how the European Green Deal can help promote environmentally friendly and sustainable products and services.

Based on the analysis of respondents' answers, it can be concluded that there is a tendency to place value on environmental protection and take actions to support it. However, when it comes to purchasing green products, there is still a low frequency of consumption and pessimism towards the above-average prices of ecological products. Future studies should investigate the primary reasons why Romanian consumers are hesitant to buy and consume more ecological products, with accent on the older generation. It is possible that consumers lack awareness or have doubts about the transition to a greener lifestyle.

It is important to note that this study has certain limitations. Due to the sampling method and data collection instrument used, the findings of this study cannot be generalised. Further research on the ecological behaviour and environmental attitudes of Romanians should explore different research methods.

In order to maintain positive transformations, it is essential to remain actively involved and informed, while implementing specific measures to tackle inequalities and ensure equal opportunities for environmentally friendly solutions. Further research should be conducted to examine the long-term impact of Green Deal initiatives, as well as to develop effective approaches for involving varied communities in sustainable practices.

During the preparation of this work the author(s) used Chat GPT 4.0 in order to correct any misspellings and grammatical errors. After using this tool/ service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

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**The Application and Efficiency of Neuromarketing Tools
in Marketing Research: A Comprehensive Review
and Future Research Agenda**

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Abstract

Neuromarketing, with its automated and implicit processes, has a profound impact on understanding customer decision making and unveils concealed insights into consumer behaviour. There is an increasing interest among researchers in exploring how consumers' brain responses influence their decision-making processes. A primary goal in today's market is understanding what motivates consumers to choose one product over another. Although neuromarketing positions itself as a key research field to achieve this goal, it remains a relatively young and rapidly evolving discipline. Therefore, it is useful to present a comprehensive review of the scientific studies concerning the application of neuromarketing, with special attention to its diverse tool and outlining the distinct benefits that ensure the rigorous execution of high-quality neuromarketing research. The purpose of the present study is to provide a "comprehensive overview of the application of neuromarketing tools - classification of neuroimaging and physiological tools" - on the practice of marketing research. Thus, literature review was covered aiming academic papers, scientific articles and relevant sources in this field and using the methodology text-mining. The papers were selected between 2010 and 2023 using the search for "neuromarketing tools" in valid databases. Valuable results are provided especially for the use of "electroencephalography" (EEG) and "functional magnetic resonance imaging" (fMRI) regarding cost efficiency. Overall, this paper seeks to serve as a valuable resource for understanding the array of neuromarketing tools available and their advantages, achieved through bibliometric and content analysis studies. What distinguishes this research is its up-to-date review of neuromarketing tools and their proven effectiveness in targeted domains. Consequently,

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it provides valuable insights and guidance for both academic and business endeavours, aiming to enhance efficiency in marketing research and inspire future investigations.

Keywords: consumer behaviour, decision-making process, neuromarketing, “electroencephalography” (EEG), “functional magnetic resonance imaging” (fMRI).

JEL Classification: M31, O32.

1. Introduction

Antonio Damasio, a well-known neuroscientist and appreciated author once said, “We are not thinking machines that feel, we are feeling machines that think”. According to Damasio and many others, despite our admiration for cognitive abilities, the brain has long depended on instinctual reactions for millions of years. Regarded from a neuromarketing point of view, it suggests that certain principles should be employed in advertising messages to enhance information processing at the brain level (Morin, 2011). There is an increasing interest among marketing researchers and academics for this young neuromarketing field that helps in finding concealed insights into consumer behaviour and in understanding customer decision making.

1.1 Context

At Harvard University, “Neuromarketing” as an idea was created by therapists in 1990 (Cuesta et al., 2018; Singh et al., 2023). However, in 2002, Ale Smidts, a Dutch organisational theorist who was also a marketing professor, presented the term “Neuromarketing” (Boriceanu, 2009). A year later, in 2003, researchers utilised fMRI brain imaging techniques to investigate and comprehend consumers' preferences for common beverages such as Coca-Cola and Pepsi (McClure et al., 2004). This study, through its incomplete elucidation of consumer decision-making prompted a quest for deeper insights into this emerging research field (Stasi et al., 2017). “Neuromarketing” is part of the “Neuroscience” research domain that aims to anticipate the consumer’s behaviour through the cerebrum’s basic actions and responses. It is demarcated as the field of study of the cerebral apparatus to comprehend consumers’ behaviour to advance a business’s marketing strategies (Boriceanu, 2009).

2. Problem Statement

Year by year the number of papers focused on this young domain grows, and that is why it is very hard to get a clear overview of the neuromarketing tools and afterwards to keep up with the proven efficiency of every single one of them obtained in specific studies. That is why it is necessary to provide a user-oriented presentation of the neuromarketing literature. For a newcomer in neuromarketing field, there is a great need for a detailed guide for high-quality research. “Therefore, we discuss the different steps a newcomer is likely to take when moving into the neuromarketing

field, along with their informational needs at various stages of their development as a neuromarketing researcher” (Lee et al., 2018). The added value of this study is to present the application and the efficiency of the neuromarketing tools to marketing research demonstrated in papers published in well-regarded and influential marketing journals.

3. Aims of the Research

The objective of this research project is to provide a better understanding of the application and efficiency of neuromarketing tools in marketing research. This goal can be achieved by getting a comprehensive overview of the field: from the past up to the present and setting the future agenda. So, the contribution of this study would be to present an up-to-date review of the specialised literature and provide a set of directions for future improvement of the research in the field of neuromarketing, as discovered from the literature review (Lee et al., 2018; Sánchez-Núñez et al., 2021).

4. Research Methods

In pursuit of an exploratory approach, a research based on secondary sources was chosen, in order to obtain insights about the use of “neuromarketing tools in marketing research”. To achieve this goal, the search for papers was started by establishing the keywords: “neuromarketing”, “neuromarketing tools in marketing research”, “application of neuromarketing tools”, “EEG”, and “fMRI”. The first criterion used to select the papers for this secondary data research was related to the publishing year: the interval between 2010 and 2023 was chosen. The second criterion was represented by the scientific databases, where the keywords provided valuable results: Springer Open, Wiley Online Library, Sagepub, Emerald, MDPI, and Elsevier. In the end, a total of 20 papers were returned according to the required criteria and were included in the present analysis.

5. Findings

The articles included in this study have had performed different types of researches: comprehensive analysis using keyword cooccurrence analysis and science mapping tools; text-mining; systematic reviews; “Preferred Reporting Items for Systematic Reviews and Meta-Analyses” (PRISMA) framework; Themes, Contexts, Characteristics and Methodology framework (TCCM) or bibliometric analysis.

5.1 Literature Review - Background

Studies using neuroimaging methodologies provide insight into the real-time consumer response to a specific stimulus (Burgos-Campero & Vargas-Hernandez, 2013). What is needed before sophisticated brain imaging studies is strong theory which predicts specific neural activation differences, rather than exploratory work aiming to map “what happens in response to a marketing stimulus” (Lee et al., 2010).

The neural measures are better predictors of population-level data than self-report measures. Marketers can apply these tools to gain insights about the consumers' intention towards their products and services, and it can help them test their branding and marketing strategies before actually implementing them in the target market (Agarwal & Dutta, 2015). Neuromarketing techniques can be split into two main categories: "neuroimaging" and "non-neuroimaging" techniques (Martínez-Navarro et al., 2019). "Neuroimaging techniques" involve monitoring brain activity and electrical signals, whereas "non-neuroimaging techniques" do not engage with neurological activity (Gill & Singh, 2020). Calvert et al. (2004), Kenning and Plassmann (2005), Zurawicki (2010) and Bercea (2012) helped with further detailing this classification as presented below.

"Neuroimaging Techniques"

A. "Recording Metabolic Activity in the Brain":

- **fMRI** ("functional Magnetic Resonance Imaging"): measures the oxygen used by different areas of the brain (it measures: "memory encoding, sensory perception, trust and brand engagement, loyalty, preference, recall").
- **PET** ("Positron Emission Tomography"): "is a clinical imaging symptomatic method used to quantify the body's metabolic movement" (it measures: "memory encoding, engagement, emotional engagement, attention, processing visual input").

B. "Recording Electrical Activity in the Brain":

- **EEG** ("Electroencephalogram") test: it evaluates the electrical signals sent from one neuron to another (it measures: "attention, engagement, excitement, emotional valence and cognition, memory encoding, recognition").
- **fNIRS** ("Functional near-infrared spectroscopy"): is an optical technique for monitoring brain activity, that utilises near-infrared light.
- **MEG** ("Magnetoencephalography"): analyses and maps brain activity using a cap equipped with 100-300 sensors (it measures: "perception, attention, memory").
- **SST** ("Steady-State Topography"): it measures: "sensory perception, valence of emotions".
- **TMS** (Transcranial Magnetic Stimulation)

"Non-Neuroimaging Techniques"

- **ET** (Eye tracking): This records individuals' eye movements during an eye-tracking task (it measures: "visual search, fixation position, eye movement patterns, spatial resolution, excitement, pupil dilation").
- **Facial coding or Facial Expression**: It detects subtle muscle movements when individuals react to marketing stimuli (it measures: "unconscious reactions, emotions").

- **fEMG** (facial Electromyography): it employs facial sensors to record the electrical response generated by facial muscles contractions (it measures: “unconscious and subconscious reactions, valence”).
- **Galvanic Skin Response (GSR) or Skin Conductance:** researchers employ GSR to assess the level of customer excitement following the exposure to external stimuli (it measures: “emotional engagement, valence and arousal of emotions”).
- **Heart Rate**
- **Implicit Response Tests:** another type of tools that provides subconscious data on behaviour or attitude (it measures: “reaction time, underlying attitudes/evaluation”).
- **Measuring physiological responses.**

5.2 Neuromarketing Tools in Marketing Research: Up-to-date Review

Yadava et al. (2017) in their study utilised an affordable setup to analyse brain activity through EEG signals, which provided high temporal resolution, was more cost-effective than fMRI and used fewer electrodes - only 14. He demonstrated that these parameters expanded the application of EEG from the laboratory to everyday practice. The main contribution of that study was offering a neuromarketing framework that could be utilised to develop market strategies, conduct research and predict market success by enhancing existing models (Yadava et al., 2017). Lin et al. (2018) concentrate on “various ways in which EEG research can inform marketers, such as research on attention, memory, attitudes, decision-making, emotions and more”, while Hakim and Levy (2018) try to establish the specific application of EEG in predicting the preferences.

Neuromarketing field provides promising results as Ruanguttamanun (2014) shows in his study that fMRI offers a new cutting edge method that is able to shed light on subconscious processes, which could substantially increase the effectiveness of advertising messages.

According to Shahriari et al. (2019), marketers must comprehend the subconscious aspects of consumer behaviour to fulfil their needs, as the majority of cognitive processes occur subconsciously, making it difficult for consumers to express their preferences explicitly. Neuromarketing is the side of neuroscience research that focuses on understanding the consumer behaviour through the brain's instinctual processes and responses (Gill & Singh, 2020). Their research adds value to marketing research by offering an efficient method to measure the customer's unconscious reactions. In their study, Singh et al. (2023) demonstrate that neuromarketing methods excel in gauging customer responses to marketing actions. Their neuromarketing study “conveys valuable insights to scholars, researchers and marketers by offering comprehensive future research perspectives and theoretical evolution for augmenting their overall understanding of the neuromarketing discipline” (Singh et al., 2023).

