DETERMINANTS OF PUBLIC DEBT IN EU COUNTRIES

Toth P., Tkacova A., Gavurova B., Pechova V.[*]

Abstract: Due to the Covid-19 pandemic, governments must support their economy to prevent a possible recession which will lead to an increase in public debt. Therefore, it is necessary to know important determinants of public debt. This paper provides an analysis of public debt determinants. The main aim of the article is to identify the impact of specific variables on the level of public debt in EU countries by using econometric methods. The article analyses studies that focus on determinants of public debt, and it defines ten fundamental independent (explanatory) variables. Panel data regression model is used to monitor the impact of these variables on an independent variable – public debt, while it uses data from 1999 to 2019. The model's results show that the growth of variables, such as current account balance of payments, budget balance, public administration investments, inflation rate, and GDP growth, lead to reducing public debt in EU countries. On the other hand, the increase in variables, such as annual population density change and budget expenditure, leads to public debt growth. The impact of both, unemployment rate and purchasing power parity, on public debt is insignificant based on the study results.

Key words: public debt, determinants of public debt, panel regression, EU countries.

DOI: 10.17512/pjms.2022.25.1.25

Article history:
Received February 06, 2022; *Revised* May 11, 2022*; Accepted* May 18, 2022

Introduction

The global economy has occurred in a turbulent environment over the last two decades. Two large collisions have affected it after years of economic growth and prosperity. According to Kolková and Ključnikov (2021), the financial crisis in 2008 affected all Visegrad countries, namely, the Czech Republic, Slovakia, Poland, and Hungary. The global financial crisis in 2008 has been followed by a new crisis in a form of the COVID-19 global pandemic. The COVID-19 pandemic has influenced many Europeans too (Dvorský et al., 2021). Both crises have a common impact i.e., an excessive debt of most countries. The Eurozone governments are very sensitive to exogenous and negative surprises due to the high rate of public debt (Briceño, Perote, 2020; Rybáček, 2016). Excessive debt has been considered as one of the main limitations of the economic policy and the competitiveness of the countries in a debt crisis in the coming years (Ochotnický & Jankech, 2020). In the last decade, the

---

[*] **Peter Toth**, PhD., Technical University of Košice, Faculty of Economics, **Andrea Tkacova**, PhD., Technical University of Košice, Faculty of Economics, **Beata Gavurova,** Prof., PhD., Technical University of Košice, Faculty of Mining, Ecology, Process Control and Geotechnologies, **Viktoria Pechova**, Technical University of Košice, Faculty of Economics

✉ corresponding author: beata.gavurova@tuke.sk

✉ peter.toth@tuke.sk; andrea.tkacova@tuke.sk; viktoria.pechova@student.tuke.sk

POLISH JOURNAL OF MANAGEMENT STUDIES
Toth P., Tkacova A., Gavurova B., Pechova V.

2022
Vol.25 No.1

validity of the negative impact of public debt on economic growth had been verified by the main flow of the economy according to which high public debts and their repayments have certain limitations on economic growth (Reinhart and Rogoff, 2010; Checherita & Rother, 2010; Hasanov & Cherif, 2012; Mencinger et al., 2014; Liu & Lyu, 2020). The above-mentioned studies confirmed that countries with a level of public debt-to-GDP above 90% achieve significantly slower economic growth than countries with lower debt and/or the fact that a relationship between the level of public debt-to-GDP and GDP growth is non-linear. EU countries should have their breaking point at the level of 70 – 80% (Checherita & Rother, 2010; Hasanov & Cherif, 2012).

There are multiple theories of public debt and possible resolutions of its growth. One of such theories is fiscal consolidation. Many studies confirmed its positive effect on lowering the public debt-to-GDP (e.g., McDermott & Westcott, 1996; Fernández & Hernández, 2006; Guichard et al., 2007; Reinhart & Rogoff, 2009; Afonso & Jalles, 2011; Alesina et al., 2012; Reinhart et al., 2015). The authors used simple statistical and/or comparative methods, or more complex econometric approaches in their studies (VAR, PROBIT, LOGIT, SVAR). Reducing public debt is a politically sensitive topic as fiscal consolidation via fiscal policy change, which is connected to government spending cuts or tax growth, influences the voters' preferences. It is supposed that reduction of public debts by supporting GDP growth and expansive monetary policy should be more preferred by politicians because it could affect consumption (Hasanov and Cherif, 2012; Vrbka 2016; Rousek, Vochozka and Psárská, 2019).

Public debt may be consolidated without any consolidation interventions. Ochotnický and Jankech (2020) state that countries that successfully reduced their public debts without any previous fiscal consolidation benefited especially from a positive macro environment impact. In the post-crisis period, such policy had been applied by those countries whose public debt-to-GDP reached the level of 70% on average. Higher reduction of public debts and better budgetary management even after ending the fiscal consolidation represent a benefit of the fiscal consolidation.

It is important to be aware of those factors that significantly influence the level of public debt regardless of the consolidation type selected by a particular country. Identification of these factors and their size of the effect is the first step to successful management of public debt and it represents the main aim of this article.

Literature Review

The existing literature related to the determinants of public debt shows that those factors, which may impact the public debt are especially macroeconomic, political, institutional, and structural variables. The economic factors include such variables as interest rate, economic growth, inflation, debt status, budget deficit, public expenditure, and/or monetary policy credibility (Drazen, 2000; Imbeau & Pétry, 2004; Swaray, 2005). This article offers an overview of selected studies based on the

analysis of macroeconomic indicators (with emphasis on the EU countries) that are chronologically ordered.

Sinha et al. (2011) analysed panel group data of 31 countries from all over the world (including some selected European countries) for the period from 1993 to 2008. The authors used a panel regression model to prove that the most important determinant of public debt is the GDP growth rate in high-income and middle-income countries. Also, government spending, education expenditure and current account balance have an impact on the debt status of both groups.

The main aim of Maha et al. (2013) study was to determine the impact of government expenditure and revenue on public debt in Greece by using the VECM (vector error correction model) and the VAR model (vector autoregression) while using data from 1976 till 2011. The VECM results showed that gross national expenditure, gross national income, inflation and net FDI have a significant impact on public debt in Greece.

