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Do Governance Indicators Impact the Shadow Economy? Evidence from CEE Countries

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Abstract

In this article, shadow economy and governance indices in Central and Eastern European countries are examined. For the year 2019, we looked at cross-sectional data for 17 countries and found that the most significant governance factors affecting economic activity that occurs outside of the official sector, such as the shadow or underground economy, were control of corruption, rule of law, political stability, voice accountability, government effectiveness, and regulatory quality. Ridge, Lasso, and Elastic Net Regression are all employed in this study. The findings are used to compare the strengths and weaknesses of the three chosen models and to determine the relative importance of each governance metric in the final model. The results suggested that all three methods have similar results. In terms of R-squared the method with highest value is Lasso, while in terms of the RMSE indicator elastic net regression shows the lowest value.

Keywords: governance indicators, shadow economy, shrinkage, ridge regression, lasso regression, elastic net regression.

JEL Classification: O17, J46, E26, E27, C59.

1. Introduction

In the past decade, substantial progress has been made in characterizing the size and composition of the informal economy in Central and Eastern Europe (Kapelyushnikov et al., 2010, Williams et al., 2013; Likić-Brborić et al., 2013; Kukk, Staehr, 2014; Davies, Polese, 2015). However, until recently, this has been done by examining the reasons individuals labor in the shadow economy, resulting in intense theoretical discussions over whether undeclared employees do so out of need or choice (Maloney, 2004, Williams, 2015).

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Most countries are concerned about corruption, since it has an impact on economic growth (D'Agostino et al., 2016). Because of this phenomenon, there is a lack of trust in institutions, and so corruption does not serve as a force that fosters economic progress (Rodriguez-Pose, 2013).

The shadow economy comprises both legal and economic repercussions that have a considerable impact on a country's economic and financial policies (Dell'Anno et al., 2007; Schneider, Enste, 2000). A significant informal economy may force a country's leaders to make choices based on false indications, which may have fiscal ramifications and effect on taxes and distribution policies in that country.

As a result, it is critical to lower levels of corruption and other related phenomena, such as the shadow economy, in order to entice foreign money to come onshore, raise investment, and ultimately foster innovation. Following this logic, the goal of this study is to examine the influence of governance indicators on the shadow economy in Central and Eastern European countries using the latest available data for informal economy estimation provided by the International Monetary Fund (Kelmanson et al., 2019). Using shrinking methodology that minimizes the possibility of overfitting or underfitting the data by adding a penalty term, the results indicate that control of corruption has the most impact in shadow economy.

Such an endeavor, to the best of the authors' knowledge, has not yet been made. There are several studies that treat the issue of corruption and shadow economy or governance quality and informal economy, but there has not yet been developed a model that is trying to point out what and how governance indicators impact the shadow economy. The research is focused on Central and Eastern European countries, considering that other authors highlighted that shadow economy and corruption are alternatives in wealthy nations but complements in unwealthy countries.

The following research questions will be addressed in this study: RQ1. What governance indicator has the most impact in the shadow economy? RQ2. What shrinkage method performs the best in terms of accuracy? RQ3. Does the three methods highlight highly different results? RQ4. What variables have shrinked almost to zero in shadow economy impact?

There are five main parts to this study. The purpose of this introduction is to briefly explain the importance of the subject. Theories and studies pertinent to the topic will be discussed in the section following this one. The third section presents data and technique, while the next section demonstrates empirical outcomes. The end of the paper is a summary of the important points.

2. Review of the Scientific Literature

This research seeks to examine the influence of governance factors on the shadow economy in Central and Eastern European nations. Theoretically, corruption (a governance indicator) and the shadow economy can be substitutes or complements (Dreher, Schneider, 2010). This section presents a literature review to better comprehend these phenomena (the shadow economy and governance indicators) and their relationship.

In the early 1970s, a series of studies investigating the social and economic factors of underdevelopment sparked the first wave of study on the informal sector (Hart, 1973). For more than four decades, the shadow economy has been documented as a phenomenon, sometimes known as the unofficial, hidden, subterranean, or black market. Economists around the world are attempting to define it, assess its scope, and advocate for control or elimination. Nevertheless, it is understood that once developed, the underground economy is famously hard to ignore (Schneider, 2000).

