FISCAL SPACE IN THE EURO ZONE

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NBS Working paper

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Abstract

This paper uses data from 1995 to 2008 to estimate debt limits in the European Union countries derived from the budgetary responses to debt levels before the crisis. Based on work by the IMF (Ostry, 2010), we present our suggested approach and estimate the fiscal reaction functions and the implied critical debt levels of EU governments. Since many countries did not take advantage of the boom years for consolidation, the fiscal space – availability of debt financing – in the euro zone has shrunk, especially in countries where the response to rising debt levels has historically been weak. We conclude by stressing a need for structural changes in budget policy (shifts in the reaction on debt) or risk default in cases where fiscal space was negative or has been squeezed.

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1. INTRODUCTION

When prompted by leaders, voters, or market forces, governments try to respond to rising debt levels through various policy measures to ensure that total public debt is kept under control. We can label actions aimed at debt stabilization or debt reduction as **governmental consolidation measures**.

The reaction of governments to a particular debt level can be expressed through a government **reaction function,** which captures the relationship between primary balance and total debt. As further detailed later, it is reasonable to expect that the reaction function is non-linear: if total debt rises too far, the attempts to cut the primary deficit may become "hopeless".

This paper is motivated by the recent financial crisis, which has raised several interdependent questions:

• How do EU governments respond to their existing debts? What is the shape of the reaction to specific debt levels? What factors contribute to differences between individual countries reactions?

• At what level of debt (if this level exists) does an increased government reaction compensate for interest payments so that the level of debt[2] is stabilized? This threshold of indebtedness will be called a **sustainable debt level**.

 At what level of public debt does the risk of default emerge? An increase in the cost of debt may bring a loss of control and render stability unmanageable. The primary balance that would compensate for rising interest costs would become economically and/or politically impossible. The threshold beyond which a government is unable to reduce the level of its debt will be labeled a **critical debt level[3]**.

• Given the specific size of debt, how much room do governments have to raise further funds? The difference between the critical debt level and current debt level will be referred to as the **fiscal space**.

As debt approaches the critical threshold investors lose trust leading to higher borrowing costs and eventually a total loss of confidence. Any government that approaches its critical debt limit must decide whether to take (potentially drastic) fiscal consolidation measures, or whether to declare that it is unable to meet its prior obligations. (In the latter case, it must restructure its debt, and pay high economic and reputational costs.)

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[2] share of gross debt on nominal GDP
[3] It is rather an upper bound of the debt default level.

In this paper we 1) estimate the reaction functions of governments in the European Union before the current crisis began (before 2009), 2) estimate critical debt levels and the amount of fiscal space that governments possessed in 2009 (based on the estimates from step 1). As a framework to evaluate solvency of a sovereign, we follow the "model-based sustainability" (MBS) test, which asks whether a government's primary fiscal balance responds sufficiently to increases in public debt.

In Section 2, we describe prior literature on public debt. Section 3 describes the data, Section 4 describes the methodology, Section 5 outlines our results and Section 6 casts a closer look at debt development in Slovakia. Section 7 concludes with discussion.

2. LITERATURE

The idea of connecting an EU country's indebtedness, particularly countries that use the single currency, with their risk of insolvency has only recently been apparent. As pointed out by Giavazzi and Spaventa (Giavazzi, 2011), financial markets and the European Commission had too much confidence in some players before the crisis. It was generally assumed that euro area countries could not be subjected to speculative attacks and therefore financial markets lent to these countries without taking into account their true financial situation[4]. Reinhart and Rogoff provide a historical, panoramic view of the financial and banking crises and their impact on the crisis in public finances. An essential conclusion, amid others, is to designate a "critical" level of debt, namely 90% of GDP; if public sector debt rises above this limit, real GDP growth begins to slow and thus worsens public debt dynamics (Reinhart, 2010b). This threshold was observed in developed as well as in emerging economies.

In our work we seek to further specify a sustainable public debt limit. The framework which we adopt was first outlined by Bohn (Bohn, 1998) who analyzed the dynamics of USA debt to GDP data. He noticed that after adjusting the data from single events (war time) the primary balance correcting mechanism is proportional to debt relative to GDP level. As debt rises the effort expressed by the primary balance level which reduces this debt also

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[4] The risk, however, may not be expressed only in the form of excessive government debt. Under pressure from the financial crisis, Greece was forced to admit providing false information for years on the level of public deficit and debt. In other countries that started to have trouble borrowing on financial markets, the level of public debt was not the primary cause. Ireland and Spain were considered model countries for their management of public debt. There (as well as in Portugal) the main cause of financing failure was the high amount of private sector foreign debt, much of which had to be assumed by the public sector (Reinhart, 2011).

increases. His work assumed a linear relationship and this assumption would mean unlimited fiscal capacity for any amount of debt.

This unrealistic assumption was replaced in Ostry (Ostry, 2010) and in Ghosh (Ghosh, 2011) by the assumption of debilitating effort beyond a certain level of debt. Their approach is illustrated in section 4.

# 3. DEBT IN THE EURO ZONE AND IN SELECTED EUROPEAN COUNTRIES

Between 1995 and 2009 the collective depiction of total debt levels, the trajectory of interest rates and of consolidation efforts in EU countries is mixed. The evolution of debt in the EU and the euro zone is shown in Figure 1. Several countries that eventually adopted the euro had debt levels above 60%, failing to fulfill the official criterion for joining the monetary union. In their official plans, however, these countries assumed that their total debt levels would be lowered in the future. The four percentage points downwards shift in EU debt (shown in Figure 1) was due to the lower debt of EU members who were not members of the euro area.

Throughout the observed period there are sub-periods of changing debt trends:

- The period before entry to the euro zone typified by an initial growth in debt followed by decline. This decline was connected with fulfillment of the Maastricht criteria for deficit and debt.
- The period after euro zone entry where debt grew due to a slowdown in euro zone GDP growth (recession). The subsequent reduction in debt during "good times" (after 2005) was accelerated, among other factors, by low interest rates[5].
- The period following 2008 where several euro area countries experienced a reduction in growth or recession during the crisis, resulting in significant increases in debt levels.

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[5] With hindsight, the low interest rates on government debt financing appears to be underestimating the risks, which may have motivated governments to borrow.

Figure 1: Debt trajectory in the EU and euro zone in % of GDP
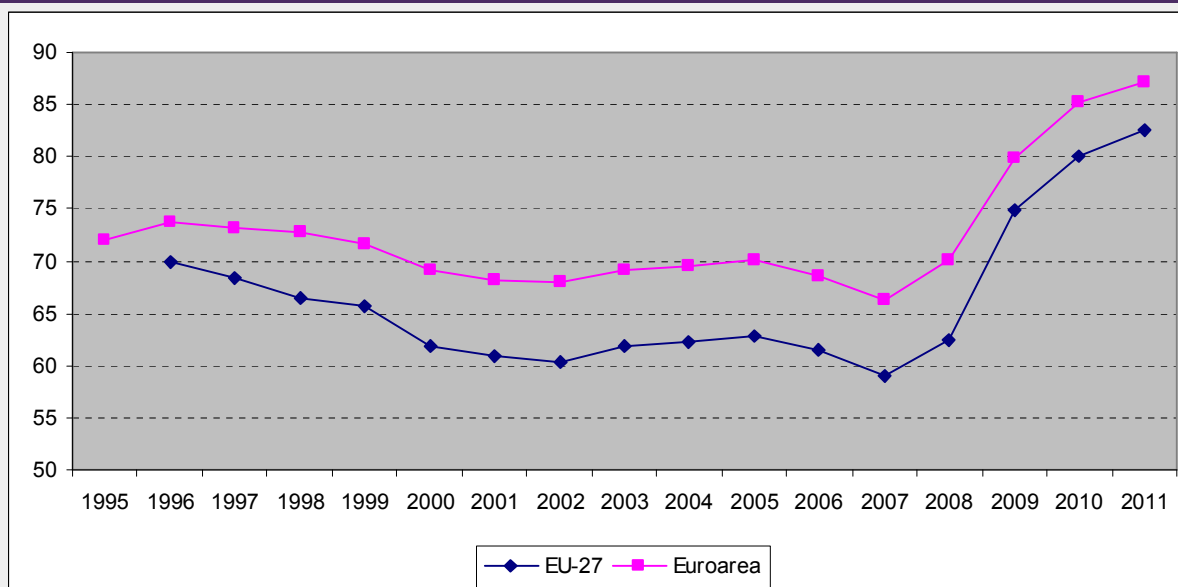
Source: Eurostat