Pirtea et al. (2013) analysed those factors that have an impact on the debt-to-GDP ratio in Romania. The authors found out that primary (fiscal) balance, real interest rate, real GDP growth rate and exchange rates are considered as significant factors. The same results may be observed in the study by Dumitrescu (2014). Veiga and Veiga (2014) suggest in their research that debt rate has an impact on revenue and expenditure structure, and a higher unemployment rate generates a higher debt. In this regard, Swamy (2015) used the panel Granger causality test and the author found out that real GDP growth, direct investments, government expenditures, inflation and population growth have a negative effect on debt. On the other hand, gross fixed capital formation, final consumption expenditure and trade openness positively influence a debt.

An empirical study by Galinski (2015) shows that public debt growth was significantly influenced by such variables which relate to the financial situation of public sector finance and local governments, including the cost of capital in Poland. On the other hand, since governments provide financial supports for businesses (Ključnikov et al., 2019; Ključnikov et al., 2021), microcredit organizations (Ključnikov et al., 2020a; Ključnikov et al., 2020b) government agencies (Durda & Ključnikov, 2019), investment banks (Civelek et al., 2021), financing systems (Gavurova et al., 2020), entrepreneurs (Ključnikov et al., 2020c) and educational institutions (Civelek et al., 2019; Žufan et al., 2020) by providing Government Loan Guarantees, Government Guaranteed Loans and Direct Government Loans (Civelek et al., 2020), the public debt might also grow.

Gargouri and Ksantini (2016) analysed 12 European countries from 2000 to 2014 by using the Panel-Corrected Standard Errors model. The results confirm the persistence of the dependant variable i.e., debt-to-GDP ratio. The authors also determined a positive impact of bank nonperforming loans, military expenditures and imports, and a negative influence of GDP growth and bank liquid reserves.

Belguith and Matosec (2016) analysed determinants of public debt in the new EU member states. The results showed that government balanced budget should

POLISH JOURNAL OF MANAGEMENT STUDIES
Toth P., Tkacova A., Gavurova B., Pechova V.

2022
Vol.25 No.1

decrease the public debt growth rate. Bader and Magableh (2009) and Awan et al. (2015) identify with this statement. In addition, the GDP growth rate had appeared to be significant, which is also expected by an economic theory that suggests the following: a higher economic growth should lower pressure on debt growth. The public debt growth rate is positively impacted by interest rates, government bonds and primary budget balance. Government expenditure related to the quarterly pre-election period generates public debt increase.

Agoraki et al. (2018) used comparative experiments in their publication to compare the sources of public debt changes in the countries of the European Periphery (Greece, Italy, Spain, Portugal, and Ireland), the European Core (Germany and France) and the G7 (Japan, the United Kingdom, Canada and the USA), The monitoring period was divided into two parts: 2000-2007 and 2008-2015. The study results proved that there was a positive dependency between primary deficit and public debt after a crisis, excluding Italy and Germany.

In this vein, Kudla (2018), considers, in his dynamic panel data econometric methodology, that the set of explanatory variables of public debt is: (a) variables that affect directly distinguished factors of spending, the ratio of interest payable, subsides, general government expenditures to the GDP; (b) social conditions of the economy, such as unemployment rate, ratio of social security expenditure to total government expenditure and population growth; (c) attractiveness of the economy to foreigners partners, net foreign direct investment (FDI) inflow, stock of FDI in the economy, openness factor−(Export + import)/GDP. Similarly think Hašková, Volf and Machová (2019).

Briceño and Perote (2020) developed an integrated perspective based on financial, social, and governance-related and/or institutional factors. The authors suggest that economic growth, interest rate, life expectancy at birth, unemployment, efficiency in government and the last sovereign debt crisis has become the main determinants of its development over the last two decades according to the authors' dynamic econometric evaluation that was tested on the Eurozone countries.

Multiple other important factors have an impact on public debt apart from those macroeconomic variables that significantly influence it. The studies by Lavigne, (2011), Elgina and Urasa (2013), González-Fernández and González-Velasco (2014), Cooray et al. (2017) deal with an effect of corruption, shadow economy and political instability on public debt rate. The research proves that all these factors have a positive effect on the level of public debt. Hence, these factors deepen public debt. Similarly, the level of political instability and political polarization in a country may have an impact on the level of public debt. At present, population ageing, which puts considerable pressure on public expenditure growth and public debt growth in two ways i.e., by health spending growth related to age and by public expenditure growth on pensions, represents a significant problem (Creel et al., 2012; Novák et al. 2016; Gavurová et al. 2021). It also deepens a decline in population growth that could worsen the government budget and could deepen public debt (Tsuchiya, 2016, Coccia, 2017). However, Lee (2018) proved, when analysing dynamic panel data,

that increasing public debt in the OECD countries may not be related to social expenditure.

Based on the previous studies, it is hypothesized that public debt is affected by the current account balance of payments, government budget balance, inflation rate, unemployment rate, purchasing power parity, GDP growth, budget expenditures, revenue budget, government investment, and population density.

Research Methodology

The main aim of this article is to identify the effect of selected variables on the level of public debt rate in the EU countries using econometric methods.

Gross government debt is analysed as % of GDP, hereinafter referred to as 'public debt'. Also, ten econometric variables, selected according to examined scientific studies, are analysed. All EU member states (including the United Kingdom) are monitored from 1999 to 2019. The research uses data from the Eurostat database and the World Bank database.

Table 1 shows selected explanatory variables, the study based on which a variable was selected, and also the expected cause of an explanatory variable on an explanatory variable, public debt.

Table 1. Explanatory Variables.

Variable	Abbreviation	Unit	Study	Expected Cause on Public Debt
Current Account Balance of Payments	CA	% of GDP	Sinha et al. (2011)	-
Government Budget Balance (Deficit/Surplus)	D/S	% of GDP	Agorakiho et al. (2018), Awana et al. (2015) and Badera and Magablehu (2009)	-
Inflation Rate	INFL	Average Annual Rate of Change (%)	Sinha et al. (2011), Reinharta et al. (2015)	+/−
Unemployment Rate	UN	% of the total labour force	Akhmadeeva et al. (2018)	+
Purchasing Power Parity	PPP	National Currency in the U.S. dollar	Badera and Magableha (2009), Alema (2019) and Awana et al. (2015)	+

GDP Growth	GDP	%	Sinha et al. (2011), Agorakiho et al. (2018)	-
Budget Expenditures	EXP	% of GDP	Sinha et al. (2011), Maha et al. (2013), Cooray et al. (2017)	+
Revenue Budget	REV	% of GDP	Agorakiho et al. (2018), Awana et al. (2015) and Badera and Magablehu (2009)	-
Gross Fixed Capital Formation/General Government Investments	INVEST	% of GDP	Coccia (2017)	-
Population Density	POPDENSITY	Number of persons per km2	Sinha et al. (2011)	-

Source: Own compilation.

