Government debt influence on EU countries economic growth: importance of matching Maastricht criterion

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Abstract: The paper aims to analyse the impact of government debt on the country's economic growth. Beginning of the economic crisis in 2007 and rapid growth of government debt has attracted interest in this topic. Government debt-to-GDP ratio in the EU has increased from 58.7 to 86.8 percent from 2007 till 2014 and opened a vast field for discussions – how economic growth is affected by this situation? Using panel data approaches, we find evidence that in short-run increasing government debt has uniform negative impact on economic growth in all EU Member States but in the long-run negative impact is only in those that do not match Maastricht criterion.

1. Introduction

The current government debt crisis in some Member States of the Euro area raises the question of how government debt and economic growth are related. Many EU countries faced with growing government debt phenomenon in 2007 at the beginning of the economic crisis. Government debt issue is now one of the most relevant issues causing debate among politicians and economists. In some EU countries (Greece, Ireland, Portugal, Spain) a rapidly growing debt shows that the

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problem is very important. Debt in EU increased by 79 percent during the period 2004-2014 and by 67 percent in Euro zone and now consist respectively 87 and 92 percent of GDP. The debt increase is a consequence of the fiscal policy measures, which have been used during the economic recession, for stabilization and then implementing the government's expansionary policies, but the question remains open – does this increase of government debt, as a consequence of expansionary policies, positively influences economic growth.

EU countries are constantly facing with the lack of the financial resources needed to implement the functions of the state, so government borrowing plays an important role. In most cases, this phenomenon is not unacceptable; contrary – it may be effective way of development. Government borrowing is often carried out of the policies that promote economic development. The borrowed funds, used for problematic or important areas of the national economy such as energy, infrastructure, environmental protection and so on, allows the state to expect that the economic situation is stable, predictable and attractive for further investment. To restrict increase of sovereign debt, European Union has created bounds for the budget deficit and government debt. They are named as the Maastricht criteria and implemented by the Maastricht treaty.

Although the empirical analysis of government debt helps to predict the impact of the debt on the economy of the country and the optimal level of government debt, but in reality due to very different various factors, which are hardly predictable, results of the researches differ. Government debt impact on economic growth is widely debated topic (Liliko et al., 2009; Checherita, Rother, 2010; Holm-Hadulla et al., 2011; Afonso et al., 2011; Afonso, Sousa, 2012: 4439-4454; Molanescu, Aceleanu, 2011: 59-74; Legrenzi, Milas, 2012: 988-999; Ryskulov, Mera, 2012: 265-275; Taylor et al., 2012: 189-204; Eggerston, Krugman, 2012: 1469-1513; Moinescu, 2013: 17-30; Faraglia et al., 2013: F164-F192; Calderon, Fuentes, 2013; Vogel, 2014), but there is no unanimous agreement about impact direction and magnitude.

The **object** of research – government debt impact on the economic growth.

The **aim** – to assess government debt impact on the EU Member States economic growth during 1995 – 2014 in terms of matching the Maastricht criterion.

Objectives of the research is to analyse scientific literature on the government debt in terms of countries' economic growth, perform dynamic analysis of government debt in the EU countries in the period 1995-2014, quantitatively evaluate government debt impact on the economic growth in terms of Maastricht criterion.

The **methods** of the research: systematization and analysis of scientific literature and previous empirical research results; econometric analysis methods integrating quantitative descriptive statistics and regression analysis. Calculations were made using GRETL program.

Rest of the paper proceeds as follows: Section 2 presents the literature review of government debt impact on economic growth; adoption of regression analysis methodology for empirical evaluation of government debt on economic growth is described in Section 3; government debt and economic growth dynamic analysis in terms of Maastricht criterion is presented in Section 4; Section 5 discusses empirical results of model application in EU Member States; Finally, Section 6 closes the paper with the main conclusions.

