

AN ECONOMETRIC APPROACH ON SHADOW ECONOMY IN EUROPEAN COUNTRIES

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Abstract: *The present article investigates the relationship between shadow economy as a percentage of GDP, direct and indirect taxes, taxes centralized by the government, personal and corporate income taxes, value added taxes. The country sample encompasses EU-28 member states, alongside Iceland and Norway, while the period analyzed spans from 2004 until 2016. By means of four econometric models that took into consideration linear and nonlinear effects, analyses indicated that there was a strong relationship between shadow economy and fiscal pressure across all countries.*

Keywords: *shadow economy; taxation; direct taxes; fiscal pressure; income tax; corporate tax.*

JEL Classification: *D33; E65; H26; P44.*

1. Introduction

The topic of shadow economy is more current than ever within European and world economy. In my opinion, shadow economy is one of the causes that triggered the 2007 world financial crisis with its two components: world banking crisis and country sovereign debt crisis. Generally, an increase in the underground economy generates a decrease in taxes levied. At the same time, its increase generates a lack of financial resources for public investment, which in turn generates a shortage of jobs financing the public pension funds. Last but not least, the underground economy is one of the causes prompting the emergence and development of organized crime, drug and human trafficking. Underground economy is a result of tax evasion and it generates a decline in citizens' living standards, rising inflation and an increase in public debt. There is a close link between underground economy and fiscal pressure in the sense that an increase in fiscal pressure can generate a rise in the underground economy. Fiscal pressure indicates the level of tax burden levied by tax authorities on personal and corporate income. At the same time, many authors consider that shadow economy can be estimated as a percentage of GDP. The global financial crisis has imposed the need for a stronger fiscal reform, which is directly linked to the banking system. According to the literature (Batrancea et al., 2013), the banking crisis has unraveled numerous inconsistencies of governmental policies. Moreover, similar crises in Latin American countries were elicited by inefficient policies focused on low taxes and fixed currency conversion rates (Batrancea et al., 2009a).

The current paper has the following structure. Section two briefly reports relevant studies investigating the topic of shadow economy. Section three includes the research hypotheses, the econometric models and estimated outcomes. Section four highlights the results of the study and concluding remarks.

2. Literature Review

The literature investigating the topic of shadow economy across countries is constantly growing (Batrancea et al., 2018; OECD, 2017; Schneider and Enste, 2002; Schneider and Klinglmair, 2004; Schneider and Williams, 2013). The present article investigates the link between shadow economy and fiscal pressure in 30 European countries during a 13-year period. By means of various methods estimating the size and development of the shadow economy phenomenon, Schneider and Buehn (2018) conclude that estimates may differ from one approach to another because no method can be considered flawless. Torgler and Schneider (2016) study the relationship between shadow economy, tax morale, and institutional quality and contribute to the literature by determining the importance of informal and formal institutions in mitigating shadow economy. Zaman and Goschin (2016) introduce a new synthetic shadow economy index that includes three indicators: size of shadow economy per capita; shadow economy as a percentage of GDP; countries' shares in EU total shadow economy. Starting from their results, the authors report that the process of estimating the size of the shadow economy should take into consideration multiple indicators. Moreover, Trebicka (2014) analyzes shadow economy based on the MIMIC (Multiple Indicators Multiple Causes) model and covariance structures.

Panel data techniques have also been constantly used. Manolas et al. (2013) assess the impact of various factors on the size of the shadow economy using data from 19 OECD countries corresponding to the period 2003-2008. Results show that shadow economy growth is triggered by the following factors: quality of governance; product regulatory framework; labor and credit markets; tax burden of entrepreneurial activity; compliance cost. Moreover, their results represent the benchmark for assessing the level of gains Greece might obtain if the country could implement best or at least average practices similar to the OECD countries.

Schneider (2007) reports shadow economy estimations for 145 countries (developing, transition, highly developed OECD members) corresponding to the period 1999-2005. According to his conclusions, shadow economy mitigates corruption in high income countries, but it increases corruption in low income countries. On the other hand, Feige (2016) investigates estimates of shadow economy levels released by various international agencies, emphasizing that the MIMIC model is far from providing accurate results.