A panel regression model is applied to analyse the impact of selected variables on public debt. The general model of panel regression is given by an equation (1), while $DEBT_{it}$ means the public debt ratio of a country (i) at the time (t) to GDP:

$$DEBT_{it} = \beta_0 + \beta_1 CA_{it} + \beta_2 D/S_{it} +$$
$$\beta_3 INVEST_{it} + \beta_4 INFL_{it} + \beta_6 GDP_{it} + \beta_7 PPP_{it} +$$
$$+ \beta_8 POPDENSITY_{it} + \beta_9 EXP_{it} + \beta_{10} REV_{it} + u_{it} , \qquad (1)$$

where:
$DEBT_{it}$ - explanatory (dependant) variable,
CA_{it}, D/S_{it}, $INVEST_{it}$, $INFL_{it}$, UN_{it}, GDP_{it}, PPP_{it}, $POPDENSITY_{it}$, EXP_{it}, REV_{it} – explanatory (independent) variables,
β_{0-10} – regression coefficients,
u_{it} – random component, or white noise and/or model error.

There are estimated three linear panel models: fixed effects model (FEM), random effects model (REM), and pooling model (PM). In the first step, there are applied tests to decide whether individual or time effects are significant in the model. The Lagrange multiplier test is applied to test it (Baltagi & Liu, 2008). In the next step, it is necessary to test conditions of use of the ordinal least square method for model estimation. Stationarity is tested by the Maddala-Wu test with a null hypothesis of non-stationarity (Fleissig & Strauss (2001). To test the existence of heteroskedasticity, the Breusch-Pagan test is used (Haas et al. (2004). Serial correlation is tested by the Wooldridge test (Drukker, (2003). Cross-section dependence is tested by Pesaran's CD test (Torres-Reyna, 2007). Existence of the

2022
Vol.25 No.1

POLISH JOURNAL OF MANAGEMENT STUDIES
Toth P., Tkacova A., Gavurova B., Pechova V.

multicollinearity is studied by the Variance Inflation Factor (VIF) (Bido et al. (2015). If conditions are not met, the robust covariance matrix estimation is applied (Yaffee, 2003). The suitability of the model specification is tested by the F-test (Goodpaster & Kennedy, 2011).

The Pool-test, the Hausman test and the coefficient of determination R^2 are used to decide which estimated linear panel model is the most appropriate. The null hypothesis of the Pool-test states that coefficients for all individuals are the same. It means that the PM represents the most appropriate data (Remolona et al., 2008), Wang et al. (2019), Croissant and Millo (2008). The Hausman test examines whether a model with fixed or random effects is more appropriate (Yaffee, 2003). Public debt in EU countries represents an explanatory (dependent) variable in the paper's analysis. Its development during the monitored period of 1999-2019 was not the same for all the countries. The debt of the individual EU countries has significantly changed over the last two decades.

As the Eurostat data for the year 1999 indicate, Belgium achieved the highest value of public debt, i.e., 115.40 % of GDP. Next, there was Italy with a value of 113.30 % of GDP. The following countries were indebted the least: the Baltic countries, Luxembourg, Romania, Slovenia, and the Czech Republic. On the other hand, these countries had the worst level of public debt at the end of the monitored period: Greece, Portugal, Italy, Spain, France, Croatia, the United Kingdom, Cyprus, and Finland. Improvement of public debt value in time t may be observed only in six countries, namely Bulgaria, Denmark, Belgium, Malta, Sweden, Germany, and the Netherlands. Major public debt reduction to GDP ratio was evident in Bulgaria (54.9% GDP) at the end of the monitored period as opposed to the year 1999. On contrary, a major public debt increase to GDP ratio was achieved in Greece (77.70% of GDP). Similarly, Greece registered the highest level of public debt (176.60% of GDP) in 2019. Generally, the maximum level of countries' debt has been increased by 61.20% of GDP during the past 20 years. It is supposed that countries of Northern and Eastern Europe are less indebted than countries of Southern and Western Europe. Also, variability, which represents countries' abilities to manage public debt, is very important, including the value of public debt itself. Figure 1 illustrates the variability of EU countries' public debt.
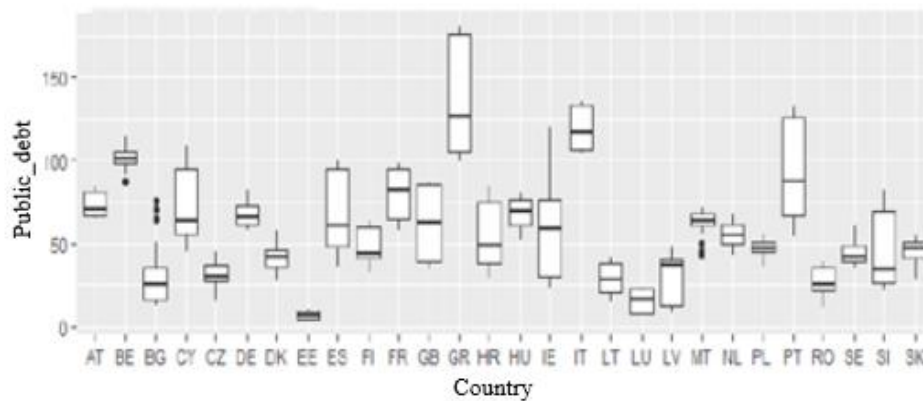
Figure 1: Boxplots of public debt as an indicator with individual countries during the years 1999-2019 (in % of GDP).
Source: Own compilation according to Eurostat (R Studio output)

Greece (GR) achieved the highest value of public debt variability as the public debt boxplot of a particular country has the largest range, i.e., the minimum is at the level of 98.90 % of GDP and the maximum is at the level of 181.20 % of GDP. High values of public debt boxplot, in the case of Greece, confirmed that the country has long-term problems with public debt. Similarly, the highest value of public debt variability showed that Greece has a low level of public debt management. On the other hand, Estonia (EE) reached the lowest value of public debt variability as the public debt boxplot, in the case of Estonia, showed the smallest possible range. The minimum is at the level of 3.80 % of GDP and the maximum is at the level of 10.60 % of GDP. Estonia represents a stable economy as the lowest value of public debt variability confirmed. Even during the crisis period in 2008, the country's public debt slightly increased. Also, low values of public debt boxplot, in the case of Estonia, showed a high level of public debt management in the country.

