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Exploring the Relationship between Exchange Rates, Gold Price and Inflation. An Multivariate Empirical Approach

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Abstract

Financial markets have calendar effects, also known as calendar anomalies. These refer to abnormal returns on traded assets with a specific frequency of occurrence at intervals of less than one year. Exchange rates formed in the financial markets are the main subjects of such calendar effects. Capital markets are studied much more frequently from this point of view. In comparison, it has been observed that those in foreign exchange markets can also have a consistent speculative dimension, which favors the appearance of calendar anomalies.

That is why we will further study the evolution of the euro-ron and dollar-ron exchange rates.

The study aims to explore the main dynamics between exchange rates, gold price, and inflation rate from a multivariate perspective covering the period 2009-2022 based on the Granger causality approach and the impulse response function testing empirically the existence of the long-run relationship using Johansen multivariate approach and the estimation of VAR/VECM model.

The gold market is a signal of crisis. When the prices of many financial assets collapse, the intrinsic value of the precious metal becomes very tempting to many investors. The pandemic has affected the Romanian foreign exchange market through various mechanisms. Fears about the prospects of the national economy, which existed even before COVID-19, have aroused distrust in the national currency. Furthermore, there are significant interdependencies between emerging and foreign capital markets, especially during periods of instability. The massive withdrawal of foreign investors from a capital market with a large share will cause stock prices to decline. Thus, it generates a substantial increase in demand in the foreign exchange market (investors will need currency to repatriate their capital).

The empirical results pointed out a long-run relationship between exchange rates, gold price, and inflation and denied any short-term relationship, while the Granger causality test highlighted a long-run causality between all four variables in the model.

Keywords: exchange rates, gold price, inflation, economic crisis, Romania.

JEL Classification: G01, G17, O24, D53, C32.

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1. Introduction

Financial markets have calendar effects, also known as calendar anomalies. These refer to abnormal returns on traded assets with a specific frequency of occurrence at intervals of less than one year. In some articles, they are considered seasonal variations in evolution. Courses formed in the financial markets are the main subjects of such calendar effects; thus, the necessity of studying the evolution of such exchange rates Euro-RON and Dollar-RON.

Capital markets are much more frequently studied from this point of view, but, by comparison, it has been observed that those in foreign exchange markets can also have a consistent speculative dimension, which favors the appearance of calendar anomalies. On the other hand, fluctuations in foreign exchange markets, as opposed to capital markets, can be decisively influenced by the prompt interventions of the Central Bank. From this perspective, the Central Bank has efficient means of buying or selling the national currency at its disposal, aiming to bring exchange rates to a desirable level (Ștefănescu, Dumitriu, 2020). Consequently, such regulatory actions mitigate or even eliminate seasonal variations.

It is worth mentioning that the National Bank of Romania opts for applying a controlled flotation regime, referring to consistent interventions on the foreign exchange market that will fade certain seasonal variations. The NBR focuses on maintaining the stability of the euro and US dollar exchange rates, the two most important currencies for the Romanian economy.

In order to determine precisely how the RON / EUR exchange rate fluctuates, three periods have been analyzed: 2 months from the financial crisis (January-February 2009), March 2009 - June 2017 post-crisis period, and the crisis caused by COVID March 2020 - May 2022.

According to the philosophy that guided the NBR's policy on foreign exchange interventions, high exchange rate volatility is detrimental to both the inflation target and the financial health of the fundamental and financial sectors. This is because high exchange rate volatility makes it more difficult to achieve inflation targets. The NBR adhered to this ideology and advocated for a floating exchange rate as a means to take advantage of the valences offered by the free market, deter speculative activity, and prevent an undue appreciation of the currency.

The NBR was necessary to make quite significant purchases of foreign currency on the market in order to maintain a consistent application of this ideology. The National Bank of Rwanda (NBR) came under fire for not allowing the exchange rate to increase in accordance with the needs of the market when it bought the currency. As of today, it has become clear that the policy in question was correct. The ongoing global financial crisis has resulted in a dramatic reversal of the trend of RON appreciation, which has been accompanied by substantial periods of volatility. Similarly to how foreign exchange inflows led to an overestimation of the local currency that was significantly higher than the level indicated by the fundamentals of the exchange rate, the reduction in external financing and uncertainty tend to lead to an unjustified depreciation of the leu as indicated by the fundamentals of the exchange rate. In times of overestimation, the reserves that are purchased on the

foreign exchange market act as interventions to calm the depreciation of the national currency (RON).

