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Corruption and shadow economy in transition economies of European Union countries: a panel cointegration and causality analysis

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ABSTRACT

Corruption and shadow economy are two critical problems which feed each other and pose an obstacle against the economic development of countries, especially those with weak fundamentals. Central and Eastern European countries have experienced an absolute political and economic transformation after the downfall of the Berlin Wall. This study researches the effect of corruption and rule of law on shadow economy in 11 transition economies of Central and Eastern Europe over the 2003–2015 term with panel cointegration and causality tests considering heterogeneity and cross-sectional dependence. The cointegration coefficients revealed a complementary interplay between size of shadow economy and corruption. Furthermore, the causality analysis indicated that there was a bilateral causality between control of corruption and shadow economy in all the cross-section units. However, there was a two-way causality between rule of law and shadow economy only in Bulgaria, Czech Republic, Poland and Romania. Furthermore, there was one-way causality from rule of law to shadow economy in Croatia, Estonia, Hungary, Slovakia and Slovenia.

1. Introduction

Both corruption and shadow economy are common problems which all countries face in several dimensions, and they have social, economic and political implications. Corruption is generally expressed as the misuse of public or private office for individual gain and consists of bribery, embezzlement, nepotism or confiscation. Thus, the existence of corruption causes the inefficient allocation or waste of public resources, increases the cost of doing business, increases income inequality and poverty, weakens the institutional and legal structure of the state and tax system, and erodes the public trust for the state (OECD, 2014). On the other side, the shadow economy is expressed as the unrecorded economic activities which make contribution to the gross

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domestic product due to avoidance of taxation or regulations (Schneider & Enste, 2000). The informality has become a key point for the problems of both government and private sectors and the analysis of the possible solutions to the problems. The shadow economy makes economic and social policy planning difficult because of incomplete and unreliable statistics. Decreases in the tax revenues and the size of the shadow economy may increase if the government raises tax rates to meet decreasing tax incomes. Furthermore, increases in the size of the shadow economy can direct the economic units to go underground (Schneider & Enste, 2000; Singh, Jain-Chandra, & Mohommad, 2012).

The interaction between corruption and shadow economy has been a much discussed topic in the relevant literature. Some researchers see corruption as a component of the shadow economy (e.g., Tanzi, 1998), whereas some researchers assert that corruption is not a component of the shadow economy (e.g., Altuǧ, 1994; Onder, 2001). However, both the shadow economy and corruption may decrease social welfare. Furthermore, the shadow economy and corruption may exhibit a complementary or substitutable relationship. On one hand, the shadow economy and corruption can be substitutes, because increasing the size of the shadow economy decreases the tendency of state employees to ask for bribes (Dreher & Schneider, 2006). On the other hand, the shadow economy and corruption may be complementary, because corruption can be regarded as a form of regulation and taxation (Johnson, Kaufmann, & Zoido-Lobatón, 1998a) and taxpayers pay a bribe to the officials in exchange for underspecifying the tax liability (Hindriks, Muthoo, & Keen, 1999). So, the interaction between the shadow economy and corruption has remained inconclusive theoretically, and a two-way causality is expected between shadow economy and corruption.

The transition economies of Central and Eastern European Union (CEEU) implemented a transition to the liberal market economies from centrally planned economies towards the end of the 1980s. CEEU countries had an economic and institutional conversion along with the contribution of European Union membership process until today. The aim of this paper is to investigate the impact of corruption and rule of law on the shadow economy in CEEU countries within the recent transformation process. In the relevant literature, relatively few studies have concentrated on the impact of corruption on the size of the shadow economy and generally used regression analysis. So this paper will aim at contributing to the relevant literature in three ways. First, it will contribute to the limited literature. Second, it will be one of the early studies investigating the corruption–shadow economy nexus for the sample of CEEU countries. Third, the study will use second-generation econometric tests considering the cross-sectional dependence and heterogeneity among the variables.

The remaining part of the study is structured as follows. The next part of the article summarises the relevant literature and Section 3 presents data and method. Then, econometric analysis and major inferences are shown in Section 4 and Section 5 concludes the study.