Firstly, econometric models, which included all ten explanatory variables illustrated in Table 1, were analysed. Then, a correlation matrix of explanatory variables was created. It showed that there exists a strong positive correlation between *REV* variables (revenue budget) and *EXP* variables (budget expenditures) as the correlation coefficient value between these two variables is 0.85. Table 2 shows strong multicollinearity in the model and VIF function output.

Table 2. VIF Function Output – Original Econometric Model.

Variable	CA	D/S	INVEST	INFL	UN
VIF Value	1.635	4182.531	1.133	1.139	1.1301
Variable	**GDP**	**PPP**	**Δ POPDENSITY**	**EXP**	**REV**
VIF Value	1.452	1.084	1.062	14080.888	14621.313

Source: Own compilation.

There are three explanatory variables with significantly higher values of VIF as the permissible value of 5 suggested by Bido et al. (2015) in Table 2. The model has strong multicollinearity, which is caused by the *REV* variable (revenue budget). *REV* variable was removed from the model.

Table 3 displays p-values and t-statistics of estimated models.

Table 3. P-Values Comparison of Econometric Models' Variables.

	Fixed Effects Model	Random Effects Model	Pooling Model
CA	<0.001 ***	<0.001 ***	0.002 **
D/S	<0.001 ***	0.007 **	<0.001 ***
INVEST	<0.001***	<0.001 ***	<0.001 ***
INFL	0.010 *	<0.001 ***	<0.001 ***
UN	<0.001***	<0.001 ***	<0.001 ***
GDP	0.025 *	0.854	0.297
PPP	0.668	0.404	0.416
Δ POPDENSITY	0.061	0.788 .	0.051 .
EXP	<0.001***	<0.001 ***	<0.001 ***
F-test	65.889(<0.001)	464.650 (<0.001)	61.537 (<0.001)
R2	0.515	0.446	0.489

Source: Own compilation.
Note: Explanatory Footnotes: Symbol * illustrates a statistical significance of regression coefficient that relates to individual explanatory variables on a particular level of significance, while the following symbols mean: *** 0.001; ** 0.01; * 0.05 and . 0.10. The lower part of Table 3 displays the testing results of a statistical significance of panel regression models, where F-statistics and relevant p-value in brackets are provided. R2 represents a determination coefficient.

It may be concluded that all three models are statistically significant based on the results provided in Table 3. The Pool Test and panel regression tests were done to identify the most appropriate model. Table 4 provides the results of these tests.

Table 4. Panel Regression Tests.

Statistical Tests		Testing Statistics	P-Value
Pool Test		9.312	<0.001
Hausman Test		59.240	<0.001
Maddala and Wu Panel Unit Root Tests	**CA**	131.800	<0.001
	D/S	142.030	<0.001
	INVEST	117.020	<0.001

	INFL	206.510	<0.001
	UN	129.550	<0.001
	GDP	297.210	<0.001
	PPP	103.254	<0.001
	POPDENSITY	58.997	0.367
	Δ POPDENSITY (a year-on-year change)	216.620	<0.001
	EXP	141.700	<0.001
	REV	118.940	<0.001
	DEBT	93.562	<0.001

Source: Own compilation.

The Pool Test showed that the panel analysis is appropriate rather than simple linear regression. Subsequently, the Hausman Test identified the fixed effects model as the most appropriate model.

The Maddala and Wu Panel Unit Root test demonstrated that data are stationary except for the population density variable. This variable was recalculated per year-on-year change, which led to its subsequent stationarity.

The fixed effects model is the most appropriate model based on the given tests. Table 5 shows an overview of panel regression statistical tests that were used to test the fixed effects model.

Table 5. Panel Regression Tests of the Fixed Effects Model.

Statistical Tests		Testing Statistics	P-Value
Lagrange Multiplier Test	Time Effects	43.431	<0.001
	Individual Effects	7.665	<0.001
	Bilateral Effects	36.131	<0.001
Wooldridge Test		2.193	0.028
Pesaran's CD Test		3.482	<0.001
Breusch-Pagan Test		106.91	<0.001

Source: Own compilation.

It may be stated, based on the results, that examined time, individual and two-way effects are significant from a panel structure point of view (the Lagrange Multiplier Test). There also appears the autocorrelation of the first order in the fixed effects model (the Wooldridge Test), the cross-sectional correlation (the Pesaran's CD Test) and the problem of heteroskedasticity (the Breusch-Pagan Test).

Table 6 provides VIF in a transformed mode.

Table 6. VIF Function Outputs – Transformed Econometric Model.

Variable	CA	D/S	INVEST	INFL	UN
VIF Value	1.635	1.702	1.132	1.139	1.299
Variable	**GDP**	**PPP**	**Δ POPDENSITY**	**EXP**	
VIF Value	1.452	1.081	1.062	1.549	

Source: Own compilation.

Table 6 shows that VIF values are lower than the permissible value of 5 in all the explanatory variables and even lower than the value of 2 (Bido et al. 2015). There also should not appear any problem related to a strong level of multicollinearity in the suggested model.

There were determined issues in autocorrelation, cross-sectional correlation and heteroskedasticity in testing the assumptions of the panel regression model. These issues could not have been resolved even by a model transformation by first differences. Then, the model equation had been divided by a variable that most probably caused heteroskedasticity (*UN* – unemployment rate). However, the problem still had not been resolved. Consequently, the model is estimated by the robust-variance-covariance matrix and Table 7 provides its results.

