

ECONOMIC CONSEQUENCES OF PUBLIC DEBT. THE CASE OF CENTRAL AND EASTERN EUROPEAN COUNTRIES

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Abstract: *The paper aims to empirically assess, using panel data estimation techniques, the effects of public indebtedness on economic growth for a group of 11 Central and Eastern European countries and over the period 1994-2013. Our hypothesis is that, although public indebtedness may fuel economic growth, once public debt breaches a certain threshold the effects are reversed and public indebtedness negatively affects GDP growth rates. The results of our study confirm this kind of relationship, with a maximum debt threshold for all countries of about 45-55% of GDP, lower for the less developed (like Romania and Bulgaria) and higher for the more developed ones. Also, the threshold for Central and Eastern European countries is found to be lower than the one identified in other empirical studies for developed EU countries, as the former enjoy lower credibility, higher vulnerability to shocks and depend more on external capital transfers.*

Keywords: public debt; economic growth; CEECs; instrumental variable estimation

Introduction

If the regular budgetary revenues coming from taxes are insufficient to cover all public expenditures, public authorities will use public loans to fill this gap, and public debt will sign on an upward trajectory. Such an approach is usually accepted both in the literature and in practice when borrowed resources are used to finance public investment expenditures with high economic and social efficiency, thus creating preconditions for ensuring an upward economic growth trend. This course of action has been taken into consideration by the countries of Central and Eastern Europe (most of them with low public debts at the beginning of the transition), that have borrowed to support the extensive program of reforms inherent to the transition to a functioning market economy and, subsequently, to recover the development gaps from other EU Member States.

The realities of the recent sovereign debt crisis in EU countries have shown that a large public debt can equally prove to be harmful to economic growth, so it should be kept within certain limits. Although the EU Member States from Central and Eastern Europe have been less affected by the crisis, and their debts generally

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are (with the exception of Hungary) much lower than those of the “old” EU Member States, that joined the EU before 2004, the question is to what extent these countries’ situation can be considered out of the “danger zone”.

Against this background, the paper seeks to empirically examine the effects of public debt on GDP growth rates in 11 EU Member States from Central and Eastern Europe, for a period of 20 years, from 1994 to 2013. More specifically, our research aims to achieve the following objectives: to establish if it is confirmed the existence of a nonlinear (quadratic) relationship between the GDP growth rate and the public debt-to-GDP ratio; to identify, for the 11 countries of Central and Eastern Europe, the public debt-to-GDP turning point, after which debt is expected to negatively affect economic growth; to determine whether there are significant differences between different subgroups of EU Member States from Central and Eastern Europe, differentiated by criteria such as the degree of development or the belonging to the euro area (in particular, to see to what extent the above identified threshold is applicable to Romania).

The remainder of the paper is structured as follows: the first section presents a short literature review on the effects of public debt on a country's economic growth rate; in sections 2 and 3 we describe the model, the estimation techniques, the variables and data sources; section 4 presents the results of our estimations and discussions; the paper ends with conclusions and some policy recommendations.

1. Short literature review

The assessment of the effects of public debt on various aspects of the socio-economic life, especially on the GDP growth rates, has become a major concern of the scientific and academic community once EU sovereign debts began their unsustainable growth path, during the recent international economic and financial crisis.

Given the particularities of the sovereign debt crisis, that mainly affected developed countries, recent empirical studies have focused on the situation of this category of countries, especially those members of the EU and the euro area (Misztal, 2010; Kumar and Woo, 2010; Reinhart and Rogoff, 2010; Reinhart and Rogoff, 2010b; Checherita and Rother, 2010; Baum *et al.*, 2012; Bilan and Ihnatov, 2014; Mencinger *et al.*, 2014; Mencinger *et al.*, 2015; Gómez-Puig and Sosvilla-Rivero, 2015; Antonakikis, 2014). However, the results of these studies are not uniform ones, in relation to the methodology used, to the group of countries or the timeframe of the analysis, they oscillate between recognizing a positive impact of public debt and identifying adverse effects of public indebtedness of the GDP growth rates. A particular category of studies, seeking to evaluate the existence of nonlinear effects of public debt on the economic growth rate of a country, identifies a maximum debt-to GDP threshold after which the positive effects of public debt substantially diminish, even becoming negative.

