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DETERMINANTS OF SHORT-TERM FISCAL IMBALANCE: THE ROLE OF TAX EVASION AS FISCAL DETERMINANT WITHIN EUROPEAN COUNTRIES

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Abstract

The paper refers to important tax evasion consequences in the form of destabilization and countries' fiscal development deteoriation. The main objective of the research is to analyse the selected determinants impact on short-term fiscal imbalance expressed as primary balance with the emphasis on tax evasion. The object of the research is analysed using a panel regression model within four pre-identified clusters during the period of 21 years. The results of the conducted analysis point out that the tax evasion has a significant effect primary balance. They also point out the differences of tax evasion impact, extent and timeing effect on primary balance between clusters. A future analysis with adjusted and modified investigated period, segmentation criteria in the cluster analysis or exogenous variables in the panel regression analysis could provide a different insight into this problem.

Keywords: short term fiscal imbalance, primary balance, determinants, tax evasion, panel regression analysis, European Union member countries

INTRODUCTION

Tax evasion, treated here as a part of the shadow economy, represents an overall problem faced by national governments. Tax evasion, measured through the estimated extent of shadow economy, but also the tax avoidance, embrace and problems. Cobham (2005) points out the importance of tracking and controlling the tax evasion and tax avoidance, as they affect both the volume and nature of government finances. The national as well as the foreign literature mainly points out the negative effects of the tax evasion and tax avoidance (as part of shadow economy) in the form of destabilization of economic and social balance and damage to macroeconomic, monetary and fiscal development. The problem of tax evasion is persisting, so is the need for its impact analysis.

There is no longer a question if the tax evasion and tax avoidance impact the fiscal balance of a country or group of countries, but the most recent issue is the size and extent of this effect. Therefore, the objective of the paper is to quantify the short-term fiscal effects of the tax evasion in the 28 EU Member countries by identifying the impact of the tax evasion indicator on the volume of the short-term fiscal imbalance. For the purpose of empirical assessment of the tax evasion impact on the development of the short-term fiscal imbalance during the period from 1995 until 2015 a panel regression analysis is used. Due to the differences in the fiscal position of individual countries, the results of the cluster analysis served as the segmentation base for the realization of the panel regression analysis. Stated above research has created a sufficient ground for further research on the size of the impact of tax evasion on a short term fiscal imbalance in the EU countries.

The paper is structured as follows. After the introduction is the first chapter describing the overview of current literature regarding the tax evasion analysis attempts and the impact of the control, economic and fiscal variables on the short-term fiscal imbalance. Next the methodology and data chapter follows describing the data used in research and the panel regression model applied. Chapter results describes the main part of the article, describing the models results in each of the identified clusters. The chapter discussion is confronting the resears results with the existing literature, or other research. Summarisation of the article findings is described in conclusion.

Literature Review

Tax evasion, measured through the estimated extent of shadow economy, but also the tax avoidance, embrace many dimensions and problems. From the macroeconomic point of view, one of the most important facts is that they negatively influence budget revenues and budget expenses and in the end they can negatively impact the country's fiscal balance, both in a short-term, as well as in a long-term horizon.

The theoretical work of the national as well as the foreign authors (e.g. Pappa *et al.*, 2015; Novysedlák and Palkovičová, 2012; Hudson, Williams *et al.*, 2012; Slemrod and Yitzhaki, 2002) and empirical research refer to important consequences of the tax evasion. The authors (such as e.g. Sarac and Basar, 2014; Bajada and Schneider, 2005; Schneider and Enste, 2000) mainly point out the negative effects of the tax evasion and tax avoidance (as part of shadow economy) in the form of destabilization of economic and social balance and damaging of macroeconomic, monetary and fiscal development. The literature (e.g. Nchor and Konderla, 2016; Saraç and Basar, 2014; Manolas, Rontos *et al.*, 2013; Çiçek and Elgin, 2011) points out the relation between the existing tax evasion and the fiscal imbalance, refer to the relevance and recency of the issue of fiscal consequences of tax evasion. According to the literature are the variables used in the models divided into thre groups: control variables, economic and fiscal variables.

Theoretical aspects of the expected effects in a group of control variables

One of the most important economic indicators of the tax evasion increase, that causes its growth, is the tax, social and health security burden in the country (Schneider, 2004). A higher level of tax burden in the area of direct and indirect taxes and an increase of the social and health security contributions, are directly related to the enlargement of the tax evasion. (Manolas *et al.*, 2013). The importance of the effect of the tax, social and health security burden on the size of the tax evasion is also emphasied in the results of empirical research (e.g. Chianini *et al.*, 2008). The tax, social and health security burden is the determinant that also has a positive impact on the primary balance. The empirical studies confirmed (e.g. Toder *et al.*, 2012) that some countries are trying to reduce the high level of their deficits through a higher tax or social and health security burden. Our analysis is based on the assumption that the growing trend of tax or social and health security burdens stimulate the growth of the tax evasion and lead to a decrease in the government revenues and at the same time increases the fiscal imbalance of the country (in the context of the variable primary balance it leads to its worsening). The variable government spending considers the level of government expenditures as a percentage of GDP. With the growing tax evasion, the governments spend more funds on fighting this situation. Excessive increase in the government expenditures causes budget deficits and the accumulation of sovereign debt, which is one of the most significant problems of the economy's dynamism. Summarizing facts stated above, it can be assumed that the growth of the government expenditures leads to a growth of the deficit (thus has a negative effect on the primary balance).

Changes in the size of the tax evasion are subject to a number of political, administrative, social and psychological factors, which also contribute to the changes in the fiscal imbalance in a country. The relative importance of each factor varies in each country. The various aspects of governance, its regulation, the government effectiveness and political stability in a country, represent areas with significant impact on the extent of the tax evasion. The political stability is perceived through the danger of political instability (or politically motivated violence, including terrorism). According to Agnello and Sousa (2009), a higher level of political instability can lead to an increase of the budget volatility and the size of the shadow economy. The rule of law, as an included control variable, represents the level of compliance with the legislative rules in the economy. The existence of a large number of regulations in the form of rules and directions in different areas of the economy, can result in restricted choices of individuals within the official economy and thus may lead to an increase of activities in the shadow economy, including the tax evasion. (Schneider and Enste, 2000). The research results of Johnson, Kaufmann and Shleifer (In: Manolas *et al.*, 2013) and Johnson, Kaufmann and Zoido-Lobatón (In: Manolas *et al.*, 2013) show that the increase of a regulation by one unit can cause a growth of the tax evasion by 8.1 percentage points. Intensification of the regulatory framework in various areas of economy tends to provide incentives to violate the rules and thus increases the tax evasion level. On the other hand, limiting the business activities in the official economy leads to the deterioration of government revenues, which results in the gradual deepening of the fiscal imbalance (in the context of the variable primary balance leads to its worsening). The aspect of the governance quality is measured through its effectiveness and the ability of corruption control, which was included into the control variables group. The increased control of corruption and government effectiveness would tend to have an adverse effect on the size of the tax evasion and an adverse effect on fiscal imbalance. It is expected that countries characterized by better governance are more effective in reducing the size of the tax evasion, which is reflected in a smaller impact of the tax evasion on the fiscal imbalance deepening. The group of control variables also includes economic freedom indicators, represented through business freedom, investment freedom, financial freedom and monetary freedom, which are a precondition for the evaluation of effectiveness of business regulation, transfer of investment capital, the independence of the banking sector and the price stability in the economy. The countries with higher values in the business freedom index are characteristic of the most liberal business environments in terms of government regulation of business. High values of this index are related to a low level of shadow activities, including the tax evasion, as the conditions for opening a business, its maintaining and termination are optimal and do not require "the system circumvention". At the same time, the functioning business environment represents a positive precondition for the reduction of the fiscal imbalance (improvement of the primary balance). In the case of investment freedom index, countries with a low value are among countries with significant restrictions in the area of investment capital transfer and also a significant level of shadow activities. The impact of the index representing the financial freedom, in terms of independence of the banking sector from the government's control, is reflected in the form of an adverse effect on the tax evasion and in the form of a favorable effect on the fiscal imbalance. In connection with the tax evasion, it can be assumed that with a decreased regulation of the banking sector by the government, the index will grow and so will the extent of tax evasion. The index of monetary freedom is focused on the assessment of price stability and price control and similarly to the business and investment freedom indices. The growth of this index is connected with the higher tendency to decrease the tax evasion and improvement of the fiscal imbalance. Each of the indices stated above can be seen from the view of double effects in the context of the tax evasion and the deficit. According to the results of the empirical researches (e.g. Schneider and Enste, 2000; Johnson *et al.*, 1998) focused on examining the institutional and the government market regulations, could be derived a more general result that a increased number or intensity of the regulations in the economy, leads more likely to an increase of the tax evasion, than to its decrease.