2. Theoretical analysis of government debt impact on economic growth

Relevant issue is how to define government debt. The evaluation of government debt depends on the definition of government debt, as it determines what data is included in the analysis. Martin (2009: 608-631) hold standard view defining net government liabilities as debt held by the government. Other view, which is supported for example by Pieper, Eisner (1984: 11-29), consider that all assets and liabilities should be included. Because of different technical and conceptual frameworks, valuation of these views is difficult. Eurostat is using term – consolidated general government gross debt at nominal (face) value, which outstands at the end of the year in the following categories of government liabilities: currency and deposits, debt securities and loans. The general government sector comprises the subsectors: central government, state government, local government and social security funds. International Monetary Fund (2013) states that total government debt consists of all liabilities that are debt instruments. A debt instrument is defined as a financial claim that requires payment(s) of interest and/or principal by the debtor to the creditor at a date, or dates, in the future.

In scientific literature government debt is defined as total amount of all government liabilities. Authors differently interpret definition of government debt but it can be stated that government debt is the amount of government's liabilities which is necessary to balance government finances. In fiscal policy debates terms "debt" and "deficit" are quite often used almost interchangeably. Clarifying differences between them we should note here that government budget deficit is the gap between flows of government revenues and expenditures *in*

a given year. The government debt is accumulated stock of government securities issued to finance deficits in the pasts. When revenues exceed expenditures for some years, the overall debt falls. According to Irons, Bivens (2010), theories concerning negative influence of government borrowing on economic growth primarily analyses deficits, but not debt. Government borrowing requirements depend on several reasons (1 table).

Table 1. Factors of government borrowing requirements

Deficit of government finances	The difference between government income and expenditure over a period of time. The main source of revenue is the fee at their shortage state borrows in the financial markets and from international institutions.
Debt refinancing	Debt refinancing need arises when the government borrows a new loan, which will cover an old debt.
Re-lending	The government borrows its funds in domestic or foreign markets and re-lend them to other state government entities or state-owned enterprises. This is done in order to implement projects which financing is unforeseen in the state budget.

Source: Author's own elaboration based on: Minenna, 2014; Adam, 2011: 57-74; Irons, Bivens, 2010.

According to the analysis of scientific literature it can be stated that there is no consensus about the role of the government debt of the country's economy. The results depend on the direction and purpose of the study, available statistical information, included variables and applied theoretical approach.

The empirical literature on the relationship between government debt and economic growth is scarce, but gaining importance. The theoretical literature tends to point to a negative link between government debt-to-GDP ratio and economic growth (Checherita-Westphal, Rother, 2012; Afonso, Jalles, 2013: 384-407). Karazijienė, Sabonienė (2009: 271-279) emphasize that governmental borrowing does not cause damage to the economy if only the opportunities provided by debt are used in an optimal way. It is important to estimate what level of the government debt is acceptable to the country and how it could be managed under certain economic conditions. While choosing criteria to determine acceptable level of the government debt, it is important to evaluate possibility to apply those criteria not only in analysis but also while forecasting. Kregždė (2012: 56-71) notes that not paying attention to the growth of government debt creates a serious risk to the country's economic growth rates. This is not a big problem as long as the country has rapid economic growth. During economic decline, it is very hard to keep non-increasing debt. To implement that in the medium term, government budget

balance should be strongly positive during economic growth in order to compensate a negative one during economic decline.

Greiner (2012) describes government debt and economic growth links by an inverted U-shaped pattern. First, higher government debt to GDP ratios go along with higher GDP growth rates before the relation becomes negative, implying that there is a growth maximizing government debt-to-GDP ratio. Greiner (2013: 272-292) shows that there could be two balanced growth paths and they depend on two characteristics of country economy: i) structural parameters and ii) flexibility of the labour market. He is arguing, that government debt does not impact long-run economic growth and employment, just stability of the economy and latter is more likely if governments making attempts on stabilizing the debt-to-GDP ratio. Jaejoon, Kumar (2010) reach two important conclusions: an inverse relationship between initial debt and growth. Afonso, Jalles (2013: 384-407) analyse the linkages between growth, government debt and productivity. Authors conclude that there is a negative effect of debt ratio and financial crisis on economic growth.

Many other authors confirmed link between economic growth and government debt (Schclarek, 2004; Reinhart, Rogoff, 2010, 2011; Kumar, Woo, 2010; Fincke, Greiner, 2011: 202-213; Cecchetti et al., 2011; Baum et al., 2012; Cheresita-Westphal, Rother, 2012: 1392-1405).

