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Economic Research-Ekonomska Istraživanja

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/rero20

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To cite this article: Miloš Pjanić, Nada Milenković, Jelena Andrašić, Branimir Kalaš & Vera Mirović (2020) Public debt's predictors in EU: evidence from members and non-members of European Monetary Union, Economic Research-Ekonomska Istraživanja, 33:1, 3562-3579, DOI: 10.1080/1331677X.2020.1776137

To link to this article: https://doi.org/10.1080/1331677X.2020.1776137

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Published online: 24 Aug 2020.

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ECONOMIC RESEARCH-EKONOMSKA ISTRAŽIVANJA
2020, VOL. 33, NO. 1, 3562–3579
https://doi.org/10.1080/1331677X.2020.1776137

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Public debt's predictors in EU: evidence from members and non-members of European Monetary Union

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ABSTRACT

The global economic crisis destabilised the public debt of many countries. The purpose of this paper is to investigate the predictors of public debt in European Union countries divided into non-member countries and members of the European Monetary Union in the period from 2001 to 2018. The aim is to discover their relationship with public debt and make recommendations for economic policy-makers. The empirical analysis was based on comparative research design, quantitative methodology and secondary data collection. It included 13 variables, with public debt being the dependent variable and the selected 12 economic indicators were treated as predictors. The analysis was based on a procedure for linear mixed models in the IBM SPSS. The basic finding was that only unemployment was statistically significant predictor of public debt in both groups of countries. Other predictors differed, and there were statistically significant differences in the magnitude of their impacts. Obtained results indicate that unemployment is one of the most important problems of all European Union countries. In addition, a major challenge for monetary and fiscal policy-makers will be profiling adequate tax, credit, and interest rate policies to reduce debt and accelerate economic growth.

ARTICLE HISTORY
Received 9 July 2019
Accepted 26 May 2020

KEYWORDS
Public debt; European Union; European Monetary Union; longitudinal data; linear mixed procedure

JEL CODE
E62; G18; H10; H60; H63

1. Introduction

Public debt reduction is one of the key problems whose resolution is of great importance for future development of many countries (Kirchgässner, 2014). With the onset of the 2008 economic crisis, public debt to gross domestic product (GDP) averaged about 73% in the European Monetary Union (EMU), about 71% in the United States, with the largest amount in Japan, where public debt was more than 170% of GDP (Greiner, 2011). In recent decades, there has been an increase in inequality among and within countries, and a deepening of polarisation, leading to an increase in social, political and economic instability (Škare & Rabar, 2017).

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The subject of this paper is the relationship of selected economic indicators to public debt in the member states and non-members of the EMU in the period 2001 to 2018. In doing so, the primary objective of the research was to detect the statistically significant impact of the studied economic indicators on public debt. The primary objective of the research thus defined was realised on the examples of the countries of the EMU and other countries that are in the European Union (EU) but have not yet adopted the euro as their currency. The purpose of the pre-defined research subject and the primary objective of the research was to determine the correctness and make recommendations for economic policy makers. In addition, the experiences and practices of developed European countries were assumed to be very valuable to other non-EU countries in Europe as well as to other countries in the world.

Previous research focussed on determinants of public debt in single countries as well in various groups of countries. One group of authors deals with the analysis of predictors of public debt in members of OECD (Ogawa et al., 2016; Reinhart & Rogoff, 2010; Škare & Rabar, 2017). Another group of authors analyzes public debt in individual countries only (Spilioti & Vamvoukas, 2015; Neaime et al., 2018; Pirtea et al., 2013; Galinski, 2015; Karafolas & Alexandrakis, 2015). A third group of authors points to the large heterogeneity of debt in developed and developing countries (Simionescu, 2016; Ramzan & Ahmad, 2014; Okafor & Tyrowicz, 2009; Okafor & Tyrowicz, 2010; Spilioti & Vamvoukas, 2015; Alvarado et al., 2017). In addition, the most researched relationships are public debt relations with economic growth (Ono, 2019; Panizza & Presbitero, 2013; Mencinger et al., 2014; Reinhart & Rogoff, 2010; Baum et al., 2013; Ogawa et al., 2016), taxes and fiscal adjustment (Alcidi et al., 2016; Baldacci & Kumar, 2010; Gali & Perotti, 2003; Heinemann et al., 2014; Reinhart & Rogoff, 2009; Reinhart & Rogoff, 2011; Laeven & Valencia, 2018; Baunsgaard & Keen, 2005; Pirtea et al., 2013; Globan & Matosec, 2016), bank loans (Barrios et al., 2010; Jorda et al., 2016; Gourinchas & Obstfeld, 2012; Lane & Milesi-Ferretti, 2011; Lane, 2012; Schularick & Taylor, 2012; Schafer, 2012; Gargouri & Ksantini, 2016), unemployment (Ono, 2019; Hassan & Nassar, 2015; Karafolas & Alexandrakis, 2015; Marelli & Signorelli, 2015), and foreign direct investment (Onafowora & Owoye, 2019; Jimborean & Kelber, 2017; Swamy, 2015; Bayar & Sasmaz, 2019; Simionescu, 2016; Alvarado et al., 2017).

