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Panel Regression Analysis of The Relationship Between Unemployment and Shadow Economy

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ABSTRACT

Previous studies considerably discuss the rising issue of shadow economy. However, little attention has been given to the relationship between unemployment and shadow economy activity. This is why the objective of this paper is to explore the relationship, if any, between these economic terms. For this purpose, the annual panel data on 34 countries over the period 1999-2015 are collected. In order to conduct analysis, different panel data econometrics techniques are applied including: linear static panel data estimators (fixed and random effects), dynamic panel data estimators (Arellano-Bond two step) as well as ARDL approach. In order to test for the stability of the model, the impact of economic growth is controlled. The results of the linear static panel data estimators indicate a significant positive relationship between unemployment and shadow economy activity. Since both of the macroeconomic variables are expected to be highly volatile, the dynamics is taken into account. Dynamic panel data estimators support the results obtained using linear static panel data estimators. The inclusion of control variable in extended model does not significantly change the results reported in the initial model, so the initial model can be considered stable. In order to test the sensitivity of the results and avoid robust errors, we employ a panel ARDL model. The study reveals a positive and significant relationship between SE and unemployment in both the short- and the long-run. Stronger impact is reported for the long-run. In terms of the extended model, a significant positive impact of unemployment on shadow economy is reported only in the long-run. The obtained results can be of great importance for decision makers in order to foster them to reduce unemployment and consequently shadow economy activity.

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INTRODUCTION

The underground economy has become an interesting topic among research community. Thus, many of the authors tried to define this economic term. The papers two date recognize many issues connected with the definition and measurement of this economic term. Thereby, Dell'anno (2016) summarizes the two main views on the definition of shadow economy. The first view defines shadow economy as: "all productive activities that may not be captured in the basic data sources used for national accounts compilation" (UNECE, 2008, p. 2).

The second view defines shadow economy as any kind of economy that is not reported; not official; not observed or hidden (Bagachwa and Naho, 1995; Feige and Urban, 2008).

Due to the fact that shadow economy increases quite intensively in the last decades at the global level, there are many of the authors explaining the potential determinants of this phenomenon (Friedman et al., 2000; Schneider and Enste, 2000; Tafenau et al., 2010; Dell'anno, 2016; Gaspareniene et al., 2016). For instance, Dell'anno (2016) has explored the potential determinants of the hidden economy using the case of 118 economies. The main findings of this paper suggest the income inequality to have a significant positive impact on the shadow economy. However, the author emphasizes the decrease in official GDP to be the main reason. Shadow economy is not found to rise exponentially.

It will be of great interest to mention the determinants of shadow economy in the case of Ukraine (Gaspareniene et al., 2016). The authors have observed the period ranging between 2005 and 2012. The findings of this paper have indicated the rate of the tax, the (un)employment rate, the trade openness (import), economic performance (GDP) and the participation in labor force to be the main determinants of the unofficial economy. Moreover, the findings suggest that the reduction in unemployment rate, i.e. the rise in employment tends to reduce the involvement in the shadow economy. Moreover, it is also important to emphasize the classification of the determinants of hidden economy presented by Ruge (2010). The authors suggest that the level of the development of the country as well as the good governance play important role and are considered to be the first important fact; the second is tax system while the third one is connected to the labor market. Thereby, Ruge (2010) and Berger et al., (2014) recognize the crucial role of the labor market in the hidden economy. These authors imply that positive conditions at the labor market tend to reduce the shadow economy whereas negative conditions tend to have stimulatory role.

Taking into account the significant role of unemployment in the shadow economy, this paper was interested to explore this link in the sample of 34 countries. The contribution of this paper to the literature to date is in the sense that this paper analyzes link of interest in the both, short- and the long-term. Moreover, it uses the last available data. In addition, it controls for the potential dynamics of all of the variables of interest. Besides these, the important contribution of this paper lies in the fact that it controls for the impact of the officially recorded GDP while analyzing the link between shadow economy and unemployment.

Thus, the main introductory remarks are presented at first. Paper proceeds further to the brief summary of the research articles treating the determinants of shadow economy as well as the link between shadow economy and unemployment. Methodology section summarizes the employed methodology. The main findings of this paper are presented in the results section. The article ends by summarizing some concluding remarks.

