Asymmetric Impact of Public Debt on Economic Growth in Selected EU Countries[1]

Veronika ŠULIKOVÁ – Mihajlo DJUKIC** – Vladimír GAZDA* – Denis HORVÁTH*** – Lumír KULHÁNEK*****

Abstract

The paper explores the asymmetric relation between public debt and economic growth in 13 EU countries in the period 1993 – 2013. A panel data model uncovers a linear relation between debt-to-GDP decrease and GDP growth, while the relation between the debt-to-GDP increase and GDP growth is defined by an inverted U-shaped curve (parabola) with the peak at a 64% debt-to-GDP ratio. We identified two main patterns in relations between debt-to-GDP and GDP growth: (i) hysteresis loop – country data trace the closed circle defined within the debt interval [53%, 113%] (Austria, Finland, Denmark) and (ii) debt trap – country debt-to-GDP ratio breaks the 113% level and indebtedness increase followed by the GDP fall is tracing the diverging tail of parabola (debt trap in Greece, Italy, Portugal).

Keywords: *public debt, economic growth, debt trap, dynamic panel data model, non-linear relation, asymmetric relation*

JEL Classification: E62, H63

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1. Introduction

Discretionary fiscal policy has always been under serious examination in the context of its efficiency and potential problems. Numerous recent studies have tried to summarise the pros and cons for active fiscal policy with regard to the recent crisis, such as brought by Eggertsson and Krugman (2012) or Eggertsson (2013). Muscatelli and Tirelli (2005) used various New Keynesian models to estimate data for both the United States and European Union (EU), proving that fiscal policy can be a useful complement to monetary policy when attempting to revive economic growth. This approach has been considered to be of special importance in a period of economic crisis since the Great Depression. Expansionary fiscal policy is usually seen as the only economic policy solution in periods of economic recession. With the European Central Bank (ECB) target interest rate close to zero, several economists, echoed by many EU political leaders, argue that only a massive fiscal stimulus can reinvigorate the weakest economies (Vranceanu and Besencenot, 2013).

However, those fiscal stimuli are also connected with an increase in public debt having a potentially negative long-term impact on economic growth and macroeconomic stability in general. This issue is rather controversial since there is no general opinion about the extent to which we should be concerned about the public debt growth. As Panizza and Presbitero (2013) stated, quoting one of the conclusions of the IMF American Association Meeting held in January 2013, "… policy makers in advanced economies will have to resolve the problem of high government debt or they may face low growth prospects". The current key challenge for fiscal authorities is how to resolve fiscal problems without seriously jeopardising the incipient economic recovery (Cecchetti, Mohanty and Zampolli, 2010).

In this paper, we explore the asymmetric effects of increasing/decreasing public debt on economic growth in 13 countries of the EU. We aim to specify a public debt level which jeopardises a country's ability to grow or even to identify a specific country exposed to the so-called debt trap problem. The analysis covers the period from 1993 to 2013.

The paper is structured as follows. First, we focus on the empirical results of particular papers, which aimed to analyse the relationship between public debt and growth of EU countries in the recent past. Then, we explain the methodology and model we used to test the effects which certain debt levels may have on economic growth. We aim to contribute to the existing empirical research by introducing the dynamic panel data model, which allows us to explain the asymmetric effects of debt-to-GDP increase and decrease simultaneously in one model. After that, we graphically construct the evolution of the real

relationship between debt-to-GDP and GDP growth with the estimations of both the debt increase and decrease. Finally, we give some final remarks and conclusions.

2. The Non-linear Relation between Debt and Growth: A Literature Review

According to the traditional view, expansionary fiscal policy stimulates aggregate demand, i.e. a GDP increase as the economy is considered to be Keynesian in the short run. However, this policy can crowd out private investments and induce a long term output decrease (Elmendorf and Mankiw, 1999). In the neoclassical setting, an endogenous growth model shows that government debt increase causes a decline in GDP growth (Saint-Paul, 1992). Calvo (1998) developed a simple growth model, according to which high debt-to-GDP ratio is linked to lower economic growth, as the tax burden increase leads to lower investments and consequently lower economic growth, and low debt-to-GDP ratio is accompanied by higher economic growth, respectively. However, Arai, Kunieda and Nishida (2014) showed that there is a crowding-out effect functioning only if the public-debt-to-GDP ratio reaches a certain threshold.