The analysis undertaken by Kumar and Woo (2010), on the example of 38 developed and emerging market economies and for the period 1970-2007, outlines the existence of an inverse relationship between public debt and long-term



economic growth, due to the negative impact of public indebtedness on investment and the rate of capital accumulation. An increase of the initial debt level with 10% of GDP is associated, according to the authors, with a reduction of the real GDP per capita growth rate of about 0.2% per year, the effects being stronger in emerging market countries and weaker in developed ones. Also, based on VAR methodology, Misztal (2010) finds for the EU Member States that, on average, over the period 2000-2010, the increase of public debt by 1% resulted in the reduction of GDP by 0.3%, while a 1% increase in GDP led to the reduction of public debt by 0.4%.

Although heavily contested, the studies of Reinhart and Rogoff (2010a; 2010b), analyzing the relationship between central government debt and the long-term real GDP growth rate for a group of 44 developed and emerging market countries and for a period of more than two centuries (1790-2009), identify the existence of a weak connection between the two indicators until debt reaches 90% of GDP. After this threshold the link is found to become stronger, the real economic growth rate in countries with public debt above 90% of GDP being, on average, a few percent lower than in other countries.

Assessing the impact of public debt on economic growth for 12 EMU Member States for the period 1970-2008, Checherita and Rother (2010) also identify the existence of a nonlinear relationship, with a maximum debt-to-GDP threshold beyond which debt's effects on the GDP growth rate became negative of about 90-100% of GDP. Based on a different methodology, but for the same group of countries and the period 1990-2010, Baum *et al.* (2012) find public indebtedness has a positive impact on short-term economic growth until debt reaches 67% of GDP, beyond this threshold the effects becoming insignificant and even negative after 95% of GDP.

Mencinger *et al.* (2014) investigate the short-term effects of public debt on the economic growth rates of 25 EU countries affected by the European sovereign debt crisis, for the period 1995-2010 (for the „new” EU Member States) and 1980-2010 (for the „old” EU Member States). They find evidence of a nonlinear (inverted U-shape) relationship, the debt turning point being higher for the „old”, more developed EU Member States (of about 80%-94% of GDP) and lower for the „new” EU Member States (of about 53%-54%). The same authors (Mencinger *et al.*, 2015) further expand their analysis for a panel of 36 countries (31 OECD countries and 5 non-OECD member states) and reach similar conclusions. The same concave relationship is validated, with a debt-to GDP threshold of about 44%-45% in emerging market countries, about half the value of developed countries.

Gómez-Puig and Sosvilla-Rivero (2015) find evidence, for EMU countries and over the period 1980-2013, for the existence of a bi-directional causal relationship between public debt and economic growth. For some of the countries included into their analysis, as Belgium, Greece, Italy and Netherlands, they also find that debt has deleterious effects on economic growth only above a certain debt threshold, ranging between 56% and 103% of GDP, depending on the country.

Evaluating the effects of sovereign (sustainable and unsustainable) debt on short-term and long-term economic growth for 12 EMU countries over the period 1970-2013, Antonakakis (2014) finds that, on the short-term, non-sustainable debt-ratios above and below the 60% threshold have detrimental effects, while sustainable debt-ratios below 90% have positive effects. Also, with regard to long-term economic growth, both unsustainable and sustainable debt-ratios above the 90% threshold and unsustainable debt-ratios below the 60% have detrimental effects.

The papers dealing more specifically with the situation of Central and Eastern European countries are limited in number (Časni *et al.*, 2014; Gál and Babos, 2014). Performing a dynamic panel data analysis based on the pooled mean group estimator, for the period between 2000 and 2011 and for a sample of 14 Central, Eastern and Southeastern European countries, Časni *et al.* (2014) find that public debt has a significant negative influence on economic growth rates over both the short-term and long-term. Therefore, their recommendation is to design policy frameworks that encourage exports, promote long-term investment, but also support fiscal consolidation, in order to promote economic growth. Gál and Babos (2014) conduct a comparative analysis on the effects of public debt on economic growth for the Western and Post-communist New Member States of the European Union from 2000 until 2013. They find that, although the later are less indebted by comparison to the „old” EU members, high levels of public debt are more damaging for them, so keeping public debt under control is especially important for young EU members.

An overall assessment of previous empirical studies on EU Member States from Central and Eastern Europe shows that they generally confirm a linear negative relationship between public debt and economic growth. Therefore, our study contributes to existing literature by testing the existence of a nonlinear, „inverted U-shape” relationship between public indebtedness and economic growth in Central and Eastern European countries, meaning that the negative effects appear only after debt breaches a certain threshold.