Sound and sustainable government finances are crucial for the optimal functioning of economic monetary union (EMU). Only few papers analysed government debt impact on economic growth in terms of Maastricht criterion. Lojsch et al., (2011) pay attention to the importance of the size and composition of government debt. Afonso, Alves (2014) conclude that debt negatively influences growth, both in the short and long-term, contrary to the signature of the Stability and Growth Pact. Baum et al. (2012) have proven that the government debt supports the growth of the GDP when it does not exceed 67%, and country has some pressure when the government debt exceeds 70%. Checherita-Westphal, Rother (2012: 1392-1405) estimated non-linear relationship between debt and growth with a turning point – at about 90–100% of GDP, beyond which government debt has negative impact on long-run economic growth. Reinhart, Rogoff (2010) have found that this turning point is at about 60% of the GDP, exceeding which significantly reduces GDP growth. Using empirical data, Kumar, Woo (2010) estimated that not only debt-to-GDP ratio but also amount of the debt has non-linear correlation with economic growth. Cecchetti et al. (2011), who analysed negative impact of government debt over a 30

years on OECD countries' economies, estimated 85% debt-to-GDP ratio threshold. Greiner (2012), after analysis which covered 132 fiscal episodes of 21 OECD countries over 28 years, concluded that: consolidation programmes of government debt reduction are more successful when they are followed by product-market deregulation and when they are adopted by left-wing governments. Despite the above fact, there are some papers to suggest some adjustments to the Maastricht criteria in order to take into account other economic data such as the GDP growth (Governatori, Eijffinger 2004). Nenovsky, Marinova (2014) argue that the combination between constraints stemming from the applied fixed exchange regime (Currency board) and Maastricht Treaty budgetary requirements have led to the fiscal discipline.

The scientific literature analysis shows that there is no consensus on government debt impact on economic growth in terms of Maastricht criteria. Various authors provide very different results of their research. There is no clear limit of government debt impact in terms of Maastricht criteria because countries differ by economic development level, also impact period is different. Evaluation of government debt of economic growth is important for further policy measures concerning management of government debt.

3. Model for assessment of government debt impact on economic growth

Our goal is to evaluate what impact on economic growth has government debt and particularly is this impact is different when EU countries do not match Maastricht criterion.

In order to do that, we will analyse panel data (structure NxT) for 28 EU Member States from 1995 to 2014 (panel data 28x20). A few widely used regression analysis approaches for analysing panel data can be applied here – first difference (FD), fixed effects (FE) and random effects (RE). All of them have their own advantages and disadvantages.

When T is large, and especially when N is not very large (as in our case, N=28 and T=20), we exercise caution in using the fixed effects estimators because they are extremely sensitive to violations of the classical fixed effects assumptions when N is small and T is large. In particular, we use data on GDP and government debt which exhibits trend generated unit root processes and this leads to spurious regression problem. In this case, using differences is favourable.

The ideal random effects assumptions include all of the fixed effects assumptions plus the additional requirement that unobserved EU member state effects are independent of all explanatory variables in all time periods. But such an assumption is very hard to ground in our case and we think that unobserved effects are correlated with explanatory variables.

One of the ways to use panel data is to view that unobserved factors (in our case unobserved EU Member States heterogeneity) affecting the dependent variable (in our case economic growth) are constant over time (endowment of natural resources, climate, neighbour trade partners and etc.). Many other factors may not be exactly constant, but they might be roughly constant over a 20-year period – education level of labour force, industrial structure, structure of population age and etc. In order to produce a consistent estimator which represents impact of government debt on economic growth, we would have to assume that the unobserved effects of EU Member States are uncorrelated with government debt. But this is not the case, constant factors which influence economic growth (for example minimal wages) correlate with government debt. The resulting bias can be eliminated differencing the data across time and as unobserved effects are constant over time they will be "differenced away." Equation (1), which we call the first-differenced equation and will use in our empirical analysis, is:

$$\Delta \ln(gdp_{i,t}) = \alpha + \delta_4 y1998 + \ldots + \delta_{20} y2014 + \beta_1 \Delta \ln(gdp_{i,t-1}) + \beta_2 \Delta \ln(debt_{i,t}) + \beta_3 maastricht_{i,t} \cdot \Delta \ln(debt_{i,t}) + \Delta u_{i,t}$$
$$(1)$$

Where:

$gdp_{i,t}$ – is gross domestic product in chain linked volumes (2010), million euro in a country i in year t. $\Delta \ln(gdp_{i,t})$ - approximates annual rate of economic growth.