1.Literature Review

The potential link between unofficial economy and the rate of unemployment has been estimated by Mauleon and Sarda (2017). Very relevant proof on the link between these two economic terms of interest has been found in the economies recording considering statistics on the rate of unemployment.

However, the countries that record moderate of low rates of unemployment provide less relevant proof on the link of interest. These findings are well justified since the unemployment rates that exceed 20% bring in serious concerns in society. Since unemployment does not

provide sufficient safety, society needs to look for the alternative solutions. Thereby, emigrations of hidden economy were found as wisdom solutions.

Dell'anno and Solomon (2008) tended to give the evidence on the size of hidden economy in US and to explore whether or not there exists a link between the unrecorded economy and the rate of unemployment. The findings of this article have displayed a decreasing trend in hidden economy in USA within the last twenty years. Moreover, the structural link between the rate of unemployment and informal economy has also been found. In addition, it is important to emphasize that the authors have found the positive link between these two variables. Thus, the authors stress the great role of shadow economy in the economy of a country since it tends to influence many of the aspects of the life both social and economic. Moreover, it can present an important obstacle for policy makers while trying to realize some of the policies. For instance, the people included in shadow economy tend to claim unemployment benefits represent a potential fraud on the social system. The positive link between shadow economy and unemployment is also supported by Boeri and Garibaldi (2002) in the case of Italy. The authors suggesting the positive link of unemployment on shadow economy suggest that government should tend to move unrecorded activities towards officially recorded ones rather than canceling them.

In terms of the link between shadow economy and unemployment, it is important to emphasize the gender differences suggested by Goel and Saunoris (2017). The findings of this paper have analyzed the unemployed male and female and have found the male to be more likely to take a part in informal economy. The authors also emphasize to take into account the differences in the nature of informal activities determined by different factors (Allen and Curington, 2014). One of these factors is gender. This is since some cultures do not encourage female to work outside the home. This will reduce the female participation in both, recorded and unrecorded sectors, whereas in some other cultures female can be enrolled in some online job which is not officially recognized (Djajic and Mesnard, 2015; Williams and Martinez, 2014).

Adriana (2014) has explored the link, if any, between the informal economy and the rate of unemployment in the case of Romania using the time-span between the 2000 and 2010. The author has employed the VECM based on quarterly data. To analyze the potential causal link between the variables of interest, the author has employed the Toda and Yamamoto approach. In terms of the link between the underground economy and unemployment it is important to mention that on the one side, higher unemployment can have a negative impact on shadow economy since it is the positive externality of the economic growth. Besides these, unemployment can have a positive impact on shadow economy since unemployed people have more time to be involved in these activities (Giles and Tedds, 2002). The findings of Adriana (2014) suggest the causal link running from the rate of unemployment to the shadow economy.

To conclude the literature review section, it is important to emphasize the great role of financial development in both, recorded official (Satrovic, 2017) and unrecorded economy (Bose et al., 2012). The financial system plays many important roles in the economy by reducing information asymmetry. Moreover, Capasso and Jappelli (2013) suggest that financial sector can play a key role in the transformation from unregistered to registered (official) economic activity by providing more favorable credit options for registered firms. Thereby, Berdiev and Saunoris (2016) have explored the potential link between the underground economy and the development of financial system in the case of 161. The data are collected in the period between 1960 and 2009 by employing panel VAR. The findings suggest the negative impact of financial development on informal economy.

Taking into account the empirical evidence presented in the literature review section, it can be easily concluded that the evidence on the link between shadow economy and unemployment is mixed. However, it is of great importance to explore this link using both, panel and time-series data, since these results can be of great importance for policy makers. Thereby, this paper tends to fill in the gap in literature by providing the evidence on the link of interest while using the latest available data.