In this light, the study aims to explore the main dynamics between exchange rates, gold price, and inflation rate from a multivariate perspective covering the period 2009-2022 based on a VAR/VECM approach together with Granger causality and impulse response function.

The paper is organized as follows. The section of the problem statement introduces the reader to the topic of the financial crisis. It explores the main implications between exchange rates and gold price focusing on the most relevant research publications.

A brief description of the data and the fundamental elements of the multivariate approach is included in the methodology section. The empirical findings section highlighted the main findings between all the model variables. The research continues with remarks and findings pointing out the dynamics between exchange rates, inflation, and the gold price.

2. Problem Statement

The findings of numerous different forms of study have provided evidence for the occurrence of a variety of calendar anomalies, which runs counter to the recognized assumptions that are the foundation of asset–pricing models. Some examples of these include the monthly effect, also known as the January effect (Kim, Park, 1994; Haug, Hirschey, 2006; Rendon, Ziemba, 2007; Agnani, Aray, 2011; Kumar, 2016a,b), the holiday effect, also known as the Liano and White effect (Vergin, McGinnis, 1999), and the week–end effect (Lakonishok, Levi, 1982; Jaffe, Westerfield, 1985; Kohli, Kohers, 1992; Levy, Yagil, 2012).

Among them, the January effect, the Day-of-the-week effect (also known as DOW), and the Turn-of-the-month effect (also known as TOM) are the most well-known and have attracted a significant amount of interest from academicians as well as practitioners (Alt, Fortin, Weinberger, 2011). Previous research has made an effort to investigate the root of these aberrations, but thus far, no satisfactory explanation has been uncovered.

The influence of the Dow Jones Industrial Average makes Monday the worst day of the week for investors when compared to the other days of the week (Condoyanni, et al., 1987). The January effect is a peculiarity of the calendar that occurs only in the context of the financial markets. This impact causes returns in January to be much higher than those in any other month of the year (Floros, 2008; Moller, Zilca, 2008; Dbouk, Jamali, Kryzanowski, 2013; Lynch, Puckett, Yan, 2014). Many experts in the field of academia are of the opinion that the performance of stocks during the first month of the year is an accurate predictor of how those stocks will perform throughout the rest of the year. When a security is carried over from one month to the next, an unusual price anomaly known as the "TOM effect" might appear in the equity markets. This impact is common knowledge among market participants. According to Moller and Zilca (2008), the last few days of December and the first few days of January are times when stock returns are particularly strong. According

to Kumar, the returns on TOM trading days were much lower than the returns on non-TOM trading days (2015).

Mondays in Central and Eastern Europe (CEE) experienced negative returns from 1997 to 2000, according to Patev (2003). Despite providing contradictory evidence for the presence of the impact in Eastern European emerging markets between 1990 and 2002, Ajayi et al. (2004) provided support for the weekday effect. Tonchev and Kim 2004 discovered that there was essentially little evidence of calendar impacts in the markets of the Czech Republic, Slovakia, and Slovenia. The research conducted by Chukwuogor-Ndu in 2006 looked at fifteen European financial markets and discovered that several countries, such as the Czech Republic, Slovakia, and Turkey, have had negative returns on Monday. After entering the EU, the nations of Central and Eastern Europe reportedly saw a decline in the occurrence of these anomalies, as stated by Heinineni and Puttonen (2008). Mondays are the days of the week when Turkey, Cyprus, and Greece have the least amount of impact, according to Hourvouliades and Kourkoumelis (2009). While Francesco and Rakesh (2010) observed a day-of-the-week effect in the Slovenian stock market following EU accession of European equity markets from 1999 to 2009, Borges (2009) found anomalies in seventeen European equities markets between the years of 1994 and 2007. Borges' research focused on the period between 1994 and 2007.