Theoretical aspects of the expected effects in a group of economic variables

The overall economic situation of the country has a tendency to contribute to the reduction of the fiscal imbalance in the times of its boom (Mayes and Virén, 2000). In addition, the low economic growth is one of the major causes of the excessive deficits within the EU. In the case of consumption and investments, the empirical research shows

that the increase in consumption and investments has positive fiscal effects in the form of reduced deficit volatility. (Mara, 2012). The unemployment is a significant determinant of the fiscal imbalance. Increase in the unemployment rate can help increase the deficit due to the fiscal effects on both sides of the budget (reduction in the government revenues and growth of the government expenditures) Mara (2012). The increased deficit mainly through the government expenditures increase is also described in the research of Maltritz and Wüste (2015). Inflation (HCPI) represents an important determinant when considering the level of economic uncertainty, which can affect the volatility of the fiscal imbalance. The inflation is very often considered as a determinant of the fiscal imbalance, however, its overall fiscal effect on the budget balance is not clear and definite (Tujula and Wolswijk, 2004). The inflationary effects may have impact on the volatility of the government expenditures and revenues or can be reflected through higher nominal interest rates and thus also increase the fiscal imbalance. The factor representing the effects of the external environment on the changes in the fiscal imbalance of a country, was defined as openness (Openness). Here the assumption is that greater openness positively contributes to enhance the country's deficit (it means that growing openness worsens the primary balance). The overall openness effect is conditional upon the relationship between the volume of export and import in the country (Hassan and Kalim, 2012). The group of economic variables also includes the determinants representing the share of population in the age and over 65 years (pop65) and the population in the age 15–64 years (PopActive) on the total population of the country. These determinants are especially used in connection with the problem of growing government expenditures due to the population aging and on the other side due to the problem of ensuring sufficient government revenues from the active population. In regards to the fiscal effect of stated variables, it can be assumed that the growth of the population over 65 years is positively associated with the fiscal imbalance (its growth is causing the increase of the fiscal imbalance). It can also be assumed that the growth in the population of the age 15-64 years is negatively related to the fiscal imbalance (it means positive effect on the primary balance, as its growth is improving the primary balance). The overall fiscal effect can be assessed depending on the share of these populations' parts on the total population of the country.

Theoretical aspects of the expected effects in a group of fiscal variables

The high level of debt may lead to a positive change – improved short-term fiscal imbalance, but a change in the debt ratio may be reflected negatively, as an increased deficit due to the exposure on growth of the interest payments (Maltritz and Wüste, 2015). The debt servicing costs, i.e. the interest expenses of the debt (Interest), are represented by the expenditures component of the general government, which is connected with the interest payments of the public debt. The debt servicing costs have a negative effect, as the increase of the real interest rate leads directly to a worsening of primary balance (Bayar and Smeets, 2009). The empirical research such as e.g. Von Hagen and Wolff (2006) or Maltritz and Wüste (2015) show that the variable stock-flow adjustment (StockFlowA), is often considered to have random impact, however the research of Maltritz and Wüste (2015) rather suggest a positive effect of the stock flow adjustment on the deficit (the growth of the variable causes a tendency of growing deficit, thus reports a negative effect on the primary balance). These adjustments have a form of financial operations, privatization revenues, etc., that are within the fiscal politics systematically used in creative accounting. The Snow ball effect (SnowBall) represents a factor that determines the growth of debt ratio in a given country, which is reflected in the growing expenditures in the form of interest payments on debt and contributes to the deepening of the short-term fiscal imbalance, therefore a negative effect of this variable on the primary balance can be assumed. The Long-term interest rate (LTInterest) captures the costs related to the debt financing in the country. High interest rates worsen the overall level of the fiscal balance through growing interest costs on newly issued debt and rolling debt (Tujula and Wolswijk, 2004). On the other side, higher interest rates may signalize higher opportunity costs of bond market financing and thus contribute to the improvement of the fiscal balance. As authors stated above indicated, the first effect dominates, thus a negative effect of LTInterest on the short-term fiscal imbalance can be assumed.

The Tab. I summarizes the individual exogenous variables with their expected effect on the endogenous variable Primary Balance, as described above.

MATERIALS AND METHODS

The main objective of this research is to quantify the short-term fiscal effects of the tax evasion (measured through the indicator of shadow economy) in the 28 EU member countries by identifying the impact of the tax evasion indicator on the volume of the fiscal imbalance.

For the purpose of empirical assessment of the tax evasion impact on the development of the short-term fiscal imbalance (represented through the cyclically adjusted primary balance indicator) during the period from 1995 until 2015, in the 28 EU countries a panel regression analysis was used. Since most of the variables are not available in higher frequency, annual data were used.

Due to the differences in the fiscal position of individual countries during the monitored period, the results of the cluster analysis served as the segmentation base for the realization of the panel regression analysis. The cluster analysis grouped the 28 European countries into four clusters with an assigned level of homogeneity and with an emphasis on similarity of their fiscal situation. The short-term fiscal impact of the tax evasion was evaluated in the pre-identified clusters. The total number of observations reached the value of 588 in each country (the number of observations in the cluster 1 was 63 observations, in the cluster 2 and 4 was 168 observations and in the cluster 3 was 189 observations). The database for the analysis of the 28 EU countries consisted of 16,464 entries. The econometric model has been designed that it takes into account relevant variables for an estimation of causal connection between fiscal imbalance and tax evasion. At the same time it considers the impact of a wide range of other economic, political and fiscal determinants of fiscal imbalance that have already been verified.