2. Methodology

In order to capture the effects of public indebtedness on economic growth in Central and Eastern European countries, we use a standard economic growth model, linking the economic growth rate of a country to its GDP per capita of the previous year, the population growth rate and other determinants of economic growth (among which public debt, the variable we were interested in), as depicted by equation (1).

$$y_{i,t}/y_{m_{i,t}/t+n} = \alpha + \beta \ln Y_{i,t-1} + \gamma \text{population}_{i,t} + \delta_1 \text{public_debt}_{i,t} + \delta_2 \text{public_debt}_{i,t}^2 + \rho_k X_{k,i,t} + \vartheta_i + e_{i,t} \quad (1)$$

where: i is the country ($i=1,11$); t is the year ($t=1,20$); y is the dependent variable (the GDP per capita growth rate); $\ln Y$ is the natural logarithm of the real GDP per



capita; *population* is the population growth rate; *public_debt* is the general government debt-to-GDP ratio; X_k is a vector of control variables with effects on economic growth; α is the constant term; ϑ_i are the country-specific intercepts; $e_{i,t}$ are the observation-specific errors; $\beta, \gamma, \delta_1, \delta_2, \rho_k$ are the coefficients of the explanatory variables.

In our baseline model, we are looking to evaluate the short-term effects of public indebtedness on economic growth, so the dependent variable is the growth rate of the GDP per capita of the same year ($y_{i,t}$). In our subsequent models, we also test for the existence of medium and long-term effects of public indebtedness, considering as dependent variable the medium GDP per capita growth rate over 3, 5 and 7 consecutive years ($ym_{i,t/t+n}$).

In agreement with the findings of some recent studies (Checherita and Rother, 2010; Baum *et al.*, 2012; Mencinger *et al.*, 2014; Mencinger *et al.*, 2015), our hypothesis is that public debt has nonlinear effects on economic growth (of the form of a „Laffer” type curve), meaning that, while beneath a certain threshold, it may have positive effects on economic growth and, after that threshold, the effects may change becoming negative. In order to test for the existence of such nonlinear effects, we include both *public_debt* and *public_debt*² as explanatory variables, expecting for δ_1 (the coefficient of *public_debt* variable) to have positive values, and for δ_2 (the coefficient of *public_debt*² variable) to have negative values.

When designing the model we also included a set of control variables to express the impact of other determinants of economic growth, variables selected in agreement with the results of other empirical studies on similar issues (Kumar and Woo, 2010; Checherita and Rother 2010). In our baseline model, such variables are: the gross fixed capital formation, to reflect the impact of physical capital accumulation (*fixed_capital*); the general government budget balance to capture broader impact of public financial policies (*budget_balance*); the sum of exports and imports to GDP, expressing the impact of the degree of openness of the economy (*openness*); Freedom House index as a proxy variable for the degree of economic freedom (*free_index*). In order to test the robustness of our estimations, we then successively introduce into the model other control variables such as the real exchange rate (*exchange*), inflation rate (*inflation*), interest rate (*interest*), the domestic credit provided by the financial sector (*credit*), the general government budgetary revenues and expenditures (*gov_revenues* and *gov_expenditures*), the secondary school enrollment rate (*school_enr*). A detailed description of all variables included into the regression models and their significance can be found in Annex 1.

Although some may consider Central and Eastern European economies as a homogeneous group, in fact they are quite heterogeneous countries. It is enough to mention that they are both developed and developing economies and that their GDP per capita substantially differs among countries (for example, the GDP per capita of Slovenia was almost four times the one of Bulgaria, in 2013). Also, this group contains both euro and non-euro countries. So, to deal with the issue of

heterogeneity, fixed effects estimations are selected, allowing us to isolate the effects of the omitted variables, specific to each country.

Another issue specific to economic growth models is that of endogeneity, more specifically that of reverse causality. In our case, we should consider not only the possibility that public debt may influence the GDP growth rate of a country, but also that a higher GDP growth rate may lead to a lower public debt-to-GDP ratio. The bi-directional relationship is confirmed by studies such as that of Gómez-Puig and Sosvilla-Rivero (2014) or Mencinger *et al.* (2014). So, to control for endogeneity, we use instrumental variable estimation techniques (namely, two-step GMM), instrumenting *public_debt* and *public_debt*² variables by their one to three-years lags. The Hausman test allows us to test the statistical significance of selected instruments.

