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Abstract

Many researchers have been focused for decades on the issue of public debt considering its effect on fiscal sustainability in the long run. There is a recent body of research showing that the current financial crises will lead to a considerable increase of public debt in a number of advanced economies. Many European countries have confronted with large and increasing public debt stocks that overrated GDP. Considering that, the question on how government should address this problem arises. Theoretically speaking, governments should increase/decrease primary surplus/deficit, and the response should be immediate. The aim of this paper is to investigate government's reaction to increasing public debt for European Union countries. Fiscal reaction function is employed on annual data spanned mostly on 1980-2012. Empirical evidence shows various results. In the case of Germany fiscal policy is pro-cyclical, but the results reveal no significant reaction of government to changes in public debt. For Belgium and Denmark the test shows a long run relationship between cyclically adjusted primary balance and public debt and error correction term indicates the existence of adjustment mechanism in the short term for assessing primary surplus. In the cases of Spain and France the response is opposite as expected and parameters point out on difficulties in achieving a cointegrated relation. For Greece and Italy test rejects any cointegration relationship and the use of fiscal rule reveals that government has difficulties in generating primary surplus. This conclusion is also valid in the case of Portugal and the UK. In the cases of Sweden and Ireland government has the ability to generate primary surplus larger than the required one that stabilizes public debt.

Keywords: public debt, fiscal policy**,** primary balance, fiscal reaction function, fiscal sustainability
JEL Code: E62, H62, H63

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1. Introduction

Numerous recent studies have brought into attention the issue of substantial increasing of public debt within the advanced economies. For instance, Ghosh, Kim, Mendoza, Ostry and Qureshi (2011) considered that stimulus spending and lower revenues in the Great Recession contributed to some of the highest ratios to GDP of public debt and primary deficits in advanced economies seen in the past forty years and many of these countries are expected to continue facing large financing needs over the coming years. Reinhart and Rogoff (2011) also pointed out that public debt in the advanced economies have surged in recent years to levels not recorded since the end of World War II. This situation could also be explained considering that the period referred by previous studies includes the making of and the strengthening of the welfare state. Governments of European economies were the firsts that implemented public pension schemes, public education and health care, social security transfers[1]. Consequently, the size of the government rapidly increased in the early '70s, due to the rise of social transfers. For instance, in Germany government spending to GDP-ratio increased from 1970 to 1975 by almost 10 p.p., from 37% up to 47%, and social transfers, including health expenditures, increased from 19% to 27% of GDP; in the Netherlands, the situation looked similar to Germany's – government spending rose from 40% of GDP to 50% due the increase of social transfers from 22% to 29% of GDP; the growth of government spending in Sweden in the early '70s was by almost 6 p.p. from 43% to 49% of GDP, and social transfers increased from 22% to 29% of GDP[2]. Many authors observed this evidence (e.g. Meltzer and Richard, 1981; North and Wallis, 1982) and tried to explain the phenomenon or investigated the impact of increasing government size on economic growth (e.g. Ram, 1986; Barro, 1989; Barro and Sala-i-Martin, 1995). Much more, Tanzi and Schuknecht (1997) pointed out that one of the main features of welfare state is to have large budgetary deficits and public debt stocks.

The focus on increasing public debt emerges from its importance as a tool of macroeconomic policy affecting national income allocation among consumers and stabilization function of government. A misuse of government borrowings may affect

[1] International Monetary Fund, 1996, „Confronting Budget Deficits", Economic Issue 3.
[2] Barr, N. (1992), „Economic Theory and the Welfare State: A Survey and Interpretation", *Journal of Economic Litarature,* Vol.30, No.2 (June,1992), 741-803.

consumers' decisions and their expectations. The conventional view in the context of the neoclassical approach (see for instance Bernheim, 1989; Inman, 1990) highlights the long term effects of public debt. In the short term, budgetary deficits increase consumption. If the workforce is totally employed, increasing consumption lowers savings in the long run. Financing deficits by government borrowings increases interest rates and capital accumulation rate will also decrease in the long run.

Moreover, increasing public debt is closely related to fiscal sustainability issues. Issuing more debt to finance fiscal deficit (including interest payments) and/or principal arrears from previous years can endanger government's liquidity and solvency. In addition, a misallocation between internal and external borrowings can raise sharply the cost of capital. All this could lead to a debt crisis which is broadly defined as episodes of default or failure to be current on external obligations (Ciarlone and Trebeschi, 2006).