T a b l e 1

Debt-to-GDP Threshold in the Relation between Debt-to-GDP and Economic Growth

Author	Countries, time	Threshold (% GDP)
Reinhart and Rogoff (2010)	44 countries in the past 200 years	About 90%
Caner, Grennes and Koehler-Geib (2010)	101 countries, 1980 – 2008	77% (full sample) 64% (developing)
Kumar and Woo (2010)	38 advanced and emerging economies, 1970 – 2007	90%
Misztal (2010)	EU-27, 2000 – 2010	65%
Cecchetti, Mohanty and Zampolli (2011)	18 OECD countries, 1980 – 2010	About 85%
Checherita and Rother (2010)	12 euro-area countries, 1970 – 2010	About 90 – 100%
Minea and Parent (2012)	Reply to Reinhart and Rogoff (2010)	115%
Elmeskov and Sutherland (2012)	77 countries, 12 OECD , 1960 – 2010	77% (full sample) 66% (OECD)
Égert (2012)	21 developed, 28 emerging economies, 1960 – 2010	20 – 60%
Chang and Chiang (2012)	19 OECD countries, 1993 – 2007	98%
Presbitero (2012)	low- and middle-income countries, 1990 – 2007	90%
Padoan, Sila and van den Noord (2012)	34 OECD countries, 1960 – 2011	90%
Vranceanu and Besencenot (2013)	26 EU countries, 1996 – 2011	148%
Baum, Checherita-Westphal and Rother (2013)	12 euro-area countries, 1990 – 2010	95%

Source: Authors' elaboration.

In recent years, several authors have considered the existence of non-linearity in the relationship between the debt-to-GDP ratio and economic growth. Here, a public debt increase has positive effects only up to a certain threshold of the debt-to-GDP ratio, whereas the effects become negative beyond this threshold. Numbers of studies (e.g., Baum, Checherita-Westphal and Rother, 2013; Caner, Grennes and Koehler-Geib, 2010; Cecchetti, Mohanty and Zampolli, 2011; Chang and Chiang, 2012) confirm the non-linear relation by applying a panel threshold methodology and find the threshold of the debt-to-GDP ratio at which a positive relation becomes negative. Some authors (e.g., Checherita-Westphal and Rother, 2012; Presbitero, 2012) estimate the thresholds using quadratic functional form, i.e. a relation described by an inverted U-shaped curve. Summary of research on the empirical determination of the thresholds is given in Table 1.

Recent practical experience leads us to stress a problem of the myopic economy growth – public debt targeting of the government policies, which leads to the so called "debt trap", i.e. situation in which high debt burden exceeding sustainable threshold prevents further economic growth and a country is unable to repay its debt obligations without increasing its actual debt position. Larger deficits further have to be filled up by new borrowing. In addition, Pasha and Ghaus (1996) stipulate that the level of outstanding debt, debt servicing, and the budget deficit are the strongest candidates to serve as a criterion for the categorisation of a country in a debt trap.

3. Data

For the purpose of our analysis, we chose 13 EU countries (EU-15 disregarding Luxembourg and Ireland).[2] Panel data cover the time period 1993 – 2013. Real GDP per capita growth here plays the role of an independent variable.[3] Public debt is expressed by the general government gross debt (in % of GDP). Motivated by Checchetti, Mohanty and Zampolli (2011) and in order to avoid the insufficient specification error and to capture the inter-country heterogeneity, we extended the list of the regressors by a set of additional macroeconomic variables as follows: (i) log of real per capita GDP to preserve the convergence tendency;[4]

[2] Luxembourg was excluded due to its size and extremely low public debt (6.4% in 1999, 20.8% in 2012). Ireland demonstrated highly unstable development of public debt in the observed period (public debt was fluctuating between 24% and 116% of GDP).

[3] Real GDP per capita, PPP (constant 2011, international USD); time series were logarithmic transformed.

[4] The convergence hypothesis predicts that the rates of growth of productivity and GDP should be higher in the developing countries. However, the empirical evidence on convergence gives mixed results.