With this in mind, this research focuses on EU countries divided on members and non-members of the EMU. The partiality of previous research, which pays attention to the analysis of the public debt of individual countries or its relation to particular indicators, is also overcome by the fact that a much larger number of potential predictors of public debt is included in the analysis.

The basic research questions in this paper concern which predictors have a statistically significant effect on public debt in one and the other group of countries surveyed, whether they are the same or different, and whether there are significant differences in the magnitude of the impact of the predictors. In doing so, our empirical analysis was based on quantitative research design, comparative approach, and secondary data collection. It included 13 variables, with public debt a dependent variable and 12 economic indicators treated as predictors. Their relationship was checked

by the procedure for linear mixed models in the IBM SPSS computer package, which is seldom found in economic analyzes, and differences in the magnitude of predictor influence between analyzed groups of countries were calculated by the appropriate z-test.

The introduction to this article is followed by an overview of previous similar studies and methodology section. Subsequently, the results of the empirical research are presented. It was followed by discussion, and concluding remarks with the contributions of the research conducted, the implications, limitations and directions of possible further research into this topic.

2. Literature review

The financial and economic crisis of 2008 has faced many EU countries with the problem of maintaining public finnace and debt. Previous extensive fiscal stimulus and assistance programmes to the financial sector have led to a dramatic deterioration of the public finances, and public debt crises have occurred in many EU countries (Lane, 2012). Some countries have seen the outbreak of the crisis in increasing consumption and some countries in austerity measures (Crotty, 2009). Also, some central banks has introduced unconvential monetary policy for financial market and economy recovering providing additional liquidity to banks, large-scale intervention by purchasing assets, and forward guidance for extended period (Belke et al., 2017; Dell'Ariccia et al., 2018; Meinusch & Tillmann, 2016).

Numerous scholars are researching public debt on multi-country as well as one-country level, in developed and less developed countries, exploring relationship between public debt and various economic indicators. At the global level, mostly researched relationship is between economic growth, measured by GDP and public debt. Some studies from developed countries indicate that their relationship is causal (Ono, 2019; Panizza & Presbitero, 2013; Mencinger et al., 2014). On example of OECD countries Reinhart and Rogoff (2010) proved non-linear negative relationship effect above 90% GDP, while Baum et al. (2013) on example of 12 EU counteies showed beneficial effects of debt reduction on economic growth, but reduction of debt levels below 67% of GDP has a detrimental effect in the short term. Also, some studies do not find a link between public debt and GDP, even for countries with high public debt (Ogawa et al., 2016).

Impact of export and import on public debt is often research topic, also. Çetintaş and Barişik (2009) and Santos et al. (2013) confitmed export-led growth hypothesis concluding that real export growth impacted real output growth. A similar finding is obtained by Dritsakis and Stamatiou (2016) in exploring relationship between debt, export and growth in Italy, Portugal and Greece. Gargouri and Ksantini (2016) found that imports have a positive and significant impact on debt-to-GDP ratio in sampe of 12 European countries. Neaime et al. (2018) found the same relationship researching Greek example.

Some papers indicated that a relation between public debt and foreign direct investments inflow is inversed (Onafowora & Owoye, 2019; Jimborean & Kelber, 2017; Swamy, 2015). Mixed effects of foreign direct investments on economic growth

and debt were discoveredon example of European transition economies by Bayar and Sasmaz (2019). However, there are studies that identified insignificant or negative impact of foreign direct investments on economic growth (Simionescu, 2016; Alvarado et al., 2017).

In accordance with The Solow model, among investment, domestic saving is a key component of long-run economic growth, so boosting of domestic saving represents important issue for policy-makers (Cerda et al., 2020). Numerous scholars empiricly proved that the lack of domestic saving is quite harmful to economic development and public debt on examples of developed as well as developing countries (Ramzan & Ahmad, 2014; Okafor & Tyrowicz, 2009; Okafor & Tyrowicz, 2010; Spilioti & Vamvoukas, 2015).