Table 7. Robust Estimation Method for the Fixed Effects Model.

	Regression Coefficient	Standard Error	T-Statistics	P-Value
CA	-1.103	0.448	-2.462	0.014 *
D/S	-1.929	0.709	-2.722	0.007 **
INVEST	-12.159	2.402	-5.061	<0.001 ***
INFL	-0.748	0.448	-1.672	0.095
UN	1.147	0.875	1.311	0.190
GDP	-0.944	0.524	-1.801	0.072
PPP	0.018	0.048	0.371	0.711
ΔPOPDENSITY	0.950	0.480	1.981	0.048 *
EXP	2.056	0.537	3.830	<0.001 ***

Source: Own compilation.

Estimation of regression coefficient β in unemployment rate variable (UN) had been wrongly marked as statistically significant and its statistical significance was caused by heteroskedasticity, autocorrelation and cross-sectional correlation based on a comparison of the fixed effects model's output (Table 3) with robust estimation of fixed effects model (Table7). Thus, it is appropriate to use the results of the robust estimation in such a case.

The robust variation-covariation matrix output identified five independent (explanatory) variables in 5 % of the significance level of α to determine a statistical significance. Statistical significance was found out in seven explanatory variables

POLISH JOURNAL OF MANAGEMENT STUDIES
Toth P., Tkacova A., Gavurova B., Pechova V.

2022
Vol.25 No.1

for 10 % of the significance level of α. Public debt determinants are, according to some regression coefficients' β estimations, the following variables: current account balance of payments (CA), government budget balance (Deficit/Surplus) (D/S), government investments (INVEST), inflation rate (INFL), GDP growth (GDP), year-on-year change of population density (Δ POPDENSITY) and budget expenditures (EXP).

It is possible to interpret regression coefficients of statistically significant explanatory variables (while maintaining other variables) as follows:

- **ß1**: if current account balance of payments increases by 1 % of GDP, public debt decreases by 1.10 % of GDP,

- **ß2**: if budget balance increases by 1 % of GDP, public debt value decreases by 1.93 % of GDP,

- **ß3**: if state investments increase by 1 % of GDP, public debt decreases by 12.16 % of GDP,

- **ß4**: if inflation rate increases by 1% of GDP, public debt level decreases by 0.75 % of GDP,

- **ß6**: if economic growth (GDP growth) increases by 1 % of GDP, public debt decreases by 0.94 % of GDP,

- **ß8**: if a year-on-year change of population density increases by 1 %, public debt value increases by 0.95 % of GDP,

- **ß9**: if budget expenditures increase by 1 % of GDP, public debt value increases by 2.06 % of GDP.

Discussion

Table 8 presents the robust estimation results of the fixed effects model, that was created by the authors, which were compared with assumptions of previous scientific studies.

Table 8. Comparison of Assumptions and Robust Fixed Effects Model Results

	Assumed Impact on Public Debt	Robust Estimation of Fixed Effects Model	
		Final Impact	**P-Value**
CA	-	-	0.014 *
D/S	-	-	0.007 **
INVEST	-	-	<0.001 ***
INFL	-/+	-	0.095 .
UN	+	+	0.190
GDP	-	-	0.072 .
PPP	+	+	0.711
ΔPOPDENSITY	-	+	0.048 *
EXP	+	+	<0.001 ***

Source: Own compilation

Note: Explanatory Footnotes: Symbol * illustrates a statistical significance of regression coefficient that relates to individual explanatory variables on a particular level of significance, while the following symbols mean: *** 0.001; ** 0.01; * 0.05 and . 0.10. Minus sign (−) means that given variable lowers public debt level to GDP and vice versa, plus sign (+) means that given variable increases public debt level in relation to GDP.

The authors determined that growth of current account balance of payments (*CA*), and hence, reporting of current account surplus, causes public debt reduction. The results of the study by Sinha et al. (2011) made similar conclusions. The model's results showed, in terms of government budget balance (deficit/surplus) (*D/S*), what achieving a budget surplus via revenue budget means. Hence, the public debt level reduces once a restrictive fiscal policy is applied. Similar conclusions were made in the studies by the authors, such as Agoraki et al. (2018), Awana et al. (2015), and Badera and Magableh (2009).

There is evident a positive dependency between a variable and public debt in the case of budget expenditures (EXP). Consequently, public debt is increased, once an expansionary fiscal policy is applied and hence, budget expenditures are increased. The same results may be observed in the studies by Sinha et al. (2011), Maha et al. (2013) and Cooray et al. (2017). In EU countries, the problem of the budget expenditures' growth lies especially in the expenditures on social transfers and the pension system in relation to fast population ageing.

Public debt reduction is also caused by state investments' growth, which is displayed by investments variable (*INVEST*). These are productive investments that support the economic growth of a country and subsequently, they reduce public debt. Public investments had the greatest impact on public debt reduction out of all monitored variables.

The research results showed that there is a negative dependency between GDP growth (*GDP*) and public debt. It means that GDP growth causes public debt reduction. Sinha et al. (2011) and Agoraki et al. (2018) provide the same conclusions in their studies. The given result shows that public debt is expressed in relation to GDP and denominator increase – GDP lowers public debt.

Different impacts on public debt had been noticed in the results of multiple studies in the case of inflation (*INFL*). The results of the study by Sinha et al. (2011) showed that a rise in inflation causes public debt reduction. On contrary, the results of the studies by Maha et al. (2013), Cooray et al. (2017) and Agoraki et al. (2018) revealed that a rise in inflation leads to public debt growth. It may be related to a theory by Arjomanda et al. (2016), which states that macroeconomic factors have an impact on the size of the budget deficit. The research results of this paper showed that there is a negative dependency between inflation and public debt. Hence, public debt reduction is caused by inflation growth in EU countries. The same results are provided in the study by Sinha et al. (2011). The results of this paper are by the theory by Reinharta et al. (2015), where the authors state that if domestic currency denominates public debt, then inflation may significantly reduce public debt.

POLISH JOURNAL OF MANAGEMENT STUDIES
Toth P., Tkacova A., Gavurova B., Pechova V.

2022
Vol.25 No.1

However, it is related to a reduction of the fair value of public debt and not to its nominal value. Thus, inflation reduces the value of the debtor's debt, in this case, it reduces the value of a state's public debt, as the state represents the debtor.