3. Data and descriptive statistics

Our study on the economic effects of public indebtedness is conducted on a panel of 11 Central and Eastern European countries that became member of the European Union starting with 2004 (namely Poland, Czech Republic, Estonia, Lithuania, Latvia, Hungary, Slovak Republic, Slovenia, Bulgaria, Romania and Croatia) and for a period of 20 years (1994-2013). The time frame of our analysis was limited by the lack of data (especially with regard to the public debt variable) from reliable, official sources to cover the first years of transition to market economy.

The data are annual series and have been collected from several international and European databases, as the International Monetary Fund's World Economic Outlook and Historical Public Debt databases, the World Bank's World Development Indicators and Health, Nutrition and Population Statistics databases and the European Commission's Annual Macro-Economic Database. A more in-depth presentation of the data sources for each of the variables included into our models can be found in Annex 1.

Table 1 - Descriptive statistics of selected variables

Countries	GDP per capita growth rate (%)				GDP per capita (constant 2005 USD)				Public debt (% of GDP)			
	Mean	Std. dev.	Min	Max	Mean	Std. dev.	Min	Max	Mean	Std. dev.	Min	Max
Bulgaria	3.4	4.4	-8.6	8.6	3487.4	901.7	2354.0	4692.4	55.8	455	14.9	172.3
Croatia	2.7	4.0	-6.8	10.0	9309.3	1498.7	6532.0	11375.2	40.4	9.2	25.5	60.2
Czech Republic	2.5	3.0	-5.0	6.7	11953.5	2046.3	8852.9	14612.2	27.0	10.6	12.5	46.0
Estonia	5.1	6.1	-13.9	13.0	8825.2	2613.0	4659.0	12274.9	6.1	1.8	3.7	9.8
Hungary	2.2	2.7	-6.7	5.0	9756.3	1501.6	7411.6	11533.8	67.7	10.3	52.6	82.6
Latvia	5.5	6.5	-16.6	13.3	6108.5	2049.2	3290.0	8999.0	18.8	10.8	7.8	39.7
Lithuania	4.9	6.4	-13.8	11.2	7022.8	2319.1	3818.5	10549.2	22.4	10.2	7.8	41.2
Poland	4.3	1.9	1.5	7.0	7814.1	1888.0	4866.4	10752.8	47.1	6.7	36.8	58.7
Romania	3.5	5.0	-6.0	9.7	4491.8	1087.3	3254.0	6072.8	23.2	7.7	12.6	39.4
Slovak Republic	4.1	3.3	-5.1	10.5	11126.1	2752.1	7216.5	15065.3	33.0	11.0	18.5	55.4



Countries	GDP per capita growth rate (%)				GDP per capita (constant 2005 USD)				Public debt (% of GDP)			
	Mean	Std. dev.	Min	Max	Mean	Std. dev.	Min	Max	Mean	Std. dev.	Min	Max
Slovenia	2.6	3.5	-8.8	6.4	16474.2	2783.5	11726.2	20682.9	30.3	13.1	17.0	70.0
All CEECs	3.7	4.5	-16.6	13.3	8758.3	4031.1	2354.0	20682.9	33.8	23.3	3.7	172.3

Source: authors' calculations

The descriptive statistics of the main variables included into our models, reflected in table 1, show that, over the period of our analysis, public debt registered high variability among countries, ranging between 3.7% of GDP in Estonia (in 2007) and 172.3% of GDP in Bulgaria (in 1994). It is well known that, at the beginning of transition, some post-communist countries (Bulgaria included) had high public debt-to-GDP ratios, however they benefited from consistent debt reduction agreements. By comparison to other, more developed EU Member States, Central and Eastern European countries have lower public debts, the mean value over the entire period of analysis being of only 33.8% of GDP. Also, the less indebted countries are the Baltic states, namely Estonia, Latvia and Lithuania, in Estonia the maximum public debt level over the last 20 years being of only 9.8% of GDP.

High disparities among countries can be observed with respect to the annual GDP per capita growth rate as well, the standard deviation for the whole country group being of 4.5%. The GDP growth rate ranged, over the period of our analysis, between 13.3% in Latvia, in 2006, and -16.6% in the same country, in 2009, on the background of the crisis. However, the average GDP growth rate was quite high over the past 20 years, of almost 4% (higher than the one of the “old” EU Member States).

The GDP per capita in constant prices also varied substantially among different Central and Eastern European countries and in time. This proves not only that these countries recorded significant development gains during the past 20 years (in some countries the GDP per capita doubled or even tripled in value), but also that they are a quite heterogenous group, the more developed countries being Slovenia, Slovak Republic and Czech Republic, and the less developed ones Romania and Bulgaria.