Inter-relationships between credits and public debt are often research topic, too. In the light of EU crisis, consolidation of banking sector is seen as cricial factor of public finance and debt stabilisation (Barrios et al., 2010). Empirical findings showed that financial crises are often preceded by domestic credit booms (Jorda et al., 2016; Gourinchas & Obstfeld, 2012; Lane & Milesi-Ferretti, 2011; Lane, 2012; Schularick & Taylor, 2012). In addition, some scholars tend to explained public debt crisis by banking system crisis, legal inconsistences and different stages of development for different countries (Schafer, 2012). Others even proposed the rule based on researching period of 100 years that the inter-relationships of private credit and sovereign debt may be stated as - credit boom tend to decline public debt in expansions that end in financial crises, but these declinesares are often small (Jorda et al., 2016). In addition, Gargouri and Ksantini (2016) indicated positive impact of bank nonperforming loans and military expenditures on debt-to-GDP ratio, but negative impact of GDP growth and bank liquid reserves on it.

Many scholars agree that public debt and inflation are closely related, but mixed results exist on their relationship magnitude. Gomez-Gonzalez (2019), Reinhart and Sbrancia (2015) and Swamy (2015) found that inflation reduces public debit, but Gargouri and Ksantini (2016) not found a significant impact of inflation in their study that covered 12 Europeans countries during the 2000-2014 period.

High unemployment makes pressure on the government to finance more expenditure, resulting in a crowding out of capital accumulation and a higher debt–GDP ratio, which means that there is a positive correlation between unemployment and public debt (Ono, 2019). On example of several EU countries and USA, Hassan and Nassar (2015) tested the relatiohsips between unemployment, GDP and public debt and conclude that there were negative ties between unemployment and economic growth. Similar findings might be found in one-country analysis on Greek example (Karafolas & Alexandrakis, 2015).

A tie between intereset rates and public debt is frequently researched, also. Globan and Matosec (2016) analysed EU new member-states and found that long-term interest rates on government bonds to be significant and positively impacting the public debt growth rate. The same was found by Galinski (2015). Significant imcapt of real interest rates on public debt was reported in one-country studies also, as Pirtea et al. (2013) demonstrated in the case of Romania. However, Cherif and Hasanov (2012) indicated that policy of low interest rates is one of crucial determinat of debt-reduction strategy.

In addition, impact of tax revenue on public debt gained significant attention of researchers with agreement on medium-term effects of fiscal adjustment on output growth (Baldacci & Kumar, 2010; Gali & Perotti, 2003; Heinemann et al., 2014). A numerous authors had shown that financial crisis negative impacts fiscal position in terms of budget balances and public debt (Reinhart & Rogoff, 2009; Reinhart & Rogoff, 2011; Laeven & Valencia, 2018). Baunsgaard and Keen (2005) analyzed 111 developing countries in period of 25 years and found that excise taxes were significantlly related to public finance and debt. Pirtea et al. (2013) have proved that fiscal balance is significant factor that influence the debt to GDP ratio. Globan and Matosec (2016) found in EU new member states that more balanced government budget decrese the growth rate of public debt.

Based on the information in this literature review we selected as predictors of public debt the following variables: GDP per capita growth, exports of goods and services, foreign direct investment net inflows and net outflows, gross domestic savings, imports of goods and services, inflation - consumer prices, domestic credit to the private sector, domestic credit provided by the financial sector, unemployment, real interest rate, tax revenue. At the same time, two hypotheses were formed:

H1: Most predictors of public debt in member and non-members of EMU are differing.

H2: There is a significant difference in the size of the impact of most of the reserached predictors on public debt in member and non-members of EMU.

These hypotheses have been empirically tested in the analysis that follows in this paper.

3. Methodology

Our empirical research was grounded on quantitative research design, because preoccupations of such research design - measurement, causality, generalisation and replication (Bryman, 2012, pp. 175-177), were in accordance with research aim, main research questions and setted hypotheses. Comparative approach was employed due intention to compare impact of 12 economic indicators on public debt between two group of EU countries - members and non-members of EMU. This approach was adopted primary due its possibility to produce high relevance information for policy makers (Lui, 2017; Luo & Golembiewski, 1997, p. 427).

The 28 member-countries of EU were researched. They were grouped in two clusters - members and non-members of EMU. Only countries that fulfilled criteria of The Treaty of Maastricht untill 2001 were treated as member of EMU. This decision was made on intention to spot differences between 'old' and 'new' members of EU. The period from 2001 to 2018 was considered. It was long enough to allow explanatory model design and identification of variables that have a meaningful and statistically significant relationship with an outcome (Rachev et al., 2010, p. 521; Focardi & Fabozzi, 2004, p. 285).