2.1 The Impact of the Day of the Week

Cross was one of the first people to look at data from the United States (US) while evaluating daily fluctuations in stock prices by the day of the week (1973). According to the available research, the prices of stocks tend to be higher on Fridays than they are on any other day of the week, whereas the opposite is true on Mondays: they tend to be lower than they are on any other day of the week. According to research on the influence of the day of the week, Mondays often have lower daily returns than the other weekdays (French, 1980). The weekdays are expected to have varying effects on the average returns (Cross, 1973; Gibbons, Hess, 1981; Cai, Li, Qi, 2006).

According to Zhang, when it comes to portfolio selection, profit management, and overall investing strategy, the day of the week influence may influence investors (2017). Furthermore, Zhang et al. (2017) point out that finance theory cannot adequately explain this type of phenomenon. They also note that, even though calendar impacts have been documented in the literature, there is no uniform consensus among the researchers because of differences in sample data and methodologies. The oddity regarding the days of the week was also found by Sias and Starks (1995). Because investors tend to trade fewer securities on Mondays than they do on other days of the week, Mondays tend to have lower returns than on the other days of the week. According to Golder and Macy (2011), a distinctive weekly pattern of better mood could be able to explain why Monday returns are lower than those seen on other days of the week.

2.2 The Influence of the First of the Month

The time-of-the-month effect (also known as the TOM effect) is a well-studied price anomaly that occurs in the stock markets and takes place at a certain period of the month or when an asset is carried over from one month to the next. Ariel (1987) referred to an empirical irregularity in stock returns as the "monthly effect," and he used that word to define the phenomenon. After analyzing the stock index returns from 1963 to 1981, he finds that stock returns are statistically distinguishable from zero on days immediately before and throughout the first half of each calendar month. His research covers the period from 1963 to 1981. Expanding on the research done by Ariel (1987) for four additional nations, Jaffe and Westerfield (1989) offer a flimsy case for the validity of his findings.

However, they uncover compelling data suggesting that the last day of the month has an impact.

The time value of the money impact is created when an asset is carried over from one month to the next. This phenomenon is well-known in the equity markets, and it has received a significant amount of research attention. An empirical irregularity in equity returns was given the name "monthly effect" by Ariel (1987), who coined the phrase. It has been discovered that the average return on stocks is profitable in the days immediately preceding and during the first half of calendar months, but that such returns are statistically negligible in the days that fall in the second half of the month. The findings of Ariel's (1987) research were extended to four other nations by Jaffe and Westerfield's (1989) investigation. Despite this, the conclusions formed by Ariel do not hold water in their eyes. On the other hand, they uncover compelling data suggesting that the last day of the month has an impact.

2.3 The Influence of the New Year (January Effect)

The January impact wasn't documented for the first time until Rozeff and Kinney (1976) did their study on the New York Stock Exchange. According to research conducted by Gultekin and Gultekin (1983), the best months for returns in the United Kingdom are January and April. In Japan, however, only one month is among the best. According to Mill and Coutts' research, there is evidence that January had an effect on the FTSE100, Mid 250, and 350 indexes from 1986 to 1992. [Citation needed] (1995).

The monthly CRSP statistics from 1926 to 2005 include evidence of the impact that January had on the market. Agnani and Aray (2011) utilize monthly data from the United States from 1940 to 2006 to investigate whether or not a time-varying January impact is both positive and strong in high volatility regimes, and low volatility regimes respectively. Jacobsen and Zhang (2013) looked at more than 300 years of stock returns in the UK and discovered that the January effect first appeared around the year 1830. However, between 1951 and 2009, the January influence gradually disappeared. This finding was based on the fact that Christmas became a public holiday in the UK in 1830.

When analyzing the relationship between currency pairings and the US dollar, Kumar (2016) focused on the influence that January had between 1995 and 2014. Statistics collected from 1995 to 2004 show that the returns on all currencies are greater in January and that they fall during the remainder of the year, which confirms the January impact. He argues that the January impact has mostly disappeared for virtually all currencies from 2005 to 2014, which is evidence that markets have become more efficient throughout this time.

