Fiscal decentralization and public debt: New evidence from EU countries

Fiškálna decentralizácia a verejný dlh: nové výsledky pre krajiny EÚ

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Abstract: The aim of the paper is to examine the relationship between fiscal decentralization and government debt of EU countries with respect to EU accession, country size and number of government levels in the period of 1999 – 2019 using panel data models based on six various estimators. The differences regarding the effect of fiscal decentralization on government debt were estimated on the basis of the seemingly unrelated regression (SUR). The research results have shown the following: 1. The effect of fiscal decentralization on public debt is statistically significant. 2. Fiscal decentralization has negatively affected public debt of EU member states in the observed period. 3. The direction and intensity of the effect of fiscal decentralization on public debt depends on the size of the country (measured by the number of its inhabitants), the number of government levels and the year of the country's accession to the EU.

Key words: Fiscal decentralization. Public debt. Panel data model.

JEL Classification: E62. H77.

Introduction

Fiscal decentralization has been the subject of numerous theoretical and empirical studies. A large number of studies have established that fiscal decentralization affects the economic growth, budget deficit, public debt and other macroeconomic performances of the economy.

The aim of the paper is to examine the relationship between fiscal decentralization and government debt of EU countries with respect to EU accession, country size and number of government levels. The study was conducted on the basis of data of Eurostat and World Bank in the period between 1999 and 2019. Panel data models based on six various estimators are employed to estimate the relationship between the government debt as dependent variable and fiscal decentralization as explanatory variable, while fiscal decentralization is measured in three different ways.

The main hypotheses on which the research was based are: 1) Fiscal decentralization significantly affects public debt. 2) Fiscal decentralization negatively affects the public debt of EU countries. 3) The intensity and the impact direction of the degree of fiscal decentralization on the public debt of EU countries depend on: a) the size of the country, b) the number of government levels and c) the year of the country's accession to the EU.

In accordance with the set hypotheses, the basic research questions are to be answered. The first question is whether the public debt depends on the degree of fiscal decentralization. Second, if there is a dependence, is it statistically significant, that is, whether fiscal decentralization has a significant impact on the public debt. Third, if fiscal decentralization has a significant impact, whether the direction of the impact is positive or negative. The fourth question refers to whether the size of the country, the number of government levels and the year of the country's accession to the EU significantly affect the dependence of the public debt on fiscal decentralization.

Starting from the aims and research hypotheses, i.e. from the research questions, this paper is structured in the following way: after a short introduction, which summarizes the aims, hypotheses and research questions, a literature review is given. The second part of the paper called Materials and methods presents a sample and research methods used to model the relationship between public debt and fiscal decentralization. In the third part of the paper, the main empirical results are presented and their interpretation is given. The final, concluding part of the paper summarizes the basic research findings.

1 Literature review

In the past twenty-odd years, a relatively large number of empirical studies have been dedicated to the analysis of the dependence of economic growth on fiscal decentralization. Among the authors who deal with this issue are for example Lin and Liu (2000), Akai and Sakata (2002), Martínez-Vazquez and McNab (2003), Akai et al. (2007), Thornton (2007), Qiao et al. (2008), Rodríguez-Pose et al. (2009), Bodman (2011), Nguyen and Anwar (2011), Cyril (2016), Kusuma, and Badrudin (2016), Baskaran et al. (2016), Yang (2016), Martínez-Vázquez et al. (2017), Filippetti and Sacchi (2016), Slavinskaitė (2017), Lago-Peñas et al. (2017), Baskaran et al. (2017), Carniti et al. (2019), Ding et al. (2019), Slavinskaitė et al. (2020), or Canavire-Bacarreza et al. (2020). The reason for such a great interest of the researchers in studying the dependence of economic growth on fiscal decentralization is, inter alia, the fact that the empirical results so far have shown that this dependence is not universal and varies by country or group of countries and over time. This implies that the strength and direction of the

impact of fiscal decentralization on economic growth depends on various factors such as country size, level of economic development, quality of political institutions and other (Baskaran et al. 2016).

The study of the dependence of budget deficit on fiscal decentralization has intensified in the past ten years or so. Particularly outstanding empirical works in this field are Neyapti (2010), Luechinger and Schaltegger (2013), Foremny (2014), Bartolini et al. (2018), and Lago-Peñas et al. (2020)

A number of empirical studies have been dedicated to the examination of the relationship between government size and fiscal decentralization, some of which are Cassette and Paty (2010), Baskaran (2011), Cantarero and Perez (2012), Liberati and Sacchi (2013), Makreshanska-Mladenovska and Petrevski (2019), Sijabat (2016), Qiao et al. (2019).

Freitag and Vatter (2008) belong to the group of authors who focus on the relationship between federal structures and public debt. They maintain that, from a theoretical point of view, decentralization and federalism can be associated with both an expansive and a dampening effect on government debt. On the one hand, decentralized structures have been argued to lead to a reduction of debt due to inherent competition between the member states and the multitude of veto positions that restrict public intervention. On the other hand, decentralization is claimed to contribute to an increase of public debt as it involves expensive functional and organizational duplications as well as cost-intensive, often debt-financed, compromise solutions between a large number of actors that operate in an uncoordinated and contradictory way. Similar findings are mentioned in Governatori and Yim (2012).

The analysis of the dependence of public debt on fiscal decentralization has been performed both at the level of individual countries and at the level of a group of countries. In Switzerland, for example, the above mentioned authors Freitag and Vatter (2008) analyse the effect of political decentralization and fiscal and administrative centralization on public debt in the period 1984-2000, dividing the sample into two subsamples, whereas the first subsample covers the period 1984-1990 and the second the period 1990-2000. Based on the observations from the first sample, the authors could not confirm the hypothesis that fiscal centralization and political decentralization significantly affected public debt, but they established that administrative centralization had a positive and statistically significant effect on public debt. In the second sample, i.e. the sub-period 1990-2000, these authors established a statistically significant and positive effect of fiscal and administrative centralization, as well as a negative effect of political decentralization, on the basis of which they concluded that decentralization significantly affected public debt only in the recession period. In the same year, Facchini and Testa (2008)

conducted a similar study in Brazil. Hernández de Cos and Pérez García (2013) study the evolution and the determinants of sub-national debt net financing needs in Spain. The analysis performed by these authors covers 17 regions over the period 1995-2010. Among the set of determinants, they pay attention to: 1) institutional factors (fiscal decentralization and fiscal rules); 2) market-disciple indicators; and 3) non-EDP (Excessive Deficit Procedure) debt. The authors concluded that fiscal decentralization and fiscal rules had no important role in the established model. Apart from the above-listed authors, the effect of fiscal decentralization on the public debt of Spain was also examined by Delgado-Téllez and Pérez (2020). In Italy, Buiatti et al. (2014) researched the effect of unemployment, the real GDP growth rate, the deviation from long run trend of the Italian government expenditure share of GDP on government surplus to GDP ratio by GMM model, as well as political power (PW) and on the population ratio (RPOP), controlling for the per capita GDP ratio (RYPC) on macro-regional government surplus to GDP ratio (GS) by OLS model. Using the data from 1963 to 2007, the research covered four Italian regions: Centre, South, North-West and North-East. They discovered that the large and persistent fiscal imbalances of poorer southern regions of Italy are the ultimate cause of the National Public debt of Italy.