(ii) annual population growth to catch population driven economy growth; (iii) gross domestic savings as a prevailing financial source; (iv) gross fixed capital formation as a proxy for physical capital; (v) average length of total schooling (in years)[5] as a human capital measure; (vi) age dependency ratio (percentage of working-age population) to catch the productivity of the labour force and financial burden evoked by ageing of the population; (vii) economy openness computed as (Import + Export)/GDP assuming to have a significantly positive effect on GDP growth in panel data growth models as estimated by Baum, Checherita-Westphal and Rother (2013); (viii) inflation given as Consumer Price Index (annual, %).

To show the variable selection robustness and independence of the estimated debt-growth relation according to the Checchetti's variables selection, we decided to estimate an alternative model by using GDP gap[6] computed by the production function methodology.[7] Data were retrieved from databases of Eurostat, World Bank, IMF and AMECO.

4. Panel Data Model

Classical approach to analyse the impact of the government debt on economic growth is based on estimation of the relation in the form of the inverted U-shaped curve. It is assumed that in the increasing zone of the curve the multiplication effects of the government outcomes prevail and evoke economy acceleration, while in the decreasing zone the high public debt burden slows the economic growth. However, the practical experience raises the question whether the economy policy focused on either promoting economic growth or austerity policy to decrease the public debt does really trace the same trajectory and so, whether the estimated inverted U-shaped curve parameters are of the same values in both regimes. Therefore, we focused our research on revealing and quantification asymmetries between the debt increase and debt reduction impacts on economic growth.

Estimation of the analysed asymmetric relation is connected with some methodological problems. First of all, endogeneity of the government debt seems to be crucial in the growth equation and can significantly bias estimated regression

[5] *Source*: Barro and Lee (2013) (data set version 2.0, 06/14). Original 5-year time series were transformed to annual proxy using the population growth data.

[6] Gap between actual and potential gross domestic product at 2010 market prices computed by the production function methodology (see Havik et al., 2014); given as percentage of potential gross domestic product.

[7] GDP-per-capita annual growth of the United States was included to take into account external growth tendencies.

parameters. Some authors solve the problem by using the moving averages of the GDP growth (see Padoan, Sila and van den Noord, 2012; Checherita and Rother, 2010; Checchetti, Mohanty and Zampolli, 2011), while the others overcome the problem using various forms of the Instrumental Variables (IV) or Generalised Method of Moments (GMM) estimation (e.g. Easterly, 2001). On the other hand, the problem is neglected in the causality analysis of Ferreira (2009).

In our case, we decided to make estimation in 2 steps. To minimize the endogeneity bias caused by reverse causation, we firstly fitted the debt panel data by regressing on all available regressors lagged by 1 period and replaced the original debt panel by its fit.

After that, we estimated four forms of panel regressions using dummy variables indicating both regimes of the (fitted) public debt increase/decrease:

(i) traditional Fixed Effects panel data model (FE);

(ii) Fixed Effects model using instrumental variables (FEIV) to minimize potential endogeneity bias;

(iii) Fixed Effects Instrumental Variables model with lagged GDP growth to capture dynamics (DFEIV);

(iv) alternative Dynamic Instrumental Variables model using GDP gap and US growth as the additional variables instead of production function proxies given in previous models (Alter. DFEIV).[8]

The estimated regression equation is given as follows.[9]

$$\begin{aligned} GROWTH_{it} &= \beta_1 GROWTH_{i,t-1} + \beta_2 POPgr_{i,t} + \beta_3 lGDP_{i,t-1} + \\ &+ \beta_4 DEBT_{i,t-1} D^M_{i,t-1} + \beta_5 DEBT_{i,t-1} D^P_{i,t-1} + \beta_6 DEBT^2_{i,t-1} D^P_{i,t-1} + \\ &+ \beta_7 D^P_{i,t-1} + \beta_8 GDS_{it} + \beta_9 GFCF_{i,t-1} + \beta_{10} AYTOA_{i,t-1} + \beta_{11} ADR_{i,t-1} + \\ &+ \beta_{12} OPEN_{i,t-1} + \beta_{13} INFL_{i,t-1} + \beta_{14} D^{08}_{i,t} + \beta_{15} D^{09}_{i,t} + u_{it} \end{aligned} \quad (1)$$

[8] GDP growth in this kind of models is denoted as „transitional growth". It is initiated by a gap arising when current GDP is below potential GDP. Here accumulable factors of production being below potential GDP means that the return to these factors is relatively high and hence additional investments are boosting GDP growth. The wider is the gap between current and potential GDP, the stronger this transitional growth.