In recent years, it has become generally accepted that every national economy consists of a formal and an informal sector (Schneider, Enste, 2013). The domestic sector (self-sufficient economy) and the shadow economy make up the latter category (products and services are traded through markets as usual). Most publications eliminate acceptable self-sufficient activities from their concerns since they are quasi-economic activities (Eilat, Zinnes, 2002; Zaman, Goschin, 2015). The shadow economy consists of illegal activities like illegal workers and the illegal sector (Schneider, 2000).

Eilat and Zinnes (2002), Mikulic and Nagyszombaty (2013), and Schneider and Hametner (2014) all highlight regulatory perception density as a crucial predictor of the shadow economy in transitional nations. Individuals and businesses are said to be able to operate without monitoring if governance and the rule of law are weak. Bribes and corruption are unfavorable outcomes of the officials' lack of control.

In recent years, there has been a significant surge in interest in discovering the roots of the shadow economy and other criminal activities. However, identifying the causes remains a developing field of study. One of the primary reasons for the interest in governance quality was the emergence of institutional flaws and corruption as key impediments to market reforms (Abed, Gupta, 2002). The informal sector, on the other hand, is essential not only in transition nations, but also in developing countries. For many people, employment in the informal sector appears to be a viable source of income.

The political system, as well as the economic system, has an impact on both official and informal economic activity. Many countries' outcomes may be explained by underlying political factors. In terms of the size and shape of their fiscal systems, countries may tend to find a middle ground that reflects the balance of political forces and institutions and remain there until "shocked" to a new middle ground (Bird et al., 2008). It is interesting to study if existing contemporary political research on the relevance of governance and institutions allows us to comprehend the scope and evolution of the shadow economy. Citizen's identification with the state grows, as does their desire to pay, when they believe their interests are effectively reflected in institutions of government and they get an appropriate quantity of common goods. In an inefficient state, on the other hand, citizens will have little faith in government, and consequently no motivation to collaborate. Citizens are more eager to contribute when the state is more comprehensive and genuine. Corruption is exacerbated when the government and administration have extensive control over resource distribution. Schneider et al. (2000) demonstrate that nations with higher levels of corruption have a higher percentage of the shadow economy. According to Dreher and Schneider (2006), the informal economy and corruption are alternatives in wealthy nations, but complements in unwealthy countries.

In countries where corruption is pervasive and the government budget is opaque, it is impossible to assume that the obligation to pay taxes is an accepted social norm. Citizens are reluctant to participate in the formal sector due to institutional insecurity, a lack of honesty, and lack of rule of law. Furthermore, when there are a significant number of corrupt colleagues, morality between tax administrators may be crowded out. Furthermore, legislative limitations and bureaucratic processes not only hinder competitiveness and market operation, but also provide as a better foundation for corrupt actions. Individuals and enterprises are likely to engage in the informal economy if they assume that neither contracts nor constructive activities will be enforced (Torgler, Schneider, 2007).

3. Data and Methodology

Using the most recent available data from 2019, this section analyses the data and methodology used in empirical research to examine how governance issues affect the shadow economy in Central and Eastern European countries. There are approximately 300 carefully selected indicators from several official sources, including the International Monetary Fund, United Nations, the World Bank, and the World Economic Forum in The Global Economy, which is the primary source of data.

Beyond that, a description of the variables considered in the analysis is provided. Starting with the key variable of interest: the shadow economy, we outline the variables used: shadow economy (percent of GDP) – the dependent variable expressed as a percentage of total yearly GDP along with the following independent governance variables control of corruption, regulatory quality, political stability, and absence of violence/terrorism, rule of law, government effectiveness, voice and accountability, political rights, competitiveness, corruption perception, and cost of starting a business.

Regarding the main objective of the paper, the following variables are included to analyse the effect of governance indicators on informal economy e in the Central and Eastern European countries. Table 1 summarizes the descriptive statistics for all the variables included in the investigation.