The model's results showed, in the case of year-on-year change of population density (Δ POPDENSITY), that public debt increases with an increasing year-on-year change of population density. However, different conclusions may be observed in the study by Sinha et al. (2011). The authors state that the growth of population density causes public debt reduction. In the case of this paper, there was observed an unusual relation between year-on-year change of population density and public debt. This finding may be related to a fact that the authors examined countries all over the world from 1980 to 2008 when overall population density was lower. Also, another reason may be that population density depends on certain particularities of a country, for instance, on a geographical location of a country, etc. Finland has a strong economy, but the lowest population density, as many citizens mostly live in the south of the country since a quarter of Finnish territory lies beyond the Arctic Circle. Consequently, this indicator may misrepresent the results. Thus, it does not mean that if population density grows, public debt reduces.

The research results showed that there is a positive dependency between the unemployment rate (UN) and public debt. Hence, unemployment rate growth leads to public debt growth. Similar results are also presented in the study by Akhmadeeva et al. (2018). However, this variable does not have a significant impact. Therefore, it cannot be considered a significant determinant of public debt. A similar case is that of purchasing power parity (PPP) variable, which is a part of the model. However, this variable had not been analysed in any of the selected studies. It was selected as a substitute for the exchange rate that was a part of the scientific studies by Badera and Magableha (2009), Alema (2019) and Awana et al. (2015). Purchase power parity means the price level ratio of two states, and it is considered as a theoretical currency exchange rate of particular states. The paper's results showed that there is a positive dependency between purchase power parity and public debt. It means that purchase power parity growth causes public debt growth. This is in line with the assumptions of the authors who wrote this paper as purchase power parity increase represents an appreciation of domestic currency that leads to a higher price of domestic products and their smaller export. And vice versa, it led to a larger import of cheaper foreign products that subsequently causes a deficit of current account balance of payments and public debt increase. However, it is not possible to consider this variable as a cause of public debt creation due to its insignificant impact.

Conclusion

Generally, EU countries have been struggling with public debts for many years. These countries create a deficit, which deepens this issue, despite a favourable economic situation. Economic recession, and/or crisis, and absence of reserves for rainy days lead these countries to deeper indebtedness for future generations. The analysis confirms that such countries as Greece, Italy, Portugal, and even France and

2022
Vol.25 No.1

POLISH JOURNAL OF MANAGEMENT STUDIES
Toth P., Tkacova A., Gavurova B., Pechova V.

the United Kingdom dealt with a large debt from 1999 to 2019. Both, debt size and variability, which indicates bad debt management, represent a significant problem. Consequently, the countries should be aware of the basic factors that significantly influence the level of public debt and help to reduce it.

Many scientific studies deal with this topic and in this article, they helped to define public debt determinants and to make the following conclusions. The value growth of such variables as current account balance of payments, budget balance, public investments, inflation rate and GDP growth leads to public debt reduction in EU countries. However, the value growth of such variables as a year-on-year change of population density and budget expenditures lead to public debt growth.

It may be assumed that fiscal consolidation may reduce the level of public debts in EU countries. It is necessary to especially focus on the size and structure of public expenditures. Also, macroeconomic variables influence the level of public debt. Public investments represent a significant determinant of public debt as they have the greatest impact on the level of public debt in EU countries according to this study. These pro-growth-oriented investments may more significantly reduce the level of public debt rather than those unpopular budget changes, or GDP growth.

Acknowledgement

References

Afonso, A., Jalle S, J., (2011). *Measuring of Success of Fiscal Consolidations.* Universidate Técnica de Lisboa. Working Paper No. 22/2011.

Agoraki, M.-E. K., Kardara, S., Kollintzas, T. And Kouretas, G.P., (2018). Debt-to-GDP Changes and the Great Recession: European Periphery versus European Core. *The 17th Conference on Research on Economic Theory and Econometrics*, July 13-17, Tinos, Greece.

Alesina, A., Favero, C. and Giavazzi, F., (2012). *The Output Effect of Fiscal Consolidations.* National Bureau of Economic Research. Cambridge Working Paper No. 18336.

Awan, R. U., Anjum, A. and Rahim, S., (2015). An econometric analysis of determinants of external debt in Pakistan. *British Journal of Economics, Management & Trade*, 5(4), 382 – 391.

Bader, M, Magableh, I. K., (2009). An enquiry into the main determinants of public debt in Jordan: An econometric study. *Dirasat, Administrative Sciences, 36*(1), 181 – 190.

Baltagi, B. H., Liu, L., (2008). Testing for random effects and spatial lag dependence in panel data models. *Statistics & Probability Letters*. *78*(102), 1 – 18.

POLISH JOURNAL OF MANAGEMENT STUDIES
Toth P., Tkacova A., Gavurova B., Pechova V.

2022
Vol.25 No.1

Bido, D., da Silva, D. and Ringle, C., (2015). Structural equation modeling with the SmartPLS. *Brazilian Journal of Marketing*, *13*(2), 1-18.

Checherita, C., Rother, P., (2010). *The Impact of High and Growing Government Debt on Economic Growth - an Empirical Investigation for the Euro Area.* ECB. Working Paper No. 1237.

Civelek, M., Gajdka, K., Světlík, J. and Vavrečka, V., (2020). Differences in the usage of online marketing and social media tools: evidence from Czech, Slovakian and Hungarian SMEs. Equilibrium. *Quarterly Journal of Economics and Economic Policy*, *15*(3), 537–563.

Civelek, M., Ključnikov, A., Fialova, V., Folvarčná, A. and Stoch, M., (2021). How innovativeness of family-owned SMEs differ depending on their characteristics? *Equilibrium. Quarterly Journal of Economics and Economic Policy*, *16*(2), 413–428.

Civelek, M., Ključnikov, A., Krajčík, V. and Žufan, J., (2019). The Importance of Discount Rate and Trustfulness of a Local Currency for the Development of Local Tourism. *Journal of Tourism and Services*, *10*(19), 77-92.

Cooray, A. Dzhumashev, R. and Scneider, F., (2017). How Does Corruption Affect Public Debt? An Empirical Analysis, *World Development*, *90*, 112-127.