Besides the research conducted at the level of individual countries, numerous authors have conducted their research at the level of EU member-states. Afonso and Hauptmeier (2009) studied the sample of 27 EU member-states in order to identify the determinants of fiscal behaviour of governments in the period 1990-2005. The research was conducted by using least squares dummy variable estimator for a dynamic panel data model with correction for bias (LSDVC) and fixed-effects estimators. These authors concluded that the lower degree of public spending decentralization positively contributed to a higher responsiveness of primary surpluses to government indebtedness. Using the same sample of the countries, but for the period 1999-2009, Horváthová et al. (2012) studied the effect of revenue decentralization on public debt. This relationship was controlled for population, GDP growth, interest rate on long-term maturity bond, inflation and unemployment on fiscal decentralization. These authors came to the following conclusions: there is a negative effect of fiscal decentralization on public debt size and is apparent after a certain time-lag; the influence of fiscal decentralization on public debt is evident in the case of large and small economies; the hypothesis about the negative effect of fiscal decentralization on public debt was not confirmed in the countries that joined the EU after 2004; no relationship was observed in the case of the average size of the lowest government unit. The public administration structure (number of government levels) has a

statistically significant positive impact on public debt, due to increase of administrative and bureaucracy costs.

The effect of fiscal decentralization has also been studied at the level of OECD countries. Among others, this question has been dealt with by Baskaran (2010), who explored whether fiscal decentralization might ensure the fiscal stability of the public sector by constraining Leviathan governments, using a panel of 17 OECD countries over the 1975-2001 period. His findings suggest that expenditure decentralization significantly reduces public indebtedness, whereas tax decentralization and vertical fiscal imbalances are insignificant.

2   Material and methods

In the evaluation[1] of the effect of fiscal decentralization on public debt, publicly available data of Eurostat and World Bank were used about the values of the variables covered by the analysis for 28 EU member states[2] in the period 1999-2019 which we created in the form of panel data.

Relying on the study by Horváthová et al. (2012), the starting regression analysis model for the panel data was formulated as follows (list of variables and their labelling is in Appendix B):

$$GOB\_DEB_{i,t} = \beta_0 + \beta_1 FD_{Gi,t} + \beta_2 GDP\_G_{i,t} + \beta_3 POPU_{i,t} + \beta_4 I_{i,t} + \beta_5 HICP_{i,t}$$
$$+ \beta_6 UNMP_{i,t} + \mu_{i,t} \tag{1}$$
$$i = 1,...,N; \quad t = 1,...,T$$

The variables Annual percentage growth rate (percent of GDP), Population on 1st January – total number of inhabitants of particular country, Interest rate on long-term maturity bond - government bond yields, 10 years' maturity, Harmonized Index of Consumer Prices (HICP) annual average index and Unemployment rate were included in the model in order to quantify the "pure" effect of fiscal decentralization on public debt.

According to the results of the preliminary correlation analysis, it was established that there was a high degree of quantitative agreement of the variations between HICP and I, and that is why we excluded HICP variable from the further analysis, so that the model (1) was reduced to the regression model with five explanatory variables:

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[1] Statistical program StataBE 17 has been used for estimations.
[2] The study also covers the United Kingdom, which was a member of the EU at the time of the sample observations.

$$GOB\_DEB_{i,t} = \beta_0 + \beta_1 FD_{G_{i,t}} + \beta_2 GDP\_G_{i,t} + \beta_3 POPU_{i,t} + \beta_4 I_{i,t}$$
$$+ \beta_5 UNMP_{i,t} + \mu_{i,t} \tag{2}$$
$$i = 1,...,N; \quad t = 1,...,T$$

In compliance with the requirements of the econometric analysis of panel data, the following research stage included the tests of stationarity of the model variables. Using Im–Pesaran–Shin (IPS) test (which belongs to the first generation of unit root tests), it was established that $GOV\_DEB, POPU, I$ and $UNMP$ were non-stationary variables[3]. In order to fulfil the condition regarding stationarity, these variables were transformed into the new ones whose values represented logarithm values of the first differences in the values of original variables, so that the regression model can now be presented in the following form:

$$DGOB\_DEB_{i,t} = \beta_0 + \beta_1 FD_{G_{i,t}} + \beta_2 GDP\_G_{i,t} + \beta_3 DPOPU_{i,t} + \beta_4 DI_{i,t}$$
$$+ \beta_5 DUNMP_{i,t} + \mu_{i,t} \tag{3}$$
$$i = 1,...,N; \quad t = 1,...,T$$

After performing the stationarity tests and the transformation of non-stationary variables, we analyzed the problem that often arises in the empirical papers from this field – the problem of selecting the variable that measures the degree of fiscal decentralization in the best manner. Following the approach of Horváthová et al. (2012), and Mali and Maličká (2021), three indicator-variables were created: 1) EXPDEC variable defined as the ratio between total local government expenditure (as percent of GDP) and total general government expenditure (as percent of GDP); 2) REVDEC variable reflecting the share of total local government revenue (as percent of GDP) in total general government revenue (as percent of GDP); and 3) TAXDEC variable representing the share of total local government tax revenue (as percent of GDP) in total general government tax revenue (as percent of GDP).

By comparing the results of the preliminary regression analysis obtained through the inclusion of some indicator variables, it was established that the coefficient of determination reached the maximum value when the indicator variable EXPDEC was included in the regression model, the effect of which was significant. Accordingly, the following regression model was used for the quantification of the effect of fiscal decentralization on public debt:

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[3] By using the Cross-sectionally augmented IPS (CIPS) unit root test, which belongs to the second generation unit root tests and takes into account the Cross-sectional Dependence panel, the same results were obtained.

$$
\begin{aligned}
\mathrm{DGOB\_DEB_{i,t}} = \beta_0 &+ \beta_1\mathrm{EXPDEC_{Gi,t}} + \beta_2\mathrm{GDP\_G_{i,t}} + \beta_3\mathrm{DPOPU_{i,t}} + \beta_4\mathrm{DI_{i,t}} \\
&+ \beta_5\mathrm{DUNMP_{i,t}} + \mu_{i,t} \qquad\qquad (4)
\end{aligned}
$$

$$ i = 1,...,N; \quad t = 1,...,T $$

where variable $EXPDEC_{i,t}$ denotes the share of total local government expenditure (as percent of GDP) in total general government expenditure (as percent of GDP).

For the purpose of studying the heterogeneity of the analysed EU member-states regarding the level of public debt, economic development, population size, number of government levels, and the EU accession year, the set of the countries was stratified analogously to the model of Horváthová et al. (2012) and Mali and Maličká (2021). In this research, according to the year of EU accession, two strata were formed: 1) the countries that joined until 2004 and 2) the countries that joined the EU after 2004. According to size, the countries are classified into three strata (based on Horváthová et al., 2012): 1) small countries (up to 10 million inhabitants), 2) medium-sized countries (countries with 10 to 30 million inhabitants) and 3) large countries (countries with over 30 million inhabitants), while according to the number of government levels, they were classified into: 1) the countries with 1 or 2 government levels and 2) the countries with 3 or more government levels.

However, in the empirical literature the EU accession variable is common. Beside it, the influence of sub-periods on fiscal discipline is considered also in Afonso and Hauptmeier (2009). They employ a dummy variable taking value 1 after 1997 for the countries that are (adhered) in (to) the EU at the base of the Stability and Growth Pact and the dummy variable for the EMU membership. The government structure or institutional arrangement of the country is mentioned in Bodman et al. (2009) or Neytapi (2013) or Belmonte et al. (2018). The effect of population on fiscal decentralization is mentioned in Jurado and León (2021) Belmonte et al. (2018) or Garrett and Rodden (2000). They stress that larger countries tend to be more decentralized, due to larger heterogeneity of preferences (question of the population diversity).