Dynamic character of the growth equations and need to avoid potential endogeneity bias caused by simultaneous character of the variables motivated us to apply the Dynamic Arellano and Bond (1991) and Blundell and Bond (1998) generalised method of moments (GMM). Unfortunately, large number of explanatory variables given by splitting the Debt variable into 5 components and necessity using additional instruments caused significant estimation instability and we excluded the GMM methodology from the further analysis.

[9] All explanatory variables are lagged by one period comparing to the explained GDP growth in order to minimize endogeneity consequences, as proposed by Baum, Checherita-Westphal and Rother (2013).

where

$GROWTH_{it}$ – real annual GDP per capita growth (%),[10]
$POPgr_{it}$ – annual growth rate of population (%),
$lGDP_{it}$ – logarithm of GDP,
$DEBT_{it}$ – general-government-debt-to-GDP ratio (% GDP),
GDS_{it} – gross domestic savings (% GDP),
$GFCF_{it}$ – gross fixed capital formation (% GDP),
$AYTOA_{it}$ – average length of total schooling (in years),
ADR_{it} – age dependency ratio (% of working-age population),
$OPEN_{it}$ – openness calculated as sum of exports and imports (% GDP),
$INFL_{it}$ – Consumer Price Index (%),
D_{it}^{P} – a dummy variable; = 1 if $DEBT_{i,t} \geq DEBT_{i,t-1}$, = 0 otherwise,
D_{it}^{M} – a dummy variable; = 1 if $DEBT_{i,t} < DEBT_{i,t-1}$, = 0 otherwise,
D_{it}^{08} – a dummy variable; = 1 if $t = 2008$, = 0 otherwise,
D_{it}^{09} – a dummy variable; = 1 if $t = 2009$, = 0 otherwise.

As we distinguish regimes of both the increasing and decreasing debt-to-GDP ratios separately, we define the dummy variables $D_{(.)}^{P}$, $D_{(.)}^{M}$ specifying each of the both regimes. Time dummy $D_{(.)}^{08} = 1$ $D_{(.)}^{09} = 1$ indicate the crisis years 2008, 2009.

After the presence of unit roots in the panel data is rejected using Levin, Lin and Chu (2002), Im, Pesaran and Shin (2003) and Maddala and Wu (1999) tests, we estimated a panel data model with Fixed Effects in its various forms described above (see Table 2). In each kind of the regression, the estimated coefficients corresponding to both regimes have expected signs detecting the expected inverted U-shaped curve in the case of indebtedness growth and a declining line in the case of indebtedness reduction.

If we compare the signs of the control variables regression coefficients (with Chechetti, Mohanty and Zampolli, 2011; Presbitero, 2012; Checherita and Rother, 2010), we can conclude that besides of POPgr variable all the regressors have expected signs. In case of the population growth, the statistically significant positive sign is rather unexpected and could be explained by rather low fertility rate and developed economy if compared to the developing countries, for which the negative relation between GDP per capita growth and population growth is typical.

[10] In our approach, we consider exclusively a short-term impact on growth (i.e. we consider the annual growth rate and we neglect a long-term impact using 3 or 5 year averages or potential (trend) growth rate).

T a b l e 2

Parsimonial Models of Non-dynamic and Dynamic Panel Data Regressions Dependent Variable: Real GDP per capita Growth (%)