Creel, J., Sterdyniak, H., (2012). *Faut-il réduire la dette publique ?* Lettre de l'OFCE, Paris, France.

Croissant, Y., Millo, G., (2008). Panel data econometrics in R: The plm package. *Journal of statistical software*, *27*(2), 1 – 43.

Drazen, A., (2000). *Political economy in macroeconomics*, Princeton: Princeton University Press

Drukker, D. M., (2003). Testing for serial correlation in linear panel-data models. *The Stata journal, 3*(2), 168 – 177.

Dumitrescu, B.A., (2014). The public debt in Romania factors of influence, scenarios for the future and a sustainability analysis considering both a finite and infinite time horizon. *Procedia Economics and Finance*, *8*, 283-292.

Durda, L., Ključnikov, A., (2019). Social networks in entrepreneurial startups development. *Economics and Sociology*, *12*(3), 192-208.

Dvorský, J., Čepel, M., Kotásková, A. and Bugánová, K., (2021). Differences in business risk effects on the future of SMEs due to Covid-19 pandemic. *International Journal of Entrepreneurial Knowledge*, *9*(2), 14-31.

Elhorst, J. P., (2014). *Spatial Panel Data Models*. Spatial Econometrics. SpringerBriefs in Regional Science. Springer, Berlin, Heidelberg.

Fernández, F., Hernández, P., (2006). *The Economic Effects of Exogenous Fiscal Shocks in Spain. European Central Bank*. Working Paper No. 647.

Fleissig, A., Strauss, J., (2001). Panel unit-root tests of OECD stochastic convergence. Review of International Economics, *9*(1), 153 – 162.

Galinski, P., (2015). Determinants of debt limits in local governments: Case of Poland, Procedia, *Social and Behavioral Sciences*, *213*, 376-382.

Gargouri, I., Ksantini, M., (2016). The Determinants of Public Debt. *The Romanian Economic Journal*. 18 (59), 111-124.

Gavurová, B., Belás, J., Rowland, Z. and Kubák, M., (2021). The impact of agreement on government procurement use on the competition in Slovak healthcare sector. *Administratie si Management Public*, *36*, 102-115.

Gavurová, B., Ivanková, V., Rigelsky, M. and Přívarová, M., (2020). Relations Between Tourism Spending and Global Competitiveness –an Empirical Study in Developed OECD Countries. *Journal of Tourism and Services*, *21*(11), 38-54.

Goodpaster, A. M., Kennedy, M. A., (2011). Quantification and statistical significance analysis of group separation in NMR-based metabonomics studies. *Chemometrics and Intelligent Laboratory Systems*, *109*(2), 162 – 170.

Guichard, S., Kennedy, M., Wurzel, E. & André, Ch., (2007). *What Promotes Fiscal Consolidation: OECD Country Experiences*. OECD Economic Department. Working Papers No. 553.

Haas, M., Mittik, S. and Paolella. M.S., (2004). Mixed normal conditional heteroskedasticity. *Journal of Financial Econometrics*, *2*(2), 211 – 250.

Hasanov, F., Cherif, R., (2012). *Public Debt Dynamics: The Effects of Austerity, Inflation, and Growth Shocks.* International Monetary Fund. Working Paper WP/12/230.

Hašková, S., Volf, P. and Machová, V., (2019). Economic convergence of Czech regions in terms of GDP and unemployment rate in response to FDI flows: Do businesses and regions flourish? *Journal of interdisciplinary research*, *9*(1), 326-329.

Hernán R., B., Perote, J., (2020). Determinants of the Public Debt in the Eurozone and Its Sustainability Amid the Covid-19 Pandemic. *Sustainability, 12*(16), 6456.

Hsiao, Ch., (2003). *Analysis of panel data.* Cambridge University Press. Cambridge, UK.

Imbeau, L.M., Pe´try, F., (2004). *Politics, Institutions, and Fiscal Policy: Deficits and Surpluses in Federated States*. Lanham, MD: Lexington Books

Ključnikov, A., Civelek, M., Čech, P. and Kloudová, J., (2019). Entrepreneurial orientation of SMEs' executives in the comparative perspective for Czechia and Turkey. *Oeconomia Copernicana*, *10*(4), 773–795.

Ključnikov, A., Civelek, M., Fialova, V. and Folvarčná, A., (2021). Organizational, local, and global innovativeness of family-owned SMEs depending on firm-individual level characteris tics: evidence from the Czech Republic. Equilibrium. *Quarterly Journal of Economics and Economic Policy*, *16*(1), 169–184.

Ključnikov, A., Civelek, M., Krajčík, V. and Ondrejmišková, I., (2020b). Innovative Regional Development of the Structurally Disadvantaged Industrial Region by the Means of the Local Currency. *Acta Montanistica Slovaca*, *25*(2), 224-235.

Ključnikov, A., Civelek, M., Polách, J., Mikoláš, Z. and Banot, M., (2020a). How do security and benefits instill trustworthiness of a digital local currency? *Oeconomia Copernicana*, *11*(3), 433–465.

Ključnikov, A., Civelek, M., Vozňáková, I. and Krajčík, V., (2020c). Can discounts ex pand local and digital currency awareness of individuals depending on their characteristics? *Oeconomia Copernicana*, *11*(2), 239–266.

Kolková, A., Ključnikov, A., (2021). Demand forecasting: an alternative approach based on technical indicator Pbands. *Oeconomia Copernicana*, *12*(4), 863–894.

Lavigne, R., (2011). The political and institutional determinants of fiscal adjustment: Entering and exiting fiscal distress, European. *Journal of Political Economy*, *27*(1), 17-35.

Lee, I., (2018). Is Social Expenditure Responsible for Recent Rise in Public Debt in OECD Countries? *Applied Economics Letters, 25*, 43–46.

Liu, Z., Lyu, J., (2020). Public debt and economic growth: Threshold effect and its influence factors. *Applied Economics Letters, 28*, 208-212.

POLISH JOURNAL OF MANAGEMENT STUDIES
Toth P., Tkacova A., Gavurova B., Pechova V.

**2022
Vol.25 No.1**

Mencinger, J., Aristovnik, A. and Verbič, M., (2014). The Impact of Growing Public Debt on Economic Growth in the European Union. *Amfiteatru Economics*, *35*, 403–414.