Fiscal pressure and shadow economy are important phenomena within empirical research mainly because they are linked to tax compliance (Batrancea et al., 2012a, 2012b; Nichita and Batrancea, 2012). After estimating shadow economy levels corresponding to 162 countries (developing, Eastern European, Central Asia, high income OECD members) for the period 1999-2007, Schneider et al. (2010) conclude that shadow economy is mainly influenced by: an increasing tax burden (direct and indirect taxes); multiple labor market regulations; the quality of public goods and services; the state of the official economy.

One must acknowledge that financial ratios are, in general, extremely helpful in studying aspects like shadow economy and fiscal pressure, which indicates the fiscal obligations a taxpayer is subject to, depending on his income and wealth (Batrancea et al., 2009a,b,c; Moscviciov et al., 2010). In his paper, Schneider (2011) determines the size of the shadow economy and the characteristics of the labor force performing

undeclared work, as part of the shadow economy. In another paper, Schneider and Buehn (2012) emphasize a very important aspect: despite the fact that tax evasion and shadow economy do not share identical components, businesses operating within shadow economy base their success on evading taxes; for this reason, it can be stated that mitigating tax evasion may trigger a similar effect in the size of the shadow economy. Considering this aspect, the authors propose a model of estimating shadow economy with seven variables: taxes; social security contributions; quality of institutions; regulations; public goods and services; tax morale; deterrence.

In this current paper, the link between shadow economy and fiscal pressure is analyzed by means of four econometric models, using data corresponding to 30 European countries (28-EU members, Iceland, Norway) for the period 2004-2016.

3. Method and Research Hypotheses

Taxation indicators corresponding to the 30 sampled countries and spanning the period 2004-2016 were used for the analyses. Data were retrieved from the European Commission Annual Macro-Economic (AMECO) database and Schneider, Buehn and Montenegro (2010), Schneider and Buehn (2018) for shadow economy levels. The sample pool comprises both Economic and Monetary Union (EMU) and non-EMU country members.

3.1. Analysis of Central Tendency and Variation of Fiscal Pressure and Shadow Economy Ratios

Using the data retrieved from the AMECO database, the following indicators have been computed:

Indicator 1: Direct taxes ratio (DT_GDP) = Direct taxes/Gross domestic product

Indicator 2: Personal income taxes ratio (PIT_GDP) = Personal income taxes/Gross domestic product

Indicator 3: Indirect taxes ratio (IT_GDP) = Indirect taxes/Gross domestic product

Indicator 4: Company income taxes ratio (CIT_GDP) = Company income taxes/Gross domestic product

Indicator 5: Value added taxes ratio (VAT_GDP) = Value added taxes/Gross domestic product

Indicator 6: Personal income tax rates (PIT)

Indicator 7: Company income tax rates (CIT)

Indicator 8: Value added tax rates (VAT)

Indicator 9: Social contributions ratio (SC_GDP) = Social contributions/Gross domestic product

Indicator 10: Shadow economy ratio (SE_GDP) = Shadow economy/Gross domestic product

As a first step, the statistical indicators of central tendency and variation for the shadow economy ratio and the fiscal pressure ratios were determined. Table 1 displays overall mean, median and standard deviation.

Table 1: Overall mean, median and standard deviation computed for the period 2004-2016

Indicators	SE GDP	CIT GDP	DT GDP	IT GDP	PIT GDP	SC GDP	VAT GDP
Average	19.61505	2.987392	11.79890	13.86555	21.29827	11.55058	7.674393
Median	18.60000	2.554177	10.87608	13.49767	19.71278	12.25564	7.553471
Maximum	35.30000	12.54848	34.02579	22.78901	59.29594	17.01753	12.97095
Minimum	7.500000	0.808625	4.348799	8.669091	7.956074	0.057948	3.872102
Observations	390	390	390	390	390	390	390

Source: Own computations.

From the table above, it can be seen that the European countries included in the sample registered higher values for SE_GDP, PIT_GDP, DT_GDP, IT_GDP and lower values for SC_GDP, CIT_GDP, and VAT_GDP. In the same time, the average shadow economy was 19.61% of GDP, while the highest taxation ratios were registered by PIT_GDP and the lowest values were registered by CIT_GDP and VAT_GDP. On one side, this indicates the existence of an incentive for public and private investments, on the other hand it emphasizes a decrease in consumption prices and inflation.