In order to resolve the problem of heterogeneity of regression parameters, instead of using dummy variables, as well as estimating regressions for each sample subsample, in this study we also used the seemingly unrelated regression (SUR) estimator that implies that the errors in all individual regressions have been generated in the same stochastic process (Troeger, 2019).

To estimate the effect of the variable of the year of EU accession, the model SUR1 was established in the form of a system of two regression equations that correspond to sample strata.

Analogously, for the purpose of studying the effect of fiscal decentralization on public debt in small (up to 10 million inhabitants), medium-sized (countries with 10 to 30 million inhabitants) and large countries (countries with over 30 million inhabitants), the model SUR2 with three separate regressions is estimated. In the end, for the purpose of estimating the effect of the number of government levels on the dependence of public debt on fiscal decentralization, the model SUR3 consisting of two regression equations is estimated for countries with 1 or 2 government levels and for countries with 3 or more government levels.

For the purpose of estimating the model parameters, the robust error estimators were used: 1) OLS estimators, such POLS (Pooled OLS), Cross-section fixed effects – FE OLS, time-fixed effects TFE OLS and PCSE (panel-corrected standard errors); 2) GLS estimators: Feasible Generalized Least Squares (FGLS) estimator and random effects (RE GLS).

The majority of the existing studies on the subject assume the fiscal decentralization to be exogenous within the empirical specifications of the model. However, theory suggests that fiscal decentralization is likely to be endogenous, for at least two reasons: i) existence of unobserved time-invariant individual effects, which affects country specific dynamics of public debt (for instance, credibility and soundness of public financial management); ii) reverse causality, as higher level of public debt might induce stabilization measures that also includes cut in local expenditure or increase in local revenues. The issue of unobserved heterogeneity is easy to address by the transformation of dummy variables. On the other hand, addressing reverse causality would require IV approach, but finding adequate instruments for fiscal decentralization is very problematic. The potential fiscal decentralization instruments, such as size of the country/population of various fractionalization measures (political, legislative, geographical, ethno-linguistic) have no variations or slowly vary over time, not helping in determining causality direction. Therefore, our analysis is strictly limited to inference on association between fiscal decentralization and public debt and does not presume causality.

In order to improve the reliability of Z and Wald-F statistics, the assumptions about heteroscedasticity, intracluster correlation and Cross-section Dependence were tested. Based on Modified Wald test for groupwise heteroscedasticity, the assumption was confirmed about the presence of heteroscedasticity; the assumption about the presence of the cross-sectional was confirmed by Pesaran Panel Unit Root Test in the Presence of Cross-section Dependence, while the assumption about the presence of the intracluster correlation, which was tested by Wooldridge test for serial correlation in panel data, was not confirmed.

For alleviating the effect of heteroscedasticity in POLS, FE OLS and RE GLS estimators, Huber-Eicker-White (HEW) procedure was used. Having in mind that with the above-listed

estimators it is not possible to eliminate and/or alleviate the problem of cross-sectional dependence of the panel, PCSE and FGLS estimators were used since they have the best characteristics from the perspective of robustness. It should be taken into account that the application of these estimators in practical research is limited. Beck and Katz (1995) have proved that in the reliable estimation PCSE and FGLS estimators require a substantially longer period of conducting the research as compared to the number of observation units in the sample (T>>N).

Finally, based on the conducted Hausman test, the estimator of fixed effects was chosen vs. the estimator of random effects. This result is in compliance with the rule that has been confirmed empirically on numerous occasions – that in the analyses of macroeconomic data, the estimator of fixed effects is superior to the estimator for estimating the model with a composite error.

3   Empirical results and discussion

Tables 1 through to 4 given in Appendix C show the descriptive statistics of key variables for the whole sample and descriptive statistics for the subsamples of the countries. The preliminary analysis of the degree of quantitative agreement (see Appendix C, Table 5) established a high degree of agreement among three observed indicator variables (correlation coefficient between EXPDEC and REVDEC variables is 0.99, between EXPDEC and TAXDEC variables 0.70, and between REVDEC and TAXDEC variables 0.70). Based on the analysis of the correlation between the control variables in the model, a high level of quantitative agreement was established among the variables Interest rate on long-term maturity bond - government bond yields, 10 years' maturity and Harmonized Index of Consumer Prices (HICP) annual average index (0.48). Having that in mind, we have omitted the variable Harmonized Index of Consumer Prices (HICP) annual average index from the model, i.e. further analysis.

Table 1 presents the estimated values of the parameters POLS Model 1, POLS Model 2 and POLS Model 3, whereas in each model the effect of fiscal decentralization on public debt was measured, expressed by one of three indicator variables. POLS Model 1 shows the effect of the share of total local government expenditure in total general government expenditure on public debt; POLS Model 2 was used to estimate the dependence of public debt on the share of total local government revenue in total general government revenue, while POLS Model 3 was also used to estimate the share of total local government tax revenue in total general government tax revenue on public debt of EU member-states in the observed period.

The sample of EU countries includes three countries (Malta, Cyprus and Luxembourg) with very limited levels of fiscal decentralization. Excluding these countries from the sample yields the POLS model statistics with indicator-variables included, which are shown in columns 2, 4 and 6, based on which it can be clearly concluded that by excluding countries with very limited levels of fiscal decentralization, the REVDEC variable became statistically significant in POLS Model 2, while the relevant statistics POLS Model 1 and POLS Model 3 remained unchanged.

Table 1 POLS model statistics with indicator-variables included

	POLS Model 1	POLS Model 1****	POLS Model 2	POLS Model 2****	POLS Model 3	POLS Model 3****
	1	2	3	4	5	6
EXPDEC	-0.081** (0.028)	-0.082** (0.027)				
REVDEC			-0.058 (0.029)	-0.057* (0.027)		
TAXDEC					-0.050 (0.041)	-0.046 (0.043)
GDP_G	-0.016*** (0.001)	-0.016*** (0.002)	-0.016*** (0.001)	-0.016*** (0.002)	-0.016*** (0.002)	-0.016*** (0.002)
DPOPU	-1.397** (0.472)	-1.370* (0.651)	-1.375** (0.477)	-1.366* (0.653)	-1.384** (0.512)	-1.415 (0.754)
DI	0.022* (0.011)	0.023** (0.008)	0.022* (0.011)	0.022** (0.008)	0.023* (0.011)	0.023** (0.008)
DUNMP	0.222*** (0.030)	0.226*** (0.034)	0.224*** (0.031)	0.229*** (0.034)	0.220*** (0.031)	0.224*** (0.035)
_cons	0.083*** (0.008)	0.083*** (0.010)	0.078*** (0.009)	0.078*** (0.011)	0.071*** (0.008)	0.071*** (0.010)
Adj. R-squared	0.499	0.492	0.494	0.488	0.490	0.483
Prob>F	0.000	0.000	0.000	0.000	0.000	0.000
F-test	100.420	39.770	98.726	39.132	93.564	37.538

Notes: Standard errors in parentheses; * $p<0.05$, ** $p<0.01$, *** $p<0.001$
****Calculation without Malta, Cyprus and Luxembourg because of the limited level of fiscal decentralization.
Source: own processing

The control variables were included in all three models. Based on the estimated parameter values with the variable measuring fiscal decentralization and the corresponding numerical values of the determination coefficient, it was established that the most adequate of the three tested models was POLS Model 1. An additional reason for choosing POLS Model 1 is a proven invariance of the results of this model in case of excluding countries with very limited level of fiscal decentralisation.