Due to its long history of usage as a medium of trade and a store of value, gold is considered to be both a commodity and a kind of money. When it was initially extracted from the ground, gold was one of the first metals discovered by humankind. The Bretton Woods system, which was put into place after World War II, established a price for gold of $35 per troy ounce. In 1971, the United States switched to a currency system based on fiat, which meant that dollars could no longer be directly exchanged for gold. Decoupling from gold was finally accomplished with the Swiss Franc in the year 2000.

Gold investment may be utilized as a risk management strategy to reduce the impact of adverse macroeconomic and financial conditions (Agyei-Ampomah, Gounopoulos, Mazouz, 2014; Baur, Lucey, 2010; Beckmann, Berger, Czudaj, 2015, 2019; Bilgin, Gozgor, Lau, Sheng, 2018; Bouoiyour, Selmi, Wohar, 2018). Investors acquire gold as a hedge against currency changes since it is seen as a stable asset in both economically challenged and non-stressed contexts. As a result, gold prices tend to remain relatively stable (Beckmann et al., 2019; Harris, Shen, 2017; Mensi, Hammoudeh, Al-Jarrah, Sensoy, Kang, 2017; Singhal, Choudhary, Biswal, 2019).

Over the course of the previous two decades, there has been a rising interest in the study and literature about gold investments. O'Connor, Batten, and Baur (2015); O'Connor, Lucey, and Batten. O'Connor, Batten, and Baur (2015). Gold is a popular investment choice among investors during times of economic instability and underperformance (Jain & Biswal, 2016). To put it another way (Bouri, Jain, Biswal, Roubaud, 2017). Since the global financial crisis (GFC), gold has been an increasingly appealing alternative hedge that may be utilized in portfolio diversification (Kirkulak, Uludag, Lkhamazhapov, 2014).

It has also been demonstrated that previous financial crises have had an effect on the relationship between gold's reputation as a safe-haven asset and a loss in the value of other currencies (Baur et al., 2010; Nguyen et al., 2020; Yang et al., 2014). According to the findings of a research done by Morales-Zumaquero and Sosvilla-Rivero (2014), which examined the period of time between 1970 and 2011, GFCs are what induce breaks in the volatility of currency rates. Because of this, the world's central banks were forced to implement unconventional monetary policy measures in order to stabilize the relationship between gold prices and currency rates. These measures included lowering interest rates to zero and initiating quantitative easing (QE), two of the more notable examples.

Since the Great Financial Crisis (GFC), the introduction of COVID-19 has sent ripples across the financial markets that have rattled them to their very foundations (Baker, Bloom, Davis, Terry, 2020; Goodell, 2020). The global market for foreign

currencies has been significantly impacted because of the financial crisis that began in COVID-19. This current financial crisis is significantly more extensive and damaging than those that have occurred in the past (Shehzad, Xiaoxing, Kazouz, 2020). In response to the impact that COVID-19 had on the currency exchange rate, several developed and developing countries implemented unconventional macroeconomic policies that encouraged interest rates to remain at or near zero. This was done to prevent the long-term trend of exchange rate volatility from being disrupted (Yilmazkuday, 2022).

Academics have established a connection between the prices of stocks and commodities such as gold and oil for many years. Economists make use of a wide variety of economic indicators, including industrial production, interest rates, inflation, and currency exchange rates (Amoateng, Jovad, 2004). El-Sharif et al. (2005) used only data from the United Kingdom in their study, and they discovered a positive and sometimes substantial correlation between the stock prices of oil and gas sector companies and the fluctuations in the prices of oil and gas on the market. Basher and Sadorsky (2006) stated that the risk of fluctuating oil prices has a substantial influence on the stock returns of developing economies.

According to Zang et al., cointegration and causality both point to a relationship between the prices of gold and crude oil (2010). The analysis found a significant relationship between the prices of crude oil and gold during the time covered by the sample. Additionally, it was revealed that the long-term equilibrium between the two markets as well as the linear Granger variation in crude oil prices were the primary drivers of the fluctuation in the gold price. In addition to this, it seems that the price of crude oil has a greater influence on the predicted effective price between the two markets than gold does.