The basic assumption of the analysis is that the country's short-term fiscal imbalance is positively influenced by the size of the tax evasion in that country. To test the formulated hypothesis H_0: that a larger short-term fiscal imbalance is associated with a larger tax evasion an econometric model with the following equation was set up (1):

$$FB_{i,t} = \beta_0 + \beta_1 \mathrm{TE}_i + \sum_{k=2}^{m} \beta_k COVA_{k_{i,t}} + \\ + \sum_{l=m+1}^{n} \beta_l ECON_{l_{i,t}} + \sum_{j=n+1}^{r} \beta_j FISC_{j_{i,t}} + \varepsilon_{i,t} \quad (1)$$

In the equation above (1), $FB_{i,t}$ represents the endogenous variable "fiscal balance" in a given year. With the intention to eliminate the effect of inertia and dynamics of interest payments on the public debt when analysing the fiscal policy of a given country, as well as the effect of the cyclical component, the endogenous variable is expressed in the form of a primary balance. The secondary data on the primary balance (net lending (+) or net borrowing (–) excluding interest of the general government adjusted for the cyclical component) expressed as a percentage of GDP, were obtained from the AMECO database in line with ESA 2010 methodology for all 28 EU countries.

Based on the theoretical knowledge and empirical researches (such as Maltritz and Wüste, 2015; Saraç and Basar, 2014; Manolas *et al.*, 2013; Çiçek and Elgin, 2011; Tujula and Wolswijk, 2004; Enste, 2003; Schneider and Enste, 2000; and others) dealing with the issue of the shadow economy, the tax evasion, as well as the fiscal imbalance and its determinants, were together four groups of exogenous variables included in the models. Expected effects of selected exogenous variables on primary balance is summarized in Tab. I.

The first exogenous variable, which represents an examination object (the analysed determinant) in the econometric model (1) is the tax evasion $TE_{i,t}$ expressed through the shadow economy indicator. The estimates of the shadow economy (and thus of the tax evasion) for all 28 EU countries for the period 1995–2015 were taken from the empirical research carried out by Schneider (specifically Schneider and Enste, 2000; Schneider, Buehn and Montenegro 2010; Schneider, 2012 and Schneider, 2015). Due to the incomplete data for the period 1995–1998 in case of some European countries, missing estimates were calculated as a moving average of three consecutive years.

The object of examination is primarily the relationship between the tax evasion and the general government fiscal imbalance. The economic interpretations of the model's results, based on the theoretical knowledge and the empirical research, considers the relation between the control variables and the tax evasion and between the control variables and the fiscal imbalance, represented through the primary balance indicator.

The vector $COVA_{k_{i,t}}$ represents a vector of various control variables. As stated by Leightner and Inoue (2012), one of the regression analysis' most serious problems is the problem of omitted variables. To fix the problem of regression coefficients distortion of analysed determinant ($TE_{i,t}$) and its statistical

significance due to the impact of omitted variables, control variables in the model were added. From the empirical point of view, the considered control variables satisfy the conditions on which the omitted variable bias problem is based, namely the existence of correlation with the analysed regressor ($TE_{i,t}$) and the existence of the relationship with the endogenous variable ($FB_{i,t}$). Among exogenous variables included into the control variable group were used: the rule of law (RofL), government effectiveness (GovEff), control of corruption (CofC), political stability (PolStab), business freedom (BusFree), monetary freedom (MonFree), investment freedom (InvestFree), financial freedom (FinFree), social security contributions burden (BurdenSSC), tax burden (BurdenTax) and government spending (GovSpend). Variables rule of law, government effectiveness, control of corruption and political stability represent a composite indicator, which is constructed as an average of data from the underlying sources that correspond to the concept of governance being measured[1]. The variable business freedom (BusFree), monetary freedom (MonFree), investment freedom (InvestFree) and financial freedom (FinFree) represent individual factors taken from The Index of Economic Freedom. Each of the economic freedom's components is graded on a scale of 0 to 100, according to the methodology used to compute the scores.[2] The data for these variables during the period 1995–2015 were obtained from The Worldwide Governance Indicators (WGI) database produced by the World Bank Development Research Group and the Natural Resource Governance Institute (NRGI) and the Brookings Institution and from the Heritage Foundation database (co-published by The Wall Street Journal). The group of selected control variables also includes variables: social security contributions burden (BurdenSSC), tax burden (BurdenTax) and government spending (GovSpend). These variables were obtained in line with the ESA 2010 methodology from the AMECO database.

The econometric model takes into account relevant parameters for assessing their impact on the short-term fiscal imbalance, in the wide scale form of already empirically verified economic determinants of deficit.

The vector $ECON_{l_{i,t}}$ in the equation (1) represents a vector of the fiscal imbalance economic determinants. In this group were included factors that are acording to empirical research considered as those that measure fiscal responsiveness to macroeconomic conditions: annual percentage growth of GDP (GrowthGDP), output gap (GapGDP), total consumption of general government and of private sector (Cons), investment of total economy (Invest) and the unemployment rate (Unempl). Taking into account the level of economic uncertainty, which can affect the volatility of fiscal imbalance was also included the determinant inflation (HCPI). The factor representing the effects of external environment on changes in the fiscal imbalance of the country was set to be the openness (Openness). The group of economic variables also includes the determinants representing the proportion of the population in the age group over 65 years (Pop65) and the population in the age group of 15–64 years (PopActive) on the total population of the country. These two variables were selected mainly with the intention to cover the issue related to the increasing expenditures due to the aging population and also ensuring the sufficient government revenues from the active population. The data for the 28 EU countries were obtained from the AMECO database for the period 1995–2015 and in line with the ESA 2010.

The fiscal determinants of the short-term fiscal imbalance were included in the econometric model within the group of fiscal variables. The variables were selected based on the empirical research in the area of the fiscal imbalance, which allowed to determine the context of their expected fiscal effects.

The third vector $FISC_{ji,t}$ represents a vector of fiscal variables, selected through the empirical research as follows: revenue volatility (VolRev) and expenditure volatility (VolExp), both computed as standard deviation for 4-years (rolling windows). The variable change in the debt ratio (GrowthDebt) captures the dynamics of debt to GDP, which can have a positive as well as a negative effect on a short-term fiscal imbalance. Debt servicing costs, i.e. interest expense on debt (Interest), represent a component of general government's expenditures, related to the payment of the interests from the public debt. The variables stock-flow adjustment (StockFlowA) and snow ball effect (SnowBall) are factors determining the debt ratio growth in countries. The long-term interest

1 For detailed description of WGI Aggregation Methodology see Kaufmann, Kraay and Mastruzzi (2010)
2 For detailed description of The Index of Economic Freedom see http://www.heritage.org/index/book/methodology

rate (LTInterest) captures the costs associated with the debt financing in the country. The data was obtained from the AMECO database for the period 1995–2015 and in line with the ESA 2010.

The list of individual determinants, including their abbreviation and expected effect on primary balance, is described in Table I. The variable descriptions are in line with AMECO database and can be viewed at its web page.

The empirical evaluation of the tax evasion impact on the development of the short-term fiscal imbalance, was executed in two main phases: a test for stationarity of time series and implementation of the panel regression analysis.