5.3 Neuromarketing Tools in Marketing Research: Future Agenda

Similar to other technologies, neuroscience technology meets a significant challenge: the ethical considerations, such as maintaining privacy and confidentiality, protecting vulnerable groups, and ensuring the honest interpretation of research findings (Shahriari et al., 2019). Ethical issues act as a barrier in the development of neuromarketing, but to a certain extent they are regulatory mechanisms for the progress of the field (Bercea Olteanu, 2015; Vlasceanu, 2014). In their paper, Ulman et al. (2014) suggest that “neuromarketing technologies should be sufficiently discussed in public spheres and its use on humans should be fully carried out according to the ethical principles and legal regulations designed in line with human rights and human dignity”.

Since 2015, the application of Machine Learning in neuromarketing focuses especially on “like/dislike classification problem” and “predicting consumer choice problem” (Rawnaque et al., 2020). For instance, using “advanced neural recording method” and “signal processing tools”, researchers can analyse EEG signals and determine how they relate to marketing stimuli. This demands the implementation of advanced “Machine Learning algorithm application” in Neuromarketing. According to Rawnaque et al. (2020) the most utilised classification algorithms in Neuromarketing experiments over the last five years included: “Support Vector Machine” (SVM), “Linear Discriminant Analysis” (LDA), “Artificial Neural Network” (ANN), “Naïve Bayes”, “k-Nearest Neighbor” (KNN) and “Hidden Markov Model” (HMM).

In their study, Alsharif et al. (2023) emphasise the neural responses related to consumer behaviour such as attention, emotions, perception, reward processing, and motivation, to be taken into account in the marketing mix, and EEG was the most involved tool in this research. “The frontal and temporal gyri were correlated with pleasure/displeasure and high/low arousal; the occipital lobe is linked to attention processes, while the hippocampus relates to long and short-term memory”. Gill and Singh (2020) state in their study that the EEG test holds an advantage over fMRI due to its portability, enabling it to test individuals in public locations such as shops and cinemas. Along with EEG, fNIRS is one of the most commonly used noninvasive neuroimaging techniques that can be applied in portable environments.

Casado-Aranda et al. (2023) stated that “fMRI and EEG stand out in providing a comprehensive insight into the brain processes underlying the processing of communication”. The activation of “deep emotional, mentalising, memory and valuation networks in communication contexts may strongly predict behavioural tendencies, persuasion, and conversion”. The added value provided by this study is the valuable overview of suitability and cost efficiency of neuromarketing tools.

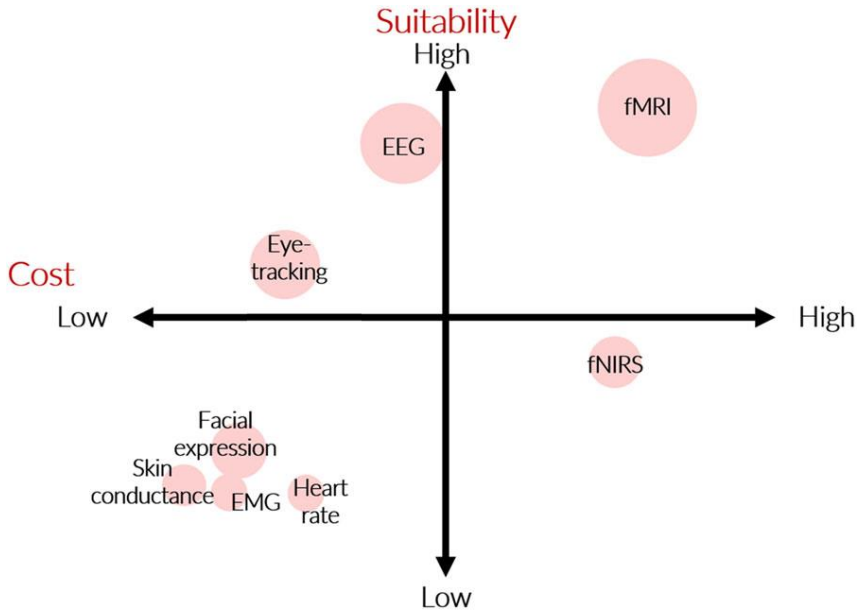


Figure 1. ‘Most relevant neurophysiological tools by cost and suitability in communication research’

Source: Casado-Aranda et. al., 2023.

In their paper (Mileti et al., 2016), the researchers introduce “the integration of neuromarketing and nanotechnologies that could start a new field of research, which is termed nanomarketing”. Nanomarketing makes possible “noninvasive and nonintrusive experiments in shopping places” and real-time monitoring of consumers' mental processes. The added value for our research: wireless and remote-controlled nanodevices could facilitate a continuous monitoring of the neurophysiological processes of the subjects. This eliminates the limitations and artificiality of laboratory studies and makes the results more applicable to everyday life conditions. So, using portable/wearable or environmental devices could significantly enhance companies' abilities to comprehend, predict and adapt to market changes.

6. Conclusions and Implications

This study revealed the application and increasing efficiency of “neuromarketing tools in marketing research”, offering a better understanding of their use in decoding the emotions that trigger the decision-making process. Using neuromarketing tools in marketing research has significant managerial implications and here are some of them: improved marketing strategies, competitive advantage, enhanced consumer insights, product development, cost efficiency, and ethical considerations.

This research has certain limitations that need to be acknowledged. Firstly, the study relied on secondary data sources, such as academic articles, which may have limited the depth of the analysis. Secondly, the criteria used for selecting articles for the analysis may have introduced a degree of subjectivity, which could potentially affect the comprehensiveness of the findings. Although efforts were made to ensure a representative sample, the inclusion and exclusion criteria might have affected the results.

As a future research direction, it should be taken into account organising an up-to-date expertise of the technological advancements of EEG test.

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**Navigating Online Success:
Assessing the Impact of Google and Meta Ads
on a Family-Owned Pharmacy Chain in Romania**

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Abstract

This paper analyses the advertising campaigns built through Google and Meta Ads (Facebook and Instagram) and the results they have generated for a family-owned chain of pharmacies in Romania. In 2022, the brand, which has been operating for almost three decades, started using online advertising to reach a wider audience and to generate online sales. The primary objective of the paper is to measure the performance of online advertising in terms of brand visibility, website traffic, and online sales over a two-year period from April 2022 to March 2024. The following key performance indicators were analysed: clicks, impressions, CTR (click-through rate), conversions, conversion rates, transactions, and ROAS (return on ad spend) in order to understand how different marketing strategies on Google and Meta Ads can improve online sales. This research aims to provide insights and incentives for other family businesses, especially those with large well-established track records of customers and using traditional forms of advertising to transition to digital marketing and e-Commerce.

Keywords: Google Ads, Meta Ads, Google Analytics, pharmacy chain, family-owned business.

JEL Classification: M31, M37.

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1. Introduction

Advertising can be defined as the process of creating and spreading messages that promote products, services, and even ideas to influence the attitudes and behaviours of a target audience (Yousef et al., 2021).

The expansion of the Internet has created not only a variety of multimedia formats for photos, sounds, or videos, but also a large pool of advertising locations ranging from social media to websites, mobile applications, or games. The ability to turn every piece of advertising into a very targeted, interest-driven message with a relatively lower cost than traditional advertising, has led the online into becoming the dominant sector in the advertising industry (Yang & Zhai, 2022).

The main reasons for choosing online advertising in the marketing strategy include the launch of a virtual presence, the facilitation of commercial promotion, the dissemination of commercial-related information, the provision of customer services, the enhancement of the public interest, access to key target populations, response to pre-existing inquiries, the creation of a permanent information dissemination mechanism, and the agile updating of content required by changing needs (Savciuc, 2016).

The data-based marketing concept refers to the process of collecting, integrating, and analysing customer data from various sources, including email marketing, digital content (websites, blogs, podcasts), social networks, and mobile ads, to inform and optimise the way marketing activities are performed (Lee & Cho, 2019).

Social media activity increases web traffic but does not significantly increase product orders or sales (Dolega et al., 2021).

Paid search advertising has a more positive impact on sales than offline advertising. Paid search is closer to the real purchase decision and has improved targeting capabilities (Bayer et al., 2020).

Once consumers know that ads are commercially sponsored messages, they will probably avoid Facebook native ads by skipping, scrolling down, or not following them (Youn & Kim, 2019).

2. Problem Statement

It is known that nowadays, television, a very popular form of advertising, is more expensive than online advertising which is a strategy to increase the awareness of the brand, traffic, and sales for any company, whether e-Commerce platforms (online stores), services (presentation websites), web applications, or mobile apps.

Google Ads is an online advertising platform where businesses can implement ads in order to reach people who are interested in their products or services. In Google Ads, different objectives can be set up: product and brand considerations, brand awareness and reach, website traffic, leads, sales, and app promotion. Google Ads is a web-based application, so advertisers can change settings, text, banners, videos, or budgets anytime. There is no minimum expenditure commitment, and advertisers can set and control their budgets. Moreover, companies can choose where the ads appear and measure the impact of their ads (Google, 2024a).

Meta Ads is a digital marketing tool that can help companies build relationships with their customers. The ads set up in Meta Ads can be shown in different placements from Facebook, Instagram, Audience Network (third-party applications), Messenger, and WhatsApp. Over one billion people worldwide use Facebook, Instagram, and WhatsApp to connect with peers and explore topics they are interested in. Meta, the umbrella company, provides a lot of resources for advertisers to have performing campaigns and they can choose different objectives depending on the marketing strategy: brand awareness, reach, traffic, engagements, app installs, video views, lead generation, messages, conversions, catalogue sales, and store traffic (Facebook, 2024).

Google Analytics (GA4) is a necessary tool for analysis that helps businesses understand the user who visits the website or mobile application and how he navigates through them. This platform collects data to create custom reports or predefined reports such as audience, demographics, behaviour, acquisitions, conversions, and technology giving in this way valuable insights for the business (Google, 2024b).

By understanding how site statistics are collected and what they mean, marketers can make site statistics work for the company (Ledford et al., 2011).

To facilitate the technical implementation of the tracking code, whether it is a remarketing code, a conversion tag from Google Ads or a code referring to events in Google Analytics (GA4) such as purchases, form leads, clicks to call, etc., Google has developed a new tool named Google Tag Manager that allows marketers to implement these codes without the help of a developer. There is a limitation for the marketers and developers' help is needed for tracking website purchases because they implement code that pushes transaction information after a successful one, to the Data Layer.

Events and variables can be sent via Data Layer which is a function used by Google Tag Manager and `gtag.js` to transmit information to the tags. Also, triggers can be set based on the value of variables (Google Developers, 2024).

Google Tag Manager can be defined as a tool that collects data strategically and develops analysis systems that give information about user activity on the website (Silverbauer, 2017).

Weber (2015) said that Google Tag Manager should be used because tags can be organised without errors and duplicates, and it can be easily verified if they are activated correctly with the debug mode. Also, adding or updating new codes does not change the website source code. Moreover, there is a control that marketers can have because older published versions of the tags can be used and permissions can be changed at different levels (view, edit, and publish tags).