The lack of association between tax decentralization and public debt might seem as a surprise. However, several other studies came to a similar conclusion that revenue decentralization measures are not associated with fiscal outcomes (Horváthová et al., 2012;

Baskaran, 2010; Thornton, 2009). Possible explanations on the lack of this association revolves around considerations that subnational tax autonomy might aggravate reliance of local governments on bailout transfers from central government (so-called soft-budget constraint argument) and coordination failures between central and local governments (De Mello, 2000).

For the purpose of obtaining efficient estimations of model parameters, we performed a set of pre-estimation tests. The panel stationarity was examined by using IPS and CIPS tests; the assumption about the presence of cross-sectional dependence was tested between the panels for the variables covered by the model by using Pesaran's CADF test; the individual effects were analysed by using Hausman test; the assumptions regarding heteroscedasticity, intracluster correlation and comparative correlation of random errors were tested by using Modified Wald test for groupwise heteroscedasticity, Wooldridge test for serial correlation in panel data and Pesaran Panel Unit Root Test in the Presence of Cross-section Dependence.

By using the first generation unit root IPS test and the second generation unit root CIPS test, the null hypothesis was tested about the presence of unit roots of the regression model variables for the panel data. Based on the empirical p-value, the null hypothesis was refuted regarding the presence of unit roots for EXPDEC, REVDEC, TAXDEC and GDP_G variables. The remaining model variables were transformed by taking logarithm values of the first differentiated original variables, thus resolving the problem of the presence of unit roots in the sample (see Table 2).

Table 2 Unit root panel tests

	IPS unit root test	CIPS unit root test		
		t-bar	Z-bar	p-value
EXPDEC	-2.0498**	-2.116	-1.975	0.024
REVDEC	-2.1671**	-1.616	0.722	0.765
TAXDEC	-2.7385***	-1.959	-1.106	0.134
GOV_DEB	2.8502	-1.823	-0.394	0.347
GDP_G	-7.9278***	-2.736	-5.325	0.000
POPU	8.1980	-1.376	2.019	0.978
I	5.0083	-	-0.606	0.272
HICP	-1.4829	-1.978	-1.234	0.109
UNMP	3.0210	-1.764	-0.073	0.471

Notes: Standard errors in parentheses; * p<0.05, ** p<0.01, *** p<0.001
Source: own processing

The null hypothesis about the presence of cross-sectional dependence in the sample of the observed countries was tested by the variant of Pesaran Cross-sectional Dependence Test (Pesaran, 2021), which implies that the null hypothesis is the sum of all correlations between panel units for the given variable is equal to zero (Wursten, 2017). When the null hypothesis is

correct, Pesaran's Cross-sectional Dependence (CD) test statistics has the standardized normal distribution, and the truthfulness of the null hypothesis can be checked by using the standard Z test.

Taking into account that the null hypothesis was rejected for all the variables, the results of Pesaran's test indicate the presence of cross-sectional dependence in the panel that is the subject of the analysis (Table 3). The identification of the expressed cross-sectional dependence is not surprising when we take into account that the country sample is homogeneous regarding geographical dispersion, regional integration and the level of economic development. In the analysed period, there are two distinct global trends at the sub-period level: the growth trend before the outbreak of the world economic crisis, and the recession and recovery trend after the outbreak of the crisis, which can also be considered a cause of the presence of cross-sectional dependence among the panel units.

Table 3 Pesaran's Cross-Sectionally Augmented Dickey-Fuller (CADF) test

Variable	t-bar	Z(t-bar)	p-value
DGOV_DEB	-2.566	-4.287	0.000
EXPDEC	-2.116	-1.975	0.024
GDP_G	-2.736	-5.325	0.000
DPOPU	-2.418	-3.517	0.000
DI		-5.145	0.000
DUNMP	-2.608	-4.502	0.000

Notes: Standard errors in parentheses; * $p<0.05$, ** $p<0.01$, *** $p<0.001$
Source: own processing

The results of Hausman test (see Table 4) conducted on the analyzed sample of panel data indicate a relatively small difference in the values of the estimated regression coefficients between FE and RE estimation, which speaks in favour of rejecting the null hypothesis and the use of FE estimator in the next stage of the econometric analysis. The obtained result is consistent with the previously stated hypothesis that in the analysis of macroeconomic data, FE estimator is a superior estimator for estimating the model with a composite error.

The limitation in applying Hausman test refers to the fulfilment of OLS hypotheses about random errors of the model, and that is why in the event of residual random errors of FE and RE estimation being heteroscedastic and correlated, this test cannot be considered reliable. That is why the problems of heteroscedasticity and correlation of random errors were examined with the aim to examine the robustness of the results obtained by using Hausman test.

Table 4 Hausman test of individual effects estimator selection

Variables	Fixed effects (b)	Random effects (B)	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
EXPDEC	-0.094	-0.057	-0.038	0.245
GDP_G	-0.021	-0.018	-0.002	0.000
DPOPU	-1.770	-1.479	-0.291	0.817
DI	0.024	0.023	0.001	.
DUNMP	0.174	0.197	-0.023	0.002

Note: H_0: Difference in coefficients not systematic, chi2(5) = 46.56, Prob>chi2 = 0.000
Source: own processing

The test results of the residuals shown in Table 5 point to the presence of heteroscedasticity and cross-sectional dependence in FE estimation residuals, so that it is necessary to use alternative robust estimations of variant-covariant residual matrix.

Table 5 Residual tests of FE estimations

Test	t-statistics	p-value
Modified Wald test for groupwise heteroscedasticity	chi2 (27) = 2680.50	0.0000
Wooldridge test for serial correlation in panel data	F(1, 26) = 0.059	0.8097
Pesaran Panel Unit Root Test in the Presence of Cross-section Dependence	z =7.600	0.0000

Note: Standard errors in parentheses; * $p<0.05$, ** $p<0.01$, *** $p<0.001$
Source: own processing

Table 6 shows the estimation results of the model obtained by using different estimators: POLS, FE OLS, TFE OLS, PCSE OLS, FGLS and RE GLS. The obtained results show that the fiscal decentralization variable has the expected sign, i.e. that the effect of the share of total local government expenditure in total general government expenditure on public debt is negative. The estimated values of regression coefficients for all the used estimators are negative, whereas the statistically significant estimations at the confidence level are 1% and 5%, obtained by using POLS, TFE OLS, PCSE OLS and FGLS estimators. These values vary from -0.060 to -0.081 so it can be concluded that the model is robust.

Similar results were obtained by Baskaran (2010) on a sample of 17 OECD countries in the period 1975-2001. Using FE OLS, PCSE OLS and GMM estimators, the author came to the conclusion that fiscal decentralization measured by expenditure decentralization significantly reduces public indebtedness. Beside it, Governatori and Yim (2012) argue that subnational governments often do not have real power over subnational expenditure due to the legislation and national directives. It contributes to higher fiscal discipline implicitly. The findings *of* Sow and Razafimahefa (2017) support the negative relationship between the expenditure

decentralization and government indebtedness considering the stronger fiscal balance observed in the case of higher expenditure decentralization.