2. Literature review

Theoretically, there exists a mutual interaction between corruption and shadow economy. The relationship can be in a substitutable form in the case where the existence

of a shadow economy decreases the tendency of state employees to ask for bribes (Dreher & Schneider, 2006). On the other hand, the relationship can be in a complementary form when corruption can be regarded as a form of regulation and taxation (Johnson et al., 1998a) and taxpayers pay a bribe to the officials in exchange for underspecifying the tax liability (Hindriks et al., 1999). Therefore, a bilateral interaction is expected between shadow economy and corruption in theory.

A great number of scholars have researched the determinants and economic effects of corruption and shadow economy. However, the mutual effect between shadow economy and corruption has stayed relatively untouched considering the relevant literature. The limited number of studies have reached mixed findings, but most of the empirical studies revealed a complementarity between corruption and shadow economy (e.g., see Albulescu, Tamisila, & Taucean, 2016; Buehn & Schneider, 2009; Johnson et al., 1998a, 1998b; Manolas, Rontos, Sfakianakis, & Vavouras, 2013; Schneider, 2007; Shahab, Pajooyan, & Ghaffari, 2015; Virta, 2010).

Johnson et al. (1998a, 1998b) primarily analysed the relationship of the shadow economy and corruption in countries from different parts of the world and discovered that improvements in corruption decreased the shadow economy. Friedman, Johnson, Kaufmann and Zoido-Lobatón (2000) researched the major causes underlying shadow economy in a panel with 69 countries by regression analysis and revealed corruption as a crucial determinant of shadow economy. Chowdhury (2005) also researched the major causes underlying shadow economy in a panel of 96 countries with regression analysis and discovered that corruption was a significant determinant of shadow economy.

Schneider (2007) researched the interplay between shadow economy and corruption in 145 countries during the 1999–2003 period through regression analysis and found that the shadow economy decreased corruption in high-income countries, whereas it raised corruption in low-income countries. Buehn and Schneider (2009) also investigated the interplay between shadow economy and corruption in 51 states during the 2000–2005 period using a structural equation model and revealed a positive relationship between corruption and the shadow economy, but shadow economy had a relatively higher effect on corruption given the effect of corruption on the shadow economy. On the other hand, Virta (2010) analysed the interaction between corruption and shadow economy with a panel of 79 and 95 cross-sections using panel regression and revealed that corruption increased the shadow economy inside the tropical region, but did not affect the shadow economy outside the tropical region.

In another study, Dreher and Schneider (2010) investigated the interplay between shadow economy and corruption in 98 countries through data of the 2000–2002 period averages by using panel regression and discovered that shadow economy and corruption were complementary in low-income countries. Manolas et al. (2013) also researched the major determinants underlying shadow economy in 19 OECD countries over the period 2003–2008 with regression analysis and discovered that improvements in the control of corruption negatively affected the shadow economy.

Vo, Ha and Ly (2015) researched the relation between shadow economy and corruption in the Association of Southeast Asian Nations during 1995–2014 and revealed a complementarity between shadow economy and corruption; however, the

Table 1. Data definition.

Variables	Data Definition	Source
SHAD	Shadow economy (% of GDP)	Schneider (2015)
COC	Control of corruption	World Bank (2016)
ROL	Rule of law	World Bank (2016)

Source: Authors' own elaboration.

corruption had a relatively higher effect on shadow economy against the effect of shadow economy on the corruption. Shahab et al. (2015) analysed the interaction between shadow economy and corruption in two groups of 25 countries from developed and developing countries during the 1999–2007 period using static and dynamic panel regression and revealed that the relationship may exhibit complementarity or substitutability depending on the corruption index.

Albulescu et al. (2016) analysed the effect of corruption, taxation and financial stability on shadow economy with a panel of 23 OECD countries during the 2001–2013 period with dynamic regression and revealed that corruption positively influenced the size of the shadow economy. Borlea, Achim and Miron (2017) investigated the interaction between corruption and shadow economy in 28 EU countries during 2005–2014 through regression analysis. They discovered that corruption affected the shadow economy positively. Finally, Ouédraogo (2017) researched the interaction among corruption, governance and shadow economy in 23 sub-Saharan economies with regression analysis and revealed that corruption positively affected the shadow economy.