PPC (pay-per-click) advertising is one of the most performance-oriented forms of advertising that allow ads to appear on the SERP (search engine results pages) above SEO (search engine optimisation) listings (Kapoor et al., 2016).

Social media is a marketing tool that can generate engagement and it can be implemented with low-cost technology (Huo et al., 2020).

3. Research Questions / Aims of the Research

This pharmacy chain started advertising on Meta Ads (Facebook and Instagram) and Google Ads to increase brand visibility, website traffic, and online sales.

The experiments were conducted because online advertising can generate orders, increase sales value or revenue and achieve a ROAS (return on ad spend) better than traditional advertising such as OOH (out-of-home) advertising, TV or radio.

In online advertising, it is known that operating expenses and the health of business influence a good ROAS, and the average ROAS for pay-per-click advertising in the pharmaceutical industry is around 11-12 points. For this family pharmacy chain, a ROAS established that could be profitable for the business was 16. It was an ambitious ROAS, considering that the pharmacy chain had no online presence and had previously addressed only a specific area in Romania (central-south region) and, at the same time, they had a small range of products on their website and a high price for most of the products compared to the competition. Also, the large invested budgets and the notoriety of the competitors made it difficult to achieve this goal.

This pharmacy chain decided to advertise throughout Romania to increase the chances of finding the right audience for its products.

4. Research Methods

This paper explores the potential of advertising on Google and Meta Ads (Facebook and Instagram) for a family-owned pharmacy chain that had been active for almost three decades. This pharmacy chain has physical pharmacies only in the central-south region of Romania, and approximately 60% of them address the rural communities. In 2022, this pharmacy chain understood that it needed more exposure to increase its profit and decided to advertise its products through its e-Commerce website. It was an ambitious goal since the pharmaceutical business vertical is a market monopolised by giants.

The main goal was to measure and analyse the performance of online ads for the period between April 2022 and March 2024 regarding brand visibility, website traffic, and sales.

This research conducted experiments over two years, a period in which the performance of the campaigns was analysed. The main benchmark in campaign performance was the achievement of the desired ROAS by the pharmacy chain representatives (16 points). This required big efforts from both sides, the performance marketing and the representatives of the pharmacy chain because, as it was already mentioned, an average ROAS for the pharma businesses is around 11-12 points. The monthly budget of the pharmacy chain for PPC advertising gradually increased as the performance of the campaigns improved, especially in what regards ROAS.

Google Analytics (GA4 and Google Universal Analytics) was chosen to gather data about website users.

The platforms for which accounts were created were Google Ads, Meta Ads, Google Tag Manager, Google Analytics, and Google Merchant Center (for the Shopping / Performance Max campaigns).

Afterwards, the tracking codes were implemented and tested, ad copies and banners were developed. Finally, the campaigns were set up on both platforms, Google and Meta Ads.

During the aforementioned months, ongoing optimisations were made to scale the campaigns.

5. Findings

Meta Ads was included in the digital marketing mix to increase brand visibility and website traffic. The product offer was reminded of to users through Facebook and Instagram campaigns in which remarketing lists were added, and this helped increase conversions from Google Ads.

Compared to Google, the investment in Meta Ads was much smaller because this channel is a push marketing tool based on interests and demographics, users are there to explore content, unlike Google Ads, which is a type of pull marketing tool, and users are there because they need products or services. Unlike Google, which had active campaigns throughout the analysed period, Facebook was not always active and it was only used when necessary. Even if a significant number of direct conversions did not come from Meta Ads, this channel helped to increase the number of conversions overall.

5.1 Meta Ads (Facebook and Instagram) Performance

The following table contains the results obtained in terms of traffic to the website and the improvement of brand awareness because these are the main objectives pursued on Facebook and Instagram. These results offer perspectives regarding the effectiveness of the campaigns set and the strategies used in Meta Ads.

Table 1. Facebook & Instagram KPIs

Month	Reach	Impressions	Frequency	Amount spent (RON)	Link clicks	CTR	CPC
Jun-22	19,700	29,541	1.50	155.61	174	0.59	0.89
Jul-22	108,640	225,319	2.07	1,352.32	3,070	1.36	0.44
Aug-22	71,550	160,417	2.24	1,002.20	3,623	2.26	0.28
Sep-22	130,717	271,065	2.07	1,178.11	7,951	2.93	0.15
Oct-22	140,146	294,603	2.10	1,158.85	8,745	2.97	0.13
Nov-22	91,792	209,077	2.28	1,249.06	9,154	4.38	0.14
Dec-22	21,788	53,825	2.47	590.55	2,138	3.97	0.28
Jan-23	50,320	117,660	2.34	851.48	3,778	3.21	0.23
Feb-23	45,577	106,320	2.33	705.45	3,335	3.14	0.21
Mar-23	97,183	231,595	2.38	1,940.22	6,585	2.84	0.29
Apr-23	28,672	93,611	3.26	1,132.70	1,420	1.52	0.80

Month	Reach	Impressions	Frequency	Amount spent (RON)	Link clicks	CTR	CPC
May-23	11,172	44,581	3.99	475.06	1,221	2.74	0.39
Jun-23	5,525	34,817	6.30	450.71	777	2.23	0.58
Jul-23	29,703	102,989	3.47	767.04	1,170	1.14	0.66
Aug-23	24,241	74,830	3.09	368.98	737	0.98	0.50
Sep-23	13,208	41,061	3.11	200.00	284	0.69	0.70
Mar-24	23,285	52,708	2.26	509.94	304	0.58	1.68

Source: Meta Ads platform, Jun-2022 - Sep-2023 and Mar-2024.

The advertising strategy developed focused on the use of carousel ads, also called dynamic product ads with a product catalogue. Thus, the ads were displayed according to the user's interest and represent a good strategy for remarketing audiences.

Regarding the performance indicators obtained, one can see that the CPC (cost per link click) was relatively constant, and thus the traffic on the website was reached. However, the CPC increased in March 2024 because the campaigns were interrupted, and it had to re-assume its learning process.

Also, many impressions and reach can be observed every month, marking that the objective of increasing the visibility of the brand has been achieved.

Moreover, in June 2023, there was a focus on remarketing audiences, especially on the users from the traffic generated from Meta Ads and from Google Ads campaigns. As the frequency indicator shows, if an ad was shown to a user about 2-3 times over the other months, an ad was shown to a user an average of 6 times in June.

These achievements reassured our decision-makers about the effectiveness of our marketing efforts.

5.2 Google Ads Performance

The following table contains results from Google Ads which was focused on ROAS (return on ad spend).

Table 2. Google Ads KPIs

Month	All conv. (sales)	Conv. rate	Conv. value	Cost	Cost / conv.	Conv. value / cost
Apr-22	1,217.51	1.38%	49,579.57	4,964.85	12.22	9.99
May-22	977.82	1.23%	48,488.95	7,121.7	15.97	6.81
Jun-22	1,122.38	1.28%	55,579.74	8,398.39	17.33	6.62
Jul-22	941.34	1.16%	65,150.13	6,412.15	14.77	10.16
Aug-22	1,065.78	1.45%	70,096.47	6,625.03	14.13	10.58
Sep-22	925.4	1.16%	52,455.56	6,634.06	16.45	7.91
Oct-22	963.88	1.09%	66,046.23	6,883.43	14.62	9.59
Nov-22	959.23	1.15%	68,563.25	8,128.6	18.83	8.43

Month	All conv. (sales)	Conv. rate	Conv. value	Cost	Cost / conv.	Conv. value / cost
Dec-22	851.27	1.03%	61,150.30	6,840.73	18.04	8.94
Jan-23	1,362.59	1.28%	97,547.99	8,197.63	13.36	11.9
Feb-23	1,429.90	1.24%	107,328.74	9,478.18	14.49	11.32
Mar-23	1,353.83	1.35%	93,531.86	8,030.83	12.86	11.65
Apr-23	1,448.59	1.63%	97,296.77	8,658.63	13.14	11.24
May-23	1,415.13	1.69%	98,296.55	8,870.39	13.02	11.08
Jun-23	1,614.28	1.85%	107,650.85	11,260.79	15.24	9.56
Jul-23	1,639.85	2.59%	120,505.64	10,451.05	12.99	11.53
Aug-23	1,662.53	2.56%	134,436.72	10,257.83	12.68	13.11
Sep-23	2,112.95	2.06%	163,603.52	10,629.06	10.49	15.39
Oct-23	1,058.17	1.85%	130,207.12	8,948.12	10.77	14.55
Nov-23	1,265.16	1.85%	151,219.47	13,024.99	14.85	11.61
Dec-23	1,438.94	1.58%	122,831.64	11,608.68	15.28	10.58
Jan-24	2,282.28	1.89%	196,319.41	11,722.87	9.86	16.75
Feb-24	2,297.56	2.08%	195,549.40	11,889.56	9.98	16.45
Mar-24	2,198.80	2.64%	194,791.41	11,930.44	10.13	16.33

Source: Google Ads platform, Apr-2022 - Mar-2024.

Notably, the weakest months of May and June 2022 were significantly impacted by the ongoing work optimising the product data attributes for the feed in Google Merchant Center, including refining titles and descriptions with keywords, ensuring the recommended character length, and enhancing image quality. The misinterpretation of Google bots led to the disapproval of certain healthcare-related products, which were later approved. The advertising strategy was focused on setting Google Display, Search, and Shopping / Performance Max campaigns.

The best months in terms of achieved ROAS of 16 points were January, February, and March 2024.

One of the significant changes that influenced the performance of the campaigns was the introduction of the locker delivery method. Users appreciate this type of delivery more and more because it offers them the convenience of taking the package when they want without waiting for the courier, but also because it is much cheaper than the delivery with a dedicated person.

Also, at the end of 2023, we started to focus only on the Performance Max campaigns, as it was the best ad campaign in terms of ROAS.

Moreover, another tactic was to establish a top of products that were in demand and sold well, and these products were constantly monitored to have a lower profit margin to attract customers and generate more sales. The lower price compared to the competition for these top products brought more sales. This change was reflected in the increase in average basket size because this top of well-sold products acted as a “hook”, and users bought other products as well.

As expected, the campaigns needed a longer period to reach the desired ROAS of 16 points, a value that was reached in January 2024. This long period of time

was also necessary because the visibility of the brand was reduced throughout Romania, this pharmacy being known only in the central-south region through its physical pharmacies. At the same time, certain business decisions were taken later than expected, by the representatives of the pharmacy chain, such as the introduction of locker delivery, the price reduction for top products, thus making achieving the performance of the campaigns very challenging.

Moreover, in Romania there are remarkable pharmacy chains, which offer a more varied range of products, better prices, and which have been active in the online environment for a long time. Competitors also have large advertising budgets which makes their digital marketing mix more complex.