The descriptive statistics show a mean value of 23.55 for the informal economy in case of Central and Eastern European nations. The minimum value for shadow economy of 10.47 is represented by Czechia, while the maximum value of 37.6 is attributed to North Macedonia. Skewness and kurtosis values between -2 and 2 are adequate to show a normal univariate distribution. All the current distributions are perfectly normal.

Table 1. Summary statistics of the variables included in the analysis

Variable	Mean	Standard deviation	Median	Min	Max	Skewness	Kurtosis
Shadow Economy	23.55	8.58	20.83	10.47	37.6	0.3	-1.19
Rule of Law	0.38	0.56	0.37	-0.41	1.28	0.14	-1.51
Government Effectiveness	0.42	0.53	0.41	-0.63	1.17	-0.15	-1.15
Control of Corruption	0.16	0.58	0.01	-0.61	1.54	0.65	-0.37
Regulatory Quality	0.68	0.49	0.59	-0.19	1.59	0.03	-1.12
Voice Accountability	0.43	0.55	0.49	-0.83	1.21	-0.49	-0.65
Political Stability	0.35	0.59	0.53	-1.37	0.95	-1.45	1.71
Corruption	49.29	10.91	45	35	74	0.61	-0.55
Political Rights	2.35	1.32	2	1	5	0.45	-1.22
Civil liberties	2.41	1.28	2	1	6	1.12	1.17
Competitiveness	64.28	4.97	64.9	54.7	70.9	-0.3	-1.16
Cost of starting a new business	3.88	4.36	1.5	0	13.78	1.08	-0.32

Source: Author's work.

This section provides an overview of the processing approach, variable building, and model estimation strategies used in this paper. Our approaches are based on linear regression, which is outlined in this section. Following a group of independent variables $x_1,x_2,\dots,x_n$ and a dependent features y of interest that it is wanted to highlight the impact, seeked parameters β_0, $\beta_1,\dots,\beta_n$ so that $\beta_0 + \Sigma_{i=1}^{n}\beta_i x_i$ represents a fine approximation of y. When given a collection of m instances of each x_i, termed $x_{i,j}$, and the associated instances y_i, it was chosen the values β_i to minimize the residuals sum of squares $RSS = \Sigma_{j=1}^{m}(\beta_o + \Sigma_{i=1}^{n}\beta_i x_{i,j} - y_j)^2$.

As shown by Hastie et al., forward stepwise selection (Bendel and Afifi, 1977) first sets β_o to $\bar{y}$ and every other $\beta = 0$. Then it picks i and a β value repeatedly to construct a model that minimizes the error function as much as feasible. Once a β_i value is selected, it cannot be changed. As a result, each subsequent model differs only by one coefficient from the prior model. As a result, $n+1$ distinct models are generated, each with a smaller error than the previous one in the series.

The impacts of multicollinearity in regression when highly correlated variables are included have an influence on the model. To check the multicollinearity hypothesis of the regression model, the first approach is to compute the correlation coefficients between variables using Pearson coefficient$\rho_{xy} = \sigma_{xy}/\sigma_x\sigma_y$, where σ_x and σ_y represents the population standard deviation and σ_{xy} as the population covariance. The variance inflation factor (VIF) can be used to describe the impacts of multicollinearity in a regression model. The VIF has been proposed as a second diagnostic for multicollinearity in this paper. If two or more independent variables have an exact linear connection, there is perfect multicollinearity. The first estimation of the regression model has considered shadow economy as a dependent variable and all other governance indicators as independent variables. The VIF of $\widehat{\beta_\iota}$ is defined as *VIF* $(\widehat{\beta_\iota})=\sigma^2/(1-R_j^2)$, where R_j^2 is the coefficient of determination of the initial model. The presence of severe multicollinearity is considered when *VIF* $(\widehat{\beta_\iota}) > 10$.