3. Data and econometric methodology

We explored the cointegrating relationship and causality between corruption, rule of law and shadow economy in 11 CEEU states over the 2003–2015 period with panel cointegration and causality tests.

3.1. Data

In this study, we analysed the long-run and causal interaction among corruption, rule of law and shadow economy. In this context, the data of shadow economy calculated by Schneider (2015) with the MIMIC method was used as the dependent variable. On the other hand, the data of rule of law and control of corruption were extracted from world governance indicators from World Bank (2016). The values of both variables, which vary from –2.5 to +2.5, and increases in the indexes reflect the improvement in corruption and rule of law (see Kaufmann, Kraay, & Mastruzzi (2010) for detailed information about the measurement of both variables) (Table 1).

The sample of the study consisted of 11 CEE states from EU (Bulgaria (BGR), Croatia (HRV), Czech Republic (CZE), Estonia (EST), Hungary (HUN), Latvia (LVA), Lithuania (LTU), Poland (POL), Romania (ROU), Slovakia (SVK) and Slovenia (SVN)), considering the institutional and economic transformation of the countries. The Gauss 11.0 and Stata 14.0 programs were benefited at the section of empirical analysis.

Bulgaria had the largest shadow economy with 30.6% of GDP in 2015, while Slovakia had the smallest shadow economy with 14.1% in 2015. However, all countries experienced improvements in the shadow economy as seen in Chart 1. In this regard, Slovakia, Latvia and Czech Republic, respectively, made the largest improvements in size of the shadow economy with 23.37, 22.37, and 22.56%. On the other hand, Slovenia made the least improvement in size of shadow economy with 12.73%.

The descriptive statistics of the data set on a country basis and overall panel basis are presented in Table 2. The characteristics indicated that the mean of the shadow economy was 26.886%, the mean of control of corruption index was 0.2956 and the mean of rule of law index was 0.5964. Furthermore, the size of the shadow economy had the largest standard deviation, while the standard deviations of both control of corruption and rule of law were relatively much smaller.

3.2. Econometric model and the hypotheses

Tax and regulatory burden, business and labour regulations, corruption, institutional and legal quality and income inequality have been documented as the major determinants of the shadow economy (Dell'anno, 2016; Gaspareniene, Remeikiene, & Heikkila, 2016). In this study, we focused on the interaction between corruption, legal quality and shadow economy. Therefore, the following model was established

$$SHAD = f(COC, ROL) \qquad (1)$$

We expect that the improvements in both corruption and rule of law decrease the size of the shadow economy considering the relevant theoretical and empirical literature and the sample. Therefore, the following hypotheses were established and investigated in the study:
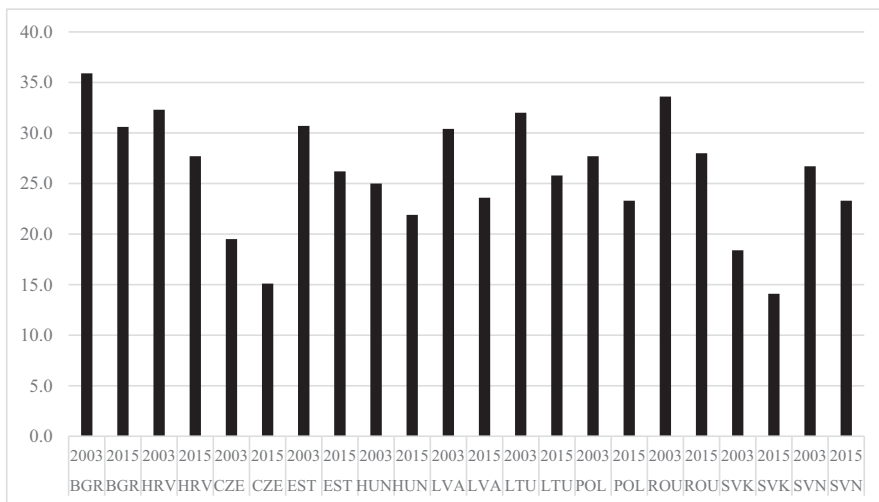

Chart 1. Size of shadow economy (% of GDP). Source: Schneider, 2015.