Table 6 Panel model statistics with the EXPDEC variable included as the fiscal decentralization degree measure for the whole sample

	POLS	**FE OLS**	**TFE OLS**	**PCSE OLS**	**FGLS**	**RE GLS**
EXPDEC	-0.081** (0.025)	-0.176 (0.159)	-0.079*** (0.023)	-0.081** (0.025)	-0.060** (0.021)	-0.088 (0.045)
GDP_G	-0.016*** (0.002)	-0.020*** (0.002)	-0.014*** (0.002)	-0.016*** (0.002)	-0.015*** (0.001)	-0.018*** (0.002)
DPOPU	-1.397* (0.630)	-0.893 (0.937)	-1.219 (0.643)	-1.397* (0.621)	-1.395*** (0.378)	-1.346 (0.873)
DI	0.022** (0.008)	0.024* (0.009)	0.025* (0.013)	0.022* (0.011)	0.012 (0.006)	0.023** (0.009)
DUNMP	0.222*** (0.032)	0.180*** (0.037)	0.189*** (0.051)	0.222*** (0.035)	0.207*** (0.023)	0.202*** (0.037)
_cons	0.083*** (0.010)	0.112** (0.037)	0.077*** (0.010)	0.083*** (0.008)	0.067*** (0.006)	0.089*** (0.018)
Adj. R-squared	0.499	0.556	0.531	0.504		0.503
Prob.	0.000	0.000	0.000	0.000	0.000	0.000
Wald Chi2				349.75	690.39	217.15
F-test	43.483	52.813	19.129			

Note: Standard errors in parentheses; * p<0.05, ** p<0.01, *** p<0.001
Source: own processing

Following the example of Horváthová et al. (2012), who found that the impact of fiscal decentralization on a country's public debt depends on whether the observed country is the old EU member or it joined the EU later, a control variable is included in the econometric analysis model to investigate the impact of fiscal decentralization on public debt. The control variable is referred to as Date of EU Accession. Table 7 shows the numerical values of the parameters that express the impact of Time of EU Accession on Fiscal Decentralization, where the values of the parameters obtained using different estimators and the levels of significance of the assessed parameters are shown separately.

Taking into account the estimated values of the parameters using different estimators and the level of significance of the estimates, it can be concluded: (1) the impact of fiscal decentralization on the country's public debt depends on whether the country joined the EU before or after 2004; (2) in the old EU member states, fiscal decentralization has a negative impact on public debt, with the degree of impact varying from -0.297 to -0.085 depending on the econometric specification of the random error, i.e. the estimator used to quantify the impact of the degree of decentralization on public debt; (3) all ratios, regardless of the estimator, that express the impact of fiscal decentralization on public debt are positive and vary from 0.128 to

0.314, except in the case of FE OLS; fiscal decentralization in the countries that joined the EU later significantly affects the public debt, so that the new member states of the EU that have a higher degree of decentralization also have a higher public debt; (4) except in the case of estimates of the parameters of the impact of fiscal decentralization on public debt obtained using FE FES and RE GLS estimators, the differences in the dependence of public debt on the degree of decentralization between new and old EU member states are statistically significant.

Table 1 Estimation of SUR1 model

		POLS	**FE OLS**	**TFE OLS**	**PCSE OLS**	**FGLS**	**RE GLS**
EXPDEC_old		-0.112*** (0.026)	-0.297*** (0.072)	-0.112*** (0.024)	-0.112*** (0.027)	-0.085*** (0.021)	-0.117*** (0.029)
EXPDEC_new		0.173** (0.058)	0.314 (0.431)	0.164** (0.056)	0.173*** (0.047)	0.128*** (0.037)	0.161* (0.079)
GDP_G_old		-0.016*** (0.002)	-0.018*** (0.003)	-0.014*** (0.002)	-0.016*** (0.003)	-0.015*** (0.002)	-0.016*** (0.002)
GDP_G_new		-0.020*** (0.003)	-0.022*** (0.004)	-0.020*** (0.003)	-0.020*** (0.002)	-0.016** (0.002)	-0.021*** (0.003)
DPOPU_old		1.690 (1.161)	-0.156 (1.468)	1.464 (1.034)	1.690 (1.051)	0.545 (0.628)	1.373 (1.032)
DPOPU_new		-0.471 (0.704)	-1.391 (1.678)	-0.288 (0.729)	-0.471 (0.760)	-0.247 (0.595)	-0.603 (1.010)
DI_old		0.013 (0.008)	0.015 (0.011)	0.011 (0.012)	0.013 (0.011)	0.010 (0.007)	0.013 (0.010)
DI_ new		0.032* (0.015)	0.035* (0.013)	0.028 (0.017)	0.032 (0.021)	0.021 (0.016)	0.034** (0.013)
DUNMP_old		0.173*** (0.035)	0.157** (0.046)	0.160*** (0.048)	0.173*** (0.045)	0.154*** (0.028)	0.170*** (0.050)
DUNMP_new		0.220*** (0.049)	0.181** (0.051)	0.172** (0.062)	0.220*** (0.050)	0.234*** (0.039)	0.210*** (0.049)
_cons		0.062*** (0.008)	0.087* (0.036)	0.059*** (0.008)	0.062*** (0.008)	0.055*** (0.006)	0.065*** (0.014)
Adj. R-squared		0.542	0.562	0.569	0.551		0.551
Prob.		0.000	0.000	0.000	0.000		0.000
Wald Chi2					420.97	662.24	453.85
F-test		31.109	57.700	14.046			
H₀: $\beta_1=\beta_2$	**t-test**	3.68	0.82	4.37	10.94	12.07	3.90
	Prob>F	0.012	0.496	0.005	0.012	0.007	0.273

Note: Standard errors in parentheses; * $p<0.05$, ** $p<0.01$, *** $p<0.001$
Source: own processing

Similar results regarding the impact of the accession date on the dependence of public debt on fiscal decentralization were obtained by the authors Horváthová et al. (2012) who investigated the impact of fiscal decentralization on public debt in a sample of EU country data

panels in the period 1999-2009. They showed that the date of accession affects the dependence of fiscal decentralization on public debt by finding that in old member states fiscal decentralization reduces public debt, and in new member states fiscal decentralization increases public debt. However, these authors did not find that the results of the survey of the impact of the degree of decentralization on public debt in the new EU member states are statistically significant. The argument explaining the observed results is given in Oates (1985). He stresses the natural increase of public expenditure tied to the implementation of fiscal decentralization. In fact, in new EU members the fiscal decentralization was implemented with some time delay (in comparison with old EU members) mostly in the beginning of the 21st century (Maličká, 2016). According to Oates (1985) the shift of responsibilities to local authorities and their real execution is accompanied by the increase of local public expenditure as well as by additional administrative and bureaucracy costs and includes block costs of reforms, too. This might decelerate the desired negative relationship between the fiscal decentralization and public debt.

In addition to the date of accession to the EU, the size of the EU member state measured by the number of inhabitants is included in the model as a control variable (see Table 8).

This point of the examination arises out of the idea of Jurado and León (2021), Belmonte et al. (2018) or Garrett and Rodden (2000). They mention that larger countries tend to be more decentralized. The results of the research showed: (1) the impact of fiscal decentralization on public debt is negative in subsamples of countries: small, medium and large countries; (2) based on the parameters assessed using four of the six estimators, it can be concluded that the negative impact of decentralization on reducing public debt is statistically significant; (3) the estimated value of the parameter with the main explanatory variable in small countries varies in the interval from -0.074 to -0.055, in the medium-sized countries from -0.137 to -0.120, and in large countries in the interval from -0.121 to -0.082; (4) the F-test showed that the intensity of the impact varies statistically significantly from country to country depending on its size; (5) estimates of the negative impact of fiscal decentralization on public debt, regardless of country size, are robust.

Observed results correspond partially with findings of Horváthová et al. (2012). They showed that the impact of fiscal decentralization on public debt is negative and statistically significant in large EU countries, while in small and medium-sized countries this impact is not statistically significant. In this research, additionally, the fiscal decentralization influences significantly and negatively the public debt in countries small in population, too, but the effect of expenditure decentralization is stronger in case of large economies, which supports the argument of Jurado and León (2021), Belmonte et al. (2018) or Garrett and Rodden (2000).