Explanatory variable		Fixed effects model (FE)	Fixed effects instrumental variables (FEIV)	Dynamic fixed effects instr. variables (DFEIV)	Alternative dynamic fixed effects instr. variables (Alter DFEIV)
$GROWTH_{i,t-1}$	β_1	x	x	0.067443*	0.214234*
$POPgr_{i,t}$	β_2	not signif.	not signif.	0.63501*	0.697020**
$lGDP_{i,t-1}$	β_3	–8.1793***	−12.027***	−12.648***	–6.47463***
$DEBT_{i,t-1}D^M_{i,t-1}$	β_4	–0.012445**	–0.02857***	–0.036303***	–0.0254214***
$DEBT_{i,t-1}D^P_{i,t-1}$	β_5	0.14118***	0.12461***	0.11994***	0.1383345***
$DEBT^2_{i,t-1}D^P_{i,t-1}$	β_6	–0.0009706***	−0.000932***	−0.0009432***	–0.00099535***
$D^P_{i,t-1}$	β_7	–5.45682***	−5.4891***	−5.6319***	–5.976741***
$GDS_{i,t-1}$	β_8	0.250426***	0.35295***	0.34375***	0.4807214***
$GFCF_{i,t-1}$	β_9	not signif.	not signif.	–0.18505**	x
$AYTOA_{i,t-1}$	β_{10}	not signif.	0.47989**	0.5727***	x
$ADR_{i,t-1}$	β_{11}	–0.12437**	−0.12987**	–0.16707**	x
$OPEN_{i,t-1}$	β_{12}	not signif.	not signif.	not signif.	not signif.
$INFL_{i,t-1}$	β_{13}	–0.58144***	−0.61002***	−0.8069***	–0.462321***
$D^{08}_{i,t-1}$	β_{14}	–1.6369***	−1.7439***	−1.6223***	–1.7317444***
$D^{09}_{i,t-1}$	β_{15}	–4.9960***	−5.0301***	−4.4720***	–4.462321***
$USgrowth_{i,t-1}$	β_{16}	x	x	x	not signif.
$GAP_{i,t-1}$	β_{17}	x	x	x	–0.309951***
Adjusted R-squared		0,660	0.724	0.727	0.728
Pooling F test		F = 7.26***	F = 6.6269***	F = 8.9174***	F = 6.58***
Breusch-Pagan LM test (Chisq stat.)		Chisq = 199.04***	Chisq = 184.67***	Chisq = 155.20***	Chisq = 185.37***
Pessaran Cross correl. ation test (z stat.)		z = 8.9957***	z = 8.09***	z = 6.073**	z = 8.44***
Breusch-Godfrey Woodridge (Chisq st.)		Chisq = 46.96***	Chisq = 54.47***	Chisq = 41.06***	Chisq = 49.22***
Breusch Pagan heterosced. (BP stat.)		BP = 49.45***	BP = 50.11***	BP = 62.73***	BP = 47.10***

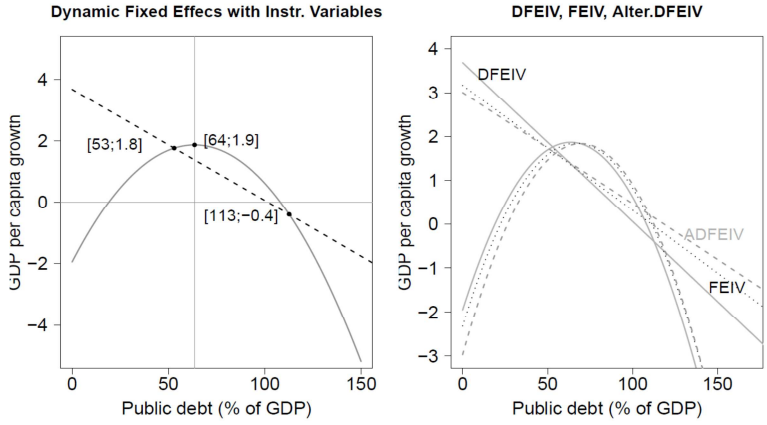
Notes: *** = 0.001, ** = 0.01, * = 0.05, = 0.1 denotes significance levels. Pooling F-test of the country specific dummies significance shows heterogeneity of the country data; Hausman test identified the Random effect model as providing the inconsistent estimations. Breusch-Pagan/LM (Breusch and Pagan, 1980) test and Pesaran cross-sectional dependence (Pesaran, 2004) test reveal significant cross-sectional dependence; the Breusch--Godfrey/Wooldridge test confirms the existence of serial correlation; the studentised Breusch-Pagan test reveals heteroscedasticity. The non-parametric method of Driscoll and Kraay (1998) was used for nonparametric covariance matrix estimator providing the heteroskedasticity and autocorrelation consistent standard errors robust to general forms of spatial and temporal dependence.

Source: Authors' calculations.

5. Graphical View of the Estimated Dynamic Model

F i g u r e 1

Illustration of Estimated Linear and Quadratic Functions for Public Debt vs. GDP Growth



Note: Dynamic Fixed Effects Instrumental Variables model (DFEIV) vs. Fixed Effects Instrumental Variables (FEIV) and Alternative Fixed Effects Instrumental Variables (Alter. DFEIV – model with alternative control variables); linear relation: in the case of previous public debt decrease; parabola: in the case of previous public debt increase.