$\Delta \ln(gdp_{i,t-1})$ – is annual rate of economic growth prior one year. This variable is included in the model to control for the fact that economic growth exhibits cumulative causation process of AR(1).

$debt_{i,t}$ – is a government's consolidated debt in millions of euros in country i in year t. $\Delta \ln(debt_{i,t})$ - approximates annual rate of debt growth.

$maastricht_{i,t}$ – is dummy variable equal to 1, if a country i in year t DO NOT match Maastricht criterion of government debt (max 60% of country GDP).

maastricht·Δln(debt$_{i,t}$) – interaction, which models differences of government debt impact on economic growth in countries that do not match Maastricht criterion of government debt compared with countries that do match this criterion.

1998$_t$,...,2014$_t$ - year dummy variables. Allowing the intercept (*α*) to change over time is important in our analysis. Secular trends in the EU will cause economic growth rates in all Member States to change ($\delta_4,...,\delta_{20}$) perhaps markedly, over a year.

β$_1$ and *β$_2$* are interpreted as coefficients of elasticity and respectively represents impact of economic growth prior one year and government debt growth on current economic growth.

β$_3$ shows the difference (in percentage points) of government debt impact on economic growth in countries that do not match Maastricht criteria of government debt compared with countries that do match this criterion.

Δu$_{i,t}$ - idiosyncratic error or time-varying error. We must assume that this error is uncorrelated over time for the usual standard errors and test statistics to be valid. This assumption will be tested in such way – if Δu_{it} follows a stable AR(1) model, then $\Delta u_{i,t}$ will be serially correlated. Only when Δu_{it} follows a random walk $\Delta u_{i,t}$ will be serially uncorrelated. If there is no serial correlation in the errors, the usual methods for dealing with heteroskedasticity are valid. We can use the Breusch-Pagan and White tests for heteroskedasticity, and we can also compute robust standard errors.

i - denotes cross-sectional observation number (28 EU Member States)

t - denotes time period (20 time periods from 1995 to 2014).

Because the *same* cross-sectional units (EU Member States) appear in each time period there is no need to control for factors that has constant distribution across time, they will be eliminated using first difference transformation.

In our analysis we use data provided by Eurostat. Data include all 28 EU Member States from 1995 till 2014 so we cover different periods of economic growth and decline as well as countries with different government debt levels. Using this data, we also assessed the countries' financial and economic situation in terms of matching Maastricht criterion on government debt – the accumulated government debt should be less than 60 per cent of GDP.

4. Analysis of the EU government debt and economic growth in terms of Maastricht

criterion

Government debt increased in all EU countries over last 10 years. The highest growth was in Luxembourg and Latvia – government debt grew more than 500 percent over last 10 years. This growth of Latvia's debt was influenced by global economic crisis. The growth of government debt in Luxemburg over last decade was driven in part by state support for Fortis, where shareholdings are now profitable, but it is still among the lowest in the EU. The detailed causes of the debt crisis varied. In several countries, private debts arising from a property bubble were transferred to government debt as a result of banking system bailouts and government responses to slowing economies post-bubble.

All EU Member States experienced growth of consolidated government debt over last 10 years. According to made calculations it can be stated that countries experienced faster government debt growth over last 10 years. This was caused mainly by three reasons: (i) bank loses (during the financials crisis, many commercial European banks lost money on their exposure to bad debts in US and that was commonly financed by the governments to avoid further bankrupts); (ii) recession (the financial crisis caused a fall in bank lending and investment; this caused an economic downturn); (iii) decrease in house prices (the recession and financial crisis also led to a fall in European house prices which increased the losses of many European banks).