Ridge regression is predicated on first normalizing the predictor variables. When calculating the standard deviation, subtract the predictor's estimated mean from all of the data before dividing it by the predicted standard deviation. A single standard deviation means that all values are on the same scale and have the same standard error of one. Ridge regression penalizes the overall magnitude of the coefficients, so models with smaller coefficients tend to perform better. Predictors with higher statistical significance should have greater coefficient values, so that the penalty does not increase the values of less significant predictors. To a minimum $RSS + \lambda\, \Sigma_{j=1}^{m} \beta_j^2$, the ridge models as a tuning parameter, with λ>0, can be used to balance between the importance of a small coefficient and low error. Each λ value is represented by a separate model.

Lasso regression (least absolute shrinkage and selection operator) reduces $RSS + \lambda\, \Sigma_{j=1}^{m} |\beta_j|$ while being otherwise identical to ridge regression. Because it zeroes out some coefficients when is large, lasso regression produces smaller models than ridge regression. Ridge regression does not do this.

The elastic net approach is a further extension of both the ridge and lasso regression methods. The elastic net regression approach is a convex mixture of the ridge regression penalty and the lasso penalty. Elastic net regression arose in response to criticism of the lasso, whose variable selection might be too dependent on data and hence unstable. Elastic net regression reduces $RSS + \lambda\, \Sigma_{j=1}^{m} \beta_j^2 + \lambda\, \Sigma_{j=1}^{m} |\beta_j|$. For all the three approached methods, the R library glmnet was used (Friedman et al., 2009).

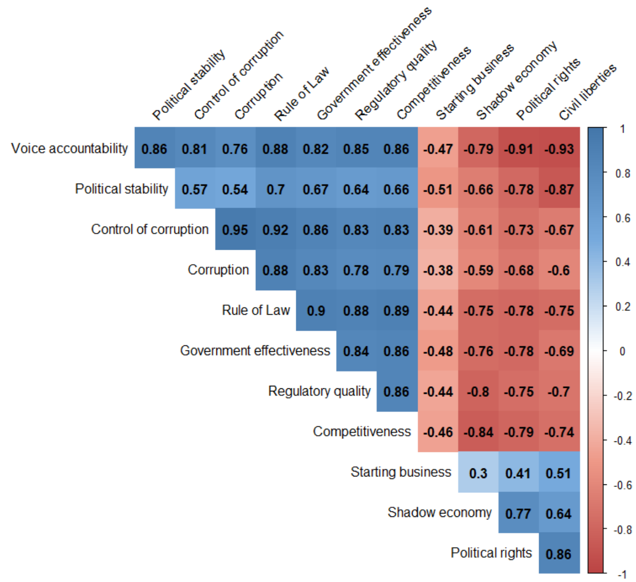
The data needed to build a model is randomly divided into two sets: those used for training the model and those used for testing it. In order to develop a model, training data is used, and the model's accuracy is measured using test data. A model's accuracy in simulating real-world data is what the results are after. When a model's error on the training data is low, but its error on the test data is large, this is called overfitting. Because of the belief that "a model with too many settable parameters is unlikely to have all of them adequately set," these models often perform poorly. The least significant criterion for picking a model is to minimize the model's error on test data samples. The model's error on the test data must be reduced. Each iteration of resolution, ridge, lasso, and elastic net refines a hyperparameter (λ) that guides the algorithm. Decisions are made based on the hyperparameter value.

4. Results and Discussion

The OLS estimator has the required attribute of objectivity. It can, however, vary greatly. This occurs when the predictor variables are significantly associated with each other or when there are many predictors. The usual answer is to minimize the variation at the expense of adding bias. This method is known as regularization, and it is virtually always helpful to the model's prediction performance.

A first glance of multicollinearity issue in a regression model can be tested using Pearson correlation. Figure 1 represents a visualization method of the correlation matrix called a correlogram. As decided to test the impact of governance indicators on shadow economy, it can be spotted that our dependent variable shadow economy is medium to highly negative correlated (ranging from -0.59 to -0.84) with all the variables included in the model except starting a new business which is positive low correlated (0.3). This is the first signal of multicollinearity.