Table 2: Descriptive statistics for the period 2004-2016

Indicators	SE GDP	CIT	PIT	VAT
Mean	19.61505	23.75322	39.42613	20.77564
Median	18.60000	24.75000	42.07000	20.00000
Maximum	35.30000	38.70000	62.28000	27.00000
Minimum	7.500000	10.00000	10.00000	15.00000
Observations	390	390	390	390

Source: Own computations.

From Table 2, it can be seen that European countries registered higher values for PIT and CIT, and lower values for SE_GDP and VAT. In the same time, the highest average taxation rates were registered by PIT and the lowest values were registered by CIT and VAT. Namely, it means that budgetary resources have increased based on the levying of corporate income tax and personal income tax. In addition, these resources have increased due to the levying of VAT.

3.2. Analysis of Correlation Regarding Fiscal Pressure and Shadow Economy Ratios

Regarding the correlation coefficients, two significance thresholds were considered: 0.01 and 0.05. The first threshold shows that the correlation coefficient is equal to 0 with a probability of 99%, while the second threshold shows that the correlation coefficient is equal to 0 with a probability of 95%. Table 3 indicates the correlation matrix for the shadow economy and fiscal pressure indicators of the European countries analyzed.

Table 3: Correlation matrix corresponding to the shadow economy and fiscal pressure indicators

Ratios	SE_GDP	CIT_GDP	DT_GDP	IT_GDP	PIT_GDP	SC_GDP	VAT_GDP
SE_GDP	1.000000						
CIT_GDP	-0.179027	1.000000					
DT_GDP	-0.569381*	0.340741	1.000000				
IT_GDP	0.126055	-0.137363	0.243073	1.000000			
PIT_GDP	-0.519512**	-0.004178	0.886652***	0.220465*	1.000000		
SC_GDP	-0.136845	0.030595	-0.276976*	-0.108969	-0.396268*	1.000000	
VAT_GDP	0.351679*	-0.083479	0.048505	0.705922***	0.005294	-0.218731*	1.000000

Note: *Correlation coefficients significant with $p < 0.1$; **Correlation coefficients significant with $p < 0.05$; ***Correlation coefficients significant with $p < 0.01$. In the table above, one can identify negative correlations for the majority of indicators, excepting IT_GDP and VAT_GDP.

Table 4: Correlation matrix corresponding to the shadow economy and fiscal pressure indicators

Ratios	SE_GDP	CIT	PIT	VAT
SE_GDP	1.000000			
CIT	-0.408415**	1.000000		
PIT	-0.545907**	0.531834**	1.000000	
VAT	-0.037659	-0.148195	0.226231*	1.000000

Note: *Correlation coefficients significant with $p < 0.1$; **Correlation coefficients significant with $p < 0.05$. In the table above, one can identify negative correlations between the indicators and SE_GDP.

In the following, the relationship between shadow economy and fiscal pressure was analyzed in order to understand the effects on fiscal pressure on the size of shadow economy across Europe.

3.3. The Econometric Models

The software package EViews version 9.0 was used to run the analyses for testing the econometric models. The analyses included the Least Squares Panel method, which is generally employed in estimating equations for time series data.

Therefore, the four research hypotheses have been formulated:

H1: There is a linear relationship between shadow economy ratio, personal income tax rates (PIT) and company income tax rates (CIT).

H2: There is a linear relationship between shadow economy ratio (SE_GDP), personal income tax rates (PIT), company income tax rates (CIT) and value added rates (VAT).

H3: There is a linear relationship between shadow economy ratio (SE_GDP), personal income tax ratio (PIT_GDP), company income tax ratio (CIT_GDP) and social contribution ratio (SC_GDP).

H4: There is a linear relationship between shadow economy ratio (SE_GDP), company income taxes ratio (CIT_GDP), direct taxes ratio (DT_GDP), indirect taxes ratio (IT_GDP), personal income taxes ratio (PIT_GDP) and value added taxes ratio (VAT_GDP).