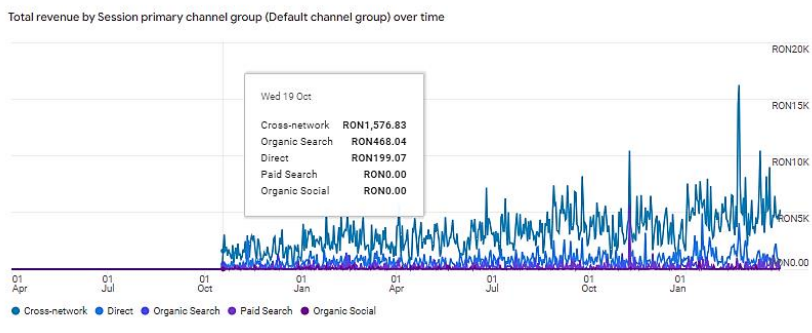
It can be observed that the obtained ROAS of 16 points was maintained throughout 2024 and it is expected that it will continue to be similar in the future if there are no major changes. However, during the summer, when the purchase intention is lower because it is the period of holidays, it is possible for the ROAS to register slight decreases.

5.3 Google Analytics (GA4 and Google Universal Analytics)

The analysis from Google Analytics (GA4) is reflected on the revenue from Google Ads campaigns that have been optimised for ROAS. This traffic monitoring tool gave insights on which channels performed best.

The main interest was the generation of transactions and revenue, and the analysis of campaigns at the primary channel group level regarding these key performance indicators it can be observed.

Figure 1. Total revenue by Session for the period 19 Oct. 2022 - 31 Mar. 2024



Source: Google Analytics 4 - GA4 (2024).

The figure above shows that, starting with October 19, 2022, GA4 started to be used even if it was not mandatory at that time. The main objective for its implementation was to have historical data and audiences before Google Universal Analytics was deprecated, and so we could optimise PPC campaigns. The correct configuration of events and the creation of audiences generated better-performing campaigns.

As it can be seen above, the channel with the best results is Cross-network, and it can also be observed a spike indicating that the best performing day was February 21, 2024 when revenue of 16,243.20 RON was recorded from this channel. According to Google's definition, "Cross-network is the channel by which users arrive at your site/app via ads that appear on a variety of networks (Demand Gen, Performance Max and Smart Shopping)" (Google, 2024c). Thus, it can be concluded that this channel is related to Performance Max / Shopping, which were active in Google Ads.

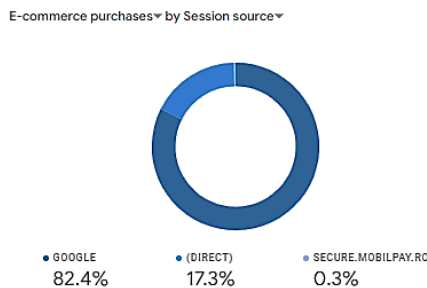
Figure 2. Total revenue by Channel Group for the period 19 Oct. 2022 - 31 Mar. 2024

Session primary_channel_group	Users	Sessions	Engaged sessions	Average engagement time per session	Engaged sessions per user	Events per session	Engagement rate	Event count All events	Key events All events	Total revenue
	723,210 100% of total	888,358 100% of total	446,105 100% of total	46s Avg %	0.62 Avg %	16.02 Avg %	50.23% Avg %	14,228,554	58,474.00	RON2,350,796.37 100% of total
1 Cross-network	549,497	671,694	338,957	43s	0.62	15.41	50.46%	10,351,034	44,753.00	RON1,757,994.50
2 Direct	61,021	69,355	38,230	1m 03s	0.63	25.76	55.12%	1,786,716	9,439.00	RON404,781.95
3 Organic Search	81,722	93,049	44,912	39s	0.55	13.06	48.27%	1,215,030	2,428.00	RON101,470.21
4 Paid Search	6,456	9,301	5,564	1m 28s	0.86	32.36	59.82%	301,003	861.00	RON55,229.14
5 Organic Social	18,413	25,708	8,981	20s	0.49	12.70	34.93%	326,572	149.00	RON11,178.98
6 Referral	2,079	3,337	1,675	33s	0.81	17.84	50.19%	59,539	521.00	RON10,042.54
7 Organic Shopping	1,153	1,293	808	1m 05s	0.70	23.87	62.49%	20,859	223.00	RON3,383.43
8 Unassigned	842	923	14	46s	0.02	13.20	1.52%	12,187	81.00	RON3,268.94
9 Paid Shopping	335	413	156	38s	0.47	15.61	37.77%	6,448	14.00	RON86.16
10 Paid Social	2,807	3,872	1,555	26s	0.55	14.41	40.16%	55,803	2.00	RON543.93

Source: Google Analytics 4 - GA4 (2024).

Above it can be seen in the report regarding Google Ads campaigns that target revenue, through Cross-network and Paid Search (Paid Shopping reflects Facebook Paid data). These two relevant channels for Google Ads amount 1,813,223.64 RON (77.13%) of total revenue.

Figure 3. E-Commerce purchases (Transactions) by Session source for the period 19 Oct. 2022 - 31 Mar. 2024



Source: Google Analytics 4 - GA4 (2024).

The most transactions came from Google (82.40%), followed by direct traffic (17.3%) and this means that Google is the first source of sales, and Google Ads campaigns (paid ads) were the most successful.

Figure 4. Total revenue by Source / Medium for the period 1 Apr. 2022 – 18 Oct. 2022

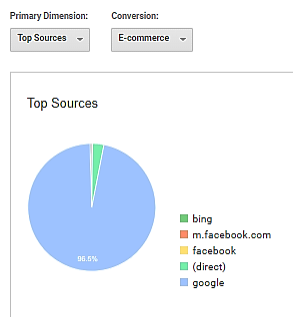
Source/Medium	Users	New Users	Sessions	Source Rate	Pages/Session	Avg. Session Duration	E-commerce Conversion Rate	Transactions	Revenue
	217,031 % of Total: 100.0% (217,031)	214,862 % of Total: 99.0% (214,862)	276,536 % of Total: 100.0% (276,536)	24.67% Avg for View: 1.0 (24.67%)	1.51 Avg for View: 1.0 (1.51)	00:01:10 Avg for View: 0:01:10 (0:01:10)	1.14% Avg for View: 1.0 (1.14%)	3,152 % of Total: 100.0% (3,152)	RON 416,281.12 % of Total: 100.0% (RON 416,281.12)
1. google / cpc	181,987 (83.9%)	179,700 (83.6%)	220,143 (79.3%)	25.9%	1.88	00:01:07	1.20%	2,491 (79.0%)	RON 279,266.03 (67.1%)
2. google / organic	18,810 (8.6%)	17,842 (8.3%)	22,886 (8.3%)	17.89%	1.81	00:01:09	0.62%	148 (4.7%)	RON 21,211.89 (5.1%)
3. (direct) / (none)	6,236 (2.8%)	6,501 (3.0%)	8,231 (3.0%)	29.49%	1.94	00:01:09	1.11%	91 (2.9%)	RON 12,014.62 (2.9%)
4. bing / organic	870 (0.4%)	930 (0.4%)	678 (0.2%)	10.47%	1.96	00:01:21	0.19%	4 (0.1%)	RON 674.88 (0.1%)
5. m.facebook.com / referral	2,283 (1.0%)	1,813 (0.8%)	2,983 (1.1%)	21.89%	1.54	00:00:42	0.13%	4 (0.1%)	RON 588.86 (0.1%)
6. facebook / cpc	4,791 (2.2%)	4,599 (2.1%)	6,784 (2.4%)	17.85%	1.82	00:01:09	0.07%	5 (0.1%)	RON 529.69 (0.1%)
7. m.facebook.com / referral	939 (0.4%)	787 (0.3%)	1,228 (0.4%)	13.84%	1.88	00:01:03	0.16%	2 (0.0%)	RON 216.74 (0.0%)

Source: Google Universal Analytics.

Google announced that on 1 July 2023, Google Universal Analytics properties would stop processing new data. They prepared their customers in advance, saying they would lose access to Universal Analytics interfaces and APIs on 1 July 2024 and must switch to GA4 (Google, 2023).

In Google Universal Analytics, it can be observed that Source / Medium, named Google / CPC, brought the most revenue in the analysed period (379,266.65 RON), representing 91.11% of all Sources / Medium.

Figure 5. E-Commerce (Transactions) by Source for the period 1 Apr. 2022 - 18 Oct. 2022



Source: Google Universal Analytics.

The figure above shows that Google Universal Analytics generated a significant percentage in terms of transactions, namely 96.50%, followed by Direct and Facebook traffic, which have a small percentage. Therefore, differences regarding Google transactions can be observed between the two periods analysed with GA4 (82.40%) and Google Universal Analytics (96.50%). These percentages are not influenced by other channels because there were no changes related to SEO, email marketing, affiliate marketing, or traditional marketing that would generate direct traffic.

Also, the more visible percentage of direct traffic in the last period is related to the ongoing campaigns, as people started to browse the website directly (17.30%). In addition, the difference in attribution also applies to revenue sources (channels) because the grouping in GA4 is different from Google Universal Analytics.

To sum up, the campaigns have been successful in terms of brand visibility and website traffic through Facebook. As predicted, Google Ads reached its sales target later, in January 2024. The site was launched in 2022 and had no historical data before this period to see other comparisons in terms of traffic or sales.

6. Conclusions

The Meta Ads channel with both Facebook and Instagram generated good results for brand visibility and website traffic, had a less serious impact on direct conversions, but in turn helped the Google campaigns, especially on remarketing, because the users who saw the ads in Google were also targeted in Meta. On the other hand, Google Ads, unlike Meta Ads, were more successful in bringing sales, especially after the implementation of different strategies such as the introduction of product delivery through lockers, the creation of a ranking with the best-selling products, lowering the selling price for top products and optimising the attributes in the Google Merchant Center feed.

The study has met multiple limitations from the legislative, ethical, and regulatory authorities, as the algorithms of the advertising platforms can misinterpret the advertising copy or banners and text from the website in the pharmaceutical industry, thus leading to the interruption of the campaigns.

The conclusions indicate the importance of digital advertising for companies trying to improve brand visibility, attract website traffic and generate sales in competitive markets such as the pharmaceutical industry. This advertising strategy can also be applied to other family businesses that operate in competitive markets.

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A Study of Consumer Trust in Online Reviews and Social Media Comments in the Age of Artificial Intelligence

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Abstract

As the digital landscape evolves with the continuous fast-paced development of Artificial Intelligence (AI), both businesses and consumers face numerous challenges posed by the ever-growing industry of AI. As business struggle to keep up with the technological advancements, consumers, on the other hand, face a more personal issue: their trust in an internet sustained by AI tools. Since half of the internet traffic is created by non-human bots and a third of all internet traffic is generated by “bad bots” which were developed for malicious purposes, the integration of AI managed to confer them human-like qualities. The “dead internet theory”, generated social media interactions and content, fake online reviews, generated blog posts, and the dilution of quality online content, all sustained by AI pose a threat to the trust and the legitimacy of the internet as a tool for humanity that was carefully built in the last decade. Our research is trying to find the level of trust of Romanian consumers in online platforms that are used as tools for selling and promotion of products and services, amidst the rapid integration of AI. The results can be used as a warning signal for consumers and policy makers alike to take a stronger stance on the online content that encourages or promotes online purchases. A survey has been deployed to 100 Romanian consumers, and the results have been analysed. Most respondents do base their purchasing decision on online reviews with slight differences between men and women yet most fear that AI and bots have a part in influencing these reviews.