Table 2. Descriptive statistics of the data set.

Country	Variables	Mean	Min.	Max	Standard deviation
Bulgaria	SHAD	32.8077	30.6	35.9	1.63781
	COC	−0.18	−0.31	0.1	0.13583
	ROL	−0.1269	−0.19	−0.07	0.03301
Croatia	SHAD	29.9846	27.7	32.3	1.52033
	COC	0.0746	−0.1	0.2	0.10397
	ROL	0.1331	−0.05	0.31	0.1057
Czech Republic	SHAD	16.9769	15.1	19.5	1.42838
	COC	0.3162	0.19	0.46	0.08272
	ROL	0.9362	0.74	1.14	0.12018
Estonia	SHAD	28.9538	26.2	30.8	1.37878
	COC	0.9815	0.79	1.27	0.14559
	ROL	1.1038	0.75	1.36	0.16439
Hungary	SHAD	23.3077	21.6	25	1.11689
	COC	0.3946	0.1	0.65	0.19203
	ROL	0.7462	0.4	0.96	0.17751
Latvia	SHAD	27.2077	23.6	30.4	2.06174
	COC	0.2254	0.13	0.4	0.09198
	ROL	0.7223	0.56	0.87	0.09825
Lithuania	SHAD	29.3769	25.8	32	1.7763
	COC	0.2546	0.03	0.56	0.16143
	ROL	0.7215	0.49	0.98	0.13625
Poland	SHAD	26.2889	25	27.7	0.98798
	COC	0.2989	0.11	0.49	0.12917
	ROL	0.5078	0.35	0.75	0.13854
Romania	SHAD	30.1308	28.00	33.60	1.77313
	COC	−0.1985	−0.30	−0.05	0.06631
	ROL	−0.0200	−0.23	0.15	0.12878
Slovakia	SHAD	16.3615	14.10	18.40	1.33575
	COC	0.2538	0.06	0.49	0.13042
	ROL	0.4900	0.33	0.57	0.06151
Slovenia	SHAD	24.6308	23.10	26.70	1.23382
	COC	0.8769	0.69	1.02	0.11636
	ROL	0.9585	0.86	1.06	0.05914
Total	SHAD	26.886	15.1	35.9	4.90648
	COC	0.2956	−0.31	1.27	0.34214
	ROL	0.5964	−0.19	1.36	0.41105

Source: Authors' own elaboration.

Hypothesis 1: A decrease in corruption reduces *ceteris paribus* the size of the shadow economy.

Hypothesis 2: An improvement in rule of law reduces *ceteris paribus* the size of the shadow economy.

3.3. Econometric methodology

At the first stage of econometric analysis, cross-sectional dependence and homogeneity were investigated to determine the tests of unit root, cointegration and causality. Then Pesaran's (2007) CIPS unit root test, the cointegration test by Westerlund and Edgerton (2007) and the bootstrap causality test by Kónya (2006) were selected to analyse the long-run and causal interaction among corruption, rule of law and shadow economy considering the presence of cross-sectional dependence and heterogeneity among the series.

In this context, the CD_{LM1} test of Breusch and Pagan (1980) and the LM_{adj} test of Pesaran, Ulla, and Yamagata (2008) were used to investigate the existence of cross-

sectional dependence, because the time dimension of the data set was higher than the cross-section of the data set. Then panel CIPS unit root test, a second-generation panel unit root test, was preferred to examine the existence of unit root in the variables considering the cross-sectional dependence among the variables. The panel cointegration test of Westerlund and Edgerton (2007) was employed to investigate the long-run relationship among the variables, because the test considers both cross-sectional dependence and heterogeneity (Westerlund & Edgerton, 2007). The test also uses bootstrap simulation to calculate the critical values and bootstrap critical values are considered when there is cross-sectional dependence. The bootstrap simulation makes resampling to produce more data given the current data set. The bootstrap method yields efficient results by reproducing the data around the same average especially in case of small samples.

