

JEL Classification: E62, H62, H63

Keywords: fiscal sustainability, fiscal reaction function, primary balance, public debt, budget balance

Fiscal Policy Reaction in the Short Term for Assessing Fiscal Sustainability in the Long Run in Central and Eastern European Countries^{*}

Andreea STOIAN – (andreea.stoian@fin.ase.ro), *corresponding author*

Emilia CÂMPEANU

both authors: Bucharest Academy of Economic Studies

Abstract

The aim of this paper is to analyze how the primary government balance in Central and Eastern European countries reacts in the short term, in order to assess fiscal sustainability in the long run. For the purpose of this study, a fiscal reaction function is used. Given the different orders of integration of the variables involved in the model, modified forms of the fiscal reaction function are considered. The results show that for Bulgaria, Czech Republic, Estonia, Hungary, and Lithuania fiscal policy reacts as expected – in the sense that governments have the ability to run a primary surplus – in the short term. This action makes fiscal sustainability easier to achieve in the long run. On the other hand, for Latvia, Poland, Romania, and Slovakia, sustainable fiscal policy will be more difficult to attain given the opposite response of governments to public debt shocks. In these countries, severe fiscal adjustments should be made in order to reach fiscal sustainability in the long run.

1. Introduction

Fiscal sustainability has been thoroughly studied in the literature of the last two decades. According to Agnello and Sousa (2009), unsustainable fiscal policy could harm the welfare state through large fiscal deficits and excessive public debt stocks, generating an inefficient allocation of resources, an excessive public debt stock that could affect future generations, and an increase in the inflation rate and its volatility. In addition, de Castro Fernandez and Hernandez de Cos (2000) argued that unsustainable fiscal policies involve a risk of future interest rate rises, leading to a slowdown in economic growth. Buitier (2004) also emphasized phenomena that are likely to happen when fiscal sustainability is not achieved: i) public spending could be lower and tax revenues could be higher than originally planned; ii) the inflation rate could be higher than expected; iii) public debt could be defaulted on. Running unsustainable fiscal policies could worsen the macroeconomic conditions and make economies more vulnerable to exogenous shocks.

European Union (EU) fiscal sustainability is still a much debated and controversial topic. Unsound fiscal policies of individual members could have adverse effects and harm other members' economies. In that sense, Afonso (2000) showed that

^{*} This research was supported by a grant from the CERGE-EI Foundation under a program of the Global Development Network. All opinions expressed are those of the authors and have not been endorsed by CERGE-EI or the GDN. Also, the authors would like to express their gratitude to the anonymous referee for helpful comments and the editors of Czech Journal of Economic and Finance, and to Edward Christie (Pan European Institute and Turku School of Economics) for his support.

before the Stability and Growth Pact (SGP) was adopted, fiscal policy was not sustainable in most European Monetary Union countries, with the possible exceptions of Germany, Austria, and the Netherlands. Recently, Afonso and Rault (2007) found that even if the sustainability of public finances in the EU-15 over the period 1970–2006 was an issue in some countries, fiscal policy was sustainable for the EU-15 panel set. One year later, Afonso and Rault (2008) conducted the first panel analysis of fiscal sustainability encompassing the enlarged set of 27 EU countries. They used data spanning the period 1960–2006 and reached the conclusion that fiscal policy is not sustainable within the EU-27 panel.

Moreover, in the years ahead, many developed countries will have to deal with the challenges of population aging. There are studies that predict that the current fiscal policies of most EU countries based on growing social spending will become unsustainable in the future (Corsetti and Roubini, 1996; Alesina, 2000; Kotlikoff and Hagist, 2005). More recently, Balassone et al. (2009) showed that countries currently recording high fiscal surpluses (Finland) or those that have undertaken major structural reforms of their pension systems (Germany, Austria, and Italy) tend to experience lower sustainability risks. However, according to the indicators calculated by these authors, most of the euro countries will have to adjust their fiscal policies sooner or later.

In addition, Fatas and Mihov (2009) found that over the period 1970–2007, fiscal policy in the euro area was mildly pro-cyclical, and the adoption of the common currency and the constraints imposed by the SGP did not have a large impact on the cyclical behavior of the structural balance. According to Marin (2002), the rules of budgetary discipline set out in SGP, which require a balanced or surplus budget, preserve fiscal sustainability via automatic stabilizers.

Empirical evidence shows that most of the European countries¹ have been confronted with large fiscal imbalances and public debt stocks since 1970. The fiscal position for many EU countries was similar also in the early '90s with notable improvement for Belgium, Italy and Netherlands (see in that sense, Afonso, Agnello, Furceri and Sousa, 2009).

There is a large stream of literature that has investigated fiscal sustainability for the developed European countries. But what is the situation in the newcomers, especially the Central and Eastern European countries (CEECs)?² There is a small body of research investigating the issue of fiscal sustainability exclusively among emerging economies within the European Union (i.e., Schneider and Zapal, 2006; Aristovnik and Bostjan, 2007; Aristovnik, 2008). This study contributes to the existing literature by shedding some light on whether fiscal sustainability represents an issue for CEECs.

CEECs are having to cope with the constraints imposed by the Maastricht Treaty on their way to becoming market economies. The statistical data show that they recorded annual fiscal deficits of below 3% of GDP on average between 2000 and 2008,³ with the exceptions of the Czech Republic, Hungary, Poland, and Slova-

¹ We refer to the members of the European Union before its enlargement to include Central and Eastern European countries.

² The Central and Eastern Europe countries are Bulgaria (BG), the Czech Republic (CZ), Estonia (EE), Hungary (HU), Latvia (LV), Lithuania (LT), Poland (PL), Romania (RO), Slovakia (SK), and Slovenia (SI).