Keywords: consumer trust, artificial intelligence, review systems, social media comments.

JEL Classification: M3.

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1. Introduction

Both scholars and practitioners agree that word-of-mouth is the most effective marketing tool. As consumers increasingly use the Internet, online reviews, a form of electronic word-of-mouth has gained an incredible importance in the purchasing decision (Arndt, 1967; Trusov et al., 2009). Online reviews are one of the most trusted forms of social proof. Even though Directive 2005/29/EC bans fake online consumer reviews in the EU, reviews are commonly manipulated or cherry-picked by online businesses that are not fully transparent with their target consumers. The authenticity of online reviews is a primary determinant of consumer trust. Reviews perceived as genuine and written by actual users are more likely to be trusted (Baek et al., 2012). Oppositely, falsified reviews, which are defined by exaggerated positive or negative wording, has the ability to reduce trust. In addition, a significant role is played by the credibility of the reviewer, since people award more trust to reviews made by verified purchasers or those who have a detailed profile (Luca & Zervas, 2016). Literature holds that retail sales are impacted in a direct manner by the online reviews made for the mentioned products, thus it may be stated that the effect of online reviews goes beyond the electronic space (Floyd et al., 2014). Even though AI technologies are generally trusted by consumers on their perceived usefulness, ease of use, and attitude on intention to use (Choung et al., 2023), their advanced capabilities to impersonate human-like can pose a threat to the slowly built consumers trust in the online space. Transparency in the review process, such as clear disclosure of any conflicts of interest or affiliations, enhances trust (Cheung et al., 2009). Platforms that rigorously monitor and disclose the authenticity of reviews, including the use of AI for detection of fake reviews, are seen as more reliable by consumers. Content authenticity and credibility are important elements to be considered when building trust in online reviews, in the case of marketers. Among this, we may include the application of robust verification processes and leveraging AI to observe and authenticate reviews. Besides these highlighted points, maintaining the trust of consumers can be realised by main pillars such as transparency regarding AI involvement and proactive management of review authenticity.

2. Problem Statement

Bauman and Bachmann (2017) note that there are two categories of trust factors, meaning technological factors, for instance the website design, trust signals, privacy reassurances, general e-commerce acceptance, and social Factors such as word-of-mouth, social presence, culture, and green trust. When developing a powerful brand identity, written assessments such as online reviews, blogs, and testimonials concerning brand experiences are outstanding by comparison with verbal interactions. Consumers' perception of the brand is shaped by online product reviews, that create a unique image in the mind of consumers (Chakraborty & Bhat, 2018). A negative online review is perceived as more credible than a positive review, while a positive review leads to better initial trust than a negative review (Kusumasondjaja et al., 2012). Following the most used "5 stars" reviewing system,

a common dilemma that both sellers and consumers face is the J-shaped distribution, in which most reviews are either 5 or 1 star, with little to no in-between grades. Studies advise that in order for people to overcome the two sources of bias, purchasing and under-reporting, consumers should not solely rely on the simple average that is easily available but they should also incorporate other variables such as the standard deviation. The authors also advocate that product review systems should provide this additional information for consumers. (Hu et al., 2009).

A vast number of reviews for various products and services exists online, yet not all those reviews can be trusted (Johnson & Kaye, 2016). Therefore, consumers are searching for credible sources of information and they only pursue online reviews if they perceive the reviews as credible (Filiari, 2015). Erkan and Evans (2016) state that credibility evaluation of online reviews can be described as a process by which consumers assess the accuracy of online reviews.

Thomas et al. (2019) proposed a theoretical model to assess a review credibility and correlate it with the purchase intention of a visitor. They identified the accuracy, completeness, and timeliness of a review as part of the argument quality and the review quantity, consistency, the expertise of the reviewer, the rating of product/service, and the website reputation as the peripheral cues. All these factors sum up to form the credibility value of a review. Even though determinants such as website reputation shape credibility in a positive manner, a great number of reviews can reduce it as a result of consumer suspicion. The volume of reviews and the consistency of ratings also impact trust. A larger number of reviews generally suggests a more reliable representation of the product or service quality (Duan et al., 2008). Consistency across reviews, with a balanced distribution of positive and negative feedback, further strengthens consumer confidence (Zhu & Zhang, 2010).

This finding is a basic theoretical pillar for our research, given that AI can generate in an easy way a variety of human-like reviews. Artificial intelligence (AI) is used to a greater extent to develop the trustworthiness of online reviews.

The identification of fraudulent reviews can be assisted by AI technologies, which can also safeguard the authenticity and credibility of the reviews that consumers rely on. Algorithms can pinpoint patterns in review language, reviewer conduct, and review timelines to identify doubtful activities (Mukherjee et al., 2012). Online retailers rely on AI to identify and erase reviews created through AI or fake reviews from their platforms (Amazon, 2024). Nevertheless, the employment of AI poses some difficulties. In this sense, consumers may be misled and their trust can be distorted due to the unclear dissemination of AI-generated reviews. In this sense, it is essential to maintain the clarity concerning the utilisation of AI in the creation and moderation of AI reviews. Consumers need to be informed about how AI is used to curate and manage reviews to maintain trust (Hennig-Thurau et al., 2015).

A popular piece of internet cultural reference that started in 2013 is the „dead internet theory” that suggests that much of the online content is in fact automatically generated, and that the number of humans on the web is dwindling in comparison with bot accounts. As the Artificial Intelligence technology advanced rapidly in the last two years, The 2024 Bad Bot Report suggests that almost 50% of internet traffic comes from non-human sources and 1/3 of all internet traffic is generated

by bad bots (Imperva, 2024). These bad bots have become more advanced and evasive and now can mimic human behaviour in such a way that it makes them difficult to detect and prevent.

These bad bots are deployed in various sectors of the Internet. Social media bots are automated instruments that are used to conduct the interaction on social platforms. Their functioning involves certain degrees of autonomy and they attempt to imitate the conduct of humans. Even though there exist bots that are helpful, a great share of them fulfils deceiving and damaging purposes. It was asserted that these malicious bots represent a considerable share of the total accounts across social media platforms. In accordance with research articles approaching this the, the following are most of the uses of social media bots (Orabi et. al., 2020; Chang et. al., 2021; Hajli et. al., 2022; Fan et al., 2020):

- **Automated Engagement:** Bots are able to like, share, comment, and follow/unfollow other accounts in an automatic manner to improve engagement and visibility.
- **Content Distribution:** The dissemination of content such as news articles, promotional material, or advertisements across social media platforms can be programmed to be conducted by bots.
- **Influence Campaigns:** The distortion of the public opinion, the emission of propaganda, or the spread of particular ideologies or political agendas is frequently performed by bots in influence campaigns.
- **Spamming:** Bots hold the ability to create and spread spam messages, links, or advertisements, and to fill the social media feeds with undesired information.
- **Fake Accounts:** Bots can issue fake accounts with the aim to increase the number of followers, the popularity of particular individuals or brands, or to spread misinformation.
- **Data Collection:** Bots can gather data regarding users' behaviour, preferences, and interactions for different purposes, for instance targeted advertising or monitoring.
- **Market Manipulation:** Bots can be utilised with the purpose of increasing or decreasing in an artificial manner the value of stocks, cryptocurrencies, or other assets by disseminating allegations or false information.
- **Cyberattacks:** Bots can be used in coordinated cyberattacks such as Distributed Denial of Service (DDoS) attacks to disrupt or disable social media platforms or specific accounts.

These algorithmically driven entities that on the surface appear as legitimate users, proved to affect the online political discussion around the 2016 U.S. Presidential election, accounting for one fifth of the entire conversation as bot generated content (Bessi & Ferrara, 2016). These bots can also be used to emotionally manipulate political supporters in social media by increasing exposure to negative and inflammatory content (Stella et al., 2018).

Yet, one of the most common uses of bad bots is the creation of fake reviews and ratings. These bots can generate a high volume of artificial reviews to either positively inflate the reputation of a product or service or to maliciously damage the

reputation of competitors (Luca & Zervas, 2016). The language used by these bots is often crafted to mimic human reviewers, making it difficult for consumers and sometimes even for platforms to distinguish between genuine and fake reviews (Mukherjee et al., 2012). Astroturfing involves the establishment of a false impression of widespread grassroots support or opposition. Bad bots can be employed to spread coordinated reviews which establish an illusory consensus on review sites and social media (Lim, 2018). This approach is a dishonest one due to the manipulation of public perception and the shaping of consumer conduct. In order to initiate negative campaigns against rival products or services, competitors can adhere to the usage of bad bots. With the aim of deteriorating the image of the target company, this kind of bots post negative reviews and comments in an ongoing manner. The effects of these actions are significant, producing loss of sales, damaged reputation, and eroded consumer trust (Mayzlin et al., 2014).

Artificial intelligence (AI) and machine learning are essential tools in the identification and mitigation of bad bots' influence. Patterns in review submissions, for instance the timing, frequency, and language of reviews can be assessed by advanced algorithms, to pinpoint troublesome activities that provide clues on bot conduct (Jindal & Liu, 2008).

Some examples of actions that display the presence of bad bots are the detection of repetitive language patterns or of unusually high volumes of reviews from certain IP addresses.

To make the distinction between human users and bots, platforms can use behavioural analysis techniques. The observation of user behaviour across sessions, such as browsing patterns, click rates, and interaction times, are among the actions performed in this sense. The existence of abnormalities in these patterns can assist in the identification of automated bots (Stieglitz et al., 2017). The inclusion of human verification processes, for instance CAPTCHA, can prevent the realisation of reviews by bots. The assessment of flagged content is fostered by human moderators, who ensure that reviews are authentic. The defence against bad bots receives more robustness through the mixture between automated detection and human oversight (Ott et al., 2012).

The existence of bad bots as well as their capability to launch fake reviews is considerably dangerous for consumers' trust. Consumer confidence in the platform is eroded when they face manipulated reviews, thus producing scepticism regarding all reviews, both genuine and fake. Further on, the decrease in the trust degree can negatively impact consumer conduct and brand loyalty in the long run (Cheung et al., 2009).

3. Research Questions / Aims of the Research

The primary aim of this research was to investigate consumer trust in online reviews and social media comments in the age of Artificial Intelligence (AI). Specifically, the study sought to address the following research questions:

- To what extent do consumers perceive online reviews as trustworthy and influential in their purchasing decisions?

- What are consumers' perceptions of the credibility and authenticity of online reviews and social media content?
- How do consumers view the effectiveness of AI in identifying and mitigating fake reviews compared to human capabilities?
- What factors influence consumer preferences and decision-making processes when evaluating online reviews, particularly in scenarios involving review volume and ratings?

By exploring these research questions, the study aimed to provide insights into consumer behaviours and attitudes towards online reviews and social media content, as well as the role of AI technologies in shaping trust and credibility in the digital marketplace. Ultimately, the research aimed to contribute to a deeper understanding of the factors influencing consumer trust and decision-making processes in the context of online information and AI technologies.