Table 2 Estimation of SUR2 model

		POLS	FE OLS	TFE OLS	PCSE OLS	FGLS	RE GLS
EXPDEC_small		-0.074** (0.026)	-0.159 (0.197)	-0.072** (0.024)	-0.074** (0.026)	-0.055* (0.021)	-0.079 (0.050)
EXPDEC_middle		-0.120 (0.074)	-0.223 (0.188)	-0.129 (0.072)	-0.120* (0.057)	-0.137** (0.044)	-0.143 (0.107)
EXPDEC_large		-0.114* (0.046)	-0.264 (0.287)	-0.121** (0.044)	-0.114** (0.041)	-0.082* (0.032)	-0.118 (0.096)
GDP_G_small		-0.017*** (0.002)	-0.022*** (0.002)	-0.016*** (0.002)	-0.017*** (0.002)	-0.015*** (0.001)	-0.020*** (0.002)
GDP_G_ middle		-0.014** (0.005)	-0.015 (0.008)	-0.010* (0.005)	-0.014*** (0.003)	-0.010*** (0.003)	-0.014 (0.008)
GDP_G_large		-0.010*** (0.003)	-0.016** (0.004)	-0.008* (0.003)	-0.010*** (0.003)	-0.011*** (0.003)	-0.013** (0.004)
DPOPU_small		-1.010 (0.737)	-0.324 (0.949)	-0.785 (0.761)	-1.010 (0.737)	-1.097* (0.475)	-0.859 (1.006)
DPOPU_ middle		-3.666 (1.946)	0.787 (3.378)	-3.371 (1.929)	-3.666* (1.673)	-2.384* (1.110)	-2.283 (2.876)
DPOPU_large		-3.027*** (0.862)	-3.138** (0.953)	-2.407* (0.995)	-3.027*** (0.862)	-2.371** (0.793)	-3.199** (1.187)
DI_small		0.023* (0.011)	0.032* (0.012)	0.024 (0.015)	0.023 (0.016)	0.007 (0.011)	0.028* (0.011)
DI_middle		0.024 (0.017)	0.007 (0.017)	0.021 (0.018)	0.024 (0.019)	0.033* (0.015)	0.018 (0.015)
DI_large		0.006 (0.010)	0.008 (0.012)	0.007 (0.012)	0.006 (0.012)	0.006 (0.010)	0.007 (0.010)
DUNMP_small		0.275*** (0.049)	0.209*** (0.055)	0.221*** (0.062)	0.275*** (0.051)	0.250*** (0.034)	0.240*** (0.058)
DUNMP_middle		0.087 (0.050)	0.110 (0.071)	0.071 (0.057)	0.087 (0.053)	0.139*** (0.042)	0.100 (0.068)
DUNMP_large		0.266*** (0.051)	0.215*** (0.044)	0.201** (0.061)	0.266*** (0.052)	0.250*** (0.046)	0.239*** (0.040)
_cons		0.085*** (0.010)	0.116** (0.036)	0.079*** (0.010)	0.085*** (0.009)	0.069*** (0.006)	0.092*** (0.016)
Adj. R-squared		0.513	0.567	0.546	0.528		0.525
Prob.		0.000	0.000	0.000	0.000	0.000	0.000
Wald Chi2					441.77	683.02	1059.34
F-test		23.303	1599.594	9.579			
H₀: $\beta_1=\beta_2=\beta_3$	**F-test**	19.73	8.86	20.57	52.90	49.03	36.59
	Prob>F	0.000	0.001	0.000	0.000	0.000	0.000

Note: Standard errors in parentheses; * $p<0.05$, ** $p<0.01$, *** $p<0.001$
Source: own processing

Neytapi (2013) mentions that the effectiveness of fiscal decentralization in delivering fiscal efficiency depends on structural and institutional characteristics of a country. According to Bodman et al. (2009) or Garrett and Rodden (2002) more decentralized countries have more

government levels. Estimating the SUR3 model (see Table 9), the impact of the number of government levels on the dependence of public debt on fiscal decentralization was examined. While Horváthová et al. (2012) observe a statistically significant positive impact of the number of government levels on public debt, our results differ in both examined cases. Empirical results have shown: (1) the number of levels of government has a negative and statistically significant impact on public debt reduction; (2) as the number of levels of government increases, the negative impact of fiscal decentralization on public debt increases; (3) the result regarding the negative and statistically significant impact of the number of government levels on the dependence of public debt on fiscal decentralization was confirmed in the case of three or more levels of government when estimating the parameters of regression models using all six estimators, while the dependence of public debt on the degree of decentralization is confirmed by using four of the six estimators; (4) the hypothesis of different intensity of the influence of the number of government levels on the dependence of public debt on fiscal decentralization was confirmed by t-test when all estimators were used with a level of significance less than 10%.

Table 3 Estimation of SUR2 model

	POLS	**FE OLS**	**TFE OLS**	**PCSE OLS**	**FGLS**	**RE GLS**
EXPDEC_glvl12	-0.082** (0.026)	-0.173 (0.170)	-0.079** (0.024)	-0.082** (0.026)	-0.052* (0.021)	-0.089 (0.051)
EXPDEC_ glvl345	-0.179*** (0.045)	-0.926* (0.416)	-0.188*** (0.045)	-0.179*** (0.039)	-0.149*** (0.027)	-0.214* (0.096)
GDP_G_ glvl12	-0.017*** (0.002)	-0.020*** (0.003)	-0.015*** (0.002)	-0.017*** (0.002)	-0.015*** (0.001)	-0.019*** (0.002)
GDP_G_ glvl345	-0.012*** (0.002)	-0.015*** (0.003)	-0.008** (0.003)	-0.012*** (0.002)	-0.014*** (0.002)	-0.014*** (0.004)
DPOPU_ glvl12	-1.193 (0.658)	-0.744 (1.076)	-1.015 (0.663)	-1.193 (0.645)	-1.252** (0.408)	-1.126 (0.897)
DPOPU_ glvl345	-4.246** (1.378)	-0.751 (1.209)	-3.638* (1.534)	-4.246*** (1.030)	-1.857* (0.846)	-2.903* (1.203)
DI_ glvl12	0.023* (0.011)	0.027* (0.012)	0.026 (0.015)	0.023 (0.015)	0.008 (0.010)	0.025* (0.011)
DI_ glvl345	0.008 (0.009)	0.006 (0.007)	0.010 (0.011)	0.008 (0.009)	0.009 (0.008)	0.007 (0.007)
DUNMP_ glvl12	0.234*** (0.036)	0.197*** (0.042)	0.190*** (0.051)	0.234*** (0.039)	0.242*** (0.027)	0.212*** (0.041)
DUNMP_ glvl345	0.095 (0.049)	0.066 (0.039)	0.083 (0.059)	0.095* (0.047)	0.065 (0.039)	0.083 (0.048)
_cons	0.089*** (0.011)	0.145*** (0.037)	0.082*** (0.011)	0.089*** (0.009)	0.070*** (0.006)	0.095*** (0.020)

		POLS	FE OLS	TFE OLS	PCSE OLS	FGLS	RE GLS
Adj. R-squared		0.508	0.559	0.540	0.518		0.516
Prob.		0.000	0.000	0.000	0.000		0.000
Wald Chi2					383.91	719.83	517.72
F-test		26.611	42.249	10.127			
H_0:	**t-test**	8.62	3.00	9.79	21.67	31.21	5.20
$\beta_1=\beta_2$	**Prob>t**	0.000	0.067	0.000	0.000	0.000	0.074

Note: Standard errors in parentheses; * p<0.05, ** p<0.01, *** p<0.001
Source: own processing

Conclusion

According to the regression analysis of panel data about fiscal decentralization and public debt of EU member-states in the period 1999-2019, a reliable conclusion has been made that fiscal decentralization, expressed as the share of total local government expenditure in total general government expenditure, negatively affects public debt and that effect is statistically significant. The research results also convincingly show that the country size, the number of government levels and the EU accession year are the variables that can significantly intensify or reduce the effect of fiscal decentralization on public debt. Furthermore, the analysis shows that the effect of fiscal decentralization is positive in the countries that became EU members after 2004. The size of the EU country cannot change the direction, but it can intensify or reduce the negative effect of fiscal decentralization on public debt. The negative effect of fiscal decentralization on public debt is slightly stronger in the countries with a larger number of government levels.