³ Annual statistical data on fiscal deficits, primary balances, public debt, real interest rates, and real growth rates over the period 2000–2008 are available from Eurostat.

kia. There was a clear downward tendency in public debt as a ratio to GDP in Bulgaria, Lithuania, and Romania. In the Czech Republic, Hungary, Slovenia, and Slovakia, public debt rose in the period considered. The region's average of public debt-ratio-to GDP was still below 60%, with Hungary as the only outlier with debt reaching 70% of GDP. The primary balance recorded, on average, a deficit in most of the countries (only Bulgaria and Estonia had primary surpluses). Real interest rates were below real growth rates with no exceptions, which should guarantee debt reduction and thus fiscal sustainability under a reasonable moderate fiscal policy stance. Considering all the above, this study would like to answer the question of whether the fiscal policy of the CEECs is sustainable in the long run, taking into account their governments' response to public debt shocks in the short term.

The aim of this paper is therefore to investigate the fiscal policy reaction to public debt shocks in the short term aimed at achieving sustainability of fiscal policy in the long run in the CEECs. In accordance with the purpose of this paper, we will use the *fiscal reaction function* (FRF). The paper is structured as follows. The next section presents the mathematical model of fiscal sustainability. Section 3 is devoted to describing the investigation methodology and the data used. It will emphasize the importance of using the fiscal reaction function. Empirical results are also presented in Section 3. The last section gives the concluding remarks of the study.

2. Theoretical Background of Fiscal Sustainability

Blanchard (1990) and Blanchard, Chouraqui, Hageman, and Sartor (1990) considered that fiscal policy is sustainable when public debt does not explode and governments are not forced to increase taxes, decrease spending, monetize fiscal deficit or repudiate public debt. In addition, they imposed the restriction that the present value of future primary surpluses must equal the current level of public debt. Considering this, the arithmetic of fiscal sustainability (see, for instance, Blanchard, 1990; Blanchard, Chouraqui, Hageman, and Sartor, 1990; Gramlich, 1990; Horne, 1991; and Buiters, 1995, among a long list of studies) starts with the government budgetary constraint:

$$B_t = G_t - R_t + B_{t-1} + i \cdot B_{t-1} = G_t - R_t + (1+i) \cdot B_{t-1} \quad (1)$$

where:

B_t = total amount of real public debt at time t ;

G_t = non-interest real government expenditure (including transfers and capital expenditures) at time t ;

R_t = real government revenues (including non-tax and privatization revenues) at time t ;

i = real interest rate for government borrowing.

According to equation (1), the total amount of public debt (B_t) at a particular moment depends on the current primary deficit ($G_t - R_t$) and on the public debt accumulated in the past (B_{t-1}), including interest payments on government borrowing ($i \cdot B_{t-1}$).⁴

⁴ There are studies (see, for instance, Buiters, 2004) that take into account the money base or seigniorage. In most of the countries (EU member states) seigniorage is forbidden by law. Consequently, we should not consider this broader model of fiscal sustainability.

Taking into account expectations E_t at time t in equation (1), the intertemporal budget constraint (IBC) is represented by:

$$B_t = -E_t \sum_{k=0}^{\infty} (1+i)^{-(1+k)} (G_{t+1+k} - R_{t+1+k}) + \lim_{k \rightarrow \infty} E_t (1+i)^{-(1+k)} B_{t+k+1} \quad (2)$$

The intertemporal budget constraint states that the public debt stock (B_t) equals the discounted present value of the expected primary balance ($G_{t+1+k} - R_{t+1+k}$) plus the limit value of discounted public debt (B_{t+k+1}). Fiscal policy is said to be sustainable if the present discounted value of public debt converges to zero, according to the transversality condition:

$$\lim_{k \rightarrow \infty} E_t (1+i)^{-(1+k)} B_{t+k+1} = 0 \quad (3)$$

In a growing economy with rising government spending and an increasing tax base, budgetary equations (1) and (2) can be expressed by taking into consideration the real growth rate of GDP (y) and the variables denoted by small letters as a ratio to GDP (b , g , r). The government budgetary constraint (1) as a ratio to GDP becomes:

$$b_t = g_t - r_t + \frac{1+i}{1+y} \cdot b_{t-1} \quad (4)$$

where:

b_t = ratio of public debt to GDP at time t ;

g_t = ratio of non-interest government expenditure (including transfers and capital expenditures) to GDP at time t ;

r_t = ratio of government revenues (including non-tax and privatization revenues) to GDP at time t ;

i = real interest rate for government borrowing;

y = real growth rate.

Considering expectations at time t in equation (4), the IBC becomes:

$$b_t = -E_t \sum_{k=0}^{\infty} \left(\frac{1+i}{1+y} \right)^{-(1+k)} (g_{t+k+1} - r_{t+k+1}) + \lim_{k \rightarrow \infty} E_t \left(\frac{1+i}{1+y} \right)^{-(1+k)} b_{t+k+1} \quad (5)$$

Consequently, fiscal policy is sustainable if:

$$\lim_{k \rightarrow \infty} E_t \left(\frac{1+i}{1+y} \right)^{-(1+k)} b_{t+k+1} = 0 \quad (6)$$

A good starting point in assessing fiscal sustainability is to check for government solvency based on the IBC.⁵ However, according to various authors, solvency is a necessary but not sufficient condition for fiscal sustainability (see, for example, Horne, 1991). Consequently, solvency requires that the debt is fully repaid

⁵ For instance, Buitert (2004) considers that analyzing fiscal sustainability relies on checking for solvency of the state. Therefore, he states that the assessment of fiscal sustainability should be investigated by including all contractual liabilities and assets of the state, or at least the consolidated central government sector and central bank. Buitert's approach to fiscal sustainability analysis is very comprehensive and has to handle at least the valuation of state assets such as natural resources, infrastructure, and other state property. In this paper, we will not follow Buitert's broad approach to fiscal sustainability.

at some point in the future, and sustainability requires that, moreover, solvency is achieved under unchanged fiscal policy (see Croce and Juan-Ramon, 2003).

The intertemporal budget constraint and the transversality condition imply that fiscal policy is sustainable when governments can use primary surpluses to finance the initial public debt stock. The IBC could be relaxed in the sense of Chalk and Hemming (2000), who consider that sustainability requires that the present value of future primary surpluses must exceed the present value of future primary deficits by a sufficient amount to cover the initial debt stock. This relaxed assumption allows for occasional primary deficits, but primary surpluses should be larger. The initial IBC and the relaxed IBC can generate the same cost in terms of primary surpluses, but that cost will be differently distributed over time.