4. Research Methods

This study employs a quantitative research approach to investigate consumer trust in online reviews and social media comments within the context of Artificial Intelligence (AI). Specifically, a cross-sectional survey design is utilised to gather data from Romanian consumers. A sample of 225 Romanian consumers is selected using convenience sampling techniques. Participants are aged 18 and above and are chosen based on their engagement with online purchasing activities. We developed a structured questionnaire to collect data on consumer perceptions of online reviews and social media content. The questionnaire consists of seven questions, including Likert scale items and dichotomous questions, designed to assess various aspects of consumer trust and three demographic questions.

In order to determine whether consumers trusted the overall average rating of a product/service or the number of reviews, we have run a scenario in the seventh question asking them what they would choose in a restaurant choice scenario. The first option, "Restaurant A" was featuring a 4.9/5 stars rating from 150 votes and the second option, "Restaurant B" had a 4.6/5 score from 1500 ratings. This question was important for measuring the importance of the commonly used ratings average compared with the ratings volume.

Ethical considerations in conducting this study have been ensured, whereby the confidentiality of the participants is maintained and participation in the survey is on voluntary bases. There is informed consent of the participants before engaging in the survey.

The study is inherently limited to biases in convenience sampling; it further considered using self-reported data. The sample size of 100 respondents may be biased. These results are to be validated and researched further to come up with a comprehensively comprehensive conclusion.

The study findings may have relevance to businesses, policymakers, and researchers: consumer trust in online review content and social content. Practical relevance may extend to the new ways in which transparency and authenticity in

online reviews may be built and functioning by having AI new technologies to moderate reviews.

5. Findings

Table 1. Research results – gender comparison

Question	Men (avg)	Women (avg)	Overall avg
Importance of Online Reviews	4,18	4,27	4,24
Trust Level of Online Reviews	3,46	3,70	3,62
Perceived Genuineness of Online Reviews	3,65	3,76	3,72
Perception of Authenticity on Social Media	3,37	3,57	3,31
Influence of Retailers on Online Reviews	3,72	3,75	3,74

Source: authors' own research.

The survey participants rated the importance of online reviews in the purchasing process with an average score of 4.24 out of 5, with women rating a slightly higher level of trust with an average of 4.27/5. This high rating indicates a significant reliance on online reviews among Romanian consumers when making purchasing decisions. The findings suggest that consumers perceive online reviews as valuable sources of information that influence their buying behaviour. Businesses should recognise the pivotal role of online reviews in shaping consumer perceptions and consider strategies to effectively manage their online reputation.

Participants demonstrated a moderate degree of trust in the online reviews, with an average rating of 3.46 out of 5. In general, consumers are known to place their trust in online reviews. The medium trust level, however, underlines the existence of some level of skepticism or ambiguity concerning the credibility and reliability of online reviews. The present finding lines up with the necessity of making online review platforms transparent and authentic to promote consumer trust and confidence.

It also measured an average rating of 3.65 out of 5 with respect to the perceived genuineness of the online reviews. This indicates that, on average, consumers find the online reviews to be at least moderately real—that is, existing with actual consumers behind the comments. Efforts to crack down on fake reviews and really nail down the authenticity of content could further shore up trust among consumers in review systems online.

The average perception of the authenticity on social media sites was relatively low, 3.31 out of 5. This result could suggest that customers are a little skeptical about the genuineness of the content and who is really posting content from accounts on social media. Working on issues of fake accounts and other possibly deceitful activities might help to build trust among users of social media.

The results of the survey showed that consumers had an average rating of 3.74 out of a 5 rating scale, which perceives a medium influence by retailers on online reviews.

The results of the survey imply that consumers are at least aware of the potential for retailers to manipulate or influence reviews posted online. Perhaps consumers take into consideration the availability of incentivized or biased reviews over the

internet. If review management is transparent and associated with strict policies against manipulation, then the concern expressed by consumers would likely decrease, while trust in online review platforms would increase.

When asked if they believed that a system based on AI would be able to distinguish a fake review from a real one, a larger portion of respondents, 65.77%, had confidence in a system based on AI versus humans, while 34.22% still remained doubtful.

The majority group trusts AI to identify patterns that would facilitate the integrity of online review platforms because it can quickly identify this type of information. The minority could be skeptical because of the concerns that AI understands subtleties in languages and biased algorithms. Accordingly, although most of the participants have faith in the potential of AI in making platforms devoid of fake reviews, there are concerns over algorithmic transparency and accuracy, which has got to be addressed very importantly to build broader trust in AI-driven solutions..

Table 2. Research results – age comparison

Question	18-25	26-33	34-41	42-49	Avg
Importance of Online Reviews	4,21	4,34	4,13	4,3	4,24
Trust Level of Online Reviews	3,51	3,72	3,67	2,66	3,62
Perceived Genuineness of Online Reviews	3,46	3,87	3,87	3,66	3,72
Perception of Authenticity on Social Media	3,16	3,70	3,72	3	3,50
Influence of Retailers on Online Reviews	3,48	3,85	3,93	4,3	3,74

Source: authors’ own research.

Comparing these results with the age of the responders, surprisingly we can notice a bell distribution among the overall level of trust in online retailers, reviews, and AI technologies. Both younger (18-25 years old) and older (42-49 years old) respondents display a slightly general lower average level of trust compared to the middle-aged counterparts. This may be since the 26-41 age group has been exposed to the internet for a longer period of time compared with the younger 18-25 and 42-49 age group. No 50+ response had been recoded.

The importance of online reviews in the purchasing process varies across educational levels. A significant level of importance on online reviews is demonstrated to be awarded by individuals with undergraduate and master’s degrees, the average rating being of approximately 4.25. This shows that such individuals consider online reviews to be the key element in making acquisition decisions. On the other hand, individuals with doctorate degree evaluated the importance of online reviews with 3, therefore they place a reduced emphasis on this aspect.

Table 3. Research results – education comparison

Question	Highschool	Undergrad	Master	Doctor
Importance of Online Reviews	4,24	4,25	4,25	3
Trust Level of Online Reviews	3,52	3,66	3,69	2
Perceived Genuineness of Online Reviews	3,47	3,83	3,86	2
Perception of Authenticity on Social Media	3,21	3,60	3,69	3
Influence of Retailers on Online Reviews	3,53	3,75	3,96	5

Source: authors’ own research.

The trust in online reviews also seems to alleviate in accordance with the educational progress. Undergraduate respondents show a trust level of 3.67, while those with a master’s degree exhibit the highest trust level at 3.69. However, doctorate holders display significantly lower trust, rating it at 2. This divergence suggests that higher education, up to the doctoral level, may instil a more critical perspective towards online reviews.

The perception of the authenticity of online reviews follows a similar pattern. Respondents with undergraduate and master’s degrees rate the authenticity of online reviews at 3.83 and 3.87, respectively, reflecting a higher belief in the genuineness of the reviews. Conversely, those with doctorate degrees rate this aspect at 2, indicating substantial scepticism regarding the authenticity of online reviews.

When it comes to the perception of the realness of social media accounts, higher educational levels correlate with a greater belief that these accounts are operated by real individuals. Master’s degree holders rate this belief highest at 3.69, followed by undergraduates at 3.60. Doctorate holders, though more sceptical, rate this perception at 3, which is higher than their trust and authenticity ratings for online reviews.

The perception that merchants can influence online reviews is consistently high across all educational levels. Doctorate holders are particularly convinced of this influence, rating it at 5. This indicates a strong belief in the manipulation of online reviews by merchants. Respondents with master’s degrees also express significant concern, rating it at 3.96, while those with undergraduate and high school education rate it at 3.76 and 3.54, respectively.

In summary, the analysis highlights a complex relationship between the educational attainment and the perceptions of online reviews and social media comments. While trust and perceived authenticity generally increase with the level of education, doctorate holders exhibit notably lower trust and belief in authenticity. This group’s higher scepticism could be attributed to a more critical evaluation approach developed through advanced academic training. Understanding these differences is crucial for marketers and platform operators, as it can help in tailoring strategies to enhance credibility and trust across various demographic segments.

5.1 The Restaurant Scenario

Table 4. Restaurant scenario

Restaurant	Men	Women	Total
Restaurant A – 4.9 / 150 reviews	14.81%	27.77%	23.11%
Restaurant B – 4.6 / 1500 reviews	85.18%	72.22%	76.88%
Total	36%	64%	100%

Source: authors' own research.

When presented with the restaurant choice scenario, a significant majority of respondents (76.88%) opted for Restaurant B, which had a rating of 4.6 out of 5 based on 1500 reviews. In contrast, only 23.11% of respondents chose Restaurant A, despite its higher rating of 4.9 out of 5 from 150 reviews. A slight preference for the Restaurant A option in the case of female responders might indicate their openness to try out new experiences whereas the slight preference for the second option in men shows their commitment to established and peer-reviewed businesses.

This preference for Restaurant B underscores the influence of review volume on consumer decision-making. Despite Restaurant A having a marginally higher average rating, the sheer volume of reviews for Restaurant B likely instilled greater confidence in its overall quality and reliability among respondents among both genders.

The overwhelming preference for Restaurant B suggests that consumers prioritise the consensus opinion reflected in a larger number of reviews over the potentially subjective rating of a smaller sample size. This phenomenon aligns with the social proof theory, which posits that individuals are more likely to conform to the behaviour of others when making decisions in uncertain situations.

In practical terms, this finding ascertains that is critical for organisations to act towards the fostering and management of online reviews, knowing that consumer perceptions and the increase in advocacy can be altered by a greater volume of positive reviews. Moreover, it underlines consumers' need to assess in a critical manner the credibility of reviews and make decisions relying on informed matters, by referring to the rating and the number of reviews.

The results of the survey indicate the decisive role posed by review volume in directing the preferences of consumers and strengthening the importance held by the social proof in consumer decision-making processes.

5.2 Discussion

The survey findings provide valuable insights into consumer trust and decision-making processes regarding online reviews and social media content. Several key themes emerge from the analysis, presenting factors that influence consumer perceptions and behaviours in the digital marketplace.

One notable finding is the high importance attributed to online reviews in the purchasing process. The majority of respondents emphasised the significance of online reviews when making buying decisions, indicating their reliance on peer

opinions and experiences to inform their choices. This underscores the influential role of online reviews as a trusted source of information for consumers navigating the vast array of products and services available online.

However, while online reviews are valued by consumers, the survey results also reveal a degree of scepticism and uncertainty regarding their credibility. Despite acknowledging the importance of online reviews, respondents expressed only moderate levels of trust and perceived genuineness in these platforms. This suggests that while consumers rely on online reviews, they are aware of the potential for manipulation, bias, and misinformation within these systems. Addressing these concerns is essential for maintaining consumer trust and confidence in online review platforms.

Furthermore, the survey highlights the evolving landscape of consumer trust in the age of Artificial Intelligence (AI). A significant majority of respondents expressed confidence in AI's effectiveness in identifying fake reviews compared to human capabilities. This reflects growing optimism towards AI-powered solutions in combating deceptive practices and enhancing the integrity of online review platforms. However, addressing concerns about algorithm transparency, fairness, and accuracy is crucial for fostering widespread trust in AI technologies.

The restaurant choice scenario provides further insights into consumer decision-making processes, demonstrating the significant influence of review volume on consumer preferences. Despite Restaurant A boasting a higher average rating, the overwhelming majority of respondents favoured Restaurant B, which had a larger volume of reviews. This underscores the importance of social proof and consensus opinions in shaping consumer perceptions and behaviours.