The analysis of government debt development can be based on a standard debt dynamics equation. The following relationship holds for the evolution of debt[6]:

$$\Delta d_t = (i_t - g_t) * d_{t-1} - PB_t - A_t \qquad (1)$$

where

- d_t denotes the change of debt in percent of the nominal GDP

- Δd_t denotes the change of debt

- PB_t is the primary balance at time t in percent of the nominal GDP

- i_t is the average (implicit[7]) interest rate on debt

- g_t denotes the growth rate of the nominal GDP

[6] This relationship is discussed in the context of budget consolidation in Strachotova, 2010.
[7] Here "implicit" stands for average interest – defined as *100*interest cost / volume of debt at the end of the previous period*

- A_t captures changes in the valuation of the debt due to, for example, a one-time sale of state-owned assets, exchange rate movements, debt write-offs

According to expression (1), ignoring the a_t term, whose sign and magnitude is difficult to predict, total debt to GDP increases when the cost of debt adjusted for nominal GDP growth- **the snow-ball effect** - exceeds the primary balance.

As shown in Figure 2, the euro zone debt level declined before joining the euro area due to a lower snow-ball effect and due to an increasing primary balance. In contrast since 2000, a larger snow-ball effect and worsening of the primary balance caused gradual debt growth. A decline in debt levels before the crisis was associated not only with accelerated economic growth, but also with low interest rates. The acceleration of debt throughout the crisis period can be attributed to a rapid mutual worsening of all factors effecting debt - namely poor budgetary outcomes (negative primary balance), the rapid growth in the cost of debt (through risk premium) and a slowdown or fall of nominal GDP.

Figure 2: Decomposition of debt change in euro zone
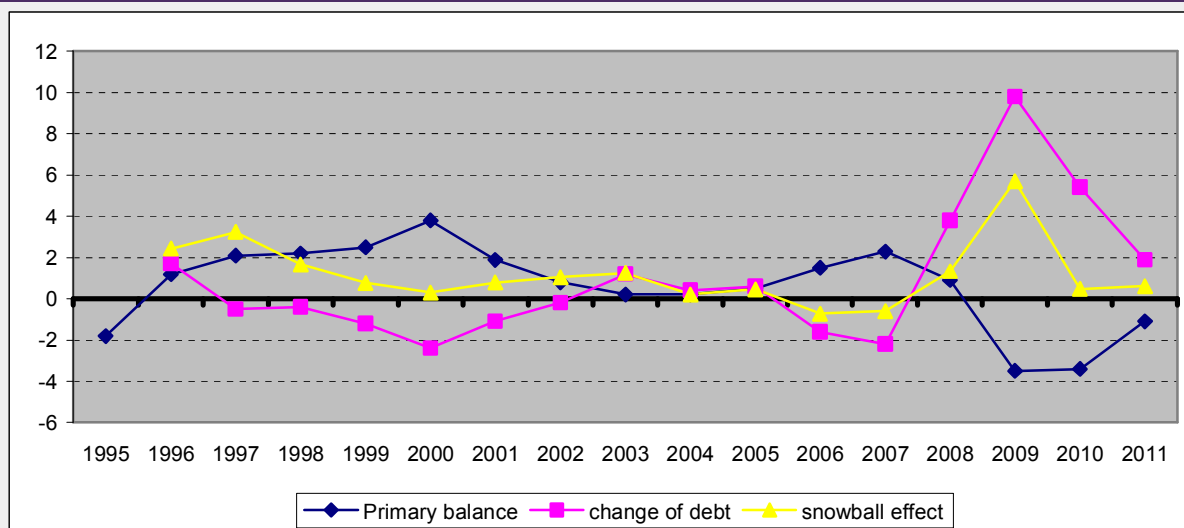
Source: Eurostat

Debt development in selected countries.

Finland is an example of a country with low debt levels and a history of responsible fiscal policy. Its primary balance was mostly positive (with the exception of crisis period).

Countries with high debt levels are more complicated as even small changes in interest rates or small decreases in the rate of economic growth may create a substantial snow-ball effect. In periods of slow growth, it is usually difficult for highly indebted countries to improve their

primary balance to compensate for the debt burden without the assistance of low interest rates.

Italy is an illustrative example. Italy's debt fell from 120% of GDP towards the 100% milestone at the beginning of the period under analysis (see Figure 3). Before joining the euro zone, its primary balance was positive. Later on, its primary balance started to fall, probably as a consequence of cyclical slowdown and/or as a response to joining the monetary union (and the resulting fall in interest rates). Public debt even rose in 2005. The negative primary balance, as well as falling nominal GDP led to a debt increase of almost one fifth and attracted negative attention from financial markets.

**Figure 3: Decomposition of debt change: Left panel: Finland; Right panel: Italy**
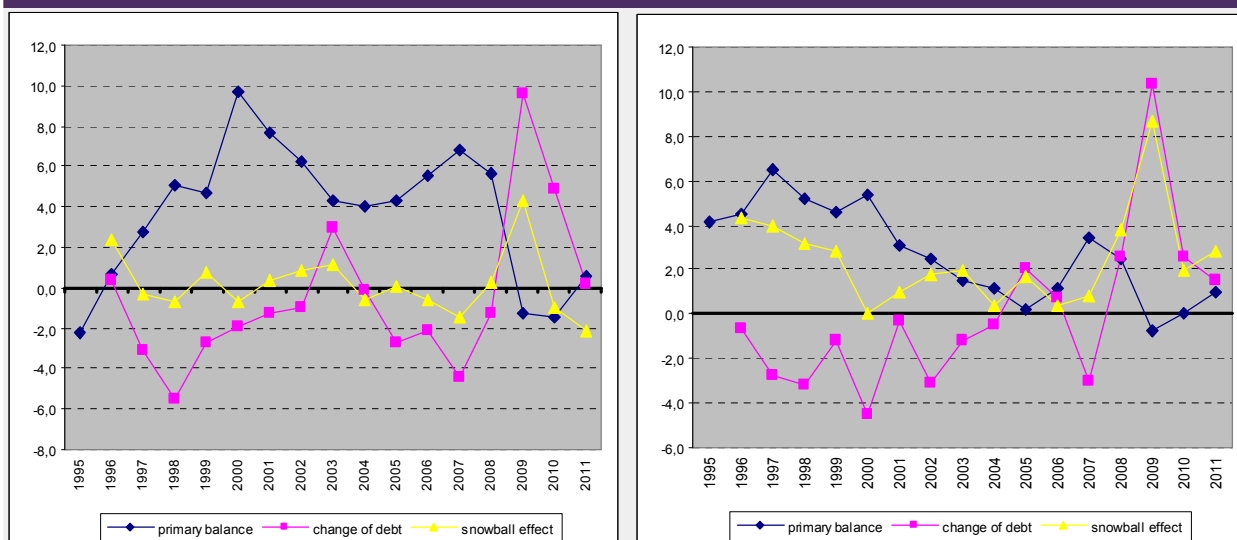
Source: Eurostat

New member states that underwent transformation from centrally planned economies joined the EU in 2004 and in 2007. At the beginning of the transformation process - except for Hungary and Poland – they had a relatively low level of debt. Their real GDP grew throughout the initial adaptation phase at a rapid pace; with higher levels of inflation nominal GDP rose rapidly too. This assisted in the maintenance of low debt levels despite deficits over 3% of GDP and relatively high interest rates on government debt. In the period preceding the financial and economic crisis and before the emergence of problems with public budgets (2009), government debt developments were positively influenced by low interest rates on financial markets. An example of such a development is also illustrated by **Slovakia[8].**

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[8] A more detailed description of Slovak debt development is in Chapter 6.