Therefore, government has to take action and to adjust fiscal policy as to bring primary surplus to a certain level that stabilizes public debt-to-GDP ratio at a reasonable threshold. Most of the literature dealing with fiscal adjustments issues focused on aspects related to the size of the adjustment, the composition of the adjustment (reducing government spending and/or increasing taxation), and the efficiency of the adjustment considering the impact on public debt-to-GDP ratio or on growth rate (see in that sense, Alesina and Perotti, 1995, 1996; Alesina and Ardagna, 1998; Alesina, Perotti, Tavares, Obstfeld and Eichengreen, 1998). These studies brought mostly into attention the fiscal actions made by governments to a particular moment as to restore fiscal balance or to reduce the size of deficit at a reasonable level. They did not reveal insights on how governments generally behave when public debt substantial increases or there are shocks that have to be absorbed. Therefore, it is to some importance to investigate government's response to shock on public debt, in terms of the sense of its reaction, magnitude and lag. The response of the government can be delayed due to its Ponzi scheme behavior. If government consider that it has all the eternity to repay its debt or to assess the stabilizing primary surplus, it may allow for more expansionary fiscal policy by lowering taxation and increasing government spending. Also, government may try to postpone its effort to assess the stabilizing primary surpluses, allowing for more debt accumulation and large deficits that might deteriorate macroeconomic variables.

Considering the advanced European countries[3], many of them have faced the tendency of increasing public debt between 1970 and 2012 (see Figure 1B in the Appendix B). The situation is similar for countries like: Germany, Greece, France, Italy, Austria, and Portugal. For other economies (e.g. Belgium, Denmark, Spain, the Netherlands, Finland, and Sweden) the upper trend had a downturn few years after the enforcement of Maastricht Treaty (MT). Ireland began to reduce its public debt-to-GDP ratio few years before MT. Only for the United Kingdom, public debt had a downward trend up to 2002 when it has begun to rise. There is a clear evidence for all of the advanced European economies on the accumulation of public debt since 2007. In this new context, there are authors (e.g. Scott, 2010) that addressed the problem of the current financial crisis, considering that government debt is expected to rise sharply that will generate concerns that public debt will reach unsustainable levels, exposing governments to solvency risk, and raising the sovereign default.

All the European countries considered for this study had on average public debt-to-GDP ratio larger than 40%, except Finland with 29% of GDP. It is difficult to state whether a certain level of public debt may negatively affect national economy or how much a government can borrow to finance its payment obligations but without exposing fiscal position to various risks. In that sense, in order to restrain debt growth, quantitative limits might be setting to limit debt levels or at least controlling debt levels by imposing deficit limits (Balassone, Franco and Zotteri, 2004). In the case of European Union member states, the enforcement of Maastricht Treaty imposed the limits for deficit and for public debt ratios at 60% of GDP, respectively, 3% of GDP. Nevertheless, a closely look to the empirical evidence before and after MT reveals that for 12 out of 14 countries considered for the current analysis, the average of public debt after 1992 is higher than the average ratio before adopting MT, and in many cases the average is larger than 60% of GDP (e.g. Belgium, Germany, Greece, France, Italy, the Netherlands, Austria, and Portugal - see Table 1A in the Appendix A).

Even if the ratio of 60% of GDP is a frequently used benchmark by European Commission or International Monetary Fund it might not be so relevant. There are

[3] This study takes into consideration countries like: Belgium, Denmark, Germany, Ireland, Greece, Spain, France, Italy, the Netherlands, Austria, Portugal, Finland, Sweden, and United Kingdom. They are also members of the European Union.

situations when economies can have difficulties in coping with a ratio less than 60%, or even if the ratio is larger than the threshold, government is able to sustain its borrowings as a result of a good management of public debt. For instance, if the growth rate of GDP exceeds the growth rate of public debt and/or interest rate on public debt then accumulating public debt under these conditions might be easier for the government to cope with. Conversely, when government borrows money at a higher cost than economy can produce and the pace of debt accumulation exceeds economic growth rate for many consecutive years, then solvency might be exposed.

In the case of the advanced European countries, empirical evidence reveals that during 1970-2012 the average public debt growth rate exceeded average economic growth rate, except Sweden and also the implicit interest rate on public debt was higher than the growth rate (see Table 2A in the Appendix A). In this context, the question is legitimate and logically on how governments response to shocks on public debt as to prevent unsustainable fiscal policies in the long run.

The aim of this paper is therefore to investigate the response of advanced European governments to shocks on public debt, considering the achievement of fiscal sustainability in the long run. In accordance with the purpose of this paper, *fiscal reaction function* (FRF) is used. The paper is structured as follows. The next section presents the equations of the dynamic of public debt model that formalizes the use of FRF on analyzing government's response to shocks on public debt. Section 3 is devoted to describing the methodology and database used. Empirical results are also presented in Section 3. The last section gives the concluding remarks of the study.