The cointegration test of Westerlund and Edgerton (2007) is based on the McCoskey and Kao (1998) LM test. The model is given in Equation (1) (where $t = 1, \ldots, T$ (time series) and $I = 1, \ldots, N$ (cross-sectional units)).

$$y_{it} = \propto_i + x'_{it}\beta_i + z_{it} \tag{2}$$

The statistic of the test is figured as the following:

$$LM_N^+ = \frac{1}{NT^2} \sum_{i=1}^{N} \sum_{t=1}^{T} W_i^{-2} S_{i,t}^2 \tag{3}$$

$S_{i,t}^2$ stands for the partial sum of z_{it}, and W_i^{-2} stands for the long-run variances of disturbance terms (N represents the cross-section dimension, T represents the time dimension). The major superiorities of the test are that it considers cross-sectional dependence and allows heteroscedasticity and autocorrelation in the cointegrating model and also yields robust results for the small samples. The null hypothesis postulates the existence of a cointegration relation for all cross-sections, and the critical values are derived from the bootstrap simulation. Finally, bootstrap critical values are taken in consideration owing to cross-sectional dependence.

The bootstrap Granger causality test of Kónya (2006) simultaneously takes notice of heterogeneity and cross-sectional dependence. The test is based on seemingly unrelated regression (SUR) estimation producing more effective results in the event of cross-sectional dependence between variables. The statistical significance of causal relation is examined with bootstrap critical values of the Wald test. Furthermore, the test does not necessitate any pretests (Kónya, 2006).

4. Empirical analysis

4.1. Results of cross-sectional dependence and homogeneity tests

The CD_{LM1} test of Breusch and Pagan (1980) and the LM_{adj} test of Pesaran et al. (2008) was conducted to investigate the presence of cross-sectional dependence between the variables and the findings of the test are presented in Table 3. The alternative hypothesis postulating the presence of cross-sectional dependence was accepted

Table 3. Homogeneity and cross-sectional dependence tests.

Variables	Cross-sectional dependence tests				Homogeneity test
	CD_{LM1} Test stat.	CD_{LM2} Test stat.	CD Test stat.	LM_{adj} Test stat.	F test Test stat.
SHAD	32.874 (0.014)	7.268 (0.000)	−5.629 (0.013)	8.563 (0.000)	−
COC	45.021 (0.002)	8.924 (0.000)	−3.773 (0.000)	7.552 (0.000)	23.895 (0.001)
ROL	49.543 (0.000)	8.422 (0.001)	−6.417 (0.000)	8.386 (0.000)	31.972 (0.023)
Model*	51.846 (0.026)	7.568 (0.005)	−5.036 (0.018)	5.288 (0.001)	−

Source: Authors' own elaboration based on the results of homogeneity and cross-sectional dependence tests.
The values in the parentheses indicated the probability values of the results.
*The model is SHAD = f(COC, ROL).

Table 4. Results of Pesaran (2007) CIPS panel unit root test.

Variables	Const.	Const.+ Trend
SHAD	−1.492	−1.558
d(SHAD)	−4.996*	−7.371*
COC	−1.523	−1.902
d(COC)	−5.342*	−6.375*
ROL	−0.861	−1.746
d(ROL)	−6.927*	−8.446*

*Statistically significant at 1%
Source: Authors own elaboration based on the results of panel unit root test

in consequence of test results of cross-sectional dependence. Then we made an inference about the presence of cross-sectional dependence between the series. In other words, any shocks in one of the countries in the sample affect the remaining countries in the sample. Furthermore, the alternative hypothesis about the heterogeneity of the cointegration coefficients was accepted as a result of the F test.

4.2. Panel unit root test results

The Pesaran (2007) CIPS test was used to investigate whether the series have unit root or not given existence of cross-sectional dependence. The test findings are shown in Table 4. The test findings revealed that the variables were not stationary, but became stationary after taking first differences.

4.3. Westerlund and Edgerton (2007) cointegration test results

The cointegration relation among corruption, rule of law and shadow economy was examined with the LM cointegration test of Westerlund and Edgerton (2007), and the findings of the test are shown in Table 5. The bootstrap p values were considered owing to the presence of cross-sectional dependency and the null hypothesis was accepted. So there was a cointegrating relationship between corruption, rule of law and shadow economy. In other words, there was a long-run relationship between the variables and we can estimate the long-run coefficients at the next stage.