4. Results and discussions

The estimation results for our sample of 11 EU Member States from Central and Eastern Europe are summarized in Table 2. Model (1) is our baseline model, where same year's GDP per capita growth rate is the dependent variable, and the drivers of economic growth are, together with public debt, the population growth rate, the gross fixed capital formation, the degree openness of the economy, the budget balance and freedom index. To confirm the robustness of our estimates, other possible explanatory variables of economic growth were successively

included as regressors, such as the exchange rate, interest rate, inflation rate, budget revenues and expenditures, domestic credit and secondary school enrollment rate (the results are synthesized in Annex 2). Also, in models (2) and (3) we introduced two dummy variables: *crisis*, to capture the impact of the economic and financial crisis on economic growth rates (taking the value 1 for the years 2007-2013 and 0 for 1994-2006) and *EU*, to capture the effects of the integration into the European Union (taking the value 1 if a country is EU member in one particular year and 0 otherwise). Models (4) to (6) evaluate the effects of public debt on medium and long-term economic growth rates, the dependent variable being the average GDP per capita growth rate over 3, 5 and 7 consecutive years (starting with the basis year).

It can be seen in Table 2 that, for all models, both the coefficients of *public_debt* and of *public_debt2* explanatory variables are statistically significant, so it is confirmed, for the case of the 11 EU Member States from Central and Eastern Europe, the hypothesis of a nonlinear, quadratic type relationship between public debt and economic growth, both over the short-term and medium and long-term (over 3, 5 and 7 consecutive years). With regard to the sign of the coefficients, it results that the one associated with *public_debt* variable always has positive values, while the one of *public_debt2* variable has negative values, which means that the functional relationship which links the growth rate of GDP and public debt is of concave type, admitting the existence of a maximum value. The results are also robust to the introduction of other explanatory variables into the model (see Annex 2).

Table 2 - Effects of public debt on short, medium and long-term economic growth in Central and Eastern European Countries (CEECs)

	Short-term effects			Medium and long-term effects		
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
				3 consecutive years avg.	5 consecutive years avg.	7 consecutive years avg.
public_debt²	-	-	-	-0.00388***	-0.00442***	-0.00208***
	0.00296***	0.00270***	0.00308***	(0.000577)	(0.000702)	(0.000339)
	(0.000448)	(0.000393)	(0.000476)			
public_debt	0.327***	0.298***	0.332***	0.354***	0.431***	0.195***
	(0.0579)	(0.0544)	(0.0577)	(0.0610)	(0.0735)	(0.0424)
L.lnY	-15.20***	-11.45***	-17.58***	-11.60***	-7.639***	-7.753***
	(1.894)	(2.711)	(2.337)	(1.540)	(1.054)	(1.099)
population	-1.425**	-1.239**	-1.499***	-1.024**	-1.405***	-1.106***
	(0.555)	(0.583)	(0.558)	(0.521)	(0.465)	(0.372)
fixed_capital	0.715***	0.657***	0.704***	0.0617	-0.0722	-0.0880
	(0.118)	(0.122)	(0.115)	(0.0991)	(0.0675)	(0.0611)
openness	0.146***	0.155***	0.136***	0.0531***	0.0472***	0.0288**
	(0.0253)	(0.0240)	(0.0252)	(0.0195)	(0.0132)	(0.0115)
budget_balance	0.458***	0.433***	0.462***	0.352***	0.236***	0.0106
	(0.122)	(0.123)	(0.119)	(0.101)	(0.0668)	(0.0626)
free_index	-2.155**	-1.821**	-1.810**	-1.445*	1.869**	0.597
	(0.838)	(0.802)	(0.814)	(0.841)	(0.836)	(0.436)



	Short-term effects			Medium and long-term effects		
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
				3 consecutive years avg.	5 consecutive years avg.	7 consecutive years avg.
crisis		-2.030** (0.892)				
EU			1.694* (0.951)			
N	180	180	180	158	136	114
adj. R ²	0.502	0.522	0.507	0.369	0.576	0.660
maximum_debt	55.28	55.23	53.94	45.59	48.79	46.90
HansenPval	0.9578	0.9949	0.9175	0.1718	0.2199	0.7048

Notes: Standard errors between parentheses; heteroskedasticity and autocorrelation robust standard errors. Maximum_debt – the maximum value of the quadratic model in public debt ($\text{maximum_debt} = \frac{-\delta_1}{2\delta_2}$). Levels of significance: * p<0.10; ** p<0.05; *** p<0.01.