2.Data and Methodology

2.1.Data

In order to investigate the relationship between unemployment and shadow economy activity, there was a need to find appropriate proxy variables of these economic terms. In terms of shadow economy, one of the most challenging issues is to give a right definition of this economic term. Therefore, this paper accepts the definition suggested by Feige (1989, 1994), Schneider (1994a, 2003, 2005) and Frey and Pommerehne (1984) who indicate that shadow economy comprises all currently unregistered economic activities that contribute to the officially calculated Gross National Product. Therefore, shadow economy size as a percentage of GDP (SE) is considered to be the appropriate proxy of shadow economy activity. Data on shadow economy are collected from Schneider et al. (2010) and Schneider (2015).

On the other hand, unemployment is approximated using unemployment, total (% of total labor force) (modeled ILO estimate) - UNEM. Data are collected from World Bank. The World Bank defines UNEM as the share of the labor force that is without work but available for and seeking employment. In terms of control variable it is important to emphasize that GDP per capita (GDPpc) is considered to be an appropriate proxy of economic growth (Satrovic, 2018a; Satrovic and Muslija, 2018). The data on GDP per capita are collected from World Bank. The panel model dataset consist of 34 countries (appendix 1). The observed period is 1999-2015. This paper contributes to the literature by using an extended econometric methodology to explore the link between the variables of interest. Moreover, it takes the latest available data and explores this link in both, short- and the long-run. From the best of our knowledge, this is the first attempt to provide the empirical evidence on the link between unemployment and shadow economy while using the selected sample of the countries. The motivation to conduct this research lies in the fact that the results tend to provide an important insight for policy makers.

2.2.Methodology

The baseline macroeconomic specification used across the regressions includes unemployment to estimate shadow economy activity. Therefore, the econometric specification of the initial model can be written as follows:

$$SE_{it} = \beta_0 + \beta_1 UNEM_{it} + \varepsilon_{it} \quad (1)$$

where i denotes the different countries in the sample, and t denotes the time dimension. The meaning of variables is described above. β_0 is constant term, β_1 is regression parameter while ε_{it} represents the error term. Extended model controls for the impact of GDP per capita and can be formalized as:

$$SE_{it} = \beta_0 + \beta_1 UNEM_{it} + \beta_2 GDPpc_{it} + \varepsilon_{it} \quad (2)$$

where all variables are explained above.

These models are initially estimated using static panel data estimators including fixed and random effects. Hausman test is used to decide between these two (Satrovic, 2018a). Taking into account potential dynamic phenomenon and endogeneity issue, Arellano-Bond estimator based on GMM is employed in addition to static panel data estimators (Satrovic and Muslija, 2018).

2.3.Generalized Method of Moments

To incorporate dynamics into the model, aforementioned models can be rewritten as an AR (1) model, that is:

$$SE_{it} = \alpha_t + (v + 1)SE_{it-1} + \beta x_{it} + u_i + \varepsilon_{it} \quad (3)$$

where SE_{it} is the dependent variable, SE_{it-1} is the lagged value of the SE, x_{it} represents a vector of explanatory variables, u_i is individual effect, ε_{it} - error term while α_t represents the period-specific intercept terms to capture changes common to all countries. In addition, Sargan test

of overidentifying restrictions as well as Arellano-Bond test of serial correlation in the first-differenced errors at order 2 are applied.

2.4. ARDL model

The ARDL model found to be suitable to explore the potential link between the variables of interest in the short-term and long-term (Pesaran et al., 1999). The formalization of the model presented by Attaoui et al. (2017) is presented by (Eq. 4):

$$\Delta Y_{1,it} = \alpha_{li} + \gamma_{li} Y_{1,it-1} + \sum_{l=2}^k \gamma_{li} X_{1,it-1} + \sum_{j=1}^{p-1} \delta_{lij} \Delta Y_{1,it-j} + \sum_{j=0}^{q-1} \sum_{l=2}^k \delta_{lij} \Delta X_{1,it-j} + \varepsilon_{1,it} \quad (4)$$

where the outcome variable is denoted by Y, the regressors are denoted by X, Δ suggests that we are operating with the first difference, while ε_{it} denotes error term. ARDL model can be used in the case when all variables are stationary at level; all variables are stationary at first difference or when variables are stationary at level and first difference (Satrovic, 2018b). ARDL model in terms of panel data can be estimated using PMG (Pooled Mean Group) and MG (Mean Group) procedure. The main characteristic of PMG is that it allows short-run coefficients, including the intercepts, to adjust to the long-run equilibrium values. Contrary to PMG, MG allows all coefficients to vary and be heterogeneous in the long- and short-run. In terms of the matter of interest, it is expected that the obtained results vary in both, short- and long-run, therefore MG is considered to be more appropriate in the study to follow. To select between PMG and MG model, there is a simple Hausman test. The guideline to select between PMG and MG is given below. If the probability value comes more than 5%, PMG should be run otherwise, MG will be considered appropriate.