Laughlin (1997) stated that the value of gold rises regardless of whether the value of other commodities falls. In his analysis of the future price of gold, Pravit (2009) makes use of a combination of multiple regression and ARIMA. The ARIMA (1, 1, 1) model provides the most accurate projections of the short-term movement of gold prices. The multiple regression model used in the research revealed that fluctuations in the price of gold in Thailand are influenced by a variety of economic variables, including but not limited to the following: the value of the Australian Dollar, the Japanese Yen, the United States Dollar, the Canadian Dollar, the European Union Ponds, the price of oil, and the price of gold futures.

3. Research Questions / Aims of the Research

The paper investigates the nature of the relationship between the euro-Ron exchange rate, the dollar-Ron exchange rate, gold price, and inflation using monthly data from January 2009 to May 2022. To do that, a multivariate approach has been applied, incorporating the cointegration analysis, Granger causality, and impulse response function.

4. Research Methods

The research used monthly data covering 2009-2022 using four main variables: average Euro-Ron exchange rate, average Dollar-Ron exchange rate, average gold price, and harmonized consumer price index.

Analyzing the average monthly Euro-Ron exchange rate between 2013 and 2015, a relatively stationary evolution is observed, fluctuating between 4.395 and 4.52. This is a relatively horizontal trend, with the recorded values fluctuating around an average value. In this case, it is not a question of a significant trend (Ștefănescu, Dumitriu, 2018). Regarding the evolution of the average monthly Euro-Ron exchange rate in the next period, 2015-2018, it is observed that the time series shows an upward trend corresponding to a significant increase. Thus, the national currency depreciated against the European one.

The reason for which the Dollar-Ron exchange rate has been included is that until 2004, the representative foreign currency in Romania was the US dollar. The evolution of this time series highlights a downward linear trend and an alternation of periods of appreciation and significant depreciation. In 2009-2020, the dollar-Ron exchange rate shows a horizontal linear trend. However, during the late period, the national currency depreciated significantly against the US dollar (Ștefănescu, Dumitriu, 2020).

The gold market is a signal of crisis. When the prices of many financial assets collapse, the intrinsic value of the precious metal becomes very tempting to many investors. If rising inflation erodes confidence in some currencies and financial market volatility is expected to remain high, gold transactions will become attractive to many investors. As a result, the price of gold followed an upward trend in the first quarter of 2020. However, as with the Dow Jones index, the positive shocks alternated with the negative ones.

The study aims to explore the main dynamics between exchange rates, gold price, and inflation rate from a multivariate perspective covering the period 2009-2022 based on the Granger causality approach and the impulse response function testing empirically the existence of the long-run relationship using Johansen multivariate approach and the estimation of VAR/VECM model.

The unit root ADF and PP were tested to determine the order in which the variables should be integrated. In addition, the presence of a long-run relationship has been investigated by utilizing a VAR model to ascertain the lack of a serial correlation in the residuals. The optimal lag length has been determined by applying informational standards such as the AIC and the SCH.

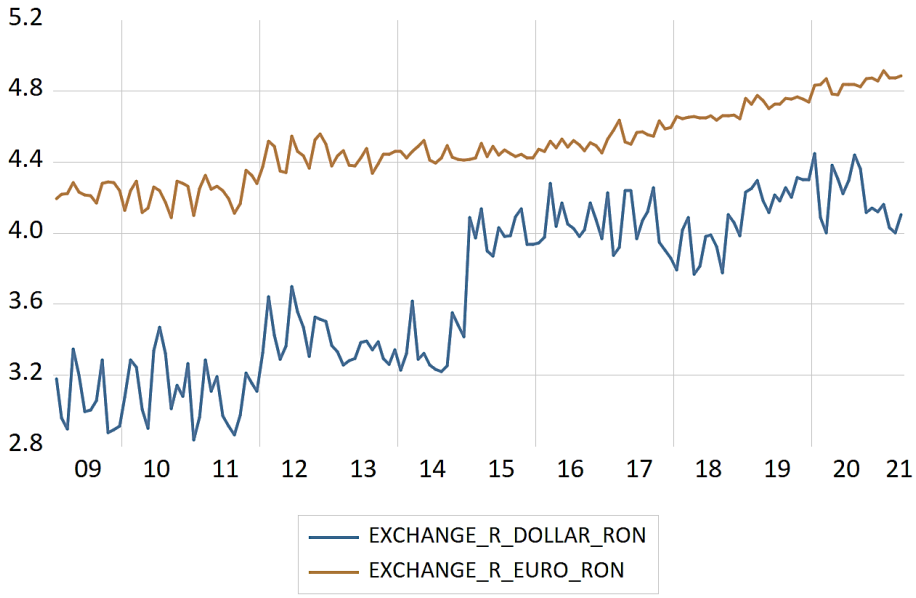
If the analysis does not reveal the presence of a cointegration relationship, a VAR model in difference needs to be estimated, and thus the Granger causality could offer only the short-term perspective. If the variables exhibit a co-movement relationship, that a cointegrated VAR model that considers an error correction mechanism will be necessary. It is possible to witness long-run and short-run causalities inside a VECM simultaneously. The ECM coefficients must be negative and statistically significant in terms of the t-test to validate the existence of Granger causation over the long run. The short-run Granger causality is validated when the lagged coefficients are jointly