Secondary data were collected from The World Bank database available on internet (The World Bank Database, 2019). The total of 13 economic variables described in Table 1 was researched.

There were no missing data and the most variables were expressed as percentage of GDP. In accordance with different typologies of longitudinal data (Das, 2019, p.

Table 1. Data description.

Variable name	Notation	Measurement	Variable role
Public debt	PD	(total % of GDP)	dependent
Gross domestic product per capita	GDP	(growth % of GDP)	independent
Exports of goods and services	EXP	(growth % of GDP)	independent
Foreign direct investment, net inflows	FDI_I	(growth % of GDP)	independent
Foreign direct investment, net outflows	FDI_O	(growth % of GDP)	independent
Gross domestic savings	GDS	(growth % of GDP)	independent
Imports of goods and services	IMP	(growth % of GDP)	independent
Inflation	INF	(%)	independent
Domestic credit to private sector	DC_PS	(% of GDP)	independent
Domestic credit by financial sector	DC_FS	(% of GDP)	independent
Unemployment	UNE	(%)	independent
Real interest rate	IR	(%)	independent
Tax revenue	TR	(% of GDP)	independent

Source: Authors' research.

460; Liu, 2016, p. 12-13), our data set may be treated as classic balanced macro longitudinal set.

Longitudinal data analysis implied necessity of applying sophisticated statistical approaches, methods and techniques. Frequently used approach of such a data analysis includes fixed and random effect regression models. We decided to employ such approach in linear mixed procedure in IBM SPSS. We made this decision based on several reasons stated in relevant literature (Heck et al., 2014; Vehkalahti & Everitt, 2019, Liu, 2016; Hedeker & Gibbons, 2006; Fitzmaurice et al., 2011; West et al., 2015). First, such a procedure has not been fully integrated in area of economic research despite its well theoretical background. Second, it allows models with both fixed and time/subject-varying, covariates and heterogenity, as well as heterogeneity in intercepts and slopes for random effect model. Third, it does not treat fixed and random effect as mutually exclusive choices. Combining them it offer more attractive option in regards to biases of each.

Analytic strategy included five steps and building three models (Vehkalahti & Everitt, 2019; Landau & Everitt, 2004). First step had exploratory character and it comprised data examination by testing several assumptions for multivariate analysis. This gave a closer insight into the data. Second step was building Model 1 as independence model, without random effect with main effect design and restricted maximum likelihood option for parameters estimation. Third step consisted of building Model 2 with adding the random intercept in the Model 1. It employed factorial design and restricted maximum likelihood option for parameters estimation. Fourth step included adding random slope for Model 3 building, with main effect design and maximum likelihood option for parameters estimation. Fifth step was models comparison by their information criterias and choosing best model. Sixth step was estimations of parameters equality between members and non-members of European Monetary Union. For such a purpose appropriate z-test for comparing regression coefficients was employed (Clogg et al., 1995; Paternoster et al., 1998).

4. Results

Preliminary analyses were conducted by recommendations from relevant literature (Snijders & Bosker, 2003, p. 120-121; Bordens & Abbott, 2008, pp. 469-472). Our

dependent and independent variables were measured on continuous scale and had ratio character. Scatterplots and partial regressions plots for dependent variable and each of independent variables, as well as for the dependent variable and the independent variables collectively shown that linear relationship could be identified. Normal Q-Q plots shown absence of normally distributed residuals. Heteroscedasticity was checked by Glejser test by regressing absolute residual value of the independent variables with appropriate regression equation (Gujarati & Porter, 2009, pp. 379-380). For independent variables FDI_I, FDI_O, IMP, DC_PS, DC_FS, UNE, IR and TR obtained p-values indicated presence of heteroscedasticity. Multicollinearity, autocorrelation, multivariate outliers and high influential points were checked by calculation of VIF and TOL values, Durbin-Watson statistics, Mahalanobis distance (MD) and Cook's distance (CD) (Brooks, 2014, pp. 217-218, pp. 193- 194; Meyers et al., 2013, p. 198). VIF values were in range from 1.222 to 8.394, and TOL values were in range from .119 to .818. We concluded that multicollinearity was not present following the proposed rule of thumb in literature (Verma & Abdel-Salam, 2019, p. 132). The Durbin–Watson statistics value of .340 indicated positive autocorrelation (Anderson et al., 2014, pp. 789). There were multivariate outliers based on calculated Mahalanobis distance value MD = 166.561 for df = 12 and $\alpha = .001$, but there were no high influential points based on value of Cook's distance CD = .181 (Meyers et al., 2013, p. 198). Conducted testings indicated that data needs adequate transformation prior to main analysis. Insight in appropriate histograms indicated that almost all data are positively skewed. The log10 transformation was employed for making the data appear more normal. Before transformation all zero and negative values are corrected with adding appropriate value of constant M (Mickey et al., 2004, p. 448). In dealing with outliers M-estimation was employed as adequate techniques for given data (Aguinis et al., 2013). Finally, before main analysis we restructure our data-set from wide to long format according to requirements of linear mixed procedure (Heck et al., 2014, p. 55).