Figure 4: Decomposition of debt change: Left panel: Greece;   Right panel: Slovakia
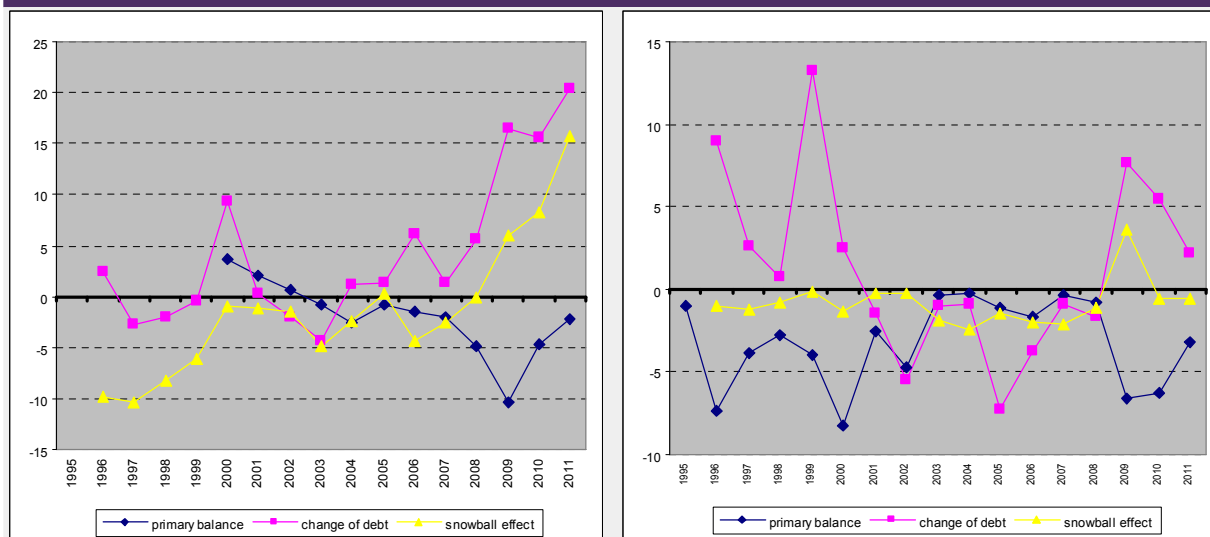
Source: Eurostat

Unlike Slovakia, **Greece** is an example of a country that had consistently high levels of debt, around 100% of GDP. Greece switched from a primary surplus to deficit and its debt has not declined despite a significant decline in interest rates before the crisis. The sharp decline in GDP and a negative primary balance raised debt from 100% of GDP to 116% of GDP (2009) and immediately attracted the attention of financial markets. This subsequently caused an increase in interest rates for (re) financing and made financing the Greek government debt unsustainable.

4. BASIC ASSUMPTIONS AND THE SPECIFICATION OF THE MODEL FOR EU27 DATA

There are many ways to identify if a country's debt level is sustainable[9]. The notion of sustainability is usually related to the stable or stabilised debt development in a given horizon (short term, medium term andlong term). From a formal perspective a government can declare any debt level to be "sustainable" as it autonomously sets tax rates and determines the size of pubic expenditure: in other words, it sets the **primary balance**.

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[9] One reasonably reliable characteristic of the sustainability of public debt development is a country's fiscal history, which reflects the behavior and the reaction to earlier fiscal problems of previous governments.

But the level of primary balance is constrained by both economic and political factors. For economic and political reasons, it is costly to increase taxes or to otherwise increase government revenues because of the potential detrimental effects such measures can have on economic activity, demand and living standards. Reducing public expenditure can also be economically and politically costly as it reduces demand and because the beneficiaries of public programs can punish elected officials in future elections.[10]

In this WP we are interested in the governmental reaction to public debt. In the above mentioned works of Ostry, Ghosh and al. it is assumed that a government's reaction to debt levels, represented by the primary balance, is non-linear. We further assume that this reaction is deterministic and the interest rate on debt is exogenous.

At low debt levels a government's response is largely benevolent; the primary balance does not compensate for the snow-ball effect, nor does it compensate for current income and/or expenditure shocks. Debt gradually moves towards its sustainable level and the reaction strengthens. If the level of debt exceeds this point, the governments generally behave more responsibly because they do not want to risk problems with repaying debt. A strengthened consolidation effort sets the primary balance to the level that exceeds the snow-ball effect and causes debt levels to shift to its sustainable level. However certain factors, namely shocks to the budget, cyclical factors and structural deficiencies of the budget, may alter this direction.

The reaction to increasing debt levels has its limits, however. If the level of debt is too high, the primary balance, which would eliminate the snow-ball effect, is economically and/or politically impassable, the government gives up the consolidation fight and declares default. This is the critical level of debt.

It is important to distinguish two qualitatively distinct cases:
- Firstly when fast growth of (nominal) GDP leads to a negative snow-ball effect when a country is "growing up" from its debt. It is typical that the primary balance of such country is negative when debt levels are low or medium in size. Slovakia and other new CEE EU member states are an example.
- The second case is typical for slowly growing developed EU countries where a positive snow-ball effect is evident even when the interest rate on debt is low. To prevent the accumulation of debt in these countries it is necessary to attain a positive primary balance in the medium to long term.

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[10] Alesina et al. (2011) asserts that fiscal consolidation need not be politically damaging.

Figure 5: The government's reaction function and snowball effect
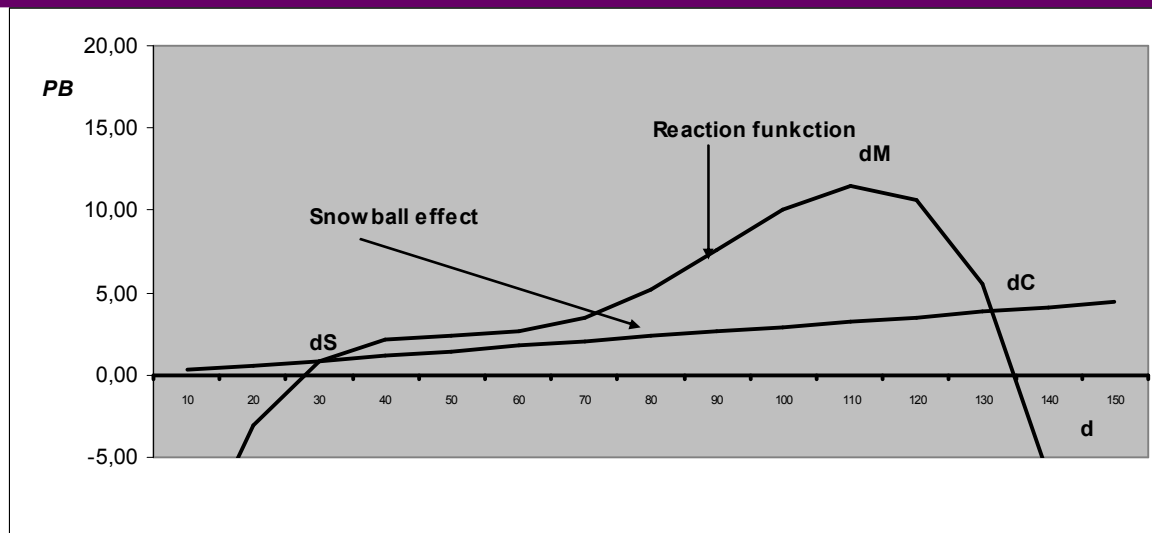
If the level of debt is lower than d^S, consolidation efforts are weak and do not fully cover the adjusted interest rate costs of debt (the snow-ball effect), represented by the linear function of debt level. If the level of debt is above d^S but lower than d^C the primary balance compensates for the snow-ball effect. The magnitude d^S represents, other things being equal, stabilizing debt situation, because the reaction on debt is stronger when debt exceeds d^S. The situation is different in the proximity of d^M. If debt oversteps d^M the reaction will weaken (government gives up) and, other things being equal, debt exceeding d^C infers that the primary balance does not compensate for the snow-ball effect and debt rises in an unlimited manner. We refer to d^C as the critical debt level.