2.5. Empirical Results and Interpretations

The results section displays first the most important measures of the summary statistics (Table 1). The average SE value in 34 selected countries over the observed period is reported to be 19.08% while the average unemployment rate is reported to be 8.17%. All of the variables are reported to deviate from normal distribution (skewness-kurtosis test). Due to this issue and in order to ease the interpretation, variables are expressed in natural logarithmic forms.

Table 1: Descriptive statistics

Statistics	SE	UNEM	GDPpc
Mean	19.08	8.17	31,113.83
SD	7.92	4.27	21,893.90
Max	37.30	27.47	119,173.00
Min	5.90	1.81	1,609.28
Skewness	0.24	1.54	1.20
Kurtosis	1.87	5.81	4.92
Countries	34		

Source: Authors

Furthermore, all of the models are estimated using fixed and random effects. Based on the Hausman test, one of the models is selected and these results are presented below. GMM method is employed to account for a dynamic phenomenon of the variables of interest and a potential bias due to the endogeneity of some of the regressors. The obtained results are reported below.

Table 2: Panel data estimation, dependent variable SE

VARIABLES	(1) FE	(2) RE	(3) A-Bond two step	(4) FE	(5) RE	(6) A-Bond two step
L.D.SE			0.0531*** (0.00816)			0.0521*** (0.00872)
D.UNEM	0.119*** (0.0123)	0.116*** (0.0121)	0.140*** (0.00365)	0.0933*** (0.0126)	0.0901*** (0.0124)	0.105*** (0.00268)
D.GDPpc				-0.972*** (0.162)	-0.983*** (0.158)	-1.094*** (0.0625)
Constant	-0.310*** (0.0170)	-0.310*** (0.0173)	-0.297*** (0.00421)	-0.264*** (0.0181)	-0.264*** (0.0183)	-0.242*** (0.00349)
Hausman test		chi2(1)=1.18			chi2(2)=2.32	
Hausman test p value		0.2764 (RE)			0.3139 (RE)	
Sargan test			chi2(104) =33.68			chi2(104)= 33.73
Sargan test p value			1.000			1.000
Second order autocorrelation			z=0.25922			z=0.69972
AR (2) p value			0.7955			0.4841
Observations	544	544	476	544	544	476
Number of id	34	34	34	34	34	34

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Source: Authors

Hausman test suggests RE model. The results indicate a significant positive relationship between unemployment and shadow economy activity in the original model. Moreover, similar result is obtained in the extended model that controls for the impact of GDPpc. Since both of the macroeconomic variables are expected to be highly volatile, the dynamics is taken into account. Dynamic panel data estimators support the results obtained using linear static panel data estimators. The inclusion of control variable in extended model does not significantly change the results reported in the initial model, so the initial model can be considered stable. Since the ARDL model requires the variables to be stationary, Harris–Tsavalis unit root test is used for this purpose. Table 3 summarizes the obtained results.

Table 3: Harris–Tsavalis unit root test

Variable	Statistic	z	p-value
SE	0.8558	0.7623	0.7771
UNEM	0.9205	2.9591	0.9985
GDPpc	0.8739	1.3765	0.9157
D.SE	-0.0199	-27.0883	0.0000
D.UNEM	0.4484	-12.0476	0.0000
D.GDPpc	0.2082	-19.7616	0.0000

Source: Authors

Table 3 indicates the unit root in the level variables. For this reason, the first difference of these variables are calculated and used in research to follow. Null hypothesis of unit root is rejected

for the first differenced variables. Therefore, first differenced variables are used in ARDL model.