3. Testing Fiscal Sustainability in the Case of CEECs

3.1. Methodology

Theoretically speaking, the IBC is a criterion that can be used by governments to choose from different sets of fiscal policies that prove to be sustainable in the future. But the major issue in that context is whether, given a fiscal policy, governments can predict the amount of budgetary expenditure and revenue or the future real interest rate over 20–30 years in order to readjust their policy. Moreover, in general, the literature assumes that, for equations (2) to (6), the real interest rate and the real growth rate are both positive and constant in the long run. This assumption is made, for instance, in Hamilton and Flavin (1986), where the authors investigate the fiscal sustainability of the USA. Choosing a different approach, Wilcox (1989) proposes variable interest rates and also allows negative discount rates. Taking this approach further, Trehan and Walsh (1991) show that in the case of a non-constant interest rate, sustainability no longer implies cointegration between the debt and the primary balance and also that the integration orders of the two variables can be different. Besides this point, they emphasize that the IBC holds as long as there are positive real interest rates. The IBC is influenced by the level of real interest rates, similarly to the case of the net present value (NPV) of an investment, where using too high or too low an interest rate can affect the investment decision. For instance, International Monetary Fund (2003) considers that the IBC is sensitive to the level of the interest rate and can be difficult to interpret when the rate changes with market conditions. Therefore, it proposes that the appropriate real interest rate should ideally capture the long-term return on risk-free assets. This can be useful when applying the IBC on estimated data in the long run, but on historical data, when dealing with a high inflation rate, it can be misleading.

There is a large literature investigating fiscal sustainability among different countries. Most of the studies rely upon the seminal work of Hamilton and Flavin (1986), Wilcox (1989), and Trehan and Walsh (1991). Generally speaking, there are two classical methodological approaches: the unit root test (Hamilton and Flavin, 1986; Trehan and Walsh, 1988; Corsetti and Roubini, 1991; Uctum and Wickens, 2000; Afonso, 2000, 2005) and cointegration tests (Elliot and Kearney, 1988; Hakkio and Rush, 1991; Payne, 1997; Afonso, 2000, 2005).

There are several studies (see, for instance, Bohn, 1998, 2005, 2007), however, that cast some doubt on the relevance of classical empirical tests. The critics

highlight the fact that the previous tests rely on assumptions about expected primary surpluses that are difficult to estimate. Therefore, Bohn demonstrated that the assessment of fiscal sustainability is ensured by the *fiscal reaction function* that describes the primary surplus-to-GDP ratio as a positive function of the public debt-to-GDP ratio. The fiscal reaction function represents a more flexible approach to investigating fiscal sustainability, and, unlike classical tests, it gives valuable insights into the magnitude and the lag of the government's reaction to public debt shocks. Moreover, the fiscal reaction function reveals the government's ability to generate a primary surplus in the short term in order to meet the constraints imposed by the IBC in the long run.

The *fiscal reaction function* (FRF) can be estimated by regressing the primary balance on public debt values:

$$p_t = \alpha + \beta \cdot b_t + \delta \cdot Z_t + \varepsilon_t \quad (7)$$

where:

- p_t = primary balance-to-GDP ratio (surplus/deficit) at time t ;
- b_t = public debt-to-GDP ratio at time t ;
- Z_t = set of explanatory variables at time t ;
- α, β, δ = coefficients;
- ε_t = error terms (white noise).

The fiscal reaction function allows for testing of the government's response to changes in the public debt stock. An increasing public debt-to-GDP ratio is expected to generate an immediate fiscal policy reaction consisting in an improvement of the primary balance (a lower deficit or a higher surplus). The fiscal sustainability model presented in section 2 can be considered a forward-looking model that uses expected values of the primary balance and discount rates. It shows whether the government can generate future primary surpluses whose discounted value equals the current stock of public debt, making the assumption that the transversality condition is fulfilled (the terminal value of the public debt stock converges to zero). The fiscal reaction function can be viewed as a backward-looking model based on historical data that indicates whether governments had the ability in the past to run higher surpluses, or at least to lower the primary deficit, when public debt increased. The FRF is a tool used to assess fiscal policy sustainability in the long run. If governments were able to generate primary surpluses in the past, and fiscal policy was flexible enough to respond to increasing public debt, then future higher surpluses assessed as meeting the constraints imposed by the IBC in the long run will not create difficulties and fiscal sustainability will be easier to achieve. Conversely, if the FRF shows that the government reacted in the opposite way and lowered surpluses when public debt increased, then, in the future it will be difficult to meet the IBC constraints and fiscal sustainability will be difficult to achieve in the long run. In addition, Bohn (1998) argues that if the primary surplus responds positively to an increase in debt, then the government's fiscal reaction function can be viewed as sustainable. Such a test reduces to examining whether $\beta > 0$ in equation (7).

Many studies that analyze fiscal sustainability based on the fiscal reaction function rely upon Barro's work (1979), which states that the determinants (Z_t) of

the fiscal stance are business cycles, temporary government spending, and several other explanatory variables. In this sense, Bohn (2005) used the squared debt-to-GDP. De Mello (2005) estimated equation (7) using the lagged primary balance, indebtedness, and inflation, while also allowing for institutional variables that took into account the impact of different fiscal laws. Greiner, Koeller, and Semmler (2005) worked with the social surplus ratio (social security budget), the long-term interest rate, and the lagged debt-to-GDP ratio besides the business cycle as explanatory variables for the primary balance. Kirchgaessner and Prohl (2006) added as explanatory variables expected inflation and temporary fluctuations in government military expenditure. IMF (2003) estimated the fiscal reaction function for industrial and emerging countries using the primary balance as a dependent variable. This study represented an extension of Bohn's (1998) paper and showed that a response of the primary balance to public debt shocks indicates "the consistency of fiscal policy with long-run solvency" (IMF, 2003, p. 127). Similar studies investigating fiscal sustainability using the fiscal reaction function were developed by Ballabriga and Martinez-Mongay (2005) and Staehr (2008) for European countries, the USA, and Japan.