Result section of this paper consists of two parts. First part included descriptions of three obtained models and decision-making of best fitting model. Second part consisted of testings of existence of statistically significant differences in parameters estimations in best model for European monetary union members as well as forits non-members.

Our models are presented in Tables 2, 3 and 4.

Results of Wald Z test in all models for both groups of countries were statistically significant. That means that all models had to be taken in consideration in choosing the best model (West et al., 2015, p. 38; Heck et al., 2014, pp. 165-166). But, calculated information criteria indicated that the best model is Model 3, i.e., random intercept and slope model. It improved fit in -2LL, AIC and BIC values over the previous models. Following the rule that the best fitting model is model with the smallest values in previously mentioned criteria we chosed Model 3 as best-fitting model (Konishi & Kitagawa, 2008; Gurka, 2006).

Results obtained in Model 3 for members of European monetary union indicated that the four variables - FDI_I_transf with estimation value of -.107, SE = .029, t = 3.624, DC_PS_transf with estimation value of -.650, SE = .118, t = −5.481,

Table 2. Model 1 (independence model).

Members of European monerary union						
Information Criteria						
−2LL			AIC		BIC	
−195.855			−167.855		−120.601	
Estimates[a]						
Parameter	Estimate	SE	t	p	95% Confidence Interval	
					Lower bound	Upper bound
Intercept	4.289	.579	7.402	.000	3.147	5.431
GDP_transf	.639	.212	3.013	.003	.221	1.057
EXP_transf	.131	.114	1.153	.250	−.093	.357
FDI_I_transf	.188	.066	2.860	.005	.058	.318
FDI_O_transf	−.707	.198	−3.566	.000	−1.098	-.316
GDS_transf	−1.184	.097	−12.141	.000	−1.377	-.992
IMP_transf	−.451	.244	−1.844	.067	−.933	.031
INF_transf	−.290	.103	−2.811	.005	−.493	−.086
DC_PS_transf	−1.080	.151	−7.145	.000	−1.378	−.782
DC_FS_transf	.961	.156	6.147	.000	.653	1.269
UNE_transf	.181	.070	2.583	.010	.042	.319
IR_transf	.059	.142	.414	.679	−.221	.339
TR_transf	.052	.105	.491	.624	−.156	.260
Estimates of Covariance Parameters[a]						
Parameter	Estimate	SE	Wald Z	p	95% Confidence Interval	
					Lower bound	Upper bound
Residual	.025	.002	10.075	.000	.020	.030
Non-members of European monerary union						
Information Criteria						
	−2LL		AIC		BIC	
	58.251		60.251		63.868	
Estimates[a]						
Parameter	Estimate	SE	t	p	95% Confidence Interval	
					Lower bound	Upper bound
Intercept	1.581	.480	3.291	.001	.635	2.528
GDP_transf	−.157	.216	−.730	.466	−.583	.267
EXP_transf	.193	.166	1.159	.247	−.134	.521
FDI_I_transf	.026	.129	.201	.841	−.229	.281
FDI_O_transf	−.122	.078	−1.566	.119	−.276	.031
GDS_transf	−.381	.151	−2.516	.012	−.679	−.082
IMP_transf	.065	.167	.390	.697	−.264	.394
INF_transf	−.506	.117	−4.304	.000	−.737	−.274
DC_PS_transf	.007	.085	.084	.933	−.160	.175
DC_FS_transf	.130	.061	2.135	.034	.010	.250
UNE_transf	−.101	.101	−.998	.319	−.302	.098
IR_transf	.396	.100	3.951	.000	.198	.593
TR_transf	.292	.168	1.739	.083	−.038	.623
Estimates of Covariance Parameters[a]						
Parameter	Estimate	SE	Wald Z	p	95% Confidence Interval	
					Lower bound	Upper bound
Residual	.065	.005	11.726	.000	.055	.077

[a]Dependent Variable: PD_transf.
Note: -2LL = -2 log-likelihood; AIC = Akaike's information criterion; AICC = Hurvich and Tsai's Criterion; CAIC = Bozdogan's Criterion; BIC = Bayesian information criterion.
Source: Authors' research.