Source: : authors'drawing

Adaptation of framework – fourth degree polynomial and error correction

Unlike the original work by Ostry (Ostry, 2010) we will not generally assume that the reaction function is a cubic polynomial. The high degree of non-linearity of reaction function can be deduced from the following chain of effects:
  (1) Markets react to increasing (or higher) debt by increasing the credit risk premium on government bonds. This premium is likely to rise in a nonlinear manner for high debt levels;
  (2) Then cost of debt increases (is higher);

(3) Higher costs of debt force the government to adopt restrictive debt consolidation measures comprising of tax increases and / or expenditure reductions;

(4) Austerity measures have a negative impact on domestic demand and economic activity. [11]

The stricter the austerity measures are, the stronger the negative impact on demand and economic activity; and

(5) A slowdown or decrease in GDP growth non-linearly increases the proportion of debt to GDP.

This sequence of events indicates that the government response to debt increases is likely to be highly nonlinear. The degree of nonlinearity of the reaction function is increasing in every step of that sequence and can be thus approximated by a polynomial of higher degree.

We assume that the reaction is up to the power of a fourth degree polynomial[12]. We also assume that beyond reacting to total debt, the primary balance is also influenced by cyclical factors namely the GDP gap and the cyclical component of government expenditure. Reactions are different for individual countries. Following Ostry et al. (2010), we assume that the "shape" of the reaction function is the same for all countries, but the magnitude of the reactions for individual countries differs.

The model to be estimated is

$$\Delta PB_t = b_1 * GDPgap_t + b_2 * GOVgap_t +$$

$$+ k * \left[PB_{t-1} - \left(\frac{c_0}{(-k)} + \frac{c_1}{(-k)} * d_{t-1} + \frac{c_2}{(-k)} * d_{t-1}^2 + \frac{c_3}{(-k)} * d_{t-1}^3 + \frac{c_4}{(-k)} * d_{t-1}^4 \right) \right]$$

$$(2)$$

It consists of two parts:

1) short-term impulses emerging through cyclical variables; the GDP gap as a proxy for cyclical budget revenues and the GOV gap that denotes the gap between actual government consumption and its trend;

2) the long-term or equilibrium component which represents a long-term or equilibrium reaction to debt in the past.

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[11] Here we follow the standard example – not considering so called expansionary consolidations

[12] Apart from the argument about the high nonlinearity of the reaction function discussed in the previous paragraph, the choice of a 4th degree polynomial is justified by statistical properties of our estimates.

Values $a_j = \dfrac{c_j}{(-k)}$, $j = 1,..4,$ are coefficients of the reaction function.

In general, there are no "prescribed" signs of coefficients a_j except for the coefficient of the polynomial of the highest degree - a_4 which must be negative to express the basic assumption of the approach: governments cease to react for high debt levels.

It is reasonable to expect the second higher coefficient to be positive to express the consolidation effort - the reaction to debt increases below the "give up" level (d_m).

A positive coefficient a_1 would express a growing or greater reaction on increasing or higher debt at the lower part of the debt spectrum. A negative coefficient a_2 then expresses a lessening or looser reaction on increasing or higher debt in the low to medium part of the debt spectrum.

For coefficients b_1 and b_2 we expect:
- Coefficient b_1 will be positive: in a boom period (positive output gap) the government is able to improve its fiscal position and raise the primary balance.
- Coefficient b_2 will be negative: A cyclical increase in government consumption causes a deterioration of its budget.

Our analysis is based on the following yearly data for 27 EU countries (listed in Table 2) covering the period 1995-2008:

- *Debt$_t$* : Gross public (general government) debt, expressed in % of GDP

- *PB$_t$* : Primary balance in % of GDP

- *GDP$_t$* : Real GDP index (2000=100), using 2005 prices

- *GNP$_t$* : Nominal GDP (in EUR millions)

- *GOV$_t$* : Real government consumption index (2000=100), using 2005 prices

In the original paper by Ghosh et al. (2011), the panel regression was estimated for developed OECD countries with country fixed effects. The paper's authors controlled for the effect of fiscal revenue from oil or gas (UK, Norway…). We examined other possibilities (random cross-sectional effects, time fixed effects, identification of differences based on political variables) but we only report the country fixed effects regressions. Nickell's correction of parameter bias in dynamic panel estimation is assumed to be negligible.

5. RESULTS

5.1 REACTION FUNCTION ESTIMATION AND INTERPRETATION

The main results – estimated coefficients of reaction function - are reported in Table 1 and the fixed effects (individual countries shift from the overall EU reaction) are reported in Table 2. Coefficients are normalized by an appropriate power of 10 (debt level is measured in %).

Table 1: Estimated model, main results					
Panel regression with fixed effects					
		1995-2008		2000-2008	
Dependent var.		ΔPB		ΔPB	
		Coefficient	Prob,	Coefficient	Prob,
Explanatory var.					
C	C_0	-7,69	0,00	-15,78	0,00
d_{t-1}	C_1	0,55	0,00	1,15	0,00
$10^{-2}*d^2_{t-1}$	C_2	-1,37	0,00	-2,80	0,00
$10^{-4}*d^3_{t-1}$	C_3	1,48	0,00	2,89	0,00
$10^{-7}*d^4_{t-1}$	C_4	-5,31	0,00	-10,23	0,01
GDPgap?	b_1	0,15	0,00	0,20	0,00
GOVgap?	b_2	-0,28	0,00	-0,33	0,00
PB?(-1)	k	-0,65	0,00	-0,59	0,00
Source: authors' calculation					

Coefficient a_3 is positive and its value is 1,48/0,65=2,28: further debt increases in the medium to high part of the debt spectrum are associated with an increasing primary balance, tighter fiscal policy or a stronger reaction on debt. Coefficient a_4 is negative: for high levels of debt the primary balance deteriorates and the reaction of debt and consolidation efforts are weakened. Coefficient b_1 is positive, as expected: a higher GDP gap allows the government to behave more prudently. A one percentage point increase in GDP gap is associated with a higher (better) primary balance by 0,15 percentage points. Coefficient b_2 is naturally negative: above-trend expenditures imply a more lenient fiscal policy and lower (worse) primary balance. The parameter is -0,28.

Table 2: Country fixed effects.