The aim of the fiscal reaction function employed in this paper is to investigate how the government responds in the short run to changes in the public debt stock, in order to assess fiscal sustainability in the long run. Generally, the theory states that the response of the primary balance to higher debt stocks should be immediate, implying fiscal sustainability. But there are authors who consider a delayed reaction on account of interest payments that occur at a later time (Greiner, Koeller, and Semmler, 2005). Consequently, a delayed response of the government to public debt shocks does not necessarily imply unsustainable fiscal policy. However, it can be argued that such a situation depends on the frequency of the time series used and should be judged accordingly.

3.2 Data

The fiscal reaction function (7) is estimated for all CEECs using quarterly data from 2000 to 2008 for the primary balance⁶ and public debt as ratios to GDP. The data is available from Eurostat. Some descriptive statistics for the data used are presented in *Table 1*.

The data used for estimation of the fiscal reaction function is seasonally adjusted using the difference from the moving average. Taking into account that the quarterly data spans only nine years (2000–2008), it was assumed that seasonal factors are constant. Moreover, the additive option was applied, considering the negative values of the primary balance.

Testing for unit roots, the results show some interesting particularities of the time series. For instance, in most of the cases considered, the primary balance is stationary, but public debt has a different order of integration than the primary balance. The results of the Augmented Dickey-Fuller test for unit roots and the options used accordingly for the time series are presented in *Table 2* and in *Table 1A* in the *Appendix*.

⁶ The primary balance-to-GDP ratio is calculated on quarterly data as the difference between total general government revenue and primary government expenditure as ratios to GDP. Primary government expenditure is calculated as the difference between total general government expenditure and interest.

Table 1 Descriptive Statistics

Country	Budget balance (% of GDP) (surplus (+) / deficit (-))			Primary balance (% of GDP) (primary surplus (+) / primary deficit (-))			Public debt (% of GDP)			Average real interest rate on public debt (%)*			Real GDP growth rate (%)							
	Min	Max	Std. dev.	Min	Max	Aver- age dev.	Min	Max	Aver- age dev.	Min	Max	Aver- age dev.	Min	Max	Aver- age dev.					
BG	-0.8	3.0	0.8	1.3	1.1	4.4	2.9	1.2	14.1	74.3	40.4	21.5	-7.6	1.4	-2.9	2.5	4.1	6.6	5.6	0.9
CZ	-6.8	-0.6	-3.8	2.2	-5.5	0.5	-2.7	2.2	18.5	30.4	27.9	3.9	-2.5	4.0	1.4	1.9	1.9	6.8	4.3	1.7
EE	-3.0	2.9	0.8	1.8	-2.7	3.1	1.0	1.8	3.5	5.7	4.8	0.7	-4.9	2.1	-0.9	2.2	-3.6	10.4	6.9	4.1
HU	-9.3	-2.9	-6.1	2.4	-5.3	2.4	-1.8	2.7	52.1	73.0	60.6	6.6	-1.8	3.4	0.9	1.9	0.6	5.2	3.6	1.6
LT	-3.6	-0.4	-1.8	1.2	-2.6	0.3	-0.8	1.0	15.6	23.7	19.8	2.8	-7.6	6.5	2.0	4.6	3.0	10.2	7.0	2.2
LV	-4.0	-0.4	-1.7	1.2	-3.1	0.2	-0.9	1.1	9.0	19.5	13.4	3.0	-5.4	5.4	-0.2	4.2	-4.6	12.2	7.3	4.8
PL	-6.3	-1.9	-4.3	1.4	-3.3	0.4	-1.6	1.2	36.8	47.7	44.0	4.2	-2.5	6.4	2.9	2.7	1.2	6.6	4.2	1.9
RO	-5.4	-1.2	-2.7	1.5	-4.7	0.5	-0.9	1.6	12.4	25.7	18.6	5.2	-27.9	1.6	-8.8	9.7	2.1	8.5	5.8	2.0
SI	-4.0	0.5	-2.0	1.4	-1.6	1.8	-0.2	1.0	22.8	28.0	26.2	1.9	-0.4	3.3	1.5	1.2	2.8	6.8	4.3	1.3
SK	-12.3	-1.9	-4.7	3.6	-8.2	-0.2	-2.3	2.6	27.6	50.3	38.7	8.5	-3.6	3.9	0.0	2.5	1.4	10.4	5.7	2.7
CEEC	-3.8	-1.0	-2.6	1.0	-1.7	0.3	-0.7	0.6	25.3	32.5	29.4	2.8	-2.9	1.5	-0.4	1.6	2.7	7.6	5.5	1.5

Notes: * Average interest rate on public debt was estimated according to IMF methodology, derived as nominal interest expenditure divided by previous period debt stock.
Average real interest rate on public debt was estimated as difference between interest rate on public debt and inflation rate.

Source: Annual data over 2000–2008 available from EUROSTAT.

Table 2 Order of Integration

Country	Order of integration for primary balance (p)	Order of integration for public debt (b)
BG	I(0)	I(2)
CZ	I(0)	I(0)
EE	I(0)	I(1)
HU	I(0)	I(1)
LV	I(0)	I(0)* I(1)**
LT	I(0)* I(1)**	I(0)
PL	I(0)* I(1)**	I(1)
RO	I(0)	I(1)
SK	I(0)	I(0)* I(1)**
SI	I(1)	I(1)

Notes: * for 5%, and 10%

** For 1%, 5% and 10%.

Equation (7) is adjusted considering the particularities given by the ADF test, and different variants are applied for each case. For instance, when the variables are stationary, the primary balance or public debt-to-GDP ratios are used in the FRF (this is the case of BG, CZ, EE, HU, LV, RO, and SK for the dependent variable, p , and the case of CZ and LT for the explanatory variable, b). When the variables are integrated of order 1 the first difference of the primary balance, Δp , and public debt, Δb , as ratios to GDP are considered (this is the case of LT, PL and SI for the dependent variable, p , and the case of EE, HU, LV, PL, RO, SK, and SI for the explanatory variable, b). In Bulgaria's case, the second difference of public debt, $\Delta^2 b$, is used to estimate the fiscal reaction function.