statistically significant in terms of the Wald test or the F test. After the Granger causality was established, generalized impulse response functions developed by Pesaran and Shin (1998) were used to determine the impact of a shock in gold price and inflation on the exchange rates.

5. Findings

The analysis has used the period 2009M01 2018M12 training period and 2019M01-2022M12 as test and forecast horizon periods.

Figure 1. The Evolution of Romanian exchange rates



Source: Own processing in EViews.

Analysing both exchange rates, the ascendant trend of the dollar-Ron exchange rate can be highlighted, as well as the oscillating trend of the euro-Ron exchange rate, even if characterized by several shocks.

In analysing the dynamic interdependencies between exchange rates, gold price and inflation, the first step requires the analysis of the stationarity of each series to test if all variables are integrated on the same order, and thus the cointegration could be considered. The ADF test revealed that all series are I (1), being integrated in the same order, and thus, the first condition from cointegration definition is accomplished. Furthermore, the Johansen approach is applied within a VAR framework to explore the existence of a long-run equilibrium relationship between the variables. The empirical results of the Johansen approach (Table 1) revealed the existence of a unique cointegration relationship at the 1% significance level. The

optimal lag length according to AIC and SBC was 1, for which the main hypotheses on residuals and the stability condition have also been validated.

Table 1. The empirical results of Johansen's approach

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.263153	84.70693	63.87610	0.0003
At most 1	0.157618	41.03832	42.91525	0.0761
At most 2	0.063197	16.51077	25.87211	0.4522
At most 3	0.048939	7.175339	12.51798	0.3266

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.263153	43.66861	32.11832	0.0013
At most 1	0.157618	24.52755	25.82321	0.0734
At most 2	0.063197	9.335430	19.38704	0.6895
At most 3	0.048939	7.175339	12.51798	0.3266

Source: Own processing in EViews.

The existence of a long-run equilibrium being proved, a VECM model has been estimated (Table 2). The empirical results pointed out a co-integration relationship between the dollar-ron exchange rate, euro-ron exchange rate, gold price, and inflation. The long-run equilibrium analysis revealed a negative and statistically significant relationship between both exchange rates, while the gold price positively impacted the euro-Ron exchange rate. The inflation pointed out a negative impact which, however, suffers from the lack of statistical significance. The results have also been confirmed by the study of Houcine et al. (2020), which found a long-run relationship between the price of crude oil, the Euro Dollar Exchange Rate, and the Gold Price pointing out the existence of a Granger causality moving from the Euro/ Dollar towards oil prices, highlighting that the variation in the exchange rate causes changes in oil prices.

Therefore, the gold price and the dollar-ron exchange rate explain the long-term changes in the euro-Ron exchange rate, given the statistical significance of the long-run coefficients.