Table 3. Model 2 (random intercept model).

Members of European monerary union						
Information Criteria						
−2LL			AIC			BIC
−406.654			−402.654			−396.028
			Estimates[a]			
					95% Confidence Interval	
Parameter	Estimate	SE	t	p	Lower bound	Upper bound
Intercept	1.222	.477	2.560	.011	.280	2.164
GDP_transf	.033	.122	.272	.786	−.208	.275
EXP_transf	.070	.059	1.193	.234	−.046	.186
FDI_I_transf	.106	.033	3.170	.002	.040	.172
FDI_O_transf	−.036	.111	−.328	.744	−.255	.182
GDS_transf	−.160	.150	−1.067	.287	−.457	.136
IMP_transf	−.222	.128	−1.728	.086	−.475	.031
INF_transf	−.118	.056	−2.088	.038	−.230	−.006
DC_PS_transf	−.936	.119	−7.829	.000	−1.172	−.700
DC_FS_transf	.891	.091	9.717	.000	.710	1.072
UNE_transf	.496	.047	10.404	.000	.402	.590
IR_transf	−.078	.090	−.869	.386	−.257	.099
TR_transf	.428	.190	2.252	.025	.053	.803
			Estimates of Covariance Parameters[a]			
Parameter	Estimate	SE	Wald Z	p	95% Confidence Interval	
					Lower bound	Upper bound
Residual	.005	.001	9.763	.000	.004	.007
Intercept	.052	.024	2.147	.032	.021	.130
Non-members of European monerary union						
Information Criteria						
−2LL			AIC			BIC
−258.805			−254.805			−247.571
Estimates[a]						
Parameter	Estimate	SE	t	p	95% Confidence Interval	
					Lower bound	Upper bound
Intercept	1.545	.396	3.903	.000	.766	2.325
GDP_transf	-.154	.119	−1.292	.197	-.390	.080
EXP_transf	.054	.087	.629	.530	-.116	.226
FDI_I_transf	-.060	.086	-.694	.488	-.231	.110
FDI_O_transf	.011	.052	.222	.824	-.091	.114
GDS_transf	.019	.164	.117	.907	-.304	.342
IMP_transf	.091	.091	1.008	.315	-.087	.271
INF_transf	-.342	.065	−5.224	.000	-.471	-.213
DC_PS_transf	-.007	.049	-.149	.882	-.105	.090
DC_FS_transf	.068	.034	1.995	.047	.001	.135
UNE_transf	.171	.072	2.366	.019	.028	.313
IR_transf	.163	.056	2.881	.004	.051	.275
TR_transf	-.060	.155	-.389	.698	-.365	.244
Estimates of Covariance Parameters[a]						
Parameter	Estimate	SE	Wald Z	p	95% Confidence Interval	
					Lower bound	Upper bound
Residual	.016	.001	11.398	.000	.014	.019
Intercept	.061	.023	2.648	.008	.029	.129

[a]Dependent Variable: PD_transf.Note: -2LL = -2 log-likelihood; AIC = Akaike's information criterion; AICC = Hurvich and Tsai's Criterion; CAIC = Bozdogan's Criterion; BIC = Bayesian information criterion.
Source: Authors' research.

DC_FS_transf, with estimation value of -.481, SE = .103, t = 4.650, and UNE_transf with estimation value of .447, SE = .042, t = 10.513, are predictive of PD_transf at the level of $p < .050$. For non-members of European monetary union this model stated that three variables - GDS_transf with estimation value of -.428, SE = .141, t = −3.037, UNE_transf with estimation value of .249, SE = .059, t = −4.200, and IR_transf with estimation value of .225, SE = .046, t = 4.838, are predictive of PD_transf at the level of $p < .050$.

To get more insight among reliability of our model interclass correlation coefficients were calculated (Shrout & Fleiss, 1979; Johnson & Koch, 2011, p. 686). Based on 95% confidence interval, interclass correlation coefficient for model with European monetary union members had value of .9069, and .8333 for model with non-members of European monetary union. Those mean that 90.69%, i.e., 83.33% of variation in variable PD_transf was due within-units differences in model.