I: *Summary of expected effects of exogenous variables on primary balance*

Group of Variables	Exogenous variables		Expected effect on PrimaryB
	Title	Abbreviation	
Object of examination	Tax evasion	TE_i	negative (–)
Control variables	Rule of Law	RofL	negative (–)
	Government effectiveness	GovEff	positive (+)
	Control of corruption	CofC	positive (+)
	Political stability	PolStab	positive (+)
	Business freedom	BusFree	positive (+)
	Monetary freedom	MonFree	positive (+)
	Investment freedom	InvestFree	positive (+)
	Financial freedom	FinFree	negative (–)
	Social security contribution burden	diffBurden SSC	positive (+)
	Tax burden	diffBurdenTax	positive (+)
	Government spending	diffGovSpend	negative (–)
Economic variables	Annual percentage growth of GDP	GrowthGDP	positive (+)
	Output gap	GapGDP	positive (+)/negative (–)
	Total consumption of general government and private sector	Cons	positive (+)
	Investment of total economy	Invest	positive (+)
	Unemployment rate	diffUnempl	negative (–)
	Inflation	HCPI	positive (+)/negative (–)
	Openness	Openness	negative (–)
	Population of 65 years and over	Pop65	negative (–)
	Population 15-64 years	PopActive	positive (+)
Fiscal variables	Revenue volatility	VolRev	positive (+)
	Expenditure volatility	VolExp	negative (–)
	Change in debt ratio	GrowthDebt	positive (+)/negative (–)
	Debt servicing costs	Interest	negative (–)
	Stock flow adjustment	StockFlowA	negative (–)
	Snow ball effect	SnowBall	negative (–)
	Long term interest rate	LTInterest	positive (+)/negative (–)

Source: Authors' own elaboration

The first phase focuses on a test for stationarity of time series for all included exogenous variables and the endogenous variable for the individual EU (28) countries. In the environment of R program, the Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test to test the stationarity in our time series[3] was applied. Taking into consideration the software limitations, the unit root test for each country individually, using a cycle was applied. The stationarity test's results of individual time series in the group of control variables in their undifferentiated form (at "the basic level") have confirmed, that in two cases (variables BurdenTax and GovSpend) time series are non-stationary in all EU countries. This situation also occurred in the case of the variable Unempl time series from the group of the economic determinants. The testing of the first differentiations of the time series (diffBurdenTax, diffGovSpend and diffUnempl) confirmed that the studied time series are in the first differentiation stationary in all 28 EU countries.

The second phase of the panel regression analysis has been conducted in three steps: model specification, quantification of model's parameters and model verification.

The model has been specified in line with the intention to determine the critical factors influencing the short-term fiscal imbalance, focusing on tax evasion factor and the quantification of the polarity of its impact. The objective of the analysis was to identify the linear equation describing the relation between the fiscal imbalance and its key determinants, estimate the coefficients of the model's parameters, confirm the theory on the relations between the variables and verify the hypothesis that the increasing tax evasion is associated with a deficit growth. The econometric model was specified so that it reflects relevant parameters for a correct estimation of causal connections and at the same time it takes into account the wide range of already empirically verified economic, political and fiscal determinants of the deficit.

The model quantification consisted of the estimation of the specified econometric model's parameters, based on the quantitative statistical data, empirically determined through selected model techniques. The panel regression model was selected based on the character of the model's variables, which are combination of cross-sectional and time series data of the 28 EU countries. In each of the considered panels, represented by the four clusters (cluster 1–cluster 4), tests for four basic types of models were performed (Ordinary Least-Squares Regression Model with dummy variables for countries and years, Pooled Regression Model, Fixed Effects Model and Random Effects Model). The selection of the final appropriate regression model was based on statistical significance tests that were applied.

The model verification consisted of statistical, econometric and economic model verification. The objects of the investigation were the resulting models: the FEM model (further marked as "PLM Fix Model") for cluster 2, 3 and 4 and model OLS (further marked as "OLS.dum1 country") for cluster 1. The purpose of the investigation was the identification of the model's parameters and the statistical verification, focused on the significance of individual estimated parameters, as well as of the model as a whole. Taking into consideration the empirical knowledge of the lagged effect of the exogenous variables and in order to differentiate between a short and a long term effect of the explanatory variables, the lagged variables were included, where all the exogenous variables were shifted up by one season (lag 1) or two seasons (lag 2). Overall, the objects of the analysis were two separate models with different time delays of the explanatory variables in each of the four considered clusters. The econometric verification was based on the verification of conditions that are necessary for the successful application of specific econometric methods. The econometric verification was carried out in the form of verification of the basic Gauss-Markov theorem: (i) verifying the existence of correlation between individual panels (Pesaranov test) and (ii) verifying the existence of serial correlation for panel models (Breusch-Godfrey/Wooldridge test). The economic

3 Kwiatkovsky unit root test assumes in null hypothesis H0 that the studied time series report stationarity and the alternative hypothesis H1 assumes the non-stationarity of this time series. If the test statistics (LM – Stat.) are higher than asymptotic critical values at the chosen level of significance (1%, 5% or 10%), then the null hypothesis is rejected and the process is non-stationary (For details see Kwiatkowski, Phillips, Schmidt and Shin, 1992).

verification decided on the feasibility of the model, based on the economic assumptions that were defined upfront.

RESULTS

The basic equation of the model, reflecting the impact of all explanatory variables on the endogenous variable (the fiscal balance represented through the primary balance indicator ($FB_{i,t}$)), was defined in form (1). The interpretation of the results needs to take into account the fact that the primary balance (defined as net lending (+)/net borrowing (–) excluding interest of the general government adjusted for the cyclical component) is explained in a positive manner, which means that the positive value of the primary balance represents a surplus (+) while the negative value is a deficit (–). Based on the above, the values of the estimated regression coefficients of statistically significant exogenous variables will display the expected sign in relation to the primary balance.

Based on the described tests above, an appropriate model for each of the two lags for all four clusters was selected. The results of the model's verification and determination have shown that there are two models types appropriate for examination of this data set and that is the OLS. dum1 country model (simple OLS regression model including dummy variables to control for the country effect) and the country FEM model (panel regression model with the fixed effects for the country). While the OLS model came out as the best solution only for cluster 1, more specifically for lag1, clusters 2,3 and 4 (for all of the lags), including lag2 for cluster 1, were further modelled through the country FEM model.

The significance of all exogenous variables was tested by comparing the probability p-value with the selected level of significance ($\alpha = 0.05$) for each cluster and each lag. Resulting model was created using the step-wise elimination method where statistically insignificant variables were systemically removed from the model with a respect to the Adjusted R-squared value. The statistical significance of each model as a whole (in a total of 8 models) has been assessed based on the Adjusted R-squared value. The criterion was chosen with the intention to balance the econometric models with the same endogenous variable, while the models differ from each other by the number of variables included, as well as by the size of the files of the observed data (i.e. the number of the observations).

The results of the panel regression, together with the corresponding estimates of the coefficients, their statistical significance and the values of Adjusted R-squared, are shown in Tab. II–Tab. VIII). Description of statistical significance level is due to space limitations only in the Tab. II. Based on these results, can be summarized that all the above mentioned prerequisites of the conducted panel regression analyses are met.

Due to the large extent of data (results of 8 models), will be the results of the panel regression described separately for each cluster, but with the emphasis on the tax evasion/avoidance effect and with only a brief description of the effects of some other significant variables, which showed unexpected or interesting results during two lags.

Cluster analysis results

The cluster analysis grouped the 28 European countries into four clusters with an assigned level of homogeneity and with an emphasis on their fiscal situation. Under evaluation was the short-term fiscal impact of the tax evasion in the pre-identified clusters.