Table 2. The empirical results of the VECM model

Cointegrating Eq:	CointEq1			
EXCHANGE R EUR...	1.000000			
EXCHANGE_R_DOLL...	0.234001 (0.05673) [4.12487]			
GOLD_PRICE(-1)	-0.001489 (0.00049) [-3.06253]			
HCPI(-1)	0.008365 (0.00460) [1.82042]			
@TREND(09M01)	-0.007278 (0.00106) [-6.87264]			
C	-5.393013			
Error Correction:	**D(EXCHA...**	**D(EXCHA...**	**D(GOLD ...**	**D(HCPI)**
CointEq1	-0.446061 (0.07172) [-6.21988]	-0.911832 (0.20610) [-4.42415]	-35.98342 (17.6915) [-2.03393]	-4.523664 (1.68435) [-2.68571]
D(EXCHANGE R EU...	0.039958 (0.09449) [0.42286]	0.297893 (0.27156) [1.09696]	10.37209 (23.3105) [0.44495]	2.558213 (2.21931) [1.15271]
D(EXCHANGE R DO...	0.024283 (0.03061) [0.79332]	-0.118490 (0.08797) [-1.34698]	-0.176224 (7.55096) [-0.02334]	0.061702 (0.71890) [0.08583]
D(GOLD PRICE(-1))	-0.000197 (0.00039) [-0.50801]	-0.000135 (0.00112) [-0.12103]	-0.193060 (0.09574) [-2.01641]	-0.002515 (0.00912) [-0.27593]
D(HCPI(-1))	0.001303 (0.00395) [0.32996]	0.007456 (0.01135) [0.65700]	1.479292 (0.97417) [1.51851]	-0.208708 (0.09275) [-2.25028]
C	0.004213 (0.00485) [0.86871]	0.006936 (0.01394) [0.49772]	0.949003 (1.19628) [0.79330]	0.233234 (0.11389) [2.04782]
R-squared	0.257018	0.176151	0.062013	0.099630
Adj. R-squared	0.229902	0.146083	0.027780	0.066770
Sum sq. resids	0.450690	3.722401	27427.41	248.6095
S.E. equation	0.057356	0.164836	14.14921	1.347096
F-statistic	9.478431	5.858517	1.811493	3.031934
Log likelihood	208.9189	57.95781	-578.7446	-242.4505
Akaike AIC	-2.838027	-0.726683	8.178247	3.474832
Schwarz SC	-2.713711	-0.602367	8.302562	3.599147
Mean dependent	0.004581	0.008852	1.056069	0.202448
S.D. dependent	0.065359	0.178379	14.34993	1.394454

Source: Own processing in EViews.

The statistical significance of the four error correction terms and the negative sign confirmed the existence of a long-run Granger causality between the four variables within the model.

Table 3. The empirical results of Granger causality

Dependent variable: D(EXCHANGE R EURO RON)

Excluded	Chi-sq	df	Prob.
D(EXCHANGE R D...	0.629349	1	0.4276
D(GOLD PRICE)	0.258079	1	0.6114
D(HCPI)	0.108872	1	0.7414
All	0.773039	3	0.8559

Dependent variable: D(EXCHANGE R DOLLAR RON)

Excluded	Chi-sq	df	Prob.
D(EXCHANGE R E...	1.203317	1	0.2727
D(GOLD PRICE)	0.014649	1	0.9037
D(HCPI)	0.431646	1	0.5112
All	2.447453	3	0.4849

Dependent variable: D(GOLD PRICE)

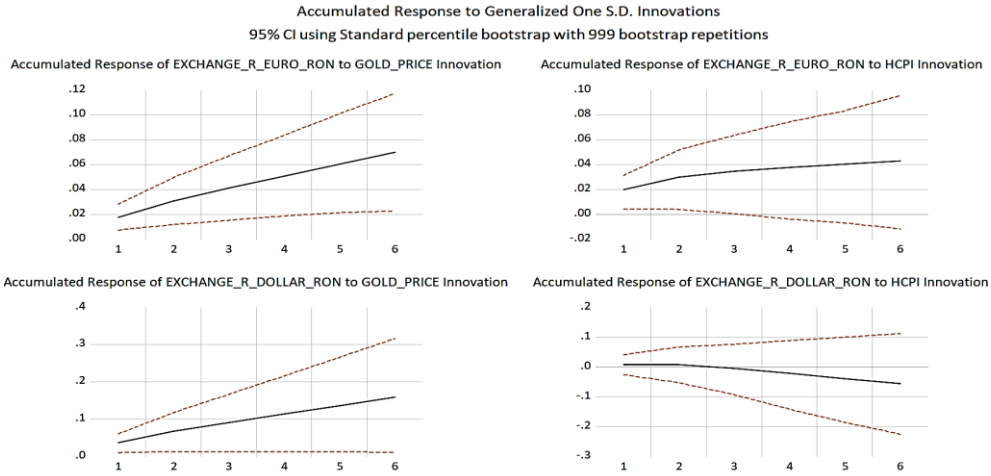
Excluded	Chi-sq	df	Prob.
D(EXCHANGE R E...	0.197984	1	0.6564
D(EXCHANGE R D...	0.000545	1	0.9814
D(HCPI)	2.305870	1	0.1289
All	3.069720	3	0.3810