Country	Fixed effects	
	1995-2008	2000-2008
Belgium	-2,57	-2,66
Bulgaria	1,82	1,92
Czech Republic	-0,48	-0,84
Denmark	2,59	1,62
Germany	-0,59	-1,35
Estonia	4,96	10,56
Ireland	0,97	0,29
Greece	-6,99	-7,05
Spain	-0,05	-0,73
France	-1,13	-1,85
Italy	-4,44	-4,82
Cyprus	-0,89	-1,06
Latvia	2,21	4,53
Lithuania	0,12	1,17
Luxembourg	6,39	10,87
Hungary	-1,86	-2,64
Malta	-2,22	-2,40
Netherlands	0,40	-0,55
Austria	-0,52	-0,97
Poland	-1,89	-2,48
Portugal	-1,52	-2,09
Romania	1,04	1,43
Slovenia	0,29	-0,33
Slovakia	-2,30	-2,41
Finland	2,87	2,03
Sweden	1,40	0,48
UK	-0,27	-1,55

Source: authors' calculation

Coefficients a_j, $j = 1,..4$, together with the constant term $a_0 = (-7,69/0,65)$ determine the reaction function for the European Union as a whole. The reaction function of individual EU countries differs from the reaction function of the EU as a whole only by a shift equal to $\dfrac{FX_j}{(-k)}$, where FX_j is the estimated fixed effect of a country j from Table 2.

The interpretation of the reaction function and conclusions based on it are strongly conditional on the model assumptions, method of estimation and the dataset used for the estimation.

First, to estimate the reaction function for the whole spectrum of debt levels, assumptions about the shape and functional form of the reaction (fourth degree polynomial) are relevant. For the robustness of this assumption the statistical properties of estimates of coefficients a_j, particularly a_4, are decisive in determining the precise location of the critical debt level and fiscal space derived from it. A significance level above 99% for the estimates provides some basis for reliably locating the critical level of debt and fiscal space. However, further improvement of the estimation method is needed.

Secondly our estimation is based more on the spatial difference (cross sectional dimension) of the reaction of the primary balance to different debt levels, rather than the change of the primary balance corresponding to a change of debt level over time. The main reason for this is the fact that the debt spectrum is wide across the country dimension (cross section), while rather narrow for a specific country (only a few number of countries' debt levels changed substantially during the observed period). This phenomenon restricts the use of our approach – it is not possible to derive a similar reaction function, critical debt level or fiscal space for an individual country or a group of countries lacking a sufficiently wide historical debt spectrum. Such a derivation would otherwise be speculative, relying too much on the functional form of the reaction function.

Thirdly, additional control variables and modeling in a simultaneous context would improve the use of the approach in (policy) simulations. Under current settings the estimated reaction function represents a description of the mutual reaction of the primary balance, GDP and interest rate[13] in the long run; it is sort of a reduced form of their mutual relationship.

## 5.2 COMMENTS ON THE ESTIMATED REACTION FUNCTION

Some countries reactions (see Figure 6) reside within positive primary balance ranges. This is typical for countries with low growth. The reaction of others is negative for low and moderate debt levels (for example, less than 60% of GDP) and positive for high debt levels. Yet for some countries the reaction function is almost entirely negative – this is typical for countries, with rapid nominal GDP growth exceeding interest rates (they outgrow their debt).

As mentioned earlier, the only specific factor differentiating the reactions of individual countries is the fixed (shift) factor. It comprises many structural and other factors which define their long term budget policy. Thus a country's typical reaction function position represents its budget policy structure – the budget policy of a slowly growing developed country must be structurally different from the budget policy of a fast growing developing country. The other possible interpretation is that when a country expects economic slowdown it has to adopt structural budgetary measures to prevent debt accumulation.

Figure 6 illustrates our estimation of reaction functions for Finland, Italy, Greece and Slovakia.

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[13] Interest rate reaction becomes ever more important in the current situation of public debt crisis

Figure 6: Reaction to debt
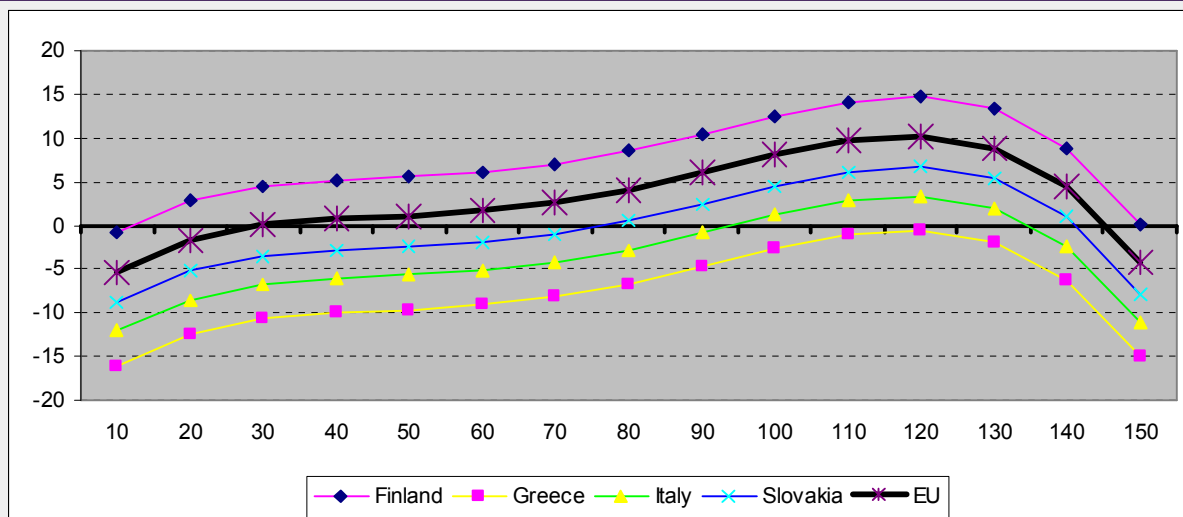
Source: authors' calculation

Finland, as a country with a responsible fiscal policy, is represented by a reaction function - in accordance with expectations; with an upwards shift of 2,87 / 0,65 = 4,4% (of its nominal GDP). The interpretation is that Finland's reaction on debt is stronger by 4,4% of GDP than the response of the EU as a whole. On the other hand, Greece and Italy's reaction to debt is weaker than the EU as a whole. Greece's reaction function shifted downwards by 6,99 / 0.65 = 10,8% of GDP compared to the EU average and the reaction of Italy is also 4,44 / 0,65 = 6,8% of GDP weaker than the EU average. Slovakia's response to debt is 2,3/0,65 = 3,5% of GDP weaker than the response of the EU.

5.2 ROBUSTNESS

One issue to be checked before applying the estimated reaction function in determining the critical level of debt is possible changes in the reaction of governments over time. Specifically, it is reasonable to assume that after joining the euro area (as impending accession to the EU) today's EU27 countries changed their fiscal behavior. Accession to the euro zone brought lower interest rates in many countries and this discouraged some from responsible fiscal policies they had previously adopted. Countries that entered the EU in later stages were encouraged to adopt fiscal consolidation in anticipation of early euro zone entry. Other countries did not change their fiscal behavior after joining the euro zone.

Another issue is the possibility of different reaction functions for individual countries and/or group of countries. Countries express individual characteristics in dealing with their debt[14]; they have differentiated fiscal disciplines[15]. As a consequence, most counties have a rather narrow debt range which makes virtually impossible to reliably estimating a country's reaction function shape.

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[14] E.g. Visegrad countries have for long time used the opportunity to grow up off the debt
[15] Current crisis changed this picture partially

The model for estimating the primary balance for the period since 2000 (listed in Tables 1 and 2) partially answers this question. It follows that the parameters of the reaction function has not significantly changed. Significant changes occur in the low debt range (in fact, hypothetical values) and in the high debt range where the reaction of the primary balance is initially stronger followed by a steep decline which influences the assessment of critical debt levels.