Curve (parabola): $GDPgrowth = -1.9474 + 0.11994 PublicDebt - 0.0009432(PublicDebt)^2$.

Line: $GDPgrowth = 4.2715 - 0.036303 PublicDebt$.

Source: Authors' calculations.

Regression results provide rather similar regression coefficients for the debt vs. economy growth relationship modelling in all modifications of the proposed panel regressions. In Figure 1, we offer graphical view on the functional relations estimated by the Dynamic Fixed Effects Instrumental Variables (DFEIV), Fixed Effects Instrumental Variables Model (FEIV) and Alternative Dynamic Fixed Effects Instrumental Variables (Alter. DFEIV) models. The locations and shapes of the curves are quite similar, which shows both the good robustness of the models against the econometric methodology and robustness against the selected set of the control variables. Definitely, we chose the DFEIV model as its functional form is predominantly used in similar research works.

Regarding debt-to-GDP decrease, there is a linear relation detected, while debt-to-GDP increase has a non-linear impact on economic growth (as it is given by the estimated model). Graphically, the curves have the form of an inverted U-shaped curve (parabola) modelling the debt-to-GDP ratio rise regime and of the line modelling the debt-to-GDP decline.

Within the economic cycle, the debt-to-GDP vs. GDP growth data oscillate along the closed shape bordered by debt-to-GDP ratios given as the intersections

of the line and parabola (i.e. 53% and 113% of the debt-to-GDP). The parabola's peak is at the 64% debt-to-GDP ratio, which means that debt extensions beyond this threshold are connected with a decline in economic growth. An increase in indebtedness, which is higher than 113%, accompanied by negative economic growth, leads a country on the path to the debt trap problems. Here, the parabola and the line start to diverge approximately, as the parabola's tail follows another direction towards large debts and negative economic growths. Even a consolidation of public finances (see the mutual positions of the line and parabola below the 113% level, Figure 1) is connected with negative economic growth and rather instability of the economy given by obvious line and parabola divergences. Although, if the country, having debt-to-GDP smaller than 108% (threshold given by the zero GDP growth), recognises an abrupt decline in GDP growth even in the case of the expansionary fiscal policy, it is still possible to maintain the sustainable economy growth by performing austerity.

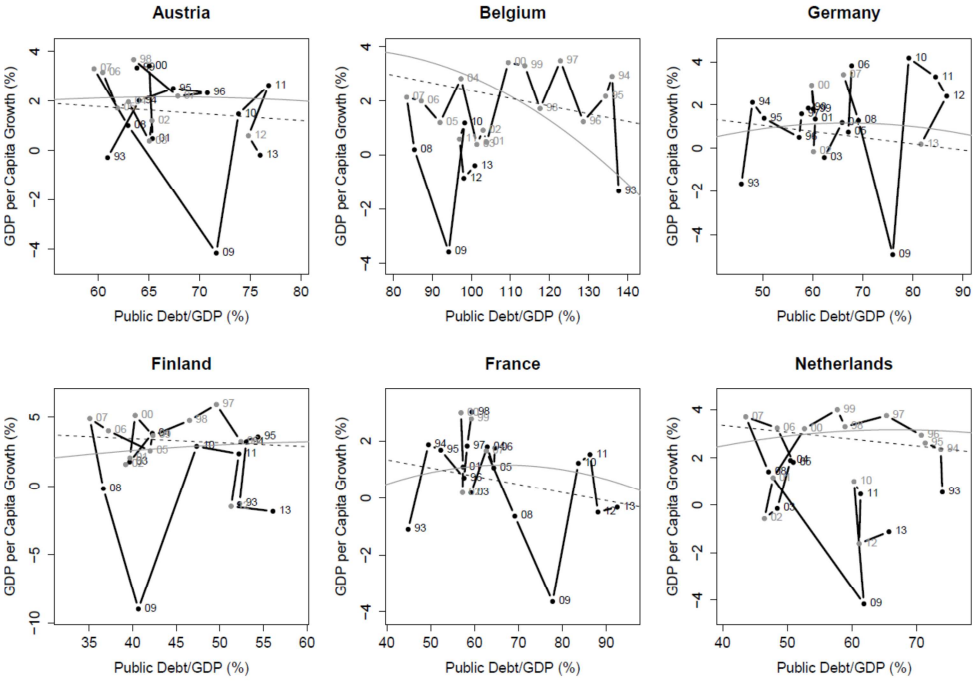
Further, we aim to confront the estimated linear and non-linear impact of debt-to-GDP on GDP growth with the empirical observations in each country separately. Figures 2 and 3 visualise country-individually shifted lines and parabolas estimated by the DFEIV panel data model. Here, the countries are divided into two groups: First, constituting from the most stable Eurozone founders and the second including the rest of the countries under our investigation.