The cointegration coefficients were estimated by fully modified ordinary least (FMOLS) estimator considering only heterogeneity and dynamic seemingly unrelated regression (DSUR) simultaneously considering cross-sectional dependence and heterogeneity after determination of the cointegration relationship among the variables

Table 5. Panel cointegration test result.

LM_N^+	Const.			Const.+ Trend		
	Test stat.	Asymp. *p*-value	Boot st. *p*-value	Test stat.	Asymp. *p*-value	Boot st. *p*-value
	0.743	0.175	0.426	4.998	0.014	0.563

Source: Authors' own elaboration based on the results of panel cointegration test.
Bootstrap probability values were produced with 10,000 simulations and asymptotic probability values were produced from standard normal distribution.

Table 6. Estimation results of cointegrating model.

Dependent variable: SHAD		COC	ROL
Method	Dynamic seemingly unrelated regression	−0.496**	−0.428**
	Fully modified ordinary least	−0.472***	−0.382**

*** and ** denotes that it is respectively significant with 1% and 5%.
Source: Authors' own elaboration based on the results of cointegrating coefficient estimation.

and the results are shown in Table 6. The findings of the test revealed that improvements in both corruption and rule of law decreased the size of the shadow economy. The estimation by the DSUR method indicated that 1 unit increase in COC (improvement in corruption) led to a 49% of unit decrease in SHAD, whereas estimation by the FMOLS method showed that 1 unit increase in COC (improvement in corruption) led to a 47% of unit decrease in SHAD. On the other hand, the estimation by DSUR method indicated that 1 unit rise in ROL (legal development) caused a 42% of unit decline in SHAD, whereas estimation by the FMOLS method showed that 1 unit rise in ROL (legal development) caused a 38% of unit decline in SHAD. Consequently, both estimators showed that improvement in corruption and rule of law decreased the size of the shadow economy considerably.

One of the reasons underlying the shadow economy is the presence of corruption. The employees in a public administration with high rate of corruption are disposed to be in contact with larger unofficial activities. Furthermore, well-functioning of legal structure and rule of law deterring the shadow economy, defending property rights and raising validity of contracts will also decrease the size of the shadow economy. So, controlling corruption, decreasing the share of th epublic sector in the whole economy and increasing transparency in the public sector and empowering citizens have the potential to decrease corruption and, in turn, shadow economy. Furthermore, a strong law enforcement and surveillance and control mechanism also contribute to the improvements in the shadow economy directly and indirectly through the control of corruption.

4.4. Kónya (2006) LM bootstrap granger causality test results

The causal interplay between control of corruption, rule of law and shadow economy was analysed by the bootstrap causality of Kónya (2006) given the presence of heterogeneity and cross-sectional dependence. The findings of the test are shown in Tables 7 and 8. The results revealed that there was a two-way causality between control of corruption (COC) and shadow economy (SHAD) in all the cross-section units. However, there was a two-way causality between rule of law (ROL) and shadow economy (SHAD) only in Bulgaria, Czech Republic, Poland and Romania. Furthermore,

Table 7. Konya (2006) bootstrap causality test results for SHAD and COC.

	Ho: SHAD ⇏ COC				Ho: COC ⇏ SHAD			
		Bootstrap critical values				Bootstrap critical values		
Countries	Wald statistics	1%	5%	10%	Wald statistics	1%	5%	10%
Bulgaria	23.89***	20.64	11.49	7.23	29.63***	27.53	14.45	10.26
Croatia	28.56***	24.15	11.58	8.06	22.78**	26.42	14.37	9.96
Czech Republic	19.67*	23.09	12.53	8.53	19.45**	32.69	18.89	12.03
Estonia	16.73**	24.67	11.61	7.74	27.43**	28.96	15.53	10.61
Hungary	15.92**	22.42	13.92	8.93	19.34**	25.41	12.51	8.56
Latvia	17.03**	32.39	15.31	9.16	26.89**	29.67	14.28	10.34
Lithuania	15.68**	22.80	12.59	8.54	17.45**	25.37	12.57	9.39
Poland	17.52**	26.61	12.74	7.89	21.83**	25.69	11.52	7.03
Romania	28.53***	26.38	15.65	9.71	29.62***	26.04	15.80	10.24
Slovakia	14.89**	20.95	11.42	7.24	17.32**	27.81	14.23	10.12
Slovenia	26.98***	24.18	12.59	8.16	29.53***	26.07	14.36	9.51

***, **, and * respectively significant at 1%, 5%, and 10%.
Source: Authors' own elaboration based on the results of panel causality test.