Figure 1. Correlation plot of the data set



Source: Author's work.

To double confirm the presence of multicollinearity in the data a simple OLS estimation is tested using a multiple regression with shadow economy being the de dependent variable and the governance indicators being the dependent variables. From Table 2 it can be concluded that the data for the regression model contains multicollinearity effects in case of rule of law, control of corruption, corruption, voice accountability, and civil liberties because VIF exceeded 10.

Based on the discussions, it has determined that it would like to reduce the model complexity, as an example, the number of predictors. It can be used the forward or backward selection for this, but it would not be able to capture anything about the influence of the eliminated variables on the response. Removing predictors from the model is equivalent to zeroing out their coefficients. Instead of ordering them to be exactly zero, the approach is to punish them if they are too far from zero, causing them to be little indefinitely. It can reduce model complexity while retaining all variables in the model.

Table 2. Multicollinearity Test

Variable	VIF
Rule of Law	16.39
Government Effectiveness	6.90
Control of Corruption	17.25
Regulatory Quality	6.79
Voice Accountability	36.16
Political Stability	7.10
Corruption	11.05
Political Rights	7.31
Civil liberties	10.6
Competitiveness	6.62
Cost of starting a new business	1.72

Source: Author's work

Regression was developed as a second complimentary strategy to favour the inclusion of simple, sparse model predictors. Cross-validation is used to construct the best-fitting parsimonious model, which forecasts hazard ratios that are shrunk closer to the null. Models with a high degree of multicollinearity or where specific components of model selection, such as variable selection/parameter removal, need to be automated, benefit greatly from this type of regression. The L1 regularization approach used by Lasso Regression involves a penalty proportionate to the magnitude of the coefficient. Sparse models with minimal coefficients can be produced using this regularization technique. It is possible that some coefficients will fall below a certain threshold, and so be deleted from the model. The higher the penalty, the lower the coefficient value becomes (ideal for producing simpler models).

Elastic net linear regression uses penalties from the lasso and ridge methodologies to regularize regression models. Combining the LASSO and ridge regression approaches, the strategy improves statistical model regularization by learning from their weaknesses. LASSO's drawbacks, such as the fact that lasso only requires a few samples for high-dimensional data, are overcome by the elastic net technique. As many variables as needed can be incorporated into the model using the elastic net approach. LASSO often selects one variable from each group and ignores the others if the variables are tightly clustered. A two-step strategy is employed to determine the elastic net method's estimate using the LASSO and ridge approaches. As soon as the ridge regression coefficients have been discovered, a LASSO can be used to reduce the original coefficients.

The optimal minimum value found for λ in the cross-validation process is 0.049, while α remained 0 in case of ridge penalty. The optimal minimum value found for λ in the cross-validation process is 0.002, while α is 1 in case of the LASSO penalty. The optimal minimum value found for λ in the cross-validation process is 0.014, while α is 0.1 in the case of elastic net penalty. The minimised value found for Ridge MSE is 5.33, for LASSO MSE is 5.15 and for Elastic Net MSE is 5.61.

To find fitted ridge regression model based on the minimum value of MSE, thus it is considered to selected Alpha (α) = 0. In Table 3 it is denoted that the most appropriate fitted ridge regression model represents $\hat{y} = 101.85 + 5.68\ x_1 – 4.91\ x_2 – 10.69\ x_3 – 5.73\ x_4 – 7.01\ x_5 – 6.15\ x_6 – 0.1\ x_7 + 0.72\ x_8 – 3.31\ x_9 – 0.95\ x_{10} + 0.09\ x_{11}$. To find fitted LASSO regression model based on the minimum value of MSE, thus it was considered to selected Alpha (α) = 1. It is denoted that the most appropriate fitted LASSO regression model represents $\hat{y} = 99.47 + 4.97\ x_1 – 5.10\ x_2 – 10.67\ x_3 – 5.50\ x_4 – 6.16\ x_5 – 5.53\ x_6 – 0.09\ x_7 + 0.61\ x_8 – 2.82\ x_9 – 0.94\ x_{10} + 0.06\ x_{11}$. To find fitted elastic net regression model based on the minimum value of MSE, thus it was considered to selected Alpha (α) = 0.1. It is denoted that the most appropriate fitted elastic net regression model represents $\hat{y} = 108.1 + 6.33\ x_1 – 5.17\ x_2 – 12.01\ x_3 – 5.75\ x_4 – 8.52\ x_5 – 6.31\ x_6 – 0.14\ x_7 + 0.73\ x_8 – 3.78\ x_9 – 0.99\ x_{10} + 0.1\ x_{11}$.