The link between the abovementioned variables is analyzed by means of the following econometric models:

$$\text{Model 1: } SE_GDP_{it} = a_0 + a_1PIT_{it} + a_2CIT_{it} + \delta_i + \theta_t + \varepsilon_{it}$$

$$\text{Model 2: } SE_GDP_{it} = a_0 + a_1PIT_{it} + a_2CIT_{it} + a_3VAT_{it} + \delta_i + \theta_t + \varepsilon_{it}$$

$$\text{Model 3: } SE_GDP_{it} = a_0 + a_1PIT_GDP_{it} + a_2CIT_GDP_{it} + a_3SC_GDP_{it} + \delta_i + \theta_t + \varepsilon_{it}$$

$$\text{Model 4: } SE_GDP_{it} = a_0 + a_1PIT_GDP_{it} + a_2CIT_GDP_{it} + a_3DT_GDP_{it} + a_4IT_GDP_{it} + a_5VAT_GDP_{it} + \delta_i + \theta_t + \varepsilon_{it}$$

where:

- δ_i represents fixed effects intended to control for time-invariant taxation-specific factors;
- θ_t represents fixed effects intended to control for common shocks (e.g., global financial crisis);
- ε_{it} represents the error term.

In order to offset the omission of other variables that might impact the direct taxes ratio, indirect taxes ratio or taxes received by government ratio, the specific unobserved effect (δ_i) of a country should be considered. Due to the fact that common shocks influence the size of the shadow economy, an estimation with fixed effects of the parameters was also performed.

Results

Estimations of the relationship between personal income tax rates (PIT), company income tax rates (CIT), value added tax rates (VAT) and shadow economy ratio (SE_GDP) are presented in Table 5.

Table 5: Estimations of the relationship between personal income tax rates (PIT), company income tax rates (CIT), value added tax rates (VAT) and shadow economy ratio (SE_GDP) via econometric models

Indicators	Model 1		Model 2	
	Constant	22.79751*** (17.81022)	18.14658*** (38.06156)	13.07311*** (18.08710)
CIT	0.142933*** (5.993937)	0.001132 (0.133901)	0.211957*** (8.531157)	-0.001388 (-0.164844)
PIT	0.038618*** (3.167388)	0.015075*** (2.336802)	0.038230*** (2.843829)	0.015110*** (3.658654)
VAT	-0.389886*** (- 8.844951)	0.040781** (2.210651)	-	-
Prob.>F	0.000	0.000	0.000	0.000
F-statistic	613.5888	4125.430	518.9110	4174.362
Cross-section effects	Fixed	Fixed	Fixed	Fixed
Time fixed effects	No	Yes	No	Yes
R ²	0.982143	0.998103	0.978229	0.998076
Observations	390	390	390	390

Note: The dependent variable is SE_GDP for country "i" in the "t" year. Robust t-statistics are shown in parentheses. *, **, *** indicate statistical significance at 10%, 5% and 1% levels. Prob.>F is the probability of the model not including fixed effects. For all estimated models, the hypothesis of multicollinearity is investigated using the variance inflation test (VIF). In all cases, the VIF values are lower than 3, thus indicating low risk of multicollinearity.

Model 1

In the first equation, the multiple regression model is significant ($R^2=0.9821$), meaning that 98.21% of the variation in the SE_GDP is explained by independent variables, while 1.79% is explained by variables outside the model. The F-statistic of 613.58 shows that predictors are significantly related to the dependent variable SE_GDP. The regression estimation indicates the existence of a positive relationship between SE_GDP and independent variables PIT and CIT and a negative relationship between SE_GDP and VAT. Namely, the coefficient 0.1429 indicates that an increase of 1% in CIT leads to an improvement of 14.29 percentage points in SE_GDP or an increase of 1,000 Euros in CIT leads to an increase of 142.9 Euros in the size of the shadow economy. At the same time, an increase of 1% in PIT leads to an improvement of 3.8% in the size of the shadow economy, while an increase of 1% in VAT leads to a decrease of 38.98 in the size of the shadow economy.

In the second equation, when taking into account fixed-time effects, the F-statistic value of 4,126.43 shows that predictors are significantly related to the dependent variable SE_GDP. Moreover, the multiple regression model is significant ($R^2=0.99$), meaning that 99% of the variation in the SE_GDP is explained by the independent variables, while 1% is explained by variables outside the model. Results show that an increase of 1,000 Euros in PIT and VAT generate an increase in the shadow economy ratio by 15 Euros and 41 Euros, respectively. The 0.133 robust t-statistic for CIT indicates statistical non-significance. Based on the results above, the null hypothesis is rejected and the alternative hypothesis is accepted, hence one can conclude that there is a positive significant impact on shadow economy.