The combined EU reaction functions for the full period 1995-2008 and for sub-period 2000-2008 are shown in Figure 7.

Figure 7: Reaction to debt of the EU
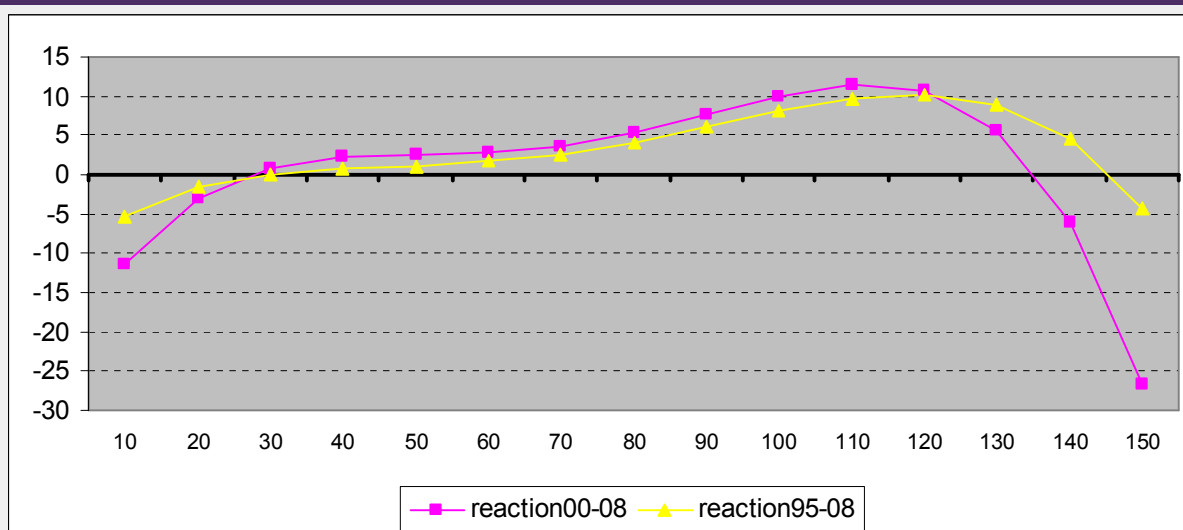
Source: authors' calculation

5.3 CRITICAL LEVEL OF DEBT

As mentioned in Chapter 4, when determining the critical level of debt, besides knowledge of the reaction function, it is also important to know other factors effecting debt dynamics, namely, the rates at which debt is financed, the nominal growth rate of output and the actual level of debt. These factors together determine whether the budget reaction (the primary balance) is sufficient to compensate for the snow-ball effect. Such an assessment is not correct in the short term, because growth rate can be influenced by the budget reaction. We instead use a long term approach – our reaction function is estimated from a longer time period. As such the interpretation is different and can be expressed as: "Is the reaction, as observed (estimated) in the long-term, sufficient to cover the snow-ball effect (adjusted interest cost of debt)?" From a formal point of view we can then make different assumptions about the snow-ball effect – for instance alternative backward time horizons as the basis for empirically assessing the snow ball effect. However selecting specific time periods changes the interpretation.

If the economy moves at its potential and government spending follows the long-term trend, then debt dynamics depend on the interaction between the response to debt and the adjusted cost of debt - **(i - g)** * d. To determine a critical level of debt, we need to estimate the future development of the adjusted cost of debt. As already mentioned, one way to determine interest rate and GDP growth rate is to calculate an average of these variables for an appropriately chosen period. If a country's debt is sufficiently far from critical levels, the interest rate / growth rate differential is assumed to be exogenous and consequently the snowball effect grows linearly with the level of debt.

Critical debt levels will be illustrated for countries whose debt was analyzed in Chapter 3 - Finland, Italy, Greece and Slovakia. For each country (except Greece[16]) two periods are considered – the full period 1995-2008 and its sub-period 2000-2008.

Table 3: Slope of snow-ball effect line.		
	1995-2008	2000-2008
Country		
Italy	2,07	1,24
Finland	0,23	-0,26
Greece	NA	-1,96
Slovakia	-3,22	-4,01
Source: authors' calculation		

The slope of the snow-ball effect line for the selected periods is the period average of the difference between (implicit) interest rates and nominal GDP growth rates. The values for individual countries are reported in Table 3. While Greece and in particular Slovakia "grew up" from debt, the snow-ball effect was relevant for Italy. The snow-ball effect was negligible for Finland,.

In 2009, Finland owed 43.3% of its GDP to creditors. From Figure 8, it is evident that Finland still has a very large capacity for debt financing. Given its reaction function, its critical debt level is estimated to be around 145% of GDP[17] (135% when considering the 2000-2008

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[16] Data before the 2000 were not available for Greece

[17] Figures 8 and 9 depict the difference between reaction function and snow-ball effect. If the difference is above zero, the reaction to debt exceeds the snow-ball effect and debt decreases. Fiscal space in these figures is any level of debt lying between current level of debt and critical level (the second zero intercept) of debt.

reaction). When interest rates fell in Finland after 2000, the available fiscal space increased but Finland retained fiscal responsibility nonetheless.

Figure 8: Fiscal space : Left panel: Finland;   Right panel: Italy
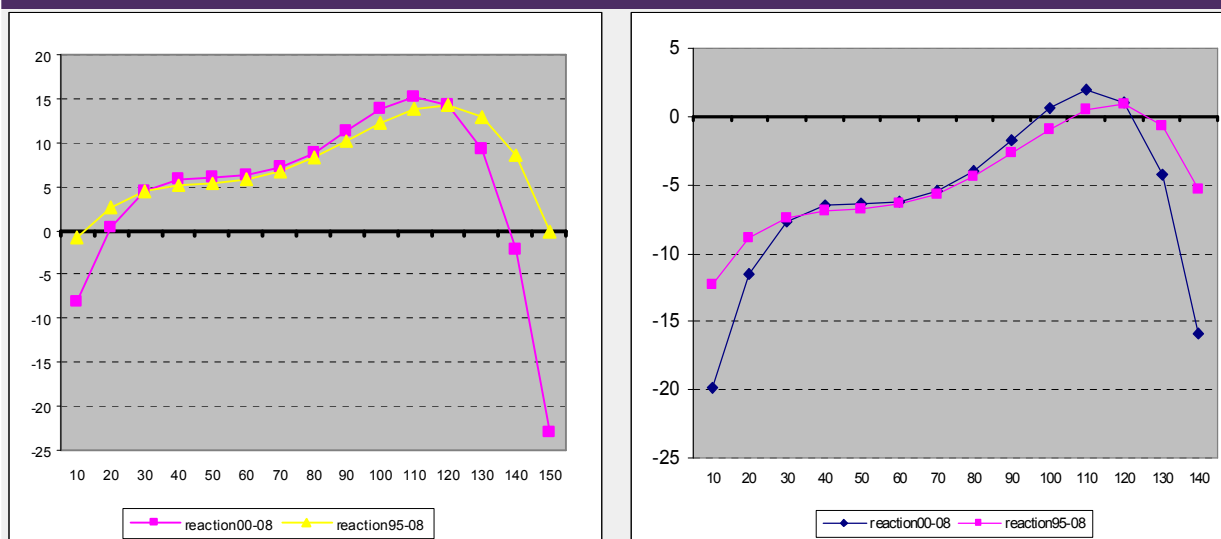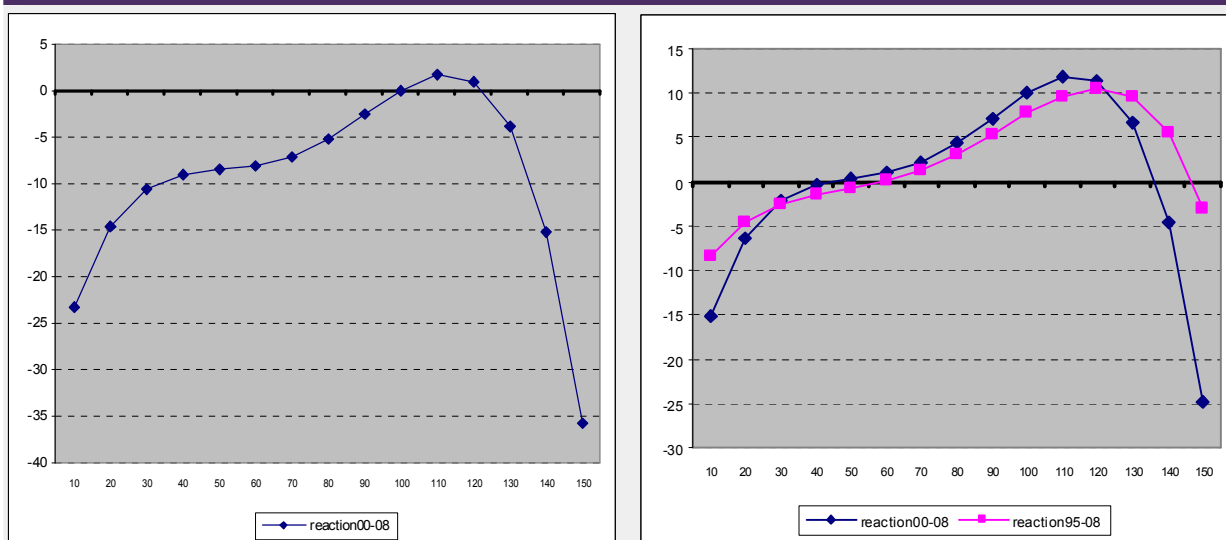