Source: authors' calculations

Therefore, it is confirmed the hypothesis that when public debt expressed as a share of GDP is small, the effects of public debt growth on the growth rate of GDP can be positive, but these effects gradually diminish as public debt is becoming more and important, and there is a certain debt threshold beyond which the effects reverse, and GDP growth rates diminish with further debt growth. For all countries in our sample, the debt-to-GDP turning point is approximately 53-55% of GDP for the short-term economic growth, and 45-48% of GDP for medium and long-term economic growth (well below the actual public debt level of countries like Hungary, Slovenia or Croatia). Our results generally confirm those of other empirical studies on similar groups of countries (Mencinger *et al.*, 2014; Mencinger *et al.*, 2015).

Table 3 - Effects of public debt on short-term economic growth for different CEEC groups

	Model (7) Romania and Bulgaria	Model (8) CEECs (Romania and Bulgaria excluded)	Model (9) Euro area CEECs
public_debt ²	-0.00285*** (0.000423)	-0.00489*** (0.000989)	-0.00402 (0.00282)
public_debt	0.241*** (0.0617)	0.500*** (0.113)	0.460** (0.226)
L.lnY	-8.656* (4.698)	-15.55*** (2.618)	-15.60*** (2.770)
population	-3.645*** (1.164)	-0.683 (0.636)	-0.964 (0.784)
fixed_capital	0.350 (0.220)	0.776*** (0.150)	0.802*** (0.169)
openess	0.0766 (0.0707)	0.138*** (0.0273)	0.136*** (0.0327)
budget_balance	1.023** (0.439)	0.423*** (0.124)	0.639*** (0.158)

	Model (7) Romania and Bulgaria	Model (8) CEECs (Romania and Bulgaria excluded)	Model (9) Euro area CEECs
free_index	3.144 (2.285)	-3.365*** (1.038)	-2.897** (1.266)
N	34	146	84
adj. R ²	0.388	0.509	0.576
maximum_debt	42.27	51.07	57.27
HansenPval	0.1923	0.6731	0.4988

Notes: Standard errors between parentheses; heteroskedasticity and autocorrelation robust standard errors. Maximum_debt – the maximum value of the quadratic model in public debt ($\text{maximum_debt} = \frac{-\delta_1}{2\delta_2}$). Levels of significance: * p<0.10; ** p<0.05; *** p<0.01.

Source: authors' calculations

To see if there are significant differences among Central and Eastern European countries, models (7) to (9) in table 3 evaluate the effects of public debt on short-term economic growth rates for different country sub-groups, among which Romania and Bulgaria (the less developed EU Member States) and the five Eurozone Central and Eastern European Countries (namely Estonia, Latvia, Lithuania, Slovak Republic and Slovenia), currently classified as developed countries. The results highlight a lower than average debt-to-GDP turning point for Romania and Bulgaria (of about 42% of GDP) and higher for the Central and Eastern European countries that currently are using euro (of about 57% of GDP), although in the case of the later the coefficient of the *public_debt2* variable is not statistically significant. So, the level of development is relevant for the maximum debt threshold, less developed countries affording lower debt-to-GDP ratios.

Public indebtedness may have positive effects on economic growth (subject to keeping debt within acceptable limits) either by demand stimulation, with impact on short-term economic growth, either by its contribution to higher (debt financed) public investments, with impact on the productive capacity of a nation and thus on long-term economic growth. From this point of view, it should be noted that the Central and Eastern European countries that joined the European Union during 2004-2013 indebted themselves to finance major public investment programs, especially infrastructure ones aimed at narrowing the development gaps compared to other EU Member States. Some studies of the European Commission confirm, in this regard, that public expenditures with gross fixed capital formation, with a more direct contribution to economic growth, are more important in the new EU Member States, most of them from Central and Eastern Europe, as result of the catching-up process (European Commission, 2012, p. 10). However, for some of these countries the efficiency of public spending on such destinations is quite low.

Our study also confirms that, once public debt exceeds a certain threshold, its effects on the GDP growth rate are predominantly negative. Given the European realities of recent years, it results that a large public debt raises concerns about its sustainability and the future stance of monetary and budgetary policies, fueling a general climate of mistrust, with negative impact on private savings and investments and, thus, on economic growth. The lack of confidence in public



authorities' ability to honor their debts without resorting to severe budgetary adjustment measures, possibly by increasing tax rates or introducing new taxes, can also entail the reduction of capital inflows in the affected country or even the increase of capital outflows, issue particularly important for countries that have eliminated restrictions on the free movement of factors of production, as is the case of our countries, members of the European Union. At the same time, when public debt rises above a certain level, it can lead to an increase in interest rates in the financial market, thus limiting the access of private agents to financial resources and leading to lower private investment and capital accumulation (Roman, 2009).