The highest rate of government debt growth over last 10 years were recorded in Luxembourg (20,2 %), Latvia (19,7 %) and Romania (17,5 %), and the lowest in Denmark (2,7 %) and Sweden (2,3 %). Figure 1 shows average annual growth rates of consolidated government debt compared with GDP growth rates. The data analysis shows that countries a borrowing not only during economic decrease but also during economic growth period.

Figure 1. Average annual growth rates of government debt and economic growth
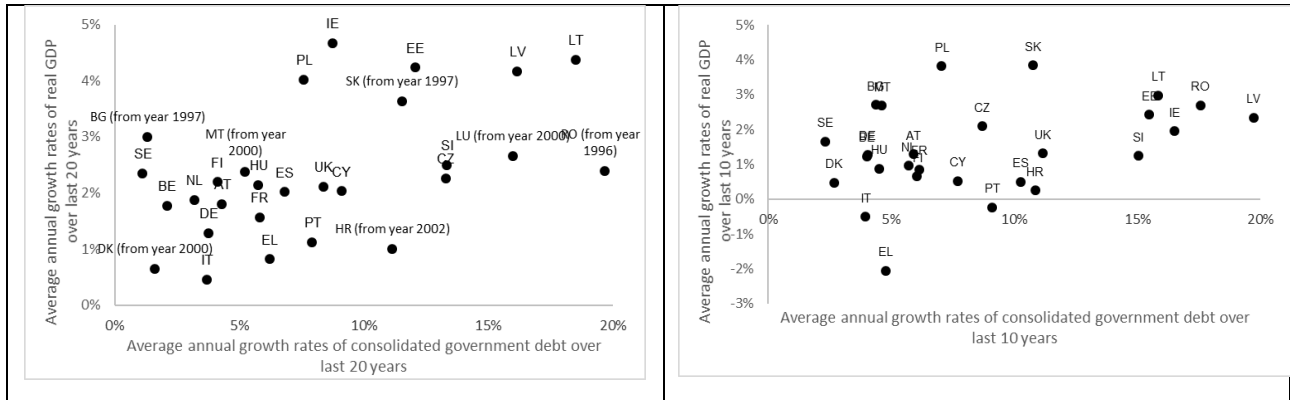
Source: Authors' own elaboration.

Comparing government debt growth over both analysis periods it can be seen that arrangement of the countries is different. The largest increases in government debt are projected for those Member States which also record the sharpest increases in fiscal deficits.
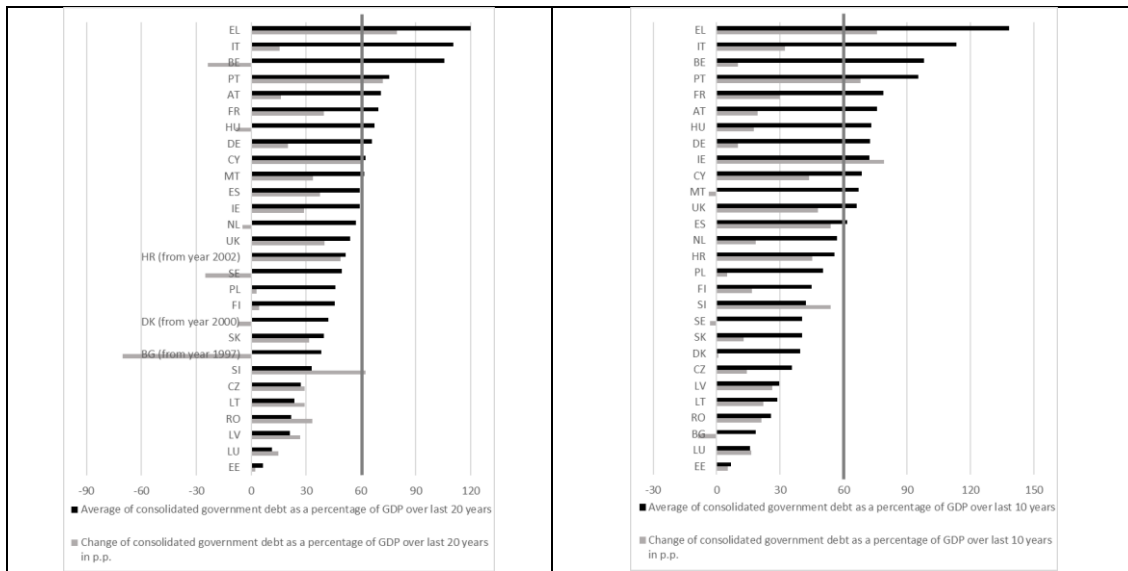

Figure 2. Average consolidated government debt as a percentage of GDP

Source: Authors' own elaboration.