2. Theoretical background of fiscal reaction function

Establishing how government responses to increasing public debt can be done by estimating a *fiscal reaction function*. FRF reveals the reaction of the primary balance (as ratio to GDP) to changes on public debt to GDP ratio, while controlling for other influences. An increasing public debt-to-GDP ratio is expected to generate an immediate fiscal policy response consisting in an improvement of the primary balance (a lower deficit or a higher surplus). The use of fiscal reaction function bases on the seminal work of Barro (1979) and his government's budget equation. At time *t,* government has

to borrow money (B_t) to finance the primary deficit (the difference between primary expenditures, G_t, and government revenues, R_t), interest payment related to previous year ($i \cdot B_{t-1}$), and public debt form previous year (B_{t-1}). In simplified terms, the constraint can be written as:

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

Rearranging equation 1, a different form is obtained:

$$B_t - B_{t-1} = G_t - R_t + i \cdot B_{t-1} \quad (2)$$

Considering the variables as ratios to GDP (small caps denote that), equation (2) becomes:

$$\left(b_t - b_{t-1}\right) \cdot \frac{1}{1+g} = p_t + \frac{i}{1+g} \cdot b_{t-1} - \frac{g}{1+g} \cdot b_t \quad (3)$$

where:

g: growth rate;

p_t: primary deficit;

i: interest rate.

Considering that government aims in achieving stabilization of public debt, then it has to ensure that public debt to GDP ratio remains unchanged ($b_t = b_{t-1}$), and that public debt is stabilize at the level from previous year. Consequently, equation (3) becomes:

$$-p_t = \frac{i-g}{1+g} \cdot b_{t-1} \quad (4)$$

Generally, theory argues that government response should be immediate, implying that towards fiscal policy actions, the actual primary surplus reacts to changes of the actual public debt. In this context, equation (4) might be rewritten as:

$$-p_t = \frac{i-g}{1+g} \cdot b_t \quad (4')$$

There are authors who consider otherwise by reason of interest payments which occur at later moments (Greiner, Koeller and Semmler, 2005). In addition, there are some lags that might be occurring in between the times when fiscal policy has to be adjusted, when action has to be taken, and when the action affects macroeconomic variables. Generally, McConnel and Brue (1996) identified at least three types of lags: (i) the recognition lag that refers to the time between the beginning of a recession and the certain awareness that it is actually happening; (ii) the administrative lag that refers to the time between the fiscal action is recognized and the time action is actually take; and (iii) the operational lag that refers to the time when fiscal action is taken by the Parliament and the time when it affects output, employment or price level. Given these arguments that allows for governments' inertia, the reaction of actual fiscal policy to one lagged public debt ratio may be logically acceptable.

Equation (4) can be also seen as a fiscal rule that estimates the required primary surplus that stabilizes the ratio of public debt.

To further study the actual behavior of government, one can estimate a fiscal reaction function that has a similar form:

$$p_t = f(b_{t-1}) + \varepsilon_t \qquad (5)$$

Studies investigating fiscal reaction function make use of various extra explanatory variables, such as: business cycle (Barro, 1979; Greiner, Koeller, and Semmler, 2005; Kirchgaessner and Prohl, 2006; Celasun, Debrun and Ostry, 2007; Burger, Stuart, Jooste and Cuevas, 2011; Ghosh, Kim, Mendoza, Ostry and Qureshi, 2011; Burger, Stuart, Jooste and Cuevas, 2011); lagged primary balance to allow for the inertia of the government behavior (De Mello, 2005; Kirchgaessner and Prohl, 2006; Burger, Stuart, Jooste and Cuevas, 2011); temporary government spending (Barro, 1979; Kirchgaessner and Prohl (2006); lagged debt to GDP, square or cubic (Bohn, 2005; Greiner, Koeller, and Semmler, 2005; Ghosh, Kim, Mendoza, Ostry and Qureshi, 2011); an other extra variables like inflation, interest rate, social surplus, fiscal rules, institutions (De Mello, 2005; Greiner, Koeller, and Semmler; 2005; Kirchgaessner and Prohl, 2006; Ghosh, Kim,

Mendoza, Ostry and Qureshi, 2011). Therefore, a much general form of FRF can be written as:

$$p_t = f(b_{t-1}) + Z_t + \varepsilon_t \quad (6)$$

where:

Z_t: a set of extra independent variables.