The negative impact of high public debt on GDP growth rates may also occur as governments are forced to adopt severe fiscal consolidation measures, either by increasing taxes or to cutting down public expenditures with possibly more favorable impact on economic growth, such as investment spending. This reaction has been confirmed in recent years in many of the Central and Eastern EU Member States with more consistent public debts and negative budget balances (European Commission, 2012; Dornean, 2012). For example, in Czech Republic, the reduction of the negative budget balance from 5.5% to 1.3% of GDP during 2009-2013 was accompanied by the reduction of public investment from 5.5% to 3.4% of GDP. In Poland, the reduction of the budget deficit from 4.9% of GDP in 2011 to 4.0% in 2013 was accompanied by a greater reduction of capital expenditures, by 1.8% of GDP. Also, in Romania, the negative budget balance was cut down from 8.9% of GDP to 2.2% of GDP during 2009-2013, while capital expenditures were reduced from 6.0% to 4.6% of GDP (European Commission, 2014).

The results of our study indicate that the debt-to-GDP turning point for Central and Eastern EU Member States, of about 45-55% of GDP (depending on the time framework of the analysis and country sub-groups), is lower than the one identified in the literature for other, more developed countries, such as the euro area countries. In this regard, recent empirical studies on the situation of developed countries, as those of Reinhart and Rogoff (2010a, 2010b), Checherita and Rother (2010), Baum *et al.* (2012), Mencinger *et al.* (2014) or Mencinger *et al.* (2015), identify a maximum public debt-to-GDP threshold of about 90-100% of GDP. One possible explanation comes from the fact that the group of countries included into our analysis also consists of developing economies, enjoying lower credibility compared to the developed ones from potential lenders, investors, etc., which makes the negative effects of a large public debt to appear sooner. At the same time, developing countries are more vulnerable and depend, to a large extent, on foreign capital for development.

Conclusions

The analysis of the impact of public indebtedness on economic growth conducted for 11 Central and Eastern EU Member States and over the period 1994-2013 confirmed the existence of an "inverted U-shape" relationship between public debt and GDP per capita growth rate, with a debt-to-GDP turning point of about

45-55% of GDP. Once this threshold is breached, a further increase in public debt is expected to negatively affect economic growth, due to increasing interest rates, the concerns about the lack of sustainability of public debt and, more generally, of fiscal policy, or to the severe budgetary consolidation measures.

However, compared to the results of other empirical studies on more developed countries (such as euro area Member States) the threshold appears to be much lower for Central and Eastern European countries. One possible explanation comes from the fact that they enjoy lower credibility, higher vulnerability to various shocks and depend to a greater extent on capital transfers from abroad for development.

Our results suggest that public authorities from the Central and Eastern European countries with high public debts (over the identified limits) should take action towards ensuring fiscal sustainability and cutting down debt, thus supporting for both short-term and long-term economic growth. Enforcing national fiscal rules imposing lower debt thresholds than the one of the Treaty of Maastricht, of 60% of GDP, could be the rationale path to follow.

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Annexes
Annex 1 – Description of the variables and data sources