13 EU countries exceed the Maastricht criteria (see Fig.2). The highest ratio of government debt to GDP was recorded in Greece (average ratio exceeds Maastricht criterion by 78 p. p.). This situation in Greece is caused by structural economic weaknesses and the long-term growing

government deficit (from 2006 to 2009 increased by more than 10 p. p.). The lowest ratio of government debt to GDP is in Estonia (7 %).

5. Assessment of government debt impact on economic growth in EU

We started from estimating model using form as it is in equation (1). Error terms of this estimated model followed a stable AR(1) process which indicates positive and statistically significant autocorrelation. After several adjustments to overcome serial correlation problem our model took a form of:

$$\Delta\ln(gdp_{i,t})=\alpha+AR(2)+\delta_6 y2000+\ldots+\delta_{20} y2014+\beta_1\Delta\ln(gdp_{i,t-1})+\beta_2\Delta\ln(debt_{i,t})$$
$$+\beta_3 maastricht_{i,t}\cdot\Delta\ln(debt_{i,t})+\Delta u_{i,t} \quad (2)$$

Errors of estimated model as it is in equation (2) did not followed AR(1) process, but White test indicated variance in error term. Taking this in to the account in Table 2 we presented our results of equation (2) estimation using robust standard errors.

Table 2. Estimation results of the government debt impact on economic growth

Variables, parameters, tests	(I)		(II)	
	Coefficient	*p-value*	*Coefficient*	*p-value*
const	0.0178	<0.0001	0.0182	<0.0001
y2000	0.0159	0.0229	0.0146	0.0361
...				
y2014	−0.0019	0.4497	−0.0006	0.8121
$\Delta\ln(gdp_{i,t-1})$	**0.6316**	<0.0001	**0.6497**	<0.0001
$\Delta\ln(debt_{i,t})$	**−0.0443**	0.0006	**−0.0572**	<0.0001
$maastricht_{i,t}\cdot\Delta\ln(debt_{i,t})$	−0.0084	0.7013	0.0407	0.0544
$\Delta\ln(debt_{i,t-1})$			0.0278	0.0825
$maastricht_{i,t-1}\cdot\Delta\ln(debt_{i,t-1})$			**−0.0839**	0.0019
AR(2)	**−0.1557**	0.0292	**−0.1560**	0.0256
	0.0659	0.0708	0.0407	0.2049
n	429		427	
Adj. R-squared	0.6840		0.6934	
p-value of testing H0: errors are not serially correlated	0.1248		0.1343	
p-value of testing H0: heteroskedasticity not present	<0.0001		<0.0001	

Source: Authors' own elaboration.

Our estimation results clearly indicate that economic growth of EU Member States follow cumulative causation process. Economic growth prior one year positively influence current economic growth. This is not surprising, because positive expectations (formed by favourable economic conditions) of economic agents have influence not just on present economic growth but thought cumulative causation process induce future economic growth. According to estimations in column (I) of Table 2, increase in GDP by one per cent (acceleration of economic growth by 1 percentage point) increases speed of economic growth by 0.63 p.p. in short-run and by 0.46 p.p. in the long-run. Regarding government debt, estimations are also quite clear. Increase of government debt slowing down speed of economic growth. According to estimations in column (I) of Table 2, increase of government debt by 10 per cent slowing down speed of economic growth by 0.44 percentage points in current year. Coefficient on interaction term is negative suggesting that magnitude of government debt impact on economic growth in countries that do not match Maastricht criterion is higher. But estimated difference is not enough statistically significant. We adjusted equation (2) to model impact of government debt on economic growth in the long-run:

$$\Delta\ln(gdp_{i,t})=\alpha+AR(2)+\delta_6 y2000+\ldots+\delta_{20}y2014+\beta_1\Delta\ln(gdp_{i,t-1})+\beta_2\Delta\ln(debt_{i,t})+\beta_3\Delta\ln(debt_{i,t-1})+$$
$$+\beta_4 maastricht_{i,t}\cdot\Delta\ln(debt_{i,t})+\beta_5 maastricht_{i,t-1}\cdot\Delta\ln(debt_{i,t-1})+\Delta u_{i,t} \qquad (3)$$