Model 2

In the first equation, the results indicate that the multiple regression model is significant ($R^2=0.97$), meaning that 97% of the variation in the SE_GDP is explained by the independent variables, while 3% is explained by variables outside the model. The F-statistic value of 518.91 shows that predictors are significantly related to the dependent variable. The regression estimation reveals the existence of a strong positive relationship between SE_GDP and the independent variables CIT and PIT. Namely, the coefficient of 0.0382 indicates that an increase of 1% in the personal income tax ratio leads to an improvement of 3.82 percentage points in SE_GDP. Hence, a 1,000-unit rise in CIT will determine a 211 Euros rise in SE_GDP.

In the second equation, when taking into account fixed-time effects, the multiple regression model is significant ($R^2=0.99$), meaning that 99% of the variation in the SE_GDP is explained by independent variables, while 1% is explained by variables outside the model. Also, the F-statistic of 4,174.362 shows that predictors are significantly related to the dependent variable SE_GDP. Results indicate that an increase of 1,000 units in PIT determine an increase of 15 Euros in SE_GDP. The -0.164844 robust t-statistic for CIT indicates statistical non-significance.

Based on the results above, the null hypothesis is rejected and the alternative hypothesis is accepted. Therefore, one can state that there is a positive significant impact on shadow economy.

Estimates of the relationship between shadow economy ratio and fiscal pressure ratios are presented in Table 6.

Table 6: Estimations of the relationship between fiscal pressure ratios and shadow economy ratio via econometric models

Indicators	Model 3		Model 4	
	Constant	27.22307*** (12.01729)	18.53142*** (27.58029)	20.32051*** (13.31543)
PIT_GDP	-0.081746** (-2.024799)	0.025052** (2.129096)	0.006337 (0.155319)	0.024793** (2.136189)
CIT_GDP	0.270974*** (3.041211)	0.040854 (1.457825)	0.521763*** (4.746264)	0.060698* (1.777823)
SC_GDP	-0.578020*** (-3.822887)	0.037056 (0.815836)	-	-
DT_GDP	-	-	-0.191525*** (-3.171291)	-0.013809 (-0.791343)
IT_GDP	-	-	0.187702 (1.430022)	-0.105008*** (-2.765759)
VAT_GDP	-	-	-0.357286* (-1.660472)	0.204786** (3.321360)
Prob.>F	0.000	0.000	0.000	0.000
F-statistic	430.8747	3979.065	401.8513	3904.069
Cross-section effects	Fixed	Fixed	Fixed	Fixed
Time fixed effects	No	Yes	No	Yes
R ²	0.974761	0.998033	0.974675	0.998094
Observations	390		390	390

Note: The dependent variable is SE_GDP in both models for country "i" in the "t" year. Robust t-statistics are shown in parentheses. *, **, *** indicate statistical significance at 10%, 5% and 1% levels. Prob.>F is the probability of the model not including fixed effects. For all estimated models, the hypothesis of multicollinearity is investigated using the variance inflation test (VIF). In all cases, the VIF values are lower than 3, thus indicating low risk of multicollinearity.

Model 3

In the first equation, results show that the multiple regression model is significant ($R^2=0.97$), meaning that 97% of the variation in the SE_GDP is explained by the independent variables, while 3% is explained by variables outside the model. The F-statistic of 430.87 shows that predictors are significantly related to the dependent variable shadow economy. The regression estimation reveals a positive relationship between SE_GDP and the independent variables CIT_GDP, and a negative relationship between SE_GDP, PIT_GDP and SC_GDP. The t-statistic for PIT_GDP indicates a statistical significance at the 5% level. For CIT_GDP and VAT_GDP, the robust t-statistic of -2.02 and -3.82 indicates a statistical significance at the 1% level. In the second equation, when taking into account fixed-time effects, the multiple regression model is significant ($R^2=0.99$), meaning that 99% of the variation in the SE_GDP is explained by the independent variables, while 1% is explained by variables outside the model. Also, the F-statistic of 3,979.065 shows that predictors are significantly related to the dependent variable SE_GDP. The 2.129 robust t-statistic for PIT indicates statistical significance at the 5% level. The t-statistic for CIT_GDP and SC_GDP indicates statistical non-significance. Based on the results above, the null hypothesis is rejected and the alternative hypothesis is accepted. Hence, there is a positive significant impact on shadow economy.