Symbol	Name	Description	Data sources
<i>Dependent variable</i>			
y	Economic growth	GDP per capita growth rate (annual %)	World Bank (World Development Indicators)
<i>Explanatory variables (baseline model)</i>			
public_debt	Public debt	General government gross debt (% of GDP)	International Monetary Fund (Historical Public Debt Database), completed with International Monetary Fund (World Economic Outlook) for 2013 (all countries) and 2000 (Bulgaria)
Y	GDP per capita	GDP per capita (constant 2005 USD)	World Bank (World Development Indicators)
population	Population growth	Population growth (annual %)	World Bank (Health, Nutrition and Population Statistics)
openess	Openess of the economy	Sum of imports and exports of goods and services (% of GDP)	World Bank (World Development Indicators), completed with AMECO for Hungary, Latvia, Lithuania, Slovak Republic and Slovenia (2012 and 2013)
fixed_capital	Fixed capital formation	Gross fixed capital formation (% of GDP)	World Bank (World Development Indicators), completed with AMECO for Hungary, Latvia, Lithuania, Slovak Republic and Slovenia (2012 and 2013)
budget_balance	General government budget balance	General government net lending/borrowing (% of GDP)	International Monetary Fund (World Economic Outlook Database) completed with AMECO for Bulgaria (1994-1999), Estonia (1994), Latvia (1994-1997), Lithuania (1994-1999), Poland (1994), Romania (1995-1999) and Slovak Republic (1994-1996)
free_index	Freedom House index (proxy variable for the degree of economic freedom)	Freedom House index (average value of civil liberties and political rights ratings)	Freedom House (Freedom in the World Report)
<i>Explanatory variables (robustness control)</i>			
exchange	Real exchange rate	Real effective exchange rate index (2010=100)	World Bank (World Development Indicators) and AMECO for Estonia, Latvia, Lithuania and Slovenia
inflation	Inflation rate	Inflation, GDP deflator (annual %)	World Bank (World Development Indicators)
interest	Interest rate	The lending interest rate (%) (the bank rate that meets the short- and medium-term financing	World Bank (World Development Indicators)



Symbol	Name	Description	Data sources
		needs of the private sector)	
gov_expenditures	Budgetary expenditures	General government expenditures (% of GDP)	International Monetary Fund (World Economic Outlook Database) completed with AMECO for Bulgaria (1995-1999), Croatia (2001), Latvia (1995-1997), Romania (1995-1999) and Slovak Republic (1995-1996)
gov_revenues	Budgetary revenues	General government revenues (% of GDP)	International Monetary Fund (World Economic Outlook Database) completed with AMECO for Bulgaria (1995-1999), Croatia (2001), Latvia (1995-1997), Romania (1995-1999) and Slovak Republic (1995-1996)
credit	Domestic credit	Domestic credit provided by financial sector (% of GDP)	World Bank (World Development Indicators)
school_enr	Secondary school enrollment	Gross secondary school enrollment (%)	World Bank (World Development Indicators)

Source: the authors

Annex 2 - Robustness check

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
public_debt ²	-0.00287*** (0.000515)	-0.00237** (0.00108)	-0.00291** (0.00116)	-0.00371*** (0.000602)	-0.00271*** (0.000468)	-0.00283*** (0.000479)
public_debt	0.332*** (0.0613)	0.265*** (0.0997)	0.323*** (0.102)	0.396*** (0.0644)	0.304*** (0.0611)	0.290*** (0.0648)
L.lnY	-19.03*** (2.918)	-14.78*** (2.142)	-15.18*** (2.047)	-14.49*** (1.735)	-12.14*** (3.142)	-18.14*** (2.240)
population	-1.449*** (0.549)	-1.459*** (0.561)	-1.411** (0.552)	-1.253** (0.579)	-1.529*** (0.544)	-1.064* (0.571)
fixed_capital	0.776*** (0.121)	0.660*** (0.122)	0.714*** (0.117)	0.690*** (0.118)	0.725*** (0.128)	0.678*** (0.114)
openess	0.153*** (0.0258)	0.136*** (0.0282)	0.145*** (0.0263)	0.134*** (0.0219)	0.143*** (0.0259)	0.165*** (0.0260)
budget_balance	0.412*** (0.121)	0.525*** (0.136)	0.452*** (0.119)		0.414*** (0.138)	0.491*** (0.129)
free_index	-2.162** (0.880)	-2.109** (0.913)	-2.203** (0.829)	-1.149 (0.832)	-1.961** (0.867)	-2.357*** (0.906)
exchange	0.0644* (0.0381)					
interest		-0.0257 (0.0232)				
inflation			-0.000163 (0.00297)			
gov_expenditures				-0.612*** (0.129)		
gov_revenues				0.0853 (0.157)		
credit					-0.0381	

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
	(0.0305)					
school_enr	0.188** (0.0743)					
<i>N</i>	180	161	180	178	175	168
adj. <i>R</i> ²	0.504	0.516	0.500	0.542	0.502	0.547
maximum_debt	57.94	55.99	55.58	53.28	56.10	51.36
HansenPval	0.9326	0.3037	0.9508	0.8431	0.9752	0.9477

Notes: Standard errors between parentheses; heteroskedasticity and autocorrelation robust standard errors. Maximum_debt – the maximum value of the quadratic model in public debt ($\text{maximum_debt} = \frac{-\delta_1}{2\delta_2}$). Levels of significance: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Source: authors' calculations