Moreover, for BG, HU, LT, PL, RO, and SK, the set of explanatory variables, Z , includes lagged values of p or Δp . The reason for including them is related to the statistical significance of the estimated regression. In these cases, public debt becomes statistically significant only by adding lagged values of the primary balance.

The number of lags for public debt is chosen considering the time when the first reaction of the government occurs and the statistical tests show that β is significant different from zero.

3.3 Empirical Results

We now study the appropriate FRF country by country. The estimated results are presented in *Table 3* (see also *Table 2A* in the *Appendix*). The results of our analysis are consistent with the ones obtained by Aristovnik and Bostjan (2007), Afonso and Rault (2008), and Aristovnik (2008), who found that emerging economies from the European Union had issues with fiscal sustainability.

In the case of *Bulgaria*, considering the different orders of integration of the two variables implied by equation (7), the primary balance (the dependent variable), p_t , is regressed on the second difference of public debt, $\Delta^2 b_t$. The fiscal reaction

Table 3 Estimation Results for CEECs

Country	Dependent variable	Estimation results		
BG	ρ	$\rho(-4)$	$\Delta^2 b(-2)$	c
		0.35	-0.15	2.08
		[2.38]	[-2.30]	[3.76]
		Rsq: 0.13 F-stat: 2.12 (0.13)		
CZ	ρ	$b(-4)$	c	
		0.32	-11.42	
		[2.31]	[-2.95]	
		Rsq: 0.19 F-stat: 7.21 (0.01)		
EE	ρ	$\Delta b(-3)$	c	
		1.29	1.29	
		[2.17]	[2.44]	
		Rsq: 0.05 F-stat: 1.62 (0.21)		
HU	ρ	$\rho(-3)$	Δb	c
		0.34	-0.63	-1.15
		[2.32]	[-1.38]	[-1.70]
		Rsq: 0.25 F-stat: 4.85 (0.01)		
LV	ρ	Δb	c	
		-0.95	-0.42	
		[-3.91]	[-1.63]	
		Rsq: 0.32 F-stat: 15.42 (0.00)		
LT	Δp	$\Delta \rho(-2)$	$b(-3)$	c
		-0.48	0.15	-3.11
		[-3.97]	[2.63]	[-2.54]
		Rsq: 0.28 F-stat: 5.85 (0.00)		
PL	Δp	$\Delta \rho(-2)$	$\Delta b(-3)$	c
		-0.47	-0.30	-0.10
		[-5.47]	[-2.73]	[-0.45]
		Rsq: 0.28 F-stat: 5.85 (0.00)		
RO	ρ	$\rho(-4)$	Δb	c
		0.13	-1.66	-1.10
		[0.55]	[-2.59]	[-1.83]
		Rsq: 0.31 F-stat: 6.34 (0.00)		
SI	Δp	$\Delta b(-1)$	c	
		-0.51	-0.03	
		[-4.07]	[-0.22]	
		Rsq: 0.29 F-stat: 13.11 (0.00)		
SK	ρ	$\rho(-1)$	Δb	c
		0.54	0.19	-0.50
		[4.27]	[1.03]	[-1.94]
		Rsq: 0.40 F-stat: 10.76 (0.00)		

Notes: Probability in () and t -statistic in []. T -statistic was computed using standard errors adjusted with Newey-West HAC.

function has a particular form given by the second difference of public debt, showing that the primary balance reacts when the dynamics of public debt are accelerating. The response is delayed by two lags (two quarters). The sign of the reaction is negative, but, considering the second difference as an approximation of convexity, and given the decreasing level of public debt ratios to GDP, the response of fiscal policy is as expected.⁷ Governments try to lower debt by running high primary surpluses.

⁷ The scenario about convexity and a decreasing level of public debt is very plausible, considering that the government aims to lower the public debt stock in the long run.

When public debt is decreasing, the primary surplus is lowered, given that it is no longer needed. Hence, the response of fiscal policy in Bulgaria's case is as expected, taking into account the particular form of the fiscal reaction function. Moreover, over the period 2000–2008, Bulgaria ran a primary surplus on average and the real interest rate was below the real growth rate. In this situation, the government is able to generate a primary surplus in order to achieve fiscal sustainability in the long run.

In the case of the *Czech Republic*, the two variables are stationary and equation (7) is applied. The primary balance reacts properly to changes in public debt, in the sense that an increase in public debt of 1 p.p. translates to an increase in the primary surplus or a decrease in the primary deficit of about 0.32 p.p. The response of the government is delayed by at least four quarters (one year). The government's response to changes in public debt first occurs in the fourth quarter. Hence, for the Czech Republic, the government has the ability, in the short term, to run primary surpluses or at least to lower the primary deficit when the stock of public debt increases. Such a fiscal reaction can create the necessary conditions to achieve fiscal sustainability in the long run.

Equation (7) is adjusted for the case of *Estonia*, and, taking into account the order of integration, the primary balance, p_t , is regressed on the first difference of the public debt stock, Δb_t . The results show that the primary balance reacts to the dynamics of the public debt stock and that the response is as expected. A positive change in public debt will generate a primary surplus or a decrease of the primary deficit. The reaction is delayed by three quarters. Moreover, an increase of the stock of public debt has a large impact on the primary balance, in the sense that the response to a 1 p.p. change in the public debt is larger than 1 p.p. However, taking into account the low values of *R*-squared (0.05), the change in public debt explains only 5% of the primary balance. In this situation, it can be argued that fiscal policy (i.e., the primary balance) reacts to other stimuli than the public debt, the former having a larger impact on the primary balance. The weak reaction of the primary balance to changes in public debt can most probably be explained by the extremely low and stable public debt during 2000–2008 (the minimum value of public debt was about 3% of GDP, and the maximum was about 5% – see *Table 1*). Therefore, Estonia's recent fiscal policy should be assessed as being sustainable in the long run, but only as long as the public debt remains at the average levels recorded over these recent years. Should the public debt increase, current fiscal policy could face difficulties responding to public debt shocks.