The main policy implication of this study is that fiscal decentralization appears beneficial for public finances of EU countries, so decentralization should remain a high priority on the EU public policy agenda. The evidence on negative and significant association between fiscal decentralization and public debt supports the view of Oates' Decentralization Theorem that in democratic countries a decentralized system leads to provision of local public outputs tailored to the local demands, improving the level of social welfare. On the other hand, we did not find any evidence on the relationship between tax decentralization and public debt, opposite to soft-budget constraint and coordination failure arguments that tax decentralization undermines public finance. Therefore, further efforts in fiscal decentralization should reconsider local taxation policy to make it more beneficial for overall fiscal sustainability.

Although the study contributes to examination on the relationship between fiscal decentralization and public debt, it is obvious that in the future certain attention should be dedicated to the expression of the degree of fiscal decentralization and identification of other

"external" factors that may also affect the relationship between fiscal decentralization and public debt such as the degree of the country's economic growth etc.

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Appendix A. Government debt scatterplots and its determinants for the whole sample
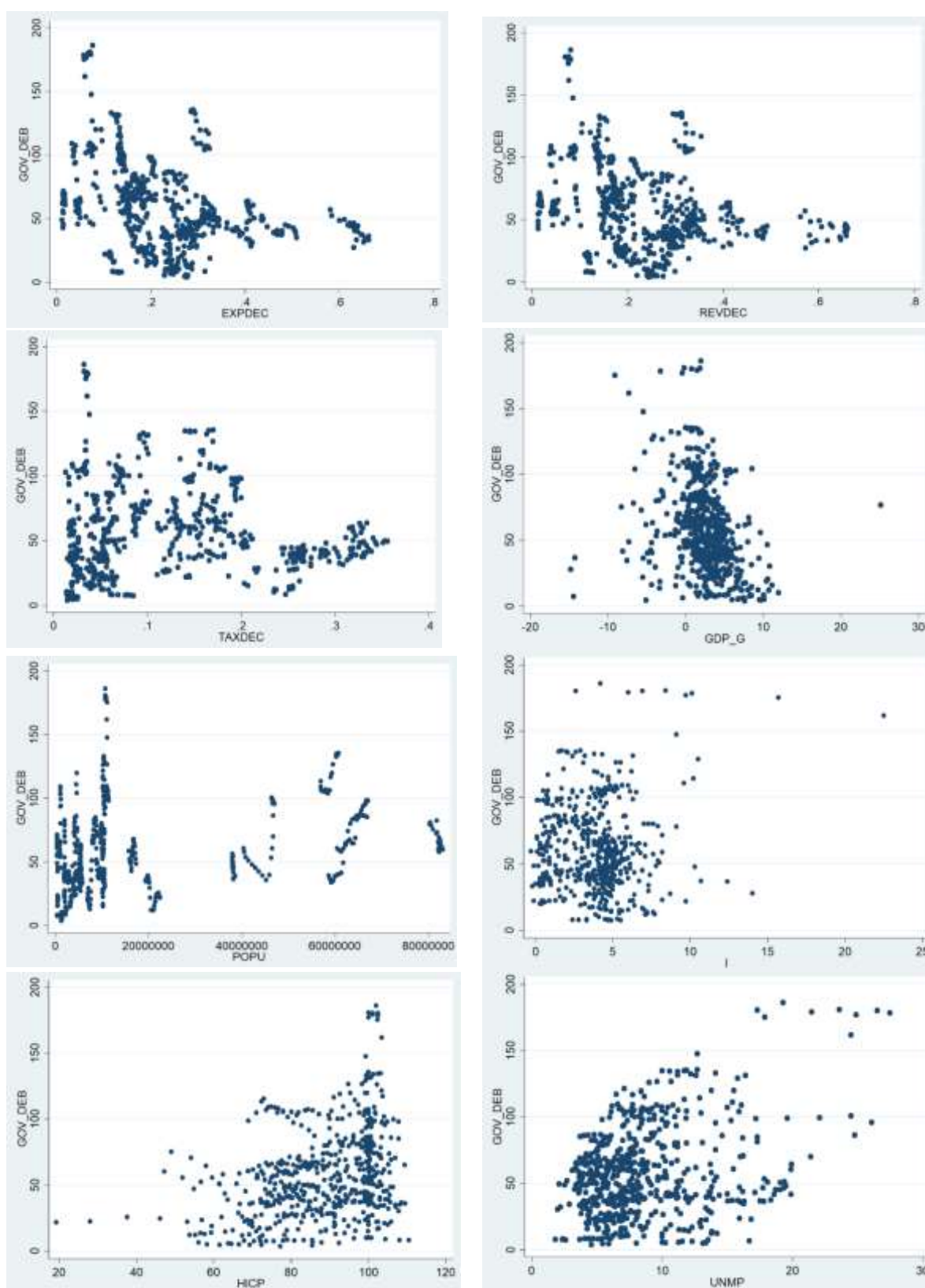
Source: own processing using StataBE 17

Appendix B. Description of variables

Variable type	Label	Operationalization	Data Source	Expected relationship according to operationalization
Dependent variable	GOV_DEB	Government consolidated gross debt	Eurostat	
Main explanatory variables	EXPDEC	Total local government expenditure (as percent of GDP) / Total general government expenditure (as percent of GDP)	Eurostat	The higher level of fiscal decentralization, the lower government debt (-)
	REVDEC	Total local government revenue (as percent of GDP) / Total general government revenue (as percent of GDP)	Eurostat	The higher level of fiscal decentralization, the lower government debt (-)
	TAXDEC	Total local government tax revenue (as percent of GDP) / Total general government tax revenue (as percent of GDP)	Eurostat	The higher level of fiscal decentralization, the lower government debt (-)
Explanatory variables	GDP_G	Annual percentage growth rate of GDP at market prices based on constant local currency. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products.	World Bank	The stronger the economic growth, the lower government debt (-)
	POPU	Population on 1. January – total number of inhabitants of particular country	World Bank	The bigger population, the lower government debt (-)
	I	Interest rate on long-term maturity bond - government bond yields, 10 years' maturity	Eurostat	The higher interest rate on long-term maturity bond, the lower government debt (-)
	HICP	Harmonized Index of Consumer Prices (HICP) annual average index	World Bank	The higher Harmonized Index of Consumer Prices, the lower government debt (-)
	UNMP	Unemployment rate	World Bank	The higher Unemployment rate, the lower

				government debt (-)
Transformed explanatory variables	DGOV_DEB	First log difference of variable GOV_DEB		
	DPOPU	First log difference of variable POPU		
	DI	First log difference of variable I		
	DHICP	First log difference of variable HICP		
	DUNMP	First log difference of variable UNMP		
Control variables	GOV_LVL	Number of government levels. Total score for given country is calculated upon complexity of its public administration structure.	Horváthová et al. (2012) and Council of European Municipalities and Regions (2012)	
	Year of EU accession	All countries from the sample were divided into two groups: 1) countries that joined the EU until 2004; 2) countries that joined the EU after 2004	Own	
	Country size	All EU member states were divided by size into 3 categories: 1) small countries (below 10,000,000 inhabitants); 2) medium-sized countries (with 10,000,000 to 30,000,000 million inhabitants); 3) large countries (with over 30,000,000 million inhabitants)	World Bank	