6. Conclusions

The survey's findings provide relevant insights concerning the dynamics of consumer trust and decision-making in the domain of online reviews and social media content. The analysis opens the way to certain key conclusions, that clarify the factors shaping consumer perceptions and behaviours in the digital marketplace.

In the first place, the survey emphasises that online reviews have a major significance in impacting consumers' acquisition decisions. A great share of the respondents perceives online reviews as a trusted source of information, and underlined that they rely on the opinions and experiences of peers when assessing goods and services.

Nevertheless, the survey indicates that consumers hold various levels of trust and scepticism in online reviews. More precisely, consumers appreciate online reviews but at the same time they are worried about their credibility and authenticity. Guaranteeing that the trust of consumers in online review platforms is maintained and that they hold relevance in the digital marketplace can be assured by addressing these concerns.

Moreover, the survey indicates the growing hopefulness regarding Artificial Intelligence (AI) in the enhancement of online review platforms' integrity. Most of the respondents believed that AI can pinpoint fake reviews and reflected the change

toward the adoption of AI-powered solutions as a method to fight against deceptive practices and to shelter the credibility of online reviews.

Last but not least, the restaurant choice scenario reinforces the asinificant impact of the review volume on consumer preferences. Most of the respondents preferred Restaurant B, whose reviews were more numerous, even though Restaurant A held a greater average rating. This strengthens the fact that when sketching consumer perceptions and conduct, social proof and consensus opinions play a significant role.

To sum up, the survey findings delineate the intricate character of consumer trust and decision-making processes in the digital era. Organisations need to offer a greater importance to transparency, authenticity, and ethical practices when managing online reviews, and consumers need to carry on a critical analysis of the review credibility to attain informed choices. The augmentation of the integrity and reliability of online review platforms is possible when AI technologies are integrated in a responsible manner, this fact finally leading to the boosted trust and confidence of consumers in in the digital marketplace.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used ChatGPT 4o in order to translate and proofread our interpretations of the research that were originally written in Romanian. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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**Empathy in Marketing:
A Customer-Oriented Approach based on Authenticity**

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Abstract

Data are undeniably crucial to success in the digital economy and modern marketing landscape, strongly influenced by artificial intelligence apps. With the help of the data, specialists derive regularities, define target audiences, and increase the effectiveness of their strategies and activities. Last but not least, they allow merchants to provide their customers with more personalised experiences. However, while data have become indispensable, it is not enough to build loyalty and an authentic connection with consumers. Current research shows that in the technology-dominated world, understanding consumers' emotions, needs, and desires is increasingly essential for building strong relationships and driving loyalty. That brings to the fore the need for a customer-centric approach based on empathy and authenticity. The paper examines the role of empathy in marketing by analysing Bulgarian marketing campaigns. The authors seek an answer to the question of to what extent empathy is part of the strategies of Bulgarian marketing specialists and marketing service agencies. The methodology used includes content analysis and interviews with marketing professionals. The study shows that Bulgarian marketing campaigns that successfully used empathy focused on the authenticity and emotionality of their messages. There is also an intertwining of essentially different concepts, such as marketing with empathy and social marketing. The results clearly demonstrate the power of empathy in building the marketing strategy of the respective brand. They also allow for a more complete definition of the marketing approach with empathy and values. Therefore, the research enriches the existing theory and practice in the field of marketing and management.

Keywords: empathy, marketing, loyalty, marketing strategy.

JEL Classification: M31, M37.

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1. Introduction

Empathy, the human capacity to understand and resonate with the emotions of others, has been a well-researched area of study in various fields for a considerable amount of time (Kostadinova & Antonova, 2018). Moreover, in marketing, empathy is nothing new. Memorable brand campaigns touch the consumer's heart, confirming the rule that people buy on emotions (Lee, 2016). The latter is so influential in the process of selection and purchase decisions that consumers often overlook key facts for them. At the same time, the sincerity and courage on the part of companies to listen to their customers are essential (Kim & Sullivan, 2019). This requires a change in thinking and adaptation to the market in all aspects (Pedersen, 2021).

On the other hand, in today's fast-paced business landscape, the search for profitable marketing strategies is becoming increasingly important. The rise of digital technologies and artificial intelligence, on the one hand, and evolving consumer behaviour and generational shifts, on the other, are rendering traditional marketing strategies obsolete and ineffective (Liu-Thompkins et al., 2022). The dynamics of the business environment, the fight against competition, and the search for ways to satisfy the over-consumerism of society have increased the importance of information. However, even though data has become indispensable, is it enough to build an authentic connection between a brand and its consumers? In fact, digitisation and information arrays have not changed the essence of marketing, but have provided it with new ways to function (Ingwer, 2012).

Research shows that no matter what steps they go through in the buying process, customers are not fully aware of exactly how they make their final decision. It turns out that 90% of decisions happen at a subconscious level – emotion is the leading one, and then consumers try to justify it with logic (Rolls, 2014). That is, the more a company understands the emotional side of its consumers' lives, the more precisely it communicates its messages and the value it can offer, and the more effectively it reaches its target audiences (Ingwer, 2012). The most sophisticated firms make emotional connections part of a broad strategy that includes every function in the value chain – from product development and marketing to sales and service (Rust, 2020).

The present study seeks an answer to two main research questions – Do Bulgarian marketing specialists apply empathy in their practice, and can it be claimed that in this way, they increase the effectiveness of marketing campaigns? For this purpose, short interviews with marketing specialists were conducted, and a specific question from the survey was used for the study. The paper has the following structure: 1) A review of the scientific literature in the field of the researched topic was carried out; 2) The main research questions are asked; 3) The methodology of the research is built; 4) The results were analysed; 5) Relevant conclusions are formulated.

2. Problem Statement

The impact of information technology on company-customer relationships is complex, bringing both benefits and risks (Lee, 2016). While technology facilitates

interaction and can optimise processes, it also hides a trap. Their overuse, motivated by “innovation” focused on cost reduction, can lead to alienation and a lack of empathy (Gorry & Westbrook, 2011).

Human connection is required to provide proper customer care. Managers and front-line employees must be able to empathically listen to customers' needs (Gorry & Westbrook, 2011). Instead of relying on technologies focused only on automation and optimisation, companies need to invest in building teams capable of empathy and emotional intelligence (Liu-Thompkins et al., 2022). A lack of human touch can lead to a lack of transparency, ineffective service, and growing customer frustration. Gorry and Westbrook (2011) believe that the right combination of technological innovation and personalised treatment is necessary to achieve a long-lasting and successful business-customer relationship.

In turn, Kim and Sullivan (2019) opine that effective marketing strategies are critical to business growth, customer acquisition, and building brand awareness. According to the scholars, companies should define marketing strategies that are in line with their business objectives and effectively reach their target market. Without challenging the formulated statement, Prasetyoh and Purnamasarit (2023) add that it is an empathy-based marketing communication that could both promote and serve to achieve common interests. Through this method, the goal is to build a relationship between stakeholders and instil brand loyalty.

Marketing is the act of individuals and groups focusing on fulfilling the desires of others in a social process (Rolls, 2014). Therefore, empathy, which is the capability to comprehend another individual's perspective, has been recognised as a longstanding foundation of marketing. Since it was established, the field has highlighted the significance of comprehending and empathising with the customer perspective in business (Pedersen, 2021). While empathy-based marketing is a concept with a long history, for most brands, building an emotional connection with consumers and partners is more guesswork than science. In this sense, it is highly underestimated and neglected (Rust, 2020).

At the same time, the rise of information and communication technology has also led to exponential growth in data-driven marketing. Its primary application is to discover patterns, build target audiences, measure and improve marketing campaigns, and provide personalised experiences for users (Liu-Thompkins et al., 2022). In line with global technological transformations, the values and needs of consumers have also fundamentally changed. Therefore, it is imperative that marketers, if they wish to be successful, adapt to the new reality and find new ways to connect with their customers (Kim & Sullivan, 2019). Data alone are not enough.

Rust (2020) argues that when companies connect with customers' emotions, the payoff can be huge. The scientists give an example of a large banking institution providing credit cards for a specific generation of consumers. The campaign, which aims to inspire an emotional connection, increases card usage among the segment by 70% and new account growth by 40%. Therefore, in order to understand and attract their customers, brands must resonate with them emotionally, i.e., they must apply a customer-centric marketing approach based on empathy (Ingwer, 2012).

What has been said so far confirms that in empathic marketing, a central place is given for communicating with customers, listening to their thoughts and feelings, observing how they use the particular product, and integrating everything described (Kim & Sullivan, 2019). A staggering 65% of B2B customers are overwhelmed by excessive messages from businesses, deeming most of them irrelevant, according to a Forrester report (Route, n.d.). According to Kim and Sullivan (2019), brands earn 52% more from emotionally engaged customers than just satisfied ones. Meanwhile, a MarketingWeek article cited by Route (n.d.) states that only 30% of marketers and advertisers demonstrate a high level of empathy in their marketing communications. The main reason is that brand empathy requires a conscious and long-term effort to engage with customers at every level of interaction: online, offline, at checkout, and even after the purchase process is finalised.

In the dynamic marketing space, technology, social media, video, and content are emerging as constant factors for success. These fundamental tools have proven their resilience over the years, and their influence is only growing stronger. According to Liu-Thompkins et al. (2022), marketers need to closely monitor the evolution of artificial intelligence, which could transform the marketing landscape. Still, it should be remembered that they are only tools and, as such, serve to implement and realise a specific approach.

The future of marketing will be increasingly linked to the automation of advertising algorithms, extensive use of artificial intelligence, technologies such as voice messages and virtual reality, and content created by both influencers and users themselves (Kim & Sullivan, 2019). However, marketing will continue to try to meet the ever-increasing demands of consumers. Therefore, in addition to data and different instruments, a tremendous amount of empathy is needed to understand the specific needs of customers and to communicate the solutions that companies offer correctly (Liu-Thompkins et al., 2022).

3. Research Questions

Based on the literature review and applied examples of the effectiveness of empathy-based marketing, the authors of the study formulate the following research questions:

RQ1: *Do Bulgarian marketers apply empathy in their marketing strategies?*

RQ2: *Do the examples applied by Bulgarian marketing practice confirm the effectiveness of empathy-based marketing?*

4. Research Methods

The research methodology is divided into two stages. The *first stage* includes interviews with representatives of the marketing community in Bulgaria. The sample is composed of full and associate members of three of the most significant associations in Bulgaria, uniting companies and specialists in marketing, advertising, communication, and public relations. These are the Bulgarian Association of Communication Agencies, Digital Outdoor Advertising Association and IAB

BULGARIA, with respectively 63, 78 and 124 full or associate members as of April 1st, 2022. Subsequently, the total number of 265 individuals and legal entities was reduced to 212 after excluding the members who were repeat members in the different associations. The final selection of respondents was made on the basis of one or more of the following criteria: 1) *for marketing specialists* – declared free profession or professional position with a company in the field of marketing, advertising, brand management, etc., from the same field of activity; 2) *for representatives of marketing agencies*: active profiles on social networks; maintained corporate site; belonging to one or more associations related to the subject of activity;

The purpose of the applied criteria is to include only people with professional experience in the field of research. Thus, the conclusive group of respondents was formed of 150 individuals and companies actively engaged in marketing, advertising, and communications. The interviews were conducted as an anonymous online survey from April 12 to April 30, 2022. For this purpose, a Google form was used, distributed through personal e-mail messages or messages on social networks. For this study, one of the seven questions included in the formal survey was addressed: *Would you give an example of this skill [showing empathy] in your work?* The question seeks a direct answer as to what meaning the Bulgarian marketing specialists attach to the concept of empathy and whether they associate it with their professional commitments.