For the case of *Hungary*, the primary balance is regressed on the first difference of public debt, taking into account the unit root tests presented in *Table 2* and the order of integration of the variables involved in the FRF. The statistical tests performed show that the dynamics of public debt do not have any significant impact on the primary balance.

In the case of *Latvia*, the primary balance is regressed on the first difference of public debt. Fiscal policy reacts to the current dynamics of public debt, but the reaction is the opposite of what is expected. A positive change in public debt generates a decrease of the primary surplus or an increase of the primary deficit. In this situation, fiscal policy is on an unsustainable path in the long run, considering that the primary balance showed a deficit on average over 2000–2008, even though the in-

Table 4 Cointegration Test in Poland's Case

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.
None	0.26	13.33	15.49	0.10
At most 1	0.09	3.17	3.84	0.07

Notes: The lag length is 1 and it is given by AIC.
The test considers intercept and no trend.

debtedness level was not too high and the interest rate was not higher than the real growth rate.

For the case of *Lithuania*, the first difference of the primary balance is considered to be dependent on the public debt-to-GDP ratio. Fiscal policy, in terms of changes in the primary balance, reacts properly to changes in the public debt stock. The reaction is delayed, but the sense is as expected. In this situation, running the same set of fiscal policies as over the period 2000–2008 would not generate sustainability issues in the long run.

For the case of *Poland*, changes in the primary balance react to the dynamics of public debt with a delay of three quarters. The response is the opposite, in the sense that positive dynamics of public debt will determine a negative change of the primary balance. In this situation, they will generate a decrease of the primary surplus or an increase of the primary deficit. Therefore, fiscal sustainability is a problem in the long run. In the case of Poland, an in-depth analysis can be undertaken, considering that the primary balance and public debt are both integrated of order one. In this situation, a cointegration test is applied to investigate if there is any equilibrium relationship among the variables involved in the FRF (see *Table 4*).

The test rejects the existence of any cointegration relationship between the primary balance and public debt. The movements of both variables are not able to respond to the magnitude of the disequilibrium, and the system will not return to the long-run equilibrium. The cointegration test confirms the OLS estimation, which showed that the reaction of the government to changes in public debt is not appropriate as far as the sign of the response is concerned. Consequently, running the same set of fiscal policies would generate sustainability issues in the long run.

In the case of *Romania*, the primary balance is regressed on the first difference of public debt, and the results show that fiscal policy reacts to the current dynamics of public debt. The reaction of the Romanian government is the opposite to what is expected, in the sense that an increase in public debt of 1 p.p. leads to a decrease in the primary surplus or an increase in the primary deficit of 1.66 p.p. Such a response of fiscal policy shows that the government is not able to run surpluses or to lower the primary deficit if the stock of public debt increases. Over the period 2000–2008, Romania had a low primary deficit and public debt stock as ratios to GDP, and the real interest rate was below the real growth rate on average (see *Table 1*). This context can partially explain the government's behavior given by the fiscal reaction function. In some scenarios, a positive public debt shock can hardly be absorbed when the response of fiscal policy is the opposite. In the long run,

Table 5 Cointegration Test in Slovenia's Case

Hypothesized No. of CE(s)	Unrestricted Cointegration Rank Test (Trace)			
	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.
None	0.31	13.66	15.49	0.09
At most 1	0.04	1.56	3.84	0.21

Notes: The lag length is 2 and it is given by AIC.
The test considers intercept and no trend

the Romanian government could face real difficulties in achieving fiscal sustainability and could be forced into taking severe fiscal adjustment measures.

In *Slovenia's* case, the dynamics of the primary balance react to the dynamics of public debt with a delay of one quarter. A positive change of Δb leads to a negative change of Δp , implying a decrease of the primary surplus or an increase of the primary deficit. Taking into consideration that both variables are integrated of order one, the cointegration test gives the results summarized in *Table 5*.

Slovenia's case is similar to Poland's, in the sense that movements of the primary balance in response to changes of public debt in the short term will not lead to an equilibrium relationship between the two variables considered. In this situation, Slovenia's recent fiscal policy would face sustainability issues in the long run.

In *Slovakia's* case, the statistical tests show that the dynamics of public debt do not have a significant impact on the primary balance.

4. Conclusions

The concept of fiscal sustainability has received much attention in the last few decades and for European Union member states is still a much debated and controversial topic. Unsound fiscal policies of individual EU member states could have adverse effects and harm other member's economies, as witnessed by the current turmoil on financial markets amid the fiscal woes of Greece and several other EU countries. This paper sheds some light on whether the fiscal policies of Central and Eastern European countries are sustainable in the long run. Using the fiscal reaction function model and a database consisting of quarterly data between 2000 and 2008, the main findings are the following.

The fiscal reaction function has different forms depending on the order of integration given by the unit root tests. Study of this function brings into light the particularities of fiscal policies among the Central and Eastern European countries.

Governments respond with some delay in most of the countries. However, taking into account the use of quarterly data, the speed of adjustment is rather quick.

Fiscal policy reacts as expected in the cases of Bulgaria, the Czech Republic, Estonia, Hungary, and Lithuania, in the sense that governments try to increase the primary surplus, or at least to lower primary deficit, when public debt is increasing. The expected reaction of fiscal policy in these cases shows that governments have the ability to generate primary surpluses in the short run and to achieve fiscal sustainability in the long run.

For Latvia, Poland, Romania, and Slovenia the fiscal policy reaction is the opposite and governments face difficulties when it comes to responding to public debt shocks in the short term. The tendency to lower surpluses when public debt increases will cause difficulties for governments if they confront higher public debt stocks in the future. These governments would have to take an abrupt and severe fiscal adjustment measures to respond properly to such shocks and to achieve fiscal sustainability in the long run.