Source: own processing

Appendix C. Descriptive statistics

Table C.1 Descriptive statistics of key variables for whole sample

	GOV_DEB	EXPDEC	REVDEC	TAXDEC	GDP_G	POPU	I	HICP	UNMP
Mean	57.7	0.227	0.235	0.124	2.5	17,905,249	18.5	88.6	8.7
Median	52.1	0.207	0.217	0.092	2.6	8,857,874	4.1	91.6	7.5
Max	186.2 GR 2018	0.663 DN 2017	0.661 DN 2010	0.356 SWE 2003	25.2 IRE 2015	83,132,799 GER 2019	22.5 GR 2012	110.5 EST 2019	27.5 GR 2013
Min	3.8 EST 2007	0.011 MT 2017	0.013 MT 2018	0.01 CY 2016	-14.8 LIT 2009	387,578 MT 1999	-0.3 GER 2019	19.2 RO 1999	1.8 LUX 2001
Std. dev.	33.7	0.129	0.126	0.095	3.4	2.27e+07	3.8	13.6	4.3

Notes: Countries and correspondent years are displayed, GR–Greece, DN-Denmark, SWE–Sweden, IRE-Ireland, GER–Germany, EST- Estonia, MT-Malta, CY- Cyprus, LIT-Lithuania, RO-Romania, LUX-Luxembourg
Source: own processing

Table C.2 Descriptive statistics of variables for countries according to the EU accession

	GOV_DEB	EXPDEC	REVDEC	TAXDEC	GDP_G	POPU	I	HICP	UNMP
	countries that acceded to EU before 2004								
Mean	71.18	0.25	0.25	0.13	1.89	26,320,614.83	3.53	90.79	8.17
Median	64.70	0.18	0.18	0.09	1.95	10,716,322.00	3.81	92.10	7.40
Max	7.40	0.06	0.07	0.02	-9.13	430,475.00	-0.25	67.87	1.81
Min	186.20	0.66	0.66	0.36	25.16	83,132,799.00	22.50	107.80	27.50
St. dev.	35.84	0.15	0.15	0.10	2.93	26,786,367.96	2.31	10.14	4.45
	countries that acceded to EU after 2004								
Mean	42.23	0.20	0.21	0.11	3.29	8,195,211.51	4.46	86.14	9.24
Median	39.70	0.23	0.24	0.09	3.74	4,299,642.00	4.54	91.19	7.82
Max	3.80	0.01	0.01	0.01	-14.84	387,578.00	0.25	19.23	2.00
Min	109.10	0.34	0.36	0.29	11.99	38,660,271.00	14.00	110.50	19.92
St. dev.	22.76	0.09	0.09	0.09	3.79	10,182,260.16	2.33	16.49	4.18

Source: own processing

Table C.3 Descriptive statistics of variables of countries according to size

	GOV_DEB	EXPDEC	REVDEC	TAXDEC	GDP_G	POPU	I	HICP	UNMP
	small countries								
Mean	43.84	0.24	0.24	0.13	3.05	4,000,393.05	3.68	88.44	8.54
Median	41.65	0.20	0.21	0.06	3.21	4,142,222.50	4.10	91.56	7.31
Max	3.80	0.01	0.01	0.01	-14.84	387,578.00	-0.19	49.02	1.81
Min	119.90	0.66	0.66	0.36	25.16	9,923,085.00	14.00	110.50	19.92
St. dev.	24.31	0.16	0.15	0.12	3.94	2,733,521.08	2.17	13.39	4.02
	medium-sized countries								
Mean	73.14	0.20	0.22	0.10	2.05	12,779,138.43	4.60	87.81	8.01

Median	64.60	0.19	0.21	0.07	2.16	10,689,841.00	4.26	91.73	7.10
Max	11.90	0.06	0.07	0.03	-9.13	9,769,949.00	-0.07	19.23	2.00
Min	186.20	0.51	0.49	0.32	10.43	22,472,040.00	22.50	109.46	27.50
St. dev.	41.81	0.10	0.09	0.07	2.97	3,853,450.18	2.97	16.19	4.53
	large countries								
Mean	73.82	0.23	0.25	0.14	1.85	58,438,833.45	3.63	90.06	9.75
Median	66.30	0.22	0.23	0.15	1.95	60,265,672.00	4.04	91.90	8.80
Max	34.00	0.12	0.15	0.05	-5.69	37,970,087.00	-0.25	63.60	3.10
Min	135.40	0.34	0.36	0.21	7.06	83,132,799.00	10.68	107.80	26.10
St. dev.	27.48	0.07	0.07	0.05	2.12	14,347,157.23	1.78	10.70	4.76

Source: own processing

Table. C.4 Descriptive statistics of variables for countries according to government levels

	GOV_ DEB	EXP DEC	REV DEC	TAX DEC	GDP_G	POPU	I	HICP	UN MP
	countries with 1 and 2 government levels								
Mean	51.27	0.23	0.24	0.12	2.74	10,850,817.66	4.04	88.15	8.78
Median	44.15	0.23	0.24	0.08	2.97	5,443,001.50	4.19	91.74	7.40
Max	3.80	0.01	0.01	0.01	-14.84	387,578.00	-0.19	19.23	1.81
Min	186.20	0.66	0.66	0.36	25.16	66,834,405.00	22.50	110.50	27.50
St. dev.	32.85	0.14	0.14	0.10	3.70	14,720,967.50	2.48	14.41	4.60
	countries with 3, 4 and 5 government levels								
Mean	81.48	0.21	0.22	0.13	1.79	43,771,497.27	3.46	90.38	8.25
Median	79.80	0.18	0.19	0.14	1.70	47,788,294.00	3.86	91.25	8.05
Max	36.40	0.13	0.13	0.04	-5.69	7,992,324.00	-0.25	63.60	3.10
Min	135.40	0.34	0.36	0.21	7.06	83,132,799.00	10.68	107.77	19.90
St. dev.	25.17	0.07	0.08	0.06	1.95	27,473,747.15	1.86	10.28	3.26

Source: own processing

Table C.5 Correlation coefficients for whole sample

	GOV_ DEB	EXP DEC	REV DEC	TAX DEC	GDP_G	POPU	I	HICP	UNM P
GOV_DE B	1								
EXPDEC	-0.34	1							
REVDEC	-0.32	0.99	1						
TAXDEC	-0.18	0.70	0.70	1					
GDP_G	-0.31	-0.01	-0.05	-0.08	1				
POPU	0.28	-0.03	-0.01	0.04	-0.14	1			
I	0.07	-0.15	-0.12	-0.12	-0.24	-0.10	1		
HICP	0.30	-0.03	-0.01	0.01	-0.28	0.01	-0.48	1	
UNMP	0.40	-0.24	-0.19	-0.01	-0.19	0.05	0.38	0.06	1

Source: own processing