Estimation results of equation (3) are presented in Table 2 column (II). These results lead to some interesting insights. First of all, when we separate impact of government debt on economic growth in short-run and long-run effects, magnitude of negative impact in short-run is a bit higher than that we estimated using equation (2) (-0.0572 compared to -0.0443) and we still see no difference of this effect in countries that do not match Maastricht criterion compared with those that match it (p-value is above 0.05 on interaction term $maastricht_{i,t}\cdot\Delta\ln(debt_{i,t})$). We have no evidence that increase of government debt has any higher or lower negative effect in long-run compared with short-run on economic growth in countries that do match Maastricht criterion (p-value is above 0.05 on $\Delta\ln(debt_{i,t-1})$), but negative effect of government debt in long-run on economic growth in countries that do not match Maastricht criterion is more than twice in magnitude compared with short-run impact. Summarizing these findings, we can conclude that increase of government debt by 10 per cent would slow down speed of economic growth in short-run by 0.572 percentage points in countries that do match Maastricht criterion as well as in those

that do not mach. In the long-run increase of government debt by 10 per cent would slow down speed of economic growth by 1.411 percentage point in countries that do not match Maastricht criterion, while having no additional long-run effect in those that do match this criterion.

6. Conclusions

The current government debt crisis in some EU Member States raises the question of how government debt and economic growth are related and it's becoming more and more relevant issue. Analysis of the scientific literature reveals that the effect of government debt is ambiguous. In some cases, the public debt is one of the factors promoting the country's economic growth; in others – this is a disincentive, even causing economic recession.

All EU Member States experienced growth of consolidated government debt over last 20 years. According to made calculations it can be stated that over last 10 years countries experienced even faster government debt growth rates – average yearly growth rate increased from 8% to 9%.

According to our calculations based on panel data from EU Member States covering 1995-2014 year period, insights about governments' debt impact on economic growth in terms of Maastricht criteria could be concluded as: (i) increase of government debt by 10 per cent would slow down speed of economic growth in short-run by 0.572 percentage points in countries that do match Maastricht criterion as well as in those that do not match; (ii) in the long-run increase of government debt by 10 per cent would slow down speed of economic growth by 1.411 percentage point in countries that do not match Maastricht criterion, while having no additional long-run effect in those that do match this criterion.

Regression analysis results clearly support view that increase of government debt negatively affect economic growth, this impact differs in short and long-run and depends on government debt-to-GDP ratio. Maastricht criterion – 60% government debt-to-GDP ratio – has empirical ground as a turning point of government debt negative long-run effect on economic growth.

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*Wpływ długu publicznego na wzrost gospodarczy krajów UE:
znaczenie spełnienia kryteriów z Maastricht*

Streszczenie

Artykuł ma na celu przeanalizowanie wpływu długu publicznego na wzrost gospodarczy danego kraju. Zainteresowanie tym tematem wzrosło znacząco po rozpoczęciu kryzysu ekonomicznego w 2007 oraz związanym z tym gwałtownym podniesieniem poziomu zadłużenia rządów. W okresie od 2007 do 2014 roku wskaźnik długu publicznego do PKB w Unii Europejskiej wzrósł z 58,7 do 86,8%, co otworzyło szerokie pole do dyskusji – czy ta sytuacja oddziałuje na wzrost gospodarczy? Wykorzystując podejście oparte na danych panelowych, autorzy artykułu znaleźli dowód na to, że w krótkim okresie rosnący dług publiczny ma stały negatywny wpływ na wzrost

gospodarczy we wszystkich krajach członkowskich Unii Europejskiej, natomiast w długim okresie negatywny wpływ występuje tylko w tych krajach, które nie spełniają kryteriów z Maastricht.

Słowa kluczowe: dług rządowy, deficyt budżetowy, wzrost gospodarczy, kryteria z Maastricht