Finally, we employed test for equality of estimated parameters between two groups of countries for each predictor from Model 3 to spot differences. Our estimation was based on one-tailed z-test using a 95% confidence level. We found that null hypothesis couldn't be supported for eight predictors GDP_transf (z = −3.981, p = .000), FDI_I_transf (z = 6.968, p = .000), FDI_O_transf (z = 2.530, p = .005), IMP_transf (z = −3.280, p = .005), INF_transf (z = 2.176, p = .014), DC_PS_transf (z = −2.643, p = .004), DC_FS_transf (z = 2.913, p = .001), UNE_transf (z = 1.803, p = .035), and IR_transf (z = −5.624, p = .000). Only for four predictor, EXP_transf (z = .157, p = .438), GDS_transf (z = .003, p = .998), UNE_transf (z = 1.803, p = .071), and TR_transf (z = .010, p = .992), hypothesis equality of estimated parameters couldn't be rejected.

5. Discussion and concluding remarks

Our study found four variables were statistically significant predictors of public debt for group of countries of EMU - inflow of foreign direct investment and domestic credits to private sector with negative impact on public debt, and domestic credits by financial sector and unemployment with positive impact on public debt. Three variables were statistically significant predictors of public debt for group of countries non-members of EMU - gross domestic savings with negative impact on public debt, and unemployment and interest rates with positive impact on public debt. In addition, equality of calculated regression coefficients between two groups of countries couldn't be assumed for majority of researched variables. Only in the case of four variables, export, gross domestic savings, unemployment and tax revenue assumption of equality of regression coefficients couldn't be rejected.Those findings do not reject hypotheses H1 and H2.

The obtained results indicate that unemployment is one of the most important problems of all EU countries, and it is believed that the debt crisis will end when the unemployment rate drops to the pre-crisis level (Marelli & Signorelli, 2015). The similar finding was confirmed in the studies of other authors (Ono, 2019; Hassan & Nassar, 2015; Karafolas & Alexandrakis, 2015). It has already been recognised in the

Table 4. Model 3 (random intercept and slope model).

Members of European monerary union						
Information Criteria						
−2LL		AIC			BIC	
−490.421		−456.421			−399.120	
Estimates[a]						
Parameter	Estimate	SE	t	p	95% Confidence Interval	
					Lower bound	Upper bound
Intercept	1.657	.444	3.731	.000	.780	2.533
GDP_transf	-.030	.108	-.282	.778	-.244	.183
EXP_transf	.044	.052	.859	.391	-.057	.147
FDI_I_transf	-.107	.029	3.624	.000	-.165	-.048
FDI_O_transf	.093	.100	.924	.357	-.105	.292
GDS_transf	-.253	.133	−1.891	.060	-.517	.010
IMP_transf	-.131	.113	−1.152	.251	-.355	.093
INF_transf	-.033	.051	-.641	.522	-.134	.068
DC_PS_transf	-.650	.118	−5.481	.000	-.885	-.416
DC_FS_transf	.481	.103	4.650	.000	.277	.685
UNE_transf	.447	.042	10.513	.000	.363	.531
IR_transf	-.066	.080	-.827	.409	-.224	.091
TR_transf	.178	.173	1.026	.306	-.164	.521
Estimates of Covariance Parameters[a]						
Parameter	Estimate	SE	Wald Z	p	95% Confidence Interval	
					Lower bound	Upper bound
Residual	.004	.001	10.026	.000	.004	.005
Intercept	.039	.017	2.254	.024	.016	.094
Non-members of European monerary union						
Information Criteria						
−2LL		AIC			BIC	
−407.044		−373.044			−310.774	
Estimates[a]						
Parameter	Estimate	SE	t	p	95% Confidence Interval	
					Lower bound	Upper bound
Intercept	1.274	.345	3.687	.000	.593	1.955
GDP_transf	.012	.098	.132	.895	-.181	.206
EXP_transf	.019	.070	.271	.787	-.120	.158
FDI_I_transf	-.051	.070	-.722	.471	-.190	.088
FDI_O_transf	.018	.042	.429	.668	-.065	.101
GDS_transf	-.428	.141	−3.037	.003	-.705	-.150
IMP_transf	.014	.074	.200	.842	-.131	.161
INF_transf	-.076	.058	−1.314	.190	-.191	.038
DC_PS_transf	-.059	.040	−1.460	.146	-.139	.020
DC_FS_transf	.031	.028	1.138	.256	-.023	.087
UNE_transf	.249	.059	4.200	.000	.132	.366
IR_transf	.225	.046	4.838	.000	.133	.317
TR_transf	.177	.129	1.380	.169	-.076	.432
Estimates of Covariance Parameters[a]						
Parameter	Estimate	SE	Wald Z	p	95% Confidence Interval	
					Lower bound	Upper bound
Residual	.011	.000	11.650	.000	.009	.013
Intercept	.055	.020	2.751	.006	.027	.112

aDependent Variable: PD_transf.Note: -2LL = -2 log-likelihood; AIC = Akaike's information criterion; AICC = Hurvich and Tsai's Criterion; CAIC = Bozdogan's Criterion; BIC = Bayesian information criterion.
Source: Authors' research.