Novák, V., Vokoun, M., Stellner, F. and Vochozka, M., (2016). Institutional analysis of the contemporary regional labour market in the Czech Republic. *E+M Ekonomie a Management*, *19*(3), 4-15.

Ochotnický, P, Jankech, P., (2020). Úspešné koncepty politiky redukcie verejných dlhov po kríze. *Politická ekonomie*, *68*(2), 168–193.

Pankaj, S., Varun, A. & Vishakha, B., (2011). *Determinants of Public Debt for middle income and high income group countries using Panel Data regression.* MPRA Paper No. 32079.

Pirtea, M.G., Nicolescu, A.C. and Mota, P.R., (2013). An empirical study on public debt's determinants: evidence from Romania. *Transylvanian Review of Administrative Sciences*, *38*, 144-157.

Reinhart, C. M., Reinhart, V. and Rogoff, K. S., (2015). Dealing with Debt. *Journal of International Economics*, *96*, 43–55.

Reinhart, C. M., Rogoff, K. S., (2009). *The Aftermath of Financial Crises*. National Bureau of Economic Research. Cambridge M.A. Working Paper No. 14656,

Reinhart, C. M., Rogoff, K. S., (2010). *Growth in a Time of Debt*. National Bureau of Economic Research. Cambridge M.A. Working Paper No. 15639,

Remolona, E., Scatinga, M. and Wu, E., (2018). The dynamic pricing of sovereign risk in emerging markets: Fundamentals and risk aversion. *The Journal of Fixed Income*, *17*(4), 57 – 71.

Rousek, P., Vochozka, M. and Psárská, M., (2019). Analysis of the consumption on the goods and services market in the cybernetic model of the 15 older EU member states, *Journal of interdisciplinary research*, *9*(1), 252-254.

Rybáček, V., (2018). The Size of Government in Empirical Research: A Case Study from the Czech Republic. *Littera Scripta*, *11*(2), 141-154.

Sinha, P, Arora, V. & Bansal, V., (2011). *Determinants of Public Debt for middle income and high income group countries using Panel Data regression*, Munich Personal Repec Archive (MPRA Paper, No. 32079).

Swamy, V., (2015). *Government Debt and its Macroeconomic Determinants*. An Empirical Investigation, Munich Personal Repec Archive (MPRA Paper, No. 64106).

Swaray, R.B., (2005). Primary Commodity Dependence and Debt Problem in Less Developed Countries, *Applied Econometrics and International Development*. 5(4), 1-12.

Torres-Reyna, O., (2007). Panel data analysis. Fixed and Random Effects using Stata. (v. 4.2). Data & Statistical Services, Priceton University.

Veiga, L.G., Veiga, F. J., (2014). *Determinants of Portuguese local governments' indebtedness.* NIPE Working Paper, 16/2014.

Vrbka, J., (2016). Predicting Future GDP Development by Means of Artificial Intelligence. *Littera Scripta, 9*(3), 154-167.

Wang, W., Zhang, X. and Paap, R., (2019). To pool or not to pool: What is a good strategy for parameter estimation and forecasting in panel regressions? *In Journal of Applied Econometrics*. *34*(5), 724 – 745.

Yaffee, R., (2003). A primer for panel data analysis. Social Sciences, Statistics and Mapping, New York University. 1 – 11.

Žufan, J., Civelek, M., Hamarneh, I. and Kmeco, Ľ., (2020). The Impacts of Firm Characteristics on Social Media Usage of SMEs: Evidence from the Czech Republic. *International Journal of Entrepreneurial Knowledge*, 8(1), 102-113.

DETERMINANTY DŁUGU PUBLICZNEGO W KRAJACH UE

Streszczenie: W związku z pandemią Covid-19 rządy muszą wspierać swoją gospodarkę, aby zapobiec ewentualnej recesji, która doprowadzi do wzrostu długu publicznego. Dlatego konieczna jest znajomość ważnych determinant długu publicznego. Artykuł zawiera analizę determinant długu publicznego. Głównym celem artykułu jest identyfikacja wpływu poszczególnych zmiennych na poziom długu publicznego w krajach UE za pomocą metod ekonometrycznych. Artykuł analizuje badania, które koncentrują się na determinantach długu publicznego i definiuje dziesięć podstawowych zmiennych niezależnych (objaśniających). Panelowy model regresji danych służy do monitorowania wpływu tych zmiennych na zmienną niezależną – dług publiczny, natomiast wykorzystuje dane z lat 1999-2019. Wyniki modelu pokazują, że wzrost zmiennych, takich jak bilans płatniczy obrotów bieżących, saldo budżetowe , inwestycje administracji publicznej, inflacja i wzrost PKB prowadzą do redukcji długu publicznego w krajach UE. Z drugiej strony wzrost zmiennych, takich jak roczna zmiana gęstości zaludnienia i wydatki budżetowe, prowadzi do wzrostu długu publicznego. Wpływ zarówno stopy bezrobocia, jak i parytetu siły nabywczej na dług publiczny jest, jak wynika z wyników badań, nieznaczny.

Słowa kluczowe: dług publiczny, determinanty długu publicznego, regresja panelowa, kraje UE.

欧盟国家公共债务的决定因素

摘要：由于 Covid-19 **大流行，政府必**须支持其经济，以防止可能导致公共债务增加的衰退。因此，有必要了解公共债务的重要决定因素。本文对公共债务的决定因素进行了分析。本文的主要目的是通过使用计量经济学方法确定特**定**变量对欧盟国家公共债务水平的影响。本文分析了关注公共债务决定因素的研究，并定义了十个基本独立（解释性）变量。面板数据回归模型用于监测这些变量对自变量——**公共**债务的影响，而它使用的是 1999 **年至** 2019 **年的数据。模型的**结果表明，经常项目国际收支、预算平衡等变量的增长、公共行政投资、通货膨胀率和 GDP **增**长，导致欧盟国家的公共债务减少。另一方面，年人口密度变化和预算支出等变量的增加导致公共债务增长。根据研究结果，失业率和购买力平价对公共债务的影响并不显着

关键词：公共债务，公共债务的决定因素，面**板回**归，欧盟国家