Eyeballing both figures, we identify two systematic patterns in evolution of the countries public debt vs. GDP growth data. The first one is the regime of the rather successful debt reduction in the period 1993 – 2007 followed by sudden decline of the economy and consequent deterioration of the public debt position in 2008 – 2009. Following recovery in 2010 led to the return to some of the previous positions and data evolution forms a closed „circle" in the figure, e.g. case of Austria, Belgium Finland, Netherlands, Italy, Spain, Denmark and Sweden. After 2010, rather successful development was discredited in case of Spain and Italy. The situation seems to be more critical for Italy, were the data follow the down trended parabola tail far behind the sustainable 113% debt level given as the intersection of the line and parabola. The second group of the countries are those where the public-debt-to-GDP vs. GDP growth relation forms an unclosed „circle", i.e. Germany, France, Greece, Portugal and United Kingdom. These countries, until the 2008 – 2009 crises period did not demonstrate any significant improvement of the public debt positions. Then, after the crisis in 2008, the countries face the problems of sudden increase of the public indebtedness and any intuitive data projection give no hope to close the data circle, meaning that we do not expect the countries are able to return to the public debt vs. economy growth relations back in early nineties. Extraordinary critical is the situation

where data fall to the position of high public debts and smaller or negative economic growths (the countries then often trace the decreasing part of the estimated parabola); as a result, they can potentially fall to or already are in debt trap problems. Here, this is the case of Greece, Portugal, and Italy.

F i g u r e 2

Approximation of Public Debt vs. GDP Growth Relation – Core Eurozone Countries



Note: Public debt/GDP (in %): general government consolidated gross debt (in % of GDP) is lagged by one period. Points and lines correspond to real values of public debt-to-GDP and GDP growth; the dashed line and solid curve are estimated by panel data (DFEIV) model, equally shaped by each country and shifted by the estimated country-specific intercept. Grey points correspond to the situations when public debt-to-GDP decrease precedes in the previous period.

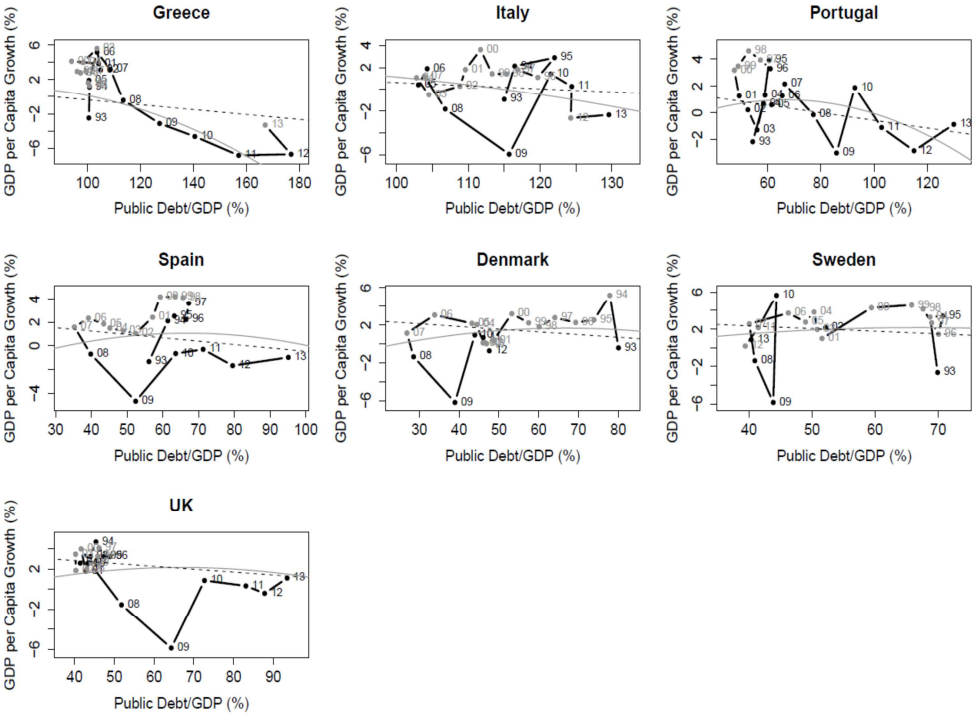
Source: Authors' calculations.