The final clusplot of clustering and final map of the 28 European countries in Figs. 1 and 2 show 4 clusters, based on five weighted and normalised segmentation criteria (GDP growth, deficit, debt, FRI and tax evasion), conducted through hierarchical Ward's method with Euclidean distance.

Cluster 1 consists of three countries with the highest gross debt among all EU (28) countries (above 100 % of GDP). Cluster 2 groups eight countries with the individual tax evasion above the EU (28) average, but with the highest GDP growth. Countries in Cluster 3 are characteristic by their average level of gross debt, but report high deficits and relatively high GDP growth. Cluster 4 consists of eight countries, which reported on individual basis relatively low gross debt and tax evasion and at the same time their primary balance was in the form of surplus or very low deficit.

The cluster 1 consists of three countries, Belgium, Greece and Italy. The cluster 1 is represented by the countries with the median values of the primary balance at 2.705 % of GDP, the tax evasion at 20.067 % of GDP and the economic growth at 2.913 % of GDP.

Bulgaria, Estonia, Cyprus, Latvia, Lithuania, Hungary, Romania and Slovenia are the countries, which are categorized in cluster 2. This cluster covers the countries with the median value of primary balance at –0.958 % of GDP, the highest value of tax evasion among all clusters with

the median value of 27.120 % of GDP and economic growth at 8.948 % of GDP.

The cluster 3 consists of nine countries: Czech Republic, Ireland, France, Croatia, Malta, Poland, Portugal, Slovakia and United Kingdom. These countries are on the overall level defined by the primary balance at –1.325 % of GDP, the tax evasion at 22.020 % of GDP, what puts the cluster on the second highest place of this criteria and GDP growth at 6.463 % of GDP.

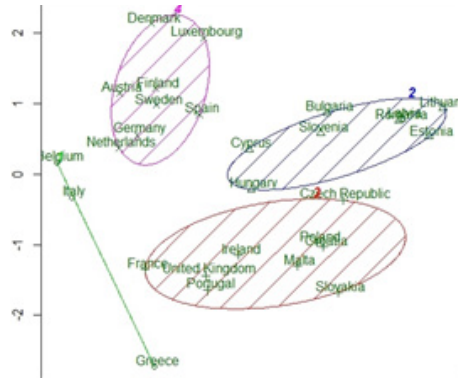
Based on the clustering analysis the countries of Denmark, Germany, Spain, Luxembourg, Netherlands, Austria, Finland and Sweden were grouped into cluster 4. This cluster is characterized by a value of the primary balance at 1.744 % of GDP, the median value of GDP growth at 4.017 and the estimated tax evasion level at 17.853 % of GDP.

Identification of Significant Variables in Clusters

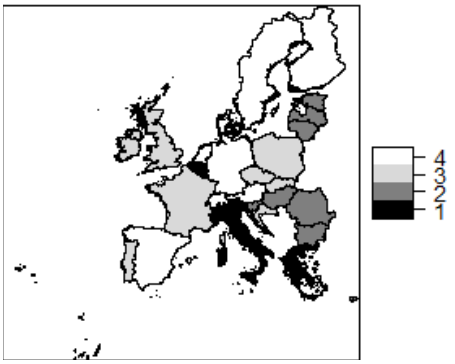
The panel regression analysis was focused on the verification of the hypothesis that the larger tax evasion is associated with a larger fiscal balance (in the form of a deficit) in the country.

The effect of tax evasion

The expected negative effect of the tax evasion on the primary balance has not been confirmed in cluster 1. The negative sign of the regression coefficient of the tax evasion proves that the larger tax evasion is associated with worsening in primary balance (respectively with a larger fiscal imbalance) in the countries categorized in clusters 3 and 4. This negative effect of the tax evasion on primary balance was confirmed in model lag1, as well as in model lag2 in the cluster 3, Comparing the regression coefficients of the tax evasion in the models lag1 and lag2, it is important to mention, that the effect of tax evasion is stronger in the period with a delay of two seasons. Based on the results of the regression models lag1–lag2 in the cluster 4, the formulated hypothesis was confirmed. The negative regression coefficients in all three models (lag1 – lag3) determine that the growing tax evasion leads to a worse primary balance. The coefficient in the model lag3 is much stronger, when it doubles to a value of –0.513262. The negative effect was confirmed also with the values of the correlation coefficient (Kralik, 2016) of each country from the cluster 4.



1: *Ward's clusplot of 28 EU countries organized in 4 clusters*
Source: Authors' own elaboration as output from R software



2: *Map projection of the EU countries grouped in four clusters*
Source: Authors' own elaboration

The seven out of eight countries included in cluster 4 reported a positive correlation coefficients, which means that they confirm the hypothesis on a negative effect of the tax evasion on the primary balance.

The positive signs of the regression coefficients in two models lag1 and lag2 (0.87998 and 1.569258) in the cluster 1, document that the growth of the tax evasion leads to the improvement of the primary balance (lower government deficit), which is in contradiction to the expected assumption. The basic assumption was not confirmed also in models lag2 and lag3 in the cluster 2. This fact is documented by the positive regression coefficients of the variable TE. Based on the results can be stated that the growing tax evasion improves the primary balance, and this effect is significant mainly in the model with two delayed seasons (lag2) in cluster 2. These results are in line with those of the correlation analysis (Kralik, 2016), where a negative correlation coefficient of the tax evasion and the government deficit, for all three countries in clusters 1 and 2 was identified. Thus both analysis confirm that the growing tax evasion decreases the deficit (improves the primary balance) in countries within these clusters.

The positive effect of the tax evasion on the primary balance, in the meaning that increased tax evasion improves the short-term fiscal imbalance, can be explained through activities impacting both, the government revenues, as well as the government expenditures. On one side, it are mainly the big corporations and high-income taxpayers that tend to engage in the tax evasion activities more easily than other taxpayers, since they tend to generate their income from multiple sources and can afford to hire lawyers and accountants to structure their income so that they owe as little tax as possible. The resources spent on evading taxes (e.g. in the form of legal fees to lawyers and accountants, etc.) are definitely lower than expected savings (otherwise it would not be beneficial for a taxpayer), however, these resources are officially recorded and taxed and thus increase the government revenues. As the high-income taxpayers are attempting to evade high amounts of taxes, the resources spent on implementing the activities related to the tax evasion are not negligible. On the other side, the literature also provides strong evidence that the shadow economy creates a shelter for many unemployed (e.g. during the time of crises) and thus frees the government budget from expenditures in the form of social contributions, etc.