Table 4: ARDL initial model (SE - dependent variable)

Estimator	D.SE	Coef.	St. Error	z	P>z	95% Conf. Interval		
	ECT							
MG	SR	D.UNEM	0.120	0.013	8.940	0.000	0.093	0.146
	ECT		-0.912	0.038	-23.860	0.000	-0.987	-0.837
		D.UNEM	0.091	0.024	3.740	0.000	0.043	0.139
		D1.						
		_cons	-0.285	0.018	-15.480	0.000	-0.322	-0.249

Source: Authors

Table 5: ARDL extended model (SE - dependent variable)

Estimator	D.SE	Coef.	St. Error	z	P>z	95% Conf. Interval		
	ECT							
MG	SR	D.UNEM	0.254	0.046	5.530	0.000	0.164	0.344
		D.GDP	-0.756	0.276	-2.740	0.006	-1.297	-0.215
	ECT		-0.951	0.044	-21.670	0.000	-1.037	-0.865
		D.UNEM	-0.004	0.038	-0.090	0.925	-0.079	0.072
		D1.						
		D.UNEM	0.068	0.359	0.190	0.849	-0.635	0.771
		_cons	-0.271	0.023	-11.570	0.000	-0.317	-0.225

Source: Authors

Table 4 shows the results of long-run and short-run elasticity of SE with respect to unemployment. The error correction is significant (for 1% level of significance) in both, PMG and MG model in the original model. This result proves that the process converges over the long-run. Hausman test suggests MG model. The study reveals a positive and significant relationship between SE and unemployment in both the short- and the long-run. Stronger impact is reported for the long-run. In terms of the extended model, following the aforementioned procedure, MG model is employed. A significant positive impact of unemployment on SE is reported only in the long-run (for a 5% level of significance – Table 5).

CONCLUSION

The motivation for this research has arisen from the fact that shadow economy is one of the most considering issues nowadays. However, the empirical evidence on the relationship between shadow economy and unemployment is lacking. Therefore, this research aims to fill in this gap by applying panel data econometric model on the sample of 34 countries over the period between 1999 and 2015.

The results of linear static panel data estimators indicate a significant positive relationship between unemployment and shadow economy activity in the original model. Moreover, similar result is obtained in the extended model that controls for the impact of GDPpc. Since both of the macroeconomic variables are expected to be highly volatile, the dynamics is taken into account. Dynamic panel data estimators support the results obtained using linear static panel data estimators. The inclusion of control variable in extended model does not significantly change the results reported in the initial model, so the initial model can be considered stable. Sargan and serial-correlation tests do not reject the null hypothesis of correct specification (p-value of Sargan test and AR (2) test of Arellano and Bond are larger than 5% for the selected countries), lending support to our estimation results.

ARDL model results indicate that the error correction is significant (for 1% level of significance) in the original model. Hausman test suggests MG model. The model reveals a positive and significant relationship between SE and unemployment in both the short- and the long-run. Stronger impact is reported for the long-run. In terms of the extended model, following the aforementioned procedure, MG model is employed. A significant positive impact of unemployment on SE is reported only in the long-run (for a 5% level of significance). The obtained results can be of great importance for decision makers in order to foster them to reduce unemployment and consequently shadow economy activity. Thus, the governments of the observed countries should first reform the education system so it can better fit the needs of labor market. Moreover, there is a need to support startup companies and entrepreneurship. In addition, the business climate should be friendlier for those who are doing the business in accordance with the law, meaning that the government should stimulate such companies through subsidies and tax reliefs. Thus, the recommendations for future research are to take into account the impact of human capital approximated using education variables as well as the financial development since both of these two variables have a great impact on the economic performance of the country (Satrovic, 2017); to control for the impact of university-business research collaboration as well as the support from governments for startups. In addition, the sample of the countries of interest should be extended as well as the period of interest.

APPENDIX 1: List of the countries

Australia	Hungary	Portugal
Austria	Ireland	Romania
Belgium	Italy	Slovakia
Bulgaria	Japan	Slovenia
Canada	Latvia	Spain
Croatia	Lithuania	Sweden
Cyprus	Luxembourg	Switzerland
Czech Republic	Malta	Turkey
Denmark	Netherlands	United Kingdom
Finland	New Zealand	United States
Germany	Norway	
Greece	Poland	

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