Dependent variable: D(HCPI)

Excluded	Chi-sq	df	Prob.
D(EXCHANGE R E...	1.328733	1	0.2490
D(EXCHANGE R D...	0.007366	1	0.9316
D(GOLD PRICE)	0.076137	1	0.7826
All	1.414063	3	0.7022

Source: Own processing in EViews.

Figure 2. The effect of a shock in gold price and inflation on the exchange rates



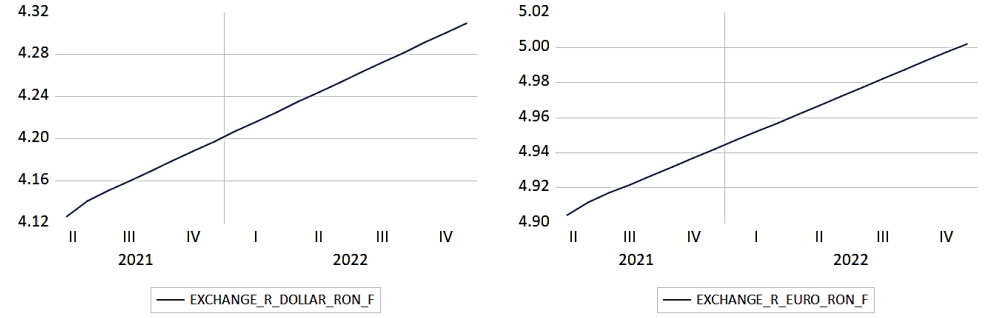
Source: Own processing in EViews.

Particularly in the case of the euro-Ron exchange rate, the ECTt-1 value of –0.44 highlighted that the deviation from the long-term equilibrium is restored by 44% each month (Table 2). The Granger causality test pointed out a long-run causal relationship between the dollar-Ron exchange rate, gold price, and inflation to the euro-Ron exchange rate.

However, in the short-run, the Granger causality test (Table 3) revealed that lack of causality relationships between all variables analysed within the model, given the high probabilities of the test.

Therefore, the relationship happened only on a long-term one. It can be revealed that a long-term equilibrium relationship exists between the euro-Ron exchange rate, dollar-Ron exchange rate, and gold price. Thus, changes in the dollar-Ron exchange rate and gold price are leading to changes in the euro-Ron exchange rate. The effect of a positive shock on the gold price revealed by the impulse response function (Figure 3) reflected a positive impact on both exchange rates.

Figure 3. Forecasts of both exchange rates for 2021-2022



Source: Own processing in EViews.

Analysing the forecasts provided by the model, it can be highlighted that at the end of this year, the dollar-Ron exchange rate will register the value of 4.31 Ron, while the exchange rate for the euro will be at the value of 5.00 Ron.

6. Conclusions

The paper investigated the relationship between euro/dollar-Ron exchange rates, gold price, and inflation for the Romanian economy using monthly data covering the period 2009M01-2022M12.

The empirical results pointed out a long-run relationship between exchange rates, gold price, and inflation and denied any short-term relationship. Also, the Granger causality test highlighted a long-run causality between all four variables in the model. The impulse response function pointed out that changes in the dollar-ron exchange rate and gold price lead to changes in the euro-ron exchange rate.

The central forecast results pointed out the value of 4.31 for dollar Ron exchange rate and 5.00 for euro-ron exchange rate at the end of 2022.

As future research directions, the analysis can be extended to the level of European Union based on VAR or VECM models using panel data.

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