Auerbach and Slemrod (1997) conclude that timing and other tax evasion behaviours are the behaviours most responsive to tax changes, while changes in real productive activities are actually the least responsive. These timings and other evasion behaviour types also likely explain that taxpayers change the timing, when they derive or evade income and "plan" their tax evasion based on various social, legal or fiscal circumstances. Thus, the size of the tax evasion in a given year does not necessarily reflect

II: *The effect of tax evasion*

Model	Cluster 1	Cluster 2	Cluster 3	Cluster 4
OLS LAG 1	0.87998 (0.005390)**			
PLM Fix LAG 2	1.569258 (7.096e-05)***			
PLM Fix LAG 1		_	–0.452484 (0.0379270)*	–0.257181 (0.009623)**
PLM Fix LAG 2		1.055182 (0.007085)**	–0.85300 (0.0005653)***	–0.270338 (0.0045792)**

Cluster 1: OLS Model (Lag 1): R-squared: 0.9215; Adjusted R-squared: 0.8929
PLM Fix Model (Lag 2): R-squared: 0.96486; Adjusted R-squared: 0.51773
Cluster 2: PLM Fix Model (Lag 1): R-squared: 0.45639; Adjusted R-squared: 0.39894
PLM Fix Model (Lag 2): R-squared: 0.46351; Adjusted R-squared: 0.38102
Cluster 3: PLM Fix Model (Lag 1): R-squared: 0.56273; Adjusted R-squared: 0.48511
PLM Fix Model (Lag 2): R-squared: 0.65296; Adjusted R-squared: 0.57194
Cluster 4: PLM Fix Model (Lag 1): R-squared: 0.63749; Adjusted R-squared: 0.56048
PLM Fix Model (Lag 2): R-squared: 0.59557; Adjusted R-squared: 0.51532
Signif.codes: 0 ***; 0,001 **; 0,01 *; 0,05 . ; 0,1 ; 1
Source: Authors' own elaboration based on testing results in R software

the shadow activities of that year and the impact on the budget might be also reflected with a delay. That would also explain the fact that for this cluster, models lag1 and lag2 indicate a positive effect.

The effect of control variables

The regression analysis in the cluster 1 confirmed significance of three control variables, which were reported in all four clusters: Rule of law (RofL), government effectiveness (GovEff) and Business freedom (BusFree). The statistically significant variable Rule of law (RofL) was recorded only in lag2 in the cluster 1 and in the cluster 4 with the expected negative effect, which only confirms that the increasing legislative regulation tends to "circumvent the system" and this is reflected in a worsening of primary balance. On the other side, the control variables rule of law (RofL) have in the cluster 2 reported an unexpected effect on the primary balance. The regression coefficient sign reported a negative effect of the control of corruption, according to which the control of corruption growth worsens the primary balance. The situation can be explained through the fact that the increase in rule of law may create a pressure that stimulates activities in the shadow economy, which are then ultimately reflected in a deeper government deficit. The positive regression coefficients of Business freedom (BusFree) in the cluster 1 and 2 reported a negative effect of the business freedom, according to which the growth in business freedom worsens the primary balance. In the terms of the indicated impact, this connection can be justified by the existence of a double effect on the primary balance. Improvements in the condition for business activities and capital movement have two sides. Not only the low level of tax evasion, with the precondition of an improved primary balance in the form of surplus, but also the enlarged environment for the monetary transactions (including e.g. money laundering) and non-monetary transactions of illegal activities (e.g. drugs, prostitution, etc.), could cause a drop in the government revenues within the official economy, with a negative impact on the primary balance. On the other hand, the positive effect on primary balance was reported in the cluster 3 and 4. A positive regression coefficient means that the improved business environment positively

III: *Control variables as determinants of primary balance*

Independent variables	Cluster 1	Cluster 2	Cluster 3	Cluster 4
	OLS Model LAG 1		PLM Fix LAG 1	
RofL		–		–6.273935 (5.900e-05)***
GovEff	6.33931 (0.006970)**	–	6.890251 (0.0013102)**	3.261019 (9.784e-06)***
PolStab	3.86361 (0.003956)**		2.183879 (0.0360975)*	
CofC		–1.780451 (0.0619213).	–4.549947 (0.0036627)**	-
BusFree		–	0.091590 (0.0345789)*	0.035947 (0.036392)*
MonFree	0.23517 (0.037676) *	–		–
InvestFree		0.053664 (0.0116438)*		
FinFree	–0.12482 (0.000469)***	–		–0.020298 (0.163136)0
BurdenSSC		0.843933 (0.0004520)***		
diffBurdenTax		0.443549 (0.0037719)**		0.472535 (7.294e-05)***
diffGovSpend		–0.178480 (0.0047712)**		–0.147768 (0.017826)*

Source: Authors' own elaboration based on testing results in R software

impacts the primary balance of a country and leads to a decreased deficit. The results of the control variables also indicate that the factor business freedom has a short-term effect in the countries of clusters 3 and 4, as this was reported only in the model with a delay of 1 season (lag1), while the other effects of determinants such as corruption control and the political stability factors may be present for a longer period.

The regression coefficient of Financial freedom in the cluster 1, 2 and in the cluster 4 reports an expected negative effect in lag1, which may occur in relation with the monetary transactions of illegal activities, as it reflects the increasing level of the banking sector's independence from the government control and so can lead to worsening of primary balance (increased deficit). However, in the cluster 1 lag2 the Financial freedom shows a positive effect on the primary balance that reflects an expected effect on the primary balance change over time and thus can be explained more as a short-term effect. The variable financial freedom with the negative regression coefficient proves that the increasing legislative financial regulation leads to a "bypass the system" tendency and thus makes the primary balance worse.

Positive regression coeficients for variables representing tax and social contribution burden (BurdenSSC and diffBurdenTax) confirmed presumtion of positive effects on primary balance in the cluster 1, 2 and 4. Based on this can be stated that the influence of tax reforms carried out is reflected with a smaller delay than changes in social security contributions.

One of the factors with a negative effect on the primary balance was with its negative regression coefficients variable government spending (GovSpend). This result is in line with the asumptions of the negative effect of government spending increase on the primary balance that was recorded in the cluster 2 and 4.

The effects of economic variables

Between significant determinants of primary balance in all of definied clusters were considered Inflation (HCPI), GrowthGDP and GapGDP, Consumption (Cons), Investments (Invest), Openess, Unemployment rate (diffUnempl) and the population size divided into two categories

IV: *Control variables as determinants of primary balance*

Independent variables	Cluster 1	Cluster 2	Cluster 3	Cluster 4
	PLM Fix LAG 2			
RofL	–20.279787 (6.169e-08)***	4.815189 (0.049978)*	–	–4.474207 (0.0283520)*
GovEff	6.147991 (0.028007)*	3.970410 (0.043674)*	–	3.661295 (9.301e-05)***
CofC		–4.908483 (0.007238)**	–	–2.361789 (0.0183052)*
PolStab	2.004119 (0.095356).		–	
BusFree		-0.101204 (0.018318)*		–
MonFree	–0.700796 (5.905e-06)***	-		0.086244 (0.0620273).
InvestFree		0.058190 (0.025942) *		
FinFree	0.081917 (0.078323).	–		–
BurdenSSC		0.88664 (0.006733) **		
diffBurdenTax		–		0.290509 (0.0199756)*
diffGovSpend		–		–

Source: Authors' own elaboration based on testing results in R software

for the age 65 years and over (Pop65) and age of 15–64 years (PopActive).

To take into account the level of economic uncertainty that can affect the volatility of fiscal balance harmonised price index (HCPI) was included into model. The inflation reported in the form of harmonized index of consumer prices was a significant determinant in all clusters. The empirical research shows that the relation between the inflation and the fiscal imbalance is not a priori clear. The results show a positive regression coefficient in lag1 and lag2 in cluster 1 and in lag2 in cluster 2 and so can be declared that the growing inflation can improve the primary balance. This fact is in line with the assumption the state's view, where the state is a debtor and so is the growing inflation a positive determinant, as it undermines the real value of the nominal debt service.