Model 4

In the first equation, results show that the multiple regression model is significant ($R^2=0.97$), meaning that 97% of the variation in the shadow economy ratio is explained by the independent variables, while 3% is explained by variables outside the model. The F-statistic of 401.85 indicates that predictors are significantly related to the dependent variable. The regression estimation reveals that a positive relationship exists between SE_GDP and the independent variables PIT_GDP, CIT_GDP and IT_GDP and a negative relationship with DT_GDP. The 0.155 robust t-statistic for PIT and the 1.43 t-statistic for IT_GDP indicate statistical non-significance. Moreover, the 4.74 t-statistic for CIT_GDP and the -3.171 value for DT_GDP indicate statistical significance at the 1% level. For VAT_GDP, the -1.66 robust t-statistic indicates statistical significance at the 10% level.

In the second equation, when taking into account fixed-time effects, the multiple regression model is significant ($R^2=0.99$), meaning that 99% of the variation in SE_GDP is explained by the independent variables, while 1% is explained by variables outside the model. The F-statistic of 3,904.06 shows that predictors are significantly related to the dependent variable SE_GDP. The -0.79 robust t-statistic for DT_GDP indicate statistical non-significance. The 1.77 robust t-statistic for CIT_GDP shows statistical significance at the 10% level, the 1.77 robust t-statistic for CIT_GDP shows statistical significance at the 10% level, while the 2.13 t-statistic for PIT_GDP indicates statistical significance at the 5% level. In the same time, the -2.76 t-statistic for IT_GDP and the 3.32 t-statistic for VAT_GDP indicate significance at the 1% level.

Based on the results presented above, the null hypothesis is rejected and the alternative hypothesis is accepted. Hence, one can conclude that there is a positive significant impact on shadow economy within the analyzed country sample pool.

4. Conclusion

The present article analyzes the relationship between shadow economy and fiscal pressure ratios on a sample pool including 30 European countries (i.e., EU-28 members, Iceland, Norway) for the period 2004-2016.

In the first place, empirical results show the existence of a linear relationship between shadow economy, personal income tax rates, company income tax rates and value added tax rates. In such context, when these taxation rates increase, the size of the shadow economy may increase as well, therefore delaying tax authorities' efforts to clamp down on tax evasion and augment budgetary revenues.

Secondly, one result worth of notice is the significant positive relationship between shadow economy, personal income tax rates and the company income tax rates. Based on this result, one can assume that, when companies operating in these countries increase their profit and employee wages, the shadow economy level tends to increase due to the existence of the black labor market.

Thirdly, when investigating taxation level as a percentage of GDP, one observes that both personal income tax ratio and social contribution tax ratio have a negative influence on shadow economy. Moreover, the direct taxes ratio and value added ratio trigger a mitigation in the size of the shadow economy. Therefore, it can be concluded that European countries can reduce shadow economy and tax evasion levels by implementing a strong policy concerning the value added rates.

Last but not least, results indicate strong correlations between shadow economy ratio (dependent variable), personal income tax rates and company income tax rates (independent variables), meaning that shadow economy ratio increases in the same time as labor and company taxation. Analyzing the result from the investors' standpoint, it can be noticed that a rising fiscal pressure tends to diminish future investments and increase the size of the shadow economy. As for the company employees, an increase in fiscal pressure negatively influences purchasing power and it increases the price of goods and services sold on the market.

All in all, the current empirical investigation advances the following measures regarding the management of the fiscal pressure and shadow economy:

- optimizing budgetary revenues by enhancing tax levying, maintaining or decreasing taxation;
- efficiently assigning budgetary revenue with the purpose of creating new jobs and boosting investments; the latter would ultimately increase the collection of direct labor taxes and mitigate shadow economy;
- offering fiscal incentives to national and foreign investors; this measure generally increases the number of new jobs on the labor market and stimulates the introduction of new manufacturing technologies; the immediate effect is the mitigation of shadow economy and tax evasion levels.

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