Table 3. Ridge, LASSO and Elastic net regression coefficients

Variable	Ridge coefficients (alpha = 0)	LASSO coefficients (alpha = 1)	Elastic net coefficients (alpha = 0.1)
(Intercept)	101.85526753	99.47321004	108.1090109
Rule of Law (x1)	5.68317331	4.97820717	6.3371185
Government Effectiveness (x2)	-4.91987653	-5.10603148	-5.1705810
Control of Corruption (x3)	-10.69500872	-10.67350288	-12.0126203
Regulatory Quality (x4)	-5.73782169	-5.50828515	-5.7570394
Voice Accountability (x5)	-7.01852379	-6.16898734	-8.5230165
Political Stability (x6)	-6.15109322	-5.53512373	-6.3120144
Corruption (x7)	-0.10287180	-0.09003829	-0.1430631
Political Rights (x8)	0.72001218	0.61045729	0.7318538
Civil liberties (x9)	-3.31819191	-2.82668945	-3.7841000
Competitiveness (x10)	-0.95138346	-0.94316216	-0.9957976
Cost of starting a new business (x11)	0.09280123	0.06260667	0.1030126

Source: Author's work.

The ridge, LASSO, and Elastic Net methods were used to build three regression models with the given features. There were eleven characteristics in the regression models based on LASSO, ridge, and Elastic Net. All models exhibited similar root mean squared error metrics and explained almost 70% of the variability in governance indicators, demonstrating that the models were good at forecasting shadow economy based on governance variables. According to the parsimony principle, elastic net regression has the lowest prediction error. The root mean square error (i.e., prediction error) was also offered as a performance metric for our models based on the estimates gained during cross-validation. Predictive error is an important consideration when selecting a model. Here again, the elastic net model (RMSE = 1.499, SD = 0.528) performed relatively better than the Ridge (RMSE =1.774, SD = 0.523) and LASSO (RMSE = 1.505, SD = 0.544) models (Table 4), supporting the choice of the elastic net model. Elastic net models were used to analyse these data.

Table 4. Explained variance results for Ridge, LASSO and Elastic Net

Model	R-squared	RMSE (95% CI)	SD
Ridge	0.6934	1.774 (1.251, 2.297)	0.523
LASSO	0.7002	1.505 (0.961, 2.049)	0.544
Elastic Net	0.6920	1.499 (0.971, 2.027)	0.528

Source: Author's work.

5. Conclusions

This paper examined the relationship between governance indicators and shadow economy estimates for CEE nations. The empirical findings indicate that the three shrinkage techniques yield comparable results. The paper extends previous empirical models of the impact of governance indicators on the shadow economy by employing an approach that considers all the model's features without omitting any but penalizes the coefficients.

The multicollinearity hypothesis was tested before shrinkage methods such as ridge regression, lasso regression, and elastic net regression were applied. Shadow economies in Central and Eastern Europe (CEE) are positively impacted by the rule of law, political rights, and the cost of launching a new firm. When it comes to control of corruption, government effectiveness and quality of regulation and the voice of the people's accountability in the legislative process, these factors have a negative influence.

Corruption control, voice accountability, political stability, the rule of law, regulatory quality, and government efficiency are the most significant factors influencing the shadow economy. The relevance of the other coefficients has been reduced by a modest coefficient.

The model with the highest variability explained by the features is the LASSO regression, while the elastic net regression has the slightest prediction error. The accuracy between the three models is similar, with small differences.

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