The regression coeficients of GDP growth and output gap confirmed the expected effects on the primary balance in cluster 4. In case of the GDP growth, it was the positive effect (growing GDP leads to an improved primary balance) and in case of the output gap it was a negative effect, where a growing difference between actual and potential GDP causes a deterioration of the primary balance. On the other side the variable GrowthGDP, reported as significant for cluster 2 lag1 model only, shows a negative impact on the primary balance. Although at first glance the reported relation between the GDP growth and the primary balance might seem to be in conflict with the expected – positive – effect, there is an open question on what should be the expected effect. In general, the growing GDP improves the primary balance, however the GDP growth is associated with many other effects (also with the impact on other variables) so the final effect, in its expected form, might not be definite. Even the empirical literature does not provide a uniform and general explanation on the expected final effect of GDP growth on the primary balance.

Two determinants consumption (Cons) and investments (Invest) were significant in all clusters. Both these variables, have not confirmed the expected positive effects on the primary balance. In the cluster 1, 2 and cluster 4, the consumption (Cons) has a negative regression coefficient which represents an unexpected negative effect on the primary balance. That means that the growing consumption of the general government and the private sector leads toward a worse primary balance. This fact can be explained through the implicit assumption that all (or most) government expenditures are of a consumption nature (instead of investment or the optimal combination of the above) and that does not contribute to the improvement of primary balance. Another economic variable that

V: *Economic determinants of primary balance*

Independent variables	Cluster 1	Cluster 2	Cluster 3	Cluster 4
	OLS LAG 1		PLM Fix LAG 1	
HCPI	0.30289 (0.004482)**	–		
GrowthGDP		-8.354601 (0.0006528)***		–
GapGDP				–0.166617 (0.001311)**
Cons	–69.24211 (0.002918)**	–		–44.696051 (4.926e-11)***
Invest	–47.97143 (0.000644)***	–		–
Openness		–	–5.987780 (0.0002830)***	
diffUnempl		–0.234324 (0.0154336)*	–0.533214 (0.0060192)**	–0.194517 (0.104253).
Pop65	–6.97216 (0.000173)***	–0.913977 (2.148e-06)***		
PopActive	–5.84175 (1.08e-05)***	–	–1.151761 (0.0005141)***	

Source: Authors' own elaboration based on testing results in R software

is reporting an unexpected effects on the primary balance is the investment of total economy (Invest), considered as significant variable in the all clusters. The investment variable reported a negative regression coefficient, meaning that the growing investments lead to worsening of the primary balance. This can be explained from the time perspective as understandable, as investments do not reflect to the government budget immediately. Depending on the structure of the investments, it might take longer than just two seasons to reflect the benefits of the investments on the primary balance.

Negative effect of the Openess variable, that represents the effects of the external environment, on the changes in primary balance was recorded as significant in lag1 and lag2 models in cluster 3. Higher openess rate according to the negative regression coefficient can lead to primary balance worsening. As the empirical researches suggest, higher openess rate stimulates higer deficits in a country. Resulting openess effect is therefore in line with the research assumptions.

The effect of the unemployment rate (diffUnempl) on the primary balance was confirmed in all clusters. According to the results in all clusters can be the assumption about the negative effect of unemployment on primary balance confirmed. According to the lag2 model in the cluster 1, lag1 model in cluster 2, 3 and 4 can be confirmed that the growing unemployment rate worsens the primary balance mainly due to the declined tax revenues and increased expenditures in the form of paid social contributions.

The population size was divided into two categories, one for the population of the age 65 years and over (Pop65) and another for the age of 15-64 years (PopActive). Both variables were significamt in three clusters. The results of lag1 cluster 1 model show the negative effect of both determinants. The growth of the population 65 years old and over increases a pressure on the volume of incurred public expenditures in terms of population aging and thus makes the primary balance worse, which represents an expected and confirmed effect in both lags. This negative effect was confirmed in lag 1model in cluster 2. In line with the assumption, the negative effect of this variable is reflected through the negative regression coefficient and thus can be assumed that this factor is positively associated with the fiscal imbalance (its growth causes the deterioration of the primary balance), as it expresses the pressure on the growth of the incurred government expenditures in the context of population aging. On the other side, the effect of the population factors (Pop65) showed an unexpected effect in lag 3 model in cluster 3. The negative regression coefficient of the population of 65 years and over indicates that

VI: *Economic determinants of primary balance*

Independent variables	Cluster 1	Cluster 2	Cluster 3	Cluster 4
	PLM Fix LAG 2			
HCPI	0.222924 (0.002445)**	0.049262 (0.043087) *		
GrowthGDP		–		10.231067 (0.0038337)**
GapGDP				–0.301761 (0.0001663)***
Cons	142.075194 (1.746e-08)***	–42.378121 (6.378e-05) ***		–50.741255 (3.771e-10)***
Invest	–65.097035 (0.001525)**	–14.224147 (0.014369)*	–30.33885 (0.0012851)**	–18.674542 (0.0279868)*
Openness		–	–5.90279 (7.363e-05)***	–
diffUnempl	–2.105489 (6.334e-06)***	–		
Pop65	0.222924 (0.002445)**	–		
PopActive	142.075194 (1.746e-08)***	–	–1.16906 (0.0007144)***	

Source: Authors' own elaboration based on testing results in R software

the older the population (of 65 years and over) in the economy is, the better the primary balance.

At first glance, the negative effect of the Active population in the age 15–64 on the primary balance in both lag1 in the cluster 1 and in lag 1 and lag 2 in the cluster 3 might seem to be in contradiction with the assumption of the positive impact on the primary balance. However, the overall effect of this variable needs to be reviewed in respect to the other various age categories and their share on the total active population and in respect to the situation on the labour market in terms of employment rates. The positive coefficients of the active population suggest that the growing size of the active population leads to worsening of the primary balance. This can be explained through the fact that if the population of 65 years and above is still active and contributes to the economy growth, then the amount of the contributions from the government might be balanced (or even overcome) by the benefits provided by this population. In addition, the structure of the population represented mainly in the active population factor, can have an important impact on the final determinant. Share of the studying population (over 15 years old) compared to the really active population, might result in the above stated adverse effect on the primary balance.

The effect of fiscal variables

Four main primary balance determinants among the fiscal variables group were identified as significant in this study: GrowthDebt, Interest, Snowball and LTInterest. Resulting models in cluster 4 are the only exeptions, were none of the fiscal variables were considered significant. For the countries in this cluster only control and economic variables were identified as significant and having an effect on primary balance. This situation is understandable, as this cluster consists of countries, whose weighted primary balance was at 1.744 % of GDP (thus representing a surplus) and they do not have to fight critically high values of debt either. Thus it can be expected that these countries do not face problems with the interest from debt of the snowball effect, etc.

The determinant GrowthDebt was significant in the remaining three clusters (1,2 and 3). The variable GrowthDebt in the model lag1 and lag2 in the cluster 1 had a positive impact on the primary balance, as expected, which means that the growing debt improves the primary balance. The growing debt will increase the efforts to decrease the deficit and motivate the country towards "smarter spending". On the other side a difference in the effect of this determinant on primary balance was reported in cluster 3. The growth of the public debt in this cluster reached a relatively high value and so did the regression coefficient. The negative sign of the regression coefficient reflected a negative effect on the primary balance. In this case the growing debt made the primary balance worse that could be the reason mainly from the growing interests from the debt and thus could negatively impact the deficit.