Source: authors' calculation

Italy's total debt was 115.5% of GDP in 2009. In 1995 total debt was already three times higher than Finland. Figure 8 illustrates how Italy did not react sufficiently to debt. Given its policy it has now joined the ranks of countries with very limited fiscal space. It has been worryingly close to its critical level, which we estimate to be between 127% and 130% of GDP). Italy's debt at the end of 2009 amounted to 129.3% of GDP.

Greece's response to debt was not sufficient (the reaction to debt was negative at all debt levels, see Figure 9). However, the weak reaction was not a critical problem in the past because Greece's nominal GDP had grown rapidly and the cost of debt was significantly reduced by the onset of low interest rates. The current situation is different. The main problem is the worsening prospect of growth (for the whole euro zone not just Greece) stripping it of the final factor which can stabilize the debt. The growing distrust of Greece's ability to repay government debt, a lack of trust in the presented information and the high level of debt (closer to the critical level estimated at about 128% of GDP) combined to instill distrust in financial markets and a rapid growth of interest in (re) financing government debt.

Slovakia's total public debt was 35% of GDP in 2009 (among the lowest is the region). Based on the adjusted reaction (derived from 2000-2008 time period), 35% represented a sustainable debt level (45% if the 1995-2008 period is used for estimation). The estimated

critical debt level ranges between 131-142% of GDP. Its debt level rose to 41% of GDP in 2010.

Figure 9: Fiscal space : Left panel: Greece;   Right panel: Slovakia

Source: authors' calculation

6. FISCAL SPACE – CASE OF SLOVAKIA

Public debt increased year on year from an initial 20% to a maximum level of 50% in 2000 (see Figure 10). From that year until the outbreak of the financial crisis in 2008 it gradually declined to 27% followed by growth during the crisis period. .

Figure 10: Debt dynamics in Slovakia (as a percentage of GDP)

Chart legend: level of debt, change of debt
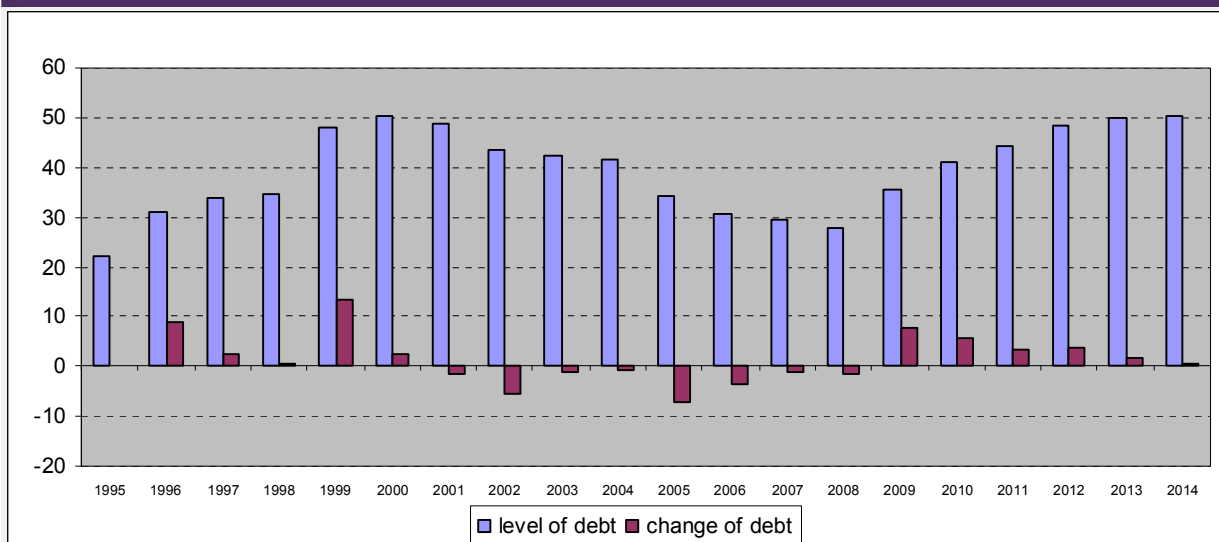
Source: Eurostat

Three phases of debt dynamics can be identified in Figure 11. The first phase between 1996 and 2000 experienced increasing debt due to a relatively high primary deficit throughout the period and a one off increase in debt in 1999 due to a banking sector bailout.

The second phase from 2001 to 2008 is characterized by a consolidation of public debt. It is due to a reduction in primary deficit (although it remained positive) and a decrease of debt caused by a combination of high nominal GDP growth and low interest rates. One off funds obtained from privatization also helped to significantly reduce debt levels in this period.

The consolidation trend was reversed in 2009 when the economic crisis struck the Slovak economy. The subsequent reduction in income and an increase in public spending caused a substantial increase in primary deficit which in turn increased debt levels. A drop in nominal GDP exacerbated this development. In 2010-11 the dynamics somewhat improved due to a renewed GDP growth but primary deficit remained too high.