APPENDIX

Table 1A Augmented Dickey-Fuller Test for Unit Root

Country	Primary balance (% GDP)				Public debt (% GDP)					
	Order of integration	[t-stat] (prob.)	1%	5%	10%	Order of integration	t-stat (prob.)	1%	5%	10%
BG	I(0) with intercept	[-6.28] (0.00)	-3.63	-2.95	-2.61	I(0) with intercept and trend	[-0.73] (0.96)	-4.26	-3.55	-3.20
CZ	I(0) with intercept	[-3.67] (0.00)	-3.63	-2.95	-2.61	I(1)	[-1.81] (0.06)	-2.66	-1.95	-1.60
EE	I(0) with intercept	[-3.69] (0.00)	-3.63	-2.95	-2.61	I(2)	[-4.88] (0.00)	-2.66	-1.95	-1.60
HU	I(0) with intercept	[-4.52] (0.00)	-3.63	-2.95	-2.61	I(0) with intercept	[-4.28] (0.00)	-3.63	-2.95	-2.61
LT	I(0) with intercept	[-3.59] (0.01)	-3.63	-2.95	-2.61	I(0) with intercept	[-1.97] (0.00)	-3.63	-2.95	-2.61
LV	I(1)	[-8.32] (0.00)	-2.63	-1.95	-1.61	I(1)	[-6.55] (0.00)	-2.63	-1.95	-1.61
PL	I(0) with intercept	[-4.57] (0.00)	-3.63	-2.95	-2.61	I(0) with intercept and trend	[-3.05] (0.13)	-4.25	-3.54	-3.20
RO	I(0) with intercept	[-3.24] (0.02)	-3.63	-2.95	-2.61	I(1)	[-3.43] (0.00)	-2.63	-1.95	-1.61
SI	I(1)	[-8.79] (0.00)	-2.63	-1.95	-1.61	I(0) with intercept and trend	[-5.02] (0.00)	-4.25	-3.54	-3.20
SK	I(0) with intercept	[-4.40] (0.00)	-3.63	-2.95	-2.61	I(0) with intercept	[-3.05] (0.04)	-3.67	-2.96	-2.62
	I(0) with intercept	[-2.31] (0.67)	-3.63	-2.95	-2.61	I(1)	[-1.22] (0.19)	-2.63	-1.95	-1.61
	I(1)	[-7.24] (0.00)	-2.63	-1.95	-1.61	I(2)	[-5.16] (0.00)	-2.62	-1.95	-1.61
	I(0) with intercept	[-3.84] (0.00)	-3.63	-2.95	-2.61	I(0) with intercept	[-1.25] (0.64)	-3.63	-2.95	-2.61
	I(0) with intercept	[-4.40] (0.00)	-3.63	-2.95	-2.61	I(1)	[-4.06] (0.00)	-2.63	-1.95	-1.61
	I(0) with intercept	[-2.31] (0.67)	-3.63	-2.95	-2.61	I(0) with intercept and trend	[-2.63] (0.26)	-4.25	-3.54	-3.20
	I(1)	[-7.24] (0.00)	-2.63	-1.95	-1.61	I(1)	[-5.51] (0.00)	-2.63	-1.95	-1.61
	I(0) with intercept	[-3.84] (0.00)	-3.63	-2.95	-2.61	I(0) with intercept and trend	[-2.39] (0.37)	-4.25	-3.54	-3.20
	I(0) with intercept	[-3.84] (0.00)	-3.63	-2.95	-2.61	I(1)	[-7.43] (0.00)	-2.63	-1.95	-1.61
	I(0) with intercept	[-3.84] (0.00)	-3.63	-2.95	-2.61	I(0) with intercept and trend	[-4.09] (0.01)	-4.62	-3.55	-3.20
	I(0) with intercept	[-3.84] (0.00)	-3.63	-2.95	-2.61	I(1)	[-3.53] (0.00)	-2.63	-1.95	-1.61

Note: For ADF test, it was used intercept and trend according to variables evolution.

Table 2A Main Findings of the Study

Country	Fiscal reaction function	Lag	Expected results	Comments (if necessary)
BG	$\rho = f(\Delta^2 b)$	2	Yes	-
CZ	$\rho = f(b)$	4	Yes	-
EE	$\rho = f(\Delta b)$	3	Yes	R-squared is 0.05 implying that changes of public debt explains only 5% of primary balance.
HU	$\Delta\rho = f(\Delta b)$	2	Yes	-
LV	$\rho = f(\Delta b)$	0	No	-
LT	$\Delta\rho = f(b)$	3	Yes	-
PL	$\Delta\rho = f(\Delta b)$	3	No	There is no cointegration relationship between primary balance and public debt.
RO	$\rho = f(\Delta b)$	0	No	-
SI	$\Delta\rho = f(\Delta b)$	1	No	There is no cointegration relationship between primary balance and public debt.
SK	$\rho = f(\Delta b)$	0	-	Statistical tests rejected estimations. Public debt does not have a significant impact on primary balance.

REFERENCES

- Afonso A (2000): Fiscal Policy Sustainability: Some Unpleasant European Evidence. *ISEG Working Paper*, 12/2000/DE/CISEP, August.
- Afonso A (2005): Fiscal Sustainability: the Unpleasant European Case. *FinanzArchiv: Public Finance Analysis*, 61(1):19–44.
- Afonso A, Agnello L, Furceri D, Sousa R (2009): Assessing Long Term Fiscal Developments: A New Approach. *European Central Bank Working Paper Series*, no. 1032/March.
- Afonso A, Rault C (2007): What Do We Really Know About Fiscal Sustainability in the EU? A Panel Diagnostic. *European Central Bank Working Paper Series*, no. 820/October.
- Afonso A, Rault C (2008): 3-Step Analysis of Public Finance Sustainability. The Case of the European Union. *European Central Bank Working Paper Series*, no. 908/June.
- Agnello L, Sousa RM (2009): The Determinants of Public Deficit Volatility. *European Central Bank Working Paper*, no. 1042, April.
- Alesina A (2000): The Political Economy of the Budget Surplus in the United States. *The Journal of Economic Perspectives*, 14(3):3–19.
- Aristonik A, Bostjan B (2007): Fiscal Sustainability in Selected Transition Countries. *Journal of Economics*, 55(7):659–675.
- Aristonik A (2008): Fiscal Sustainability in Central, Eastern and South-Eastern Europe. *Journal of International Research Publication Economy & Business*, 3:15–32.
- Balassone F et al. (2009): Fiscal Sustainability and Policy Implications for the Euro Area. *European Central Bank Working Paper Series*, no. 994/January.
- Ballabriga FC, Martinez-Mongay C (2005): Sustainability of EU Public Finances, *European Economy European Commission Directorate-General for Economic and Financial Affairs Economic Papers*, no. 225 (April):1–30.