The variable long-term investment rate (LTInterest) had an different impact, according to the results of the model in the cluster 1, cluster 2 and in the cluster 3. The positive effect of this determinant on primary balance was recorded in all lag models in the cluster 3, and in lag2 in the cluster 1. The negative effect was identified in lag1 in the cluster 1. Despite the differences both effects are in line with the assumptions. The long-term interest rate growth accompanies the growth in costs related to debt financing in the country, which makes the overall level of the fiscal balance worse through growing expenditures on the interest from the newly issued debt and from roll over debt. On the other side, the higher interest rates might signalize higher

VII: *Fiscal determinants of primary balance*

Independent variables	Cluster 1	Cluster 2	Cluster 3	Cluster 4
	OLS LAG 1		PLM Fix LAG 1	
GrowthDebt	13.83976 (0.016593)*	–	–9.862550 (0.0001269)***	
Interest		–		
SnowBall		–		
LTInterest	–0.27566 (0.015225)*	–	0.382331 (0.0212865)*	

Source: Authors' own elaboration based on testing results in R software

opportunity on bond markets for debt financing and thus to improve the fiscal balance.

The factor debt servicing cost (Interest) in the lag2 model in the cluster 3 reported a negative regression coefficient, based on which the growing interests from the debt lead to a deepening of the deficit (respectively to the primary balance worsening). Regression coefficient of this variable was in line with the assumptions, in terms of their effects on the primary balance. It represents the debt servicing costs as a part of the expenditures of the general government and its negative sign of the regression coefficient indicates the negative effect on the primary balance. The fourth fiscal variable considered in the cluster 1 as well as in the cluster 2 is the SnowBall, with a negative regression coefficient. The increasing SnowBall effect worsens the primary balance, as the growing costs of debt financing impacts the primary balance negatively.

RESULT AND DISCUSSION

The results of the panel regression analysis, with the total number of 588 observations, conducted for all four clusters, quantified the short-term effects of the tax evasion, control variables, fiscal and economic variables on the primary balance, in line with the set objective of the research. The analysis allowed to identify a linear equation describing the relationship between the primary balance and the statistically significant determinants, to estimate the coefficients of the models' final parameters, to confirm, respectively reject the theoretical assumptions of the individual parameters effects on the primary balance and most importantly to verify the hypothesis that the growth of the tax evasion is associated with a larger fiscal imbalance (i.e. with the worsening of the primary balance).

The results of the cluster 1 reported the tax evasion effects on the primary balance, including their changes within the monitored lagged periods. In both models lag1 and lag2 was the regression coefficient positive, reporting a positive impact on the primary balance (i.e. that the growing tax evasion is associated with an improvment in primary balance). In the cluster 2, the tax evasion was selected as a statistically significant variable only in lag2 model and again with the positive regression coefficients. The last two clusters, i.e. the cluster 3 and cluster 4, reported an expected negative effect of the tax evasion on the primary balance. Based on the stated results is can be concluded that the formulated and tested hypothesis was confirmed in the case of two clusters – cluster 3 and 4 and it was not confirmed in the case of cluster 1 and 2.

The positive effect of the tax evasion on the primary balance, in the context that increased tax evasion improves the short-term fiscal imbalance, can be explained through activities impacting both, the government revenues, as well as the government expenditures. On one side, the resources spent on evading taxes (e.g. in the form of legal fees to lawyers and accountants, etc.) are officially recorded and taxed and thus they increase the government revenues. On the other side, the literature also provides strong evidence that the shadow economy acts as a shelter for many unemployed (e.g. during the time of crises) and thus frees the government budget from expenditures in the form of social contributions, etc.

Another considerable fact is that timing and other evasion behaviours are behaviours most responsive to tax changes, while changes in real productive activities are actually the least

VIII: *Fiscal determinants of primary balance*

Independent variables	Cluster 1	Cluster 2	Cluster 3	Cluster 4
	PLM Fix LAG 2			
GrowthDebt	1.132157 (0.039250)*	–2.339730 (0.040686)*	–16.28978 (4.167e-13)***	
Interest		–	–0.67110 (0.0476889)*	
SnowBall	–0.137516 (0.372115)	0.307716 (0.024965)*		
LTInterest	0.480261 (7.715e-05)***	–	0.48922 (0.0073505)**	

Source: Authors' own elaboration based on testing results in R software

responsive. Then, the size of the tax evasion in a given year does not necessarily reflect the shadow activities of that year and the impact on the budget might be also reflected with a delay longer that just monitored 1–2 seasons.

In addition, we also need to take into consideration the shortcomings of the applied quantitative methods, which could participate to the fact, that the conducted panel regression analysis did not confirm the set hypothesis in all four clusters. The resulting mismatch with the expected effects may be affected by several factors, such as: the use of estimated values, as well as various indices of exogenous determinants, or the insufficient number of observations on individual panels. The existence of deficiencies in individual applied quantitative methods, such as: considering only hierarchical methods of clustering and selection of the correct clustering method or the construction of the panel regression model (problems with biased variables, lag time delays). In addition, taking into account the number of analysed countries (28 EU) and the heterogeneity in the fiscal and tax areas, the results might also be impacted by a number of random failures.

The results of the tax evasion's impact on the short-term fiscal imbalance stated above prove that the tax evasion has a significant effect on the short-term fiscal imbalance and its extent and the consequences varies depending on the country (group of countries), timing effect and other invisible "shadow" impacts.

CONCLUSION

The main objective of the research was to quantify the short-term fiscal effects of the tax evasion (measured through the indicator of shadow economy) in the 28 EU member countries by identifying the impact of the tax evasion indicator on the volume of the fiscal imbalance.

For the purpose of empirical assessment of the tax evasion impact on the development of the short-term fiscal imbalance (represented through the cyclically adjusted primary balance indicator) during the period from 1995 until 2015, in the 28 EU countries a panel regression analysis was used. Since most of the variables are not available in higher frequency, annual data were used.

The conducted panel regression analysis allowed us to determine statistically significant variables of the short-term fiscal imbalance and to quantify the polarity of their impact, with the focus on the tax evasion factor. Analysis results also verified the hypothesis that the primary balance is acting as an endogenous variable and is positively influenced by the growth of the tax evasion in a given country (respectively group of countries).

Based on the conducted analyses can be concluded that the final models and findings on the relationship between the tax evasion and a short-term fiscal imbalance are relevant and it can be assumed that the resulting (unexplained) variability of the investigated variables can be explained by random component, where the impact of the tax evasion might be insufficient, compared to the impact of random component. In addition, it needs to be noted that the final results of the individual analyses might be affected by several process-related factors, such as the number of analysed countries (28 EU), the heterogeneity in the fiscal and tax areas of the countries, the use of estimated values (when measuring the size of the tax evasion), the selection of segmentation criteria (used in the cluster analysis), the problems with the biased variables and lag time delays (in the panel regression analysis), etc.

The issues of the tax evasion and tax avoidance, including their estimated extent and their impact on the short-term fiscal imbalance represent a complex problem. Limitations of presented research did not provided an sufficient base to analyse this problem in more detail, therefore an analysis of the tax evasion and tax avoidance's impact on the fiscal imbalance in the future with the focus on the quantification of the tax avoidance's extent would be appropriate and desirable. Future analysis with adjusted and modified investigated period, segmentation criteria in the cluster analyses or exogenous variables in the panel regression analyses could provide more comprehensive results that would bring a clear insight onto this problem.

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