EU policy and numerous measures are being implemented to reduce unemployment (Marie & Alina, 2019; Banociova & Martinkova, 2017; Martínez-Molina et al., 2016).

Our finding of negative impact of foreign direct investments inflow on public debit in the case of members of EMU was previously confirmed by other authors (Onafowora & Owoye, 2019; Jimborean & Kelber, 2017: Swamy, 2015). This finding is supported by statistics data which indicate that only Chinese foreign direct investment in the EU has increased in only eight years from 700 million in 2008 to 35 billion euros in 2016 (Haneman & Houtari, 2018, p.10).

In regards to credits - public debt relation, our results indicated that members of EMU experienced good as well as bad side of credit boom. This finding is in accordance with well-founded phenomena of credits influence on economic growth and public debt (Gorton & Ordonez, 2016; Castro & Martins, 2019; Bakker et al., 2012).

In non-members of EMU our findings indicate negative impactof domestic savings on public debt, and it is in accordance with results of several previous studies (Ramzan & Ahmad, 2014; Okafor & Tyrowicz, 2009; Okafor & Tyrowicz, 2010; Spilioti & Vamvoukas, 2015). It seems that non-members of EMU had addoppted a lesson from developing countries that there is no economic growth without accumulated domestic savings. But, it could not be gereralized because distinction has to be made between West-European, Baltic, Central-European and Balkan countries due their socio-economic differences (Paczoski et al., 2019).

In addition, positive impact of interest rates on public debt in non-members of EMU is results of their higher values in comparasion to momemers of EMU. Other authors have alreday indicate that the interest rates and sovereign bond market is strongly correlated, more fragile and easily harmed to self-generated crises in a monetary union that in its non-member countries (Aizenman et al., 2013; Caporale & Girardi, 2013). However, Eurostat (2019) reported that in 2018, the highest bond yields, above 3% were in Romania, Greece, Poland and Hungary, while the lowest yields were in Denmark (0.45%), Germany (0.40%) and Lithuania (0.31%).

To the best of our knowledge presented study is the first to provide empirical information on the relationships between researched economic indicators and public debt in one place in EU countries, spotting the differnces between countries that belong to the euro-zone and the rest of European Union members. Its important contribution is comparative research approach and analytic procedure that included mixed linear modelling in IBM SPSS. Such analytic procedure, even very valuable and flexibile, is not common in economic and especially financial studies. In addition, study established causal relationships beteween researched variables which were explained using additional secondary data and previous research results. Our findings also point to the need for more research to explicate the uniqueness of economics and monetary policies in supranational entities.

Several short policy-makers implications have to be made based on our research findings. First, as several scholars indicate non-member countries of EMU have to carefully prepared if they intend to adopt euro, taking into account all costs and benefits of membership in monetary union (Mazier & Petit, 2013; Gyoerk, 2017; Pechova, 2012). Second, nowadays euro-zone perspective is less attractive then before recent crisis, so structural refroms has to be done to avoid recent troubles (Afonso

et al., 2019). Third, dealing with unemployment is still crucial challenge for all EU memebers. Fourth, credit policy has to me carefully monitorting in the future in monetary union. Fifth, interest rates policy in monetary union non-members might be more balanced to allow debit decrising but to satify investors at the same time. Fourth, total effect of unconventional monetary policy impact, not only on financial variables and interest rates, but also on some macroeconomic variables such as bank credits, investment, unemployment, GDP, inflation, have to be taken into account for accessing evaulation of such policy on public debt and real economy recovering.

Conducted research has limitations that should be mentioned for its results understanding and further research opportunities. The first is related to our consideration of European monetary union members. We considered as members only 12 countries that qualified to adopt euro untill 2001, but now there are 19 countries of euro-zone. It will be interesting to see replication of this study with including all 19 members of European monetary unionand taking into account BREXIT. Second is related to the number of public debt predictors researched and period of analysis. Our research included 12 economic indicators as potential public debt predictors, and serious crisis impacted public debt. Llist of predictors might to be expanded with trade and balance of payments deficit, government spending, factors of political stability, level of economy openes, indicators of government efficiency. Third, our analytic procedure that was based on building three simple models in linear mixed procedure, but future resarch may benefit from using more complex modelin. Fourth, our research utilised only developed countries in Europe, so similar further studies may include less development and non-members of EU countries, too. Despite mentioned we believe that our research have valuable longitudinal information for studying of area of public debt.

Disclosure statement

No potential conflict of interest was reported by the authors

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