- Barro RJ (1979): On the Determination of the Public Debt. Part 1. The *Journal of Political Economy*, 87(5):940–971.
- Blanchard O (1990): Suggestions for a New Set of Fiscal Indicators. *OECD Economics Department Working Papers*, no. 79.
- Blanchard O, Chouraqui JC, Hagemann PR, Sartor N (1990): The Sustainability of Fiscal Policy: New Answers to Old Question. *OECD Economic Studies*, no.15 (Autumn).
- Bohn H (1998): The Behavior of US Public Debt and Deficits. The *Quarterly Journal of Economics*, 113(3):949–963.
- Bohn H (2005): The Sustainability of Fiscal Policy in the United States. *CESifo Working Paper*, no.1446 (April).
- Bohn H (2007): Are Stationarity and Cointegration Restrictions Really Necessary for Intertemporal Budget Constraint? *Journal of Monetary Economics*, 54:1837–1847.
- Buiter WH (1995): *Measuring Fiscal Sustainability*. <http://www.nber.org/%7Ewbuiter/sustain.pdf>.
- Buiter WH (2004): *Fiscal Sustainability*. Paper presented at The Egyptian Center for Economic Studies, October. <http://www.nber.org/~wbuiter/egypt.pdf>.
- Castro Fernandez F de, Hernandez de Cos P (2000): On the Sustainability of the Spanish Public Budget Performance. In: Bank of Italy (eds.): *Fiscal Sustainability*:135–173.
- Chalk N, Hemming R (2000): Assessing Fiscal Sustainability in Theory and Practice. *IMF Working Paper*, WP/00/81.
- Corsetti G, Roubini N (1991): Fiscal Deficits, Public Debt, and Government Solvency: Evidence from OECD Countries. *NBER Working Paper*, no. 3658.
- Corsetti G, Roubini N (1996): European versus American Perspectives on Balanced Budget-Rules. *The American Economic Review*, 86(2):408–413.
- Croce E, Juan-Ramon VH (2003): Assessing Fiscal Sustainability: A Cross-Country Comparison, *IMF Working Paper*, WP/03/145.
- Elliot G, Kearney C (1988): The Intertemporal Government Budget Constraint and Tests for Bubbles. *Reserve Bank of Australia, Research Discussion Paper*, no. 8809.
- Fatas A, Mihov I (2009): The Euro and Fiscal Policy. *NBER Working Paper*, no.14722, February.
- Gramlich EM (1990): Fiscal Indicators. *OECD Department of Economics and Statistics Working Paper*, no. 80, April.
- Greiner A, Koeller U, Semmler W (2005): Testing Sustainability of German Fiscal Policy: Evidence for the Period 1960–2003. *CESifo Working Paper*, no. 1386(January):1–26.
- Hakkio G, Rush M (1991): Is the budget deficit "too large"? *Economic Inquiry*, XXIX(3):429–445.
- Hamilton JD, Flavin MA (1986): On the Limitations of Government Borrowing: A Framework for Empirical Testing. *The American Economic Review*, 76(4):808–819.
- Horne J (1991): Indicators of Fiscal Sustainability. *IMF Working Paper*, WP/91/5.
- International Monetary Fund (2003): *World Economic Outlook. Chapter III: Public Debt in Emerging Markets: Is it too High?* September:113–152.
- Kirchgaessner G, Prohl S (2006): Sustainability of Swiss Fiscal Policy. *CESifo Working Paper*, no. 1689 (March):1–24.
- Kotlikoff L, Hagist C (2005): Who's Going Broke? Comparing Growth in Healthcare Costs in Ten OECD Countries. *NBER Working Paper Series*, no.11833 (December).
- Marin J (2002): Sustainability of Public Finances and Automatic Stabilization under a Rule of Budgetary Discipline. *European Central Bank Working Paper*, no. 193, November.
- Mello L de (2005): Estimating a Fiscal Reaction Function: The Case of Debt Sustainability in Brazil. *OECD Economics Department Working Paper*, no. 423, April.
- Payne J (1997): International Evidence on the Sustainability of Budget Deficits. *Applied Economics Letters*, 12(4):775–779.

- Schneider O, Zápál J (2006): Fiscal Policy in New EU Member States: Go East, Prudent Man! *Post-Communist Economies, Taylor and Francis Journals*, 18(2):139–166, June.
- Staehr K. (2008): Fiscal Policies and Business Cycles in an Enlarged Euro Area. *Economic Systems*, 32:46–69.
- Trehan B, Walsh C (1988): Common trends, the government's budget constraint and revenue smoothing. *Journal of Economic Dynamics and Control*, 12(2/3):425–444.
- Trehan B, Walsh CE (1991): Testing Intertemporal Budget Constraints: Theory and Applications to U.S. Federal Budget and Current Account Deficits. *Journal of Money, Credit, and Banking*, 23(2):206–223.
- Uctum M, Wickens M (2000): Debt and Deficit Ceilings, and Sustainability of Fiscal Policy: An Intertemporal Analysis. *Oxford Bulletin of Economics and Statistics*, 622:197–222.
- Wilcox DW (1989): The Sustainability of Government Deficits: Implications of the Present-Value Borrowing Constraints. *Journal of Money, Credit, and Banking*, 21(3):291–305.