Italy, until the 2007 crisis period, demonstrated reduction of its debt position with consequent deterioration of public finance and economy fall. Promising cyclical development after renewing the initial indebtedness-growth position in 2010 was not confirmed later and economy started to fall increasing the public debts along the debt trap position of the parabola tail. Quite similar situation of the Spain as regarding the initial „cycle closing", i.e. renewing of the initial position was also deteriorated, however, not coming into the debt trap with the debt level behind the 113% level. On the other hand, the permanent economy decrease does not give much hope not to fall into the debt trap position. Portugal was stabilizing

its debt position at the 60% level for the whole period until 2007. After that, it was permanently increasing its public debt connected often with economy fall. So, the danger of the trap position in 2013 became extraordinary serious. The evolution of the United Kingdom is also noteworthy. After stabilizing its public debts until 2007, the economy fall in 2008 – 2009 was followed by significant public debt increase. On the other hand, in contrary to the previous country examples, actual indebtedness is relatively far away from the critical 113 % position.

F i g u r e 3

Approximation of Public Debt vs. GDP Growth Relation – other EU Countries



Note: Public debt/GDP (in %): general government consolidated gross debt (in % of GDP) is lagged by one period. Points and lines correspond to real values of public debt-to-GDP and GDP growth; the dashed line and solid curve are estimated by panel data (DFEIV) model, equally shaped by each country and shifted by the estimated country-specific intercept. Grey points correspond to situations when public debt-to-GDP decrease precedes in the previous period.

Source: Authors' calculations.

To conclude, if a country reaches a debt-to-GDP ratio higher than 113% while falling to zero economic growth, the country data start to trace exclusively the decreasing part of the parabola (e.g., Greece, Portugal, and Italy). Then, it is seemingly impossible to reach the estimated line, as the estimated line and parabola draw apart at this debt-to-GDP level.

Conclusion

The paper contributes to existing empirical research by quantifying the asymmetric effects of debt-to-GDP increase and decrease on economic growth. The analysis comprehends 13 European Union countries covering the time period from 1993 to 2013. The dynamic form of the fixed effects model with instrumental variables distinguishes regimes depending on either the increasing or the decreasing debt-to-GDP ratios. The estimated regression coefficients reveal a linear relation between the debt-to-GDP decrease and GDP growth, whereas the relation between the debt-to-GDP increase and GDP growth is non-linear. This non-linear relation is described by an inverted U-shaped curve with the peak at a 64% debt-to-GDP ratio.

The combination of the estimated line and parabola specifying the relation between debt-to-GDP and GDP growth and the evolution of a real data based relation between the two variables leads to the following conclusions:

(i) If a country reduces its public debt, data trace the line, i.e. its debt is on the decreasing path while GDP growth tends to be increasing.

(ii) If debt-to-GDP ratio is smaller than 64%, debt-to-GDP increase is connected with higher GDP growth. Below the 113% debt-to-GDP ratio, data freely oscillate along line and parabola. However, the 113% level of indebtedness is the starting point at which fiscal policy measures leading to the increase in a country's indebtedness are associated with negative economic growth (e.g., Greece, Italy, and Portugal).

(iii) The analysis reveals that the EU countries data exhibit two main patterns. In some countries (e.g., Austria, Finland and Denmark) the evolution of the real relation between debt-to-GDP and GDP growth forms a closed „circle". These countries were initially decreasing their debts while their economic growth was increasing. Then, their GDP abruptly fell and public debts started to increase. However, these countries, having decreasing debts in pre-crisis period, succeeded in returning approximately to their initial position. The other countries (e.g., Greece, Portugal, Italy and the United Kingdom) form a „semicircle" with a breakaway to the jeopardised position of importantly higher debt and smaller GDP growth with the potential threat of reaching the debt trap scenario.

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