The *second stage* involves the analysis of media posts and video content to identify actual campaigns, applying the principles of empathy-based marketing. Based on the literature review for the analysis, specific criteria were developed to embody these principles: 1) captivating storytelling; 2) emotional messages; 3) stated values; 4) authenticity;

5. Findings

Eighty-four people, or 59% of those invited to participate ($N=150$), responded to the survey. Although the questionnaire was distributed by personal invitation to specific individuals, the responses remained anonymous. Respondents were asked to share their first names or the name of the company they work for. The majority – 76 (90.5%) chose to remain anonymous.

Georgi Malchev (*Explora* agency), participant in the research, says that when it comes to marketing, it is most important to activate the hormone of happiness and good mood in the audience. That can happen through quality content marketing, but also through an undeniable display of empathy towards customers and their needs. Another respondent linked empathic marketing to building the right customer journey. Another respondent believes that empathy helps them better understand the target audience and also guides their communication with customers. This boosts the effectiveness of all campaigns they execute for the company.

The majority of participants linked empathy to stepping into their customers' shoes and experiencing what customers experience. The marketer's words emphasise the importance of emotions and metrics in marketing, adding to the

previous statement. Moreover, empathy is needed to understand emotions. Of the 84 comments received:

- 1 (1.2%) person gave a direct example of empathy in marketing, pointing to the world-famous advertisement of the Dove brand – *Real Beauty Sketches*;
- 1 (1.2%) respondent argued that we should not focus only on empathy;
- 3 (3.6%) people believe that empathy and emotions have no place in marketing;
- 7 (8.3%) respondents associate empathy in marketing with participation in a social cause or the implementation of social marketing;
- 20 (23.8%) associate empathy primarily with relationships within their teams and do not give examples of how they associate it with their customers;
- 60 (71.4%) are of the opinion that empathic marketing is: a) knowing their customers and communicating with them emotionally, not aggressively; b) building a long-term relationship at the expense of short-term profit; c) being helpful beyond the agreed upon; d) the main ingredient of personalisation – an increasingly imperative trend in digital marketing; e) creating emotional content and compelling storytelling.

From the summary of opinions, it is clear that Bulgarian digital marketers understand the essence of empathy-based marketing. At the same time, the Dove campaign mentioned in the interviews is a good starting point for searching for similar marketing campaigns in Bulgaria as well. *Dove Real Beauty Sketches* encourages people to rediscover themselves and appreciate their uniqueness. It is one of the most viewed ads online and has won a number of awards. The company also stated that the campaign significantly improved organic advertising and word-of-mouth sharing (Dove, 2023).

From the point of view of the campaign selection criteria set out in the Methodology, *Dove Real Beauty Sketches* fully meets the principles of empathic marketing: 1) In an inspiring way, the brand retells a significant problem – excessive self-criticism of women; 2) The messages are emotional and in no way aggressive – the advertising campaign never tells its customers “Buy a Dove product, and you will be beautiful”. Quite the opposite – the message is “You are beautiful the way you are.” 3) The principal value of the brand is perfectly communicated – “Be natural, be yourself, love yourself.” 4) For many years, Dove has communicated the same values. In this respect, the authenticity of the brand finds its natural presence in the *Real Beauty Sketches* campaign. An image built over many years that consumers recognise, appreciate, and reward with their loyalty.

In the context of the Bulgarian marketing reality, such super-fascinating examples are difficult to find. However, despite this, there are plenty of brands that purposefully apply the empathetic marketing approach. In its essence, as explained earlier, it requires authenticity and emotionality and not necessarily significant investments. That is why it is also among the most affordable marketing techniques. Content analysis of online media posts and video content identified three campaigns that met the set criteria. These are *Super Rustic Offer* of Gurmenitsa Bulgaria, *IKEA Homes* of IKEA Bulgaria and *Milk for the New Generation* of Olympus Foods Bulgaria.

The messages of the Bulgarian brand Gurmenitsa and their advertising campaign *Super Rustic Offer* are aimed at everyone who grew up in the village with their grandparents. The brand evokes memories of a carefree childhood shared with friends and typical Bulgarian food – *lyutenitsa*. The motto of the campaign is “*Rustic is delicious. It is so delicious that your face shows what you had for breakfast. Sometimes on the T-shirt too.*” (Rostar, n.d.). *Super Rustic* is an extremely well-chosen slogan that expresses the quality born from the authentic preparation of *lyutenitsa* and reverses the logic of a famous Bulgarian expression with a negative connotation: *super rustic = unpleasant behaviour*. In this case, the expression aims to show that there is nothing wrong with rural; on the contrary – it is something that the user should return to and not forget. That has been the message of the brand since its inception, and Gurmenitsa adheres to it, striving to create a bridge between the city and the village (Gurmenitsa, n.d.). The campaign tells about the taste of real food without additives and with actual Bulgarian products. *Super Rustic* achieved significant popularity with a series of videos in which selected volunteers explained, “How do you eat a Lutenica slice properly?” The brand's storytelling is flawless and unadulterated, implements the natural emotions and words of its volunteers, and stabs the consumer in the heart with the memory of the carefree summers in the countryside. *No data are available on campaign performance.*

The content marketing of IKEA Bulgaria – *IKEA Homes* also impresses with its empathic content (IKEA, n.d.). The campaign is closely focused on storytelling and tells the story of different families and their transformed homes in a series of blog posts. In every single story, problems are touched upon that are typical for Bulgarians and probably for all families – insufficient home space, low budgets, and clutter. At the same time, the campaign communicates the values of the IKEA brand – sharing, togetherness, quality of life and family spirit, which inevitably attract the audience and make the consumer dream of being part of *IKEA Homes*. *No data are available on campaign performance.*

The advertising clip of the Olympus Foods Bulgaria (n.d.) brand – *Milk for the New Generation* also relies on solid emotions and messages. At the centre are the children and their future. The storytelling describes in some seconds different negative or positive situations from the everyday life of the new generation. What is specific about this marketing campaign is the perfect collaboration between empathy-based marketing and social marketing as a concept. Social marketing seeks to influence social behaviour, not for the benefit of the marketer, but to benefit the target audience and society as a whole (Andreasen & Kotler, 2003). With its *Milk for the New Generation* campaign, Olympus aims not only to shed light on significant issues such as school aggression, the problems of disadvantaged children, and environmental pollution but also to motivate behaviour in adolescents that opposes injustice and supports others. The message is emotional and highly empathetic, and there is hardly a child or adult who does not associate with the images of the video. *No data are available on campaign performance.*

The given examples show that Bulgarian marketing specialists apply empathetic marketing in their campaigns. All three analysed marketing campaigns were

implemented by different marketing agencies, i.e., there are no isolated cases from the practice of one specialist or agency. In addition, a significant proportion of survey respondents recognise the empathetic marketing approach. That gives a positive answer to RQ1: *Do Bulgarian marketing specialists apply empathy in their marketing strategies?*

At the same time, information on the effectiveness of the messages in the specific analysed campaigns is not available in the free online space, which is why it is not included in the analysis. Traditionally, these are metrics that the respective brands or marketing agencies rarely disclose, although such a practice would only benefit the creators of this type of content. Some of the attached examples have been highly rated at industry competitions, which in itself hints at their high efficiency. However, such a correlation is not sufficient for a general conclusion. Therefore, it is not possible to answer RQ2 – *Do the examples applied from the Bulgarian marketing practice confirm the effectiveness of marketing based on empathy?*

Simultaneously, it should not be forgotten that effectiveness does not necessarily have only a material dimension. Even though it can be difficult to measure at times, efficiency can be defined as higher levels of customer loyalty and engagement. Whether they result in a direct sale or not, it is certain that similar marketing campaigns, such as the ones provided, enhance the brand's visibility and strengthen the impact of the well-established marketing strategy of word-of-mouth marketing. In summary, the lack of quantitative data does not automatically mean that empathy in marketing is ineffective. However, as the literature review made clear, marketing deals not only with emotions but also with data. Therefore, in order to be even more effective, authentic and user-oriented, it is recommended that marketing professionals generate and share more quantitative data in this direction.

5.1 Limitations of the Study

A significant limitation of the proposed study is subjectivity. Despite the formulated criteria for choosing marketing campaigns, the emotional aspect, i.e., the emotional perceptions of the study authors, also determines the choice of examples.

The second limitation is related to the lack of information regarding the effectiveness of marketing campaigns. The country's practice shows that brands rarely share this information. This complexity hinders the analysis and fails to clarify if empathic marketing is successful or merely emotional.

5.2 Applicability and Future Research

Although they emphasise the need to discuss the main aspects and advantages of empathic marketing and its effectiveness more, the study's results also demonstrate the power of empathy in building the respective brand's marketing strategy. They also allow a more complete definition of the marketing approach with empathy. Therefore, the study enriches the existing theory and practice in the fields of marketing and management.

In addition, Bulgarian marketers demonstrate an understanding of the essence of empathy in marketing, with a percentage of them making an analogy between empathic and social marketing. Some of the applied marketing campaigns meet the definition of social marketing, on the one hand, and empathic marketing, on the other. That motivates further questions about their 1) *Hypothetical sameness* – are we talking about the same concept with two names, and is every empathy-based marketing campaign also social marketing after all? 2) *Potential interdependence* – is social marketing possible without empathy? These are questions to which the authors will seek answers in their future developments.

6. Conclusions

Because of the growing emphasis on digitisation and automation, both businesses in general and marketing specifically appear to be slowly losing their empathetic core. The main objective of prioritising the client's well-being has been overshadowed by the focus on maximising profits regardless of consequences. Is this not a signal that such actions would lead to an outflow of customers but, above all, to the inability of companies to gain and retain consumer loyalty? Thanks to the new digital technologies, every company can afford to study the emotional triggers of its customers and, through additional experiments, develop successful strategies for emotional and engaging marketing.

The Bulgarian study demonstrates that local marketers perceive empathic marketing as an approach based on building an emotional connection with customers. The research also highlights that, according to brands, empathic marketing reflects the emotional perspective of consumers. Therefore, empathy in sales is associated with empathising with the emotions and expectations of customers, not investors and salespeople.

In conclusion, the authors of the current study seek to emphasise the fact that people fundamentally buy from people they trust and feel emotionally close to. It is impossible to develop emotional marketing campaigns aimed only at manipulating customers. In marketing, empathy is equal to being genuine and authentic. Even though brands aim to sell products and services and make money, they must alter their approach to guiding consumers through the marketing funnel. It needs to be more captivating, focused on the customer, and emotional – essentially, through empathetic marketing.

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