Table 8. Kónya (2006) bootstrap causality test results for SHAD and ROL.

	Ho: SHAD ⇏ ROL				Ho: ROL ⇏ SHAD			
		Bootstrap critical values				Bootstrap critical values		
Countries	Wald statistics	1%	5%	10%	Wald statistics	1%	5%	10%
Bulgaria	24.78**	32.26	20.73	13.45	23.06**	38.14	22.62	15.47
Croatia	6.31	26.16	14.24	9.43	29.45**	33.18	17.08	11.69
Czech Republic	29.23***	29.08	14.81	9.48	28.64***	26.52	18.55	13.09
Estonia	3.78	23.58	15.36	11.34	29.42**	33.05	27.35	18.88
Hungary	5.91	17.22	12.57	9.25	18.45**	28.60	14.52	9.68
Latvia	4.22	27.33	14.13	9.83	9.42	24.73	23.01	18.40
Lithuania	9.18	35.93	17.75	11.99	7.39	22.97	18.12	11.91
Poland	26.35**	32.01	16.34	10.91	32.95***	21.93	19.72	13.14
Romania	17.39**	27.28	18.43	9.26	29.56***	28.38	19.58	13.12
Slovakia	6.17	26.38	14.63	10.31	19.31**	28.80	14.11	9.47
Slovenia	7.78	25.67	17.90	9.43	17.48**	24.89	13.27	11.87

***, **, and * respectively significant at 1%, 5%, and 10%.
Source: Authors' own elaboration based on the results of panel causality test.

there was a one-way causality from ROL to SHAD in Croatia, Estonia, Hungary, Slovakia and Slovenia.

The results of the causality test also verify the theoretical expectations between corruption and the shadow economy. In other words, both corruption and shadow economy are the processes feeding each other in the short run.

5. Conclusion

This article researched the short- and long-run interaction between corruption, rule of law and shadow economy with panel cointegration and causality test considering heterogeneity and cross-sectional dependence. The estimated cointegration coefficients indicated that improvements in both corruption and rule of law decreased the shadow economy in the long run. On the other hand, the findings of the panel causality test revealed a two-way causality between control of corruption and shadow economy in all cross-section units. However, there was a two-way causality between rule of law and shadow economy only in Bulgaria, Czech Republic, Poland and

Romania. Furthermore, there was a one-way causality from rule of law and shadow economy in Croatia, Estonia, Hungary, Slovakia and Slovenia.

In general, the relevant literature has analysed the impact of corruption on the size of shadow economy with regression analysis and revealed that the improvements in the corruption decrease the size of shadow economy. Only a few studies (such as Buehn & Schneider, 2009; Vo et al., 2015) researched the two-way interaction between corruption and shadow economy and found that corruption and shadow economy affected each other significantly. Therefore, our findings were found to be consistent with the general trend in the empirical literature and theoretical expectations. This study was expected to make a significant contribution to the relevant limited literature with its method including second generation econometric tests considering the cross-sectional dependence and heterogeneity and its sample (transition economies of European Union) consisting of the countries having a considerable social, institutional and economic transformation.

Theoretically, employees in a public administration with a high rate of corruption are generally disposed to be in contact with larger unofficial activities. Furthermore, a well-functioning legal structure and rule of law deterring the shadow economy, defending property rights and raising the validity of contracts, will also decrease the size of the shadow economy. Our empirical findings verified the theoretical considerations and indicated that there was a significant relationship between shadow economy, corruption and rule of law in both the short and long runs. So, the anticorruption policies and improvements in rule of law will contribute to the decreases in the size of the shadow economy.

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