Figure 11: Change of debt - decomposition
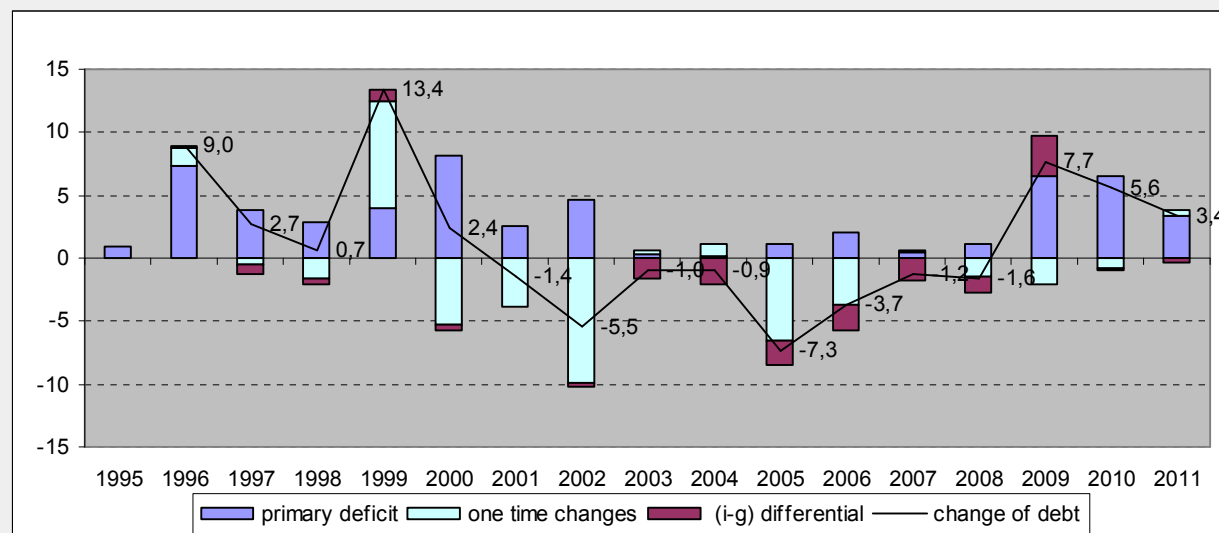
Source: Eurostat

The essence of maintaining a low level of debt in Slovakia in the past was high growth rates of (nominal and real) GDP and later on also declining interest rates. A slowdown or even recession poses a key threat to debt dynamics. The critical level of debt's dependence on the favorable development of adjusted cost of debt (the snow-ball effect) is documented below in Figure 12. In this graph, the period from 1995 (a year of deep crisis in Slovakia) to 2009 is gradually shortened to reflect the negative debt cost development and a critical debt level of Slovakia is assessed on the bases of these changes.

Figure 12 illustrates that the snow-ball effect, derived from the period 2005-2009, would not be a bigger problem if the reaction exceeds it. The assessment based on the crisis period of 2008-2009, and particularly in 2009 already shows that the current response to debt (negative primary balance of about 2% of GDP) would no longer be sufficient enough to maintain its current level. The primary balance would have to move into a surplus of +3% of GDP. Thus, fiscal policy would have to be dramatically strengthened if the government wanted to maintain current debt levels in such unfavorable (interest rate - growth rate) conditions like the crisis year 2009. It is clear that such a change in response (+5% of GDP) is unrealistic and it is probably not necessary. But the long-anticipated economic slowdown, even despite possible higher inflation and accommodative lower interest rates, will require a consolidating government response – an upward shift of reaction function in Slovakia.

Figure 12: Slovakia, Left panel: Reaction function and adjusted cost of debt; Right panel: Fiscal space
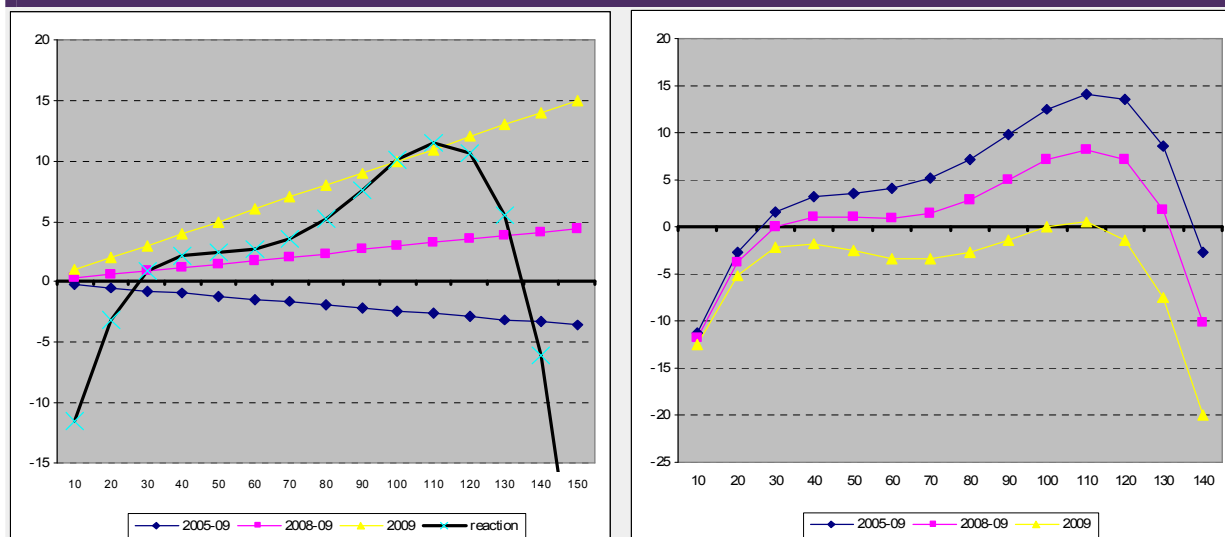
Source: authors' calculation

The government, indeed, has pledged to take additional consolidation measures to stabilize debt in the medium term. In the medium run, the government's target is a balanced budget deficit.

7. CONCLUSION

The paper presents an approach to determine critical levels of debt. The approach, originally suggested by Ostry et al., (Ostry, 2010), has been adjusted to mainly reflect the fact that our paper deals with a different set of countries (EU) than the original (developed OECD countries). We assumed that a governmental response to debt in EU countries is shaped as a polynomial of the fourth degree (it was a 3rd degree in the original paper) and that the issue of autocorrelation can be dealt with by a reaction function determined as a long term part of the error-correction model. An important result is that the EU as a whole had a rather large fiscal space - the critical level of debt is significantly higher than the actual debt (2009). Several individual EU countries also had sufficient fiscal space (Finland, among others, which this paper uses as an example of a disciplined country). Some countries, by contrast, were already close to the critical level of debt (Italy, Greece) in 2009 and their fiscal space was virtually exhausted. We also address the issues of stability and the reaction function's robustness and examine the impact of the crisis on the snow-ball effect in determining critical debt levels.

In the analyzed period debt dynamics differed significantly in individual EU countries. Some countries maintained a surplus in primary balance while others were able to contain debt mainly due to a rapid growth of (nominal) GDP. Virtually all countries might be motivated

to behave less prudently by low interest rates. Other countries might be under pressure from tax competition[18].

Specific attention is devoted in the paper to the indebtedness of Slovakia. Within the EU, Slovakia belongs to a rather more prudent group of countries in relation to managing public debt. Until the outbreak of the crisis Slovakia systematically consolidated its public debt towards 27% of GDP. Consolidation was mainly enabled by a combination of high GDP growth and decreasing interest rates on debt, but also by one-off payments acquired by privatization. It is less optimistic, however, that throughout the whole consolidation period the primary balance remained in deficit, albeit relatively low. The crisis slowed GDP growth, reversed the process of consolidation and in a short time debt rose close to 50% of GDP. According to forecasts by the Ministry of Finance debt should start to fall in the medium term.

We are aware that a number of econometric and interpretive problems have not yet been satisfactorily resolved in the paper. We have not yet addressed some problems, namely the optimal pace of consolidation and its sustainability or behavior of interest rates in the proximity to critical debt levels. These areas provide motivation for further research.

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[18] Reaction of the revenue and the expenditure side of the budget of EU countries on the debt and the deficit was analyzed by Hajnovič (2010).

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