In order to capture all the discretionary actions take by government in response to changes on public debt, one can use cyclically adjusted primary balance ($\hat{p}_t$). Hence, equation (6) becomes:

$$\hat{p}_t = f(b_{t-1}) + Z_t + \varepsilon_t \quad (7)$$

3.Data and empirical results

The fiscal reaction function as specified in equation (7) is used for modelling purposes for the advance European economies. Annual data is available from Ameco. Cyclically adjusted primary balance is estimated as difference between cyclically adjusted revenues and cyclically adjusted expenditures less interest payments. Z_t consists in lagged primary balance and output gap ($\hat{y}_t$), accounting for the business cycle. Output gap is computed as ratio between the actual GDP and the potential GDP.

One first step aims in estimating FRF using OLS is to test for the unit roots on the time series considered. The results for Augmented Dickey – Fuller test are given below:

Table 1 Augmented Dickey-Fuller Test for Unit Root

Country	Primary balance (% GDP)	[t-stat] (prob.)	1%	5%	10%	Public debt (% GDP)	t-stat (prob.)	1%	5%	10%
Belgium 1980:2012	Level with constant and trend	[-1.39] (0.84)	-4.27	-3.55	-3.21	Level with constant and trend	[-2.31] (0.41)	-4.28	-3.56	-3.21
	1st difference	[-8.33] (0.00)	-2.64	-1.95	-1.61	1st difference	[-3.01] (0.00)	-2.64	-1.95	-1.61
Denmark 1980:2012	Level with constant	[-1.07] (0.71)	-3.65	-2.95	-2.61	Level with constant	[-2.16] (0.27)	-3.66	-2.96	-2.61
	1st difference	[-3.82] (0.00)	-2.64	-1.95	-1.61	1st difference	[-3.17] (0.00)	-2.64	-1.95	-1.61
Germany 1980:2012	Level with constant	[-3.58] (0.01)	-3.65	-2.95	-2.61	Level with constant and trend	[-3.26] (0.00)	-4.28	-3.56	-3.21
						1st difference	[-3.33] (0.00)	-2.64	-1.95	-1.61
Ireland 1985:2012	Level with constant	[-2.28] (0.18)	-3.69	-2.97	-2.62	Level with constant	[-1.23] (0.64)	-3.73	-2.99	-2.63
	1st difference	[-6.78] (0.00)	-2.65	-1.95	-1.60	1st difference	[-3.01] (0.00)	-2.66	-1.95	-1.60
Greece 1988:2012	Level with constant	[-1.79] (0.37)	-3.79	-2.99	-2.63	Level with constant and trend	[-0.61] (0.96)	-4.39	-3.61	-3.24
	1st difference	[-4.61] (0.00)	-2.66	-1.95	-1.60	1st difference	[-2.69] (0.00)	-2.66	-1.95	-1.60
Spain 1995:2012	Level with constant	[-2.32] (0.17)	-3.92	-3.06	-2.67	Level with constant	[-2.58] (0.011)	-4.00	-3.09	-2.69
	1st difference	[-4.16] (0.00)	-2.72	-1.96	-1.60	1st difference	[-2.17] (0.03)	-2.72	-1.96	-1.60
France 1980:2012	Level with constant and trend	[-2.93] (0.16)	-4.27	-3.55	-3.21	Level with constant and trend	[-2.92] (0.16)	-4.28	-3.56	-3.21
	1st difference	[-5.97] (0.00)	-2.64	-1.95	-1.61	1st difference	[-2.42] (0.00)	-2.64	-1.95	-1.61
Italy 1980:2012	Level with constant	[-1.43] (0.55)	-3.65	-2.95	-2.61	Level with constant and trend	[-2.42] (0.36)	-4.28	-3.56	-3.21
	1st difference	[-5.41] (0.00)	-2.64	-1.95	-1.61	1st difference	[-2.24] (0.02)	-2.64	-1.95	-1.61
Netherlands 1980:2012	Level with constant	[-3.14] (0.03)	-3.65	-2.95	-2.61	Level with constant	[-1.92] (0.31)	-3.65	-2.95	-2.61
	1st difference	[-6.33] (0.00)	-2.64	-1.95	-1.61	1st difference	[-3.24] (0.00)	-2.64	-1.95	-1.61
Austria 1980:2012	Level with constant	[-4.06] (0.00)	-3.65	-2.95	-2.61	Level with constant and trend	[-2.77] (0.21)	-4.28	-3.56	-3.21
						1st difference	[-2.79] (0.00)	-2.64	-1.95	-1.61

Note: For ADF test, constant and/or trend were considered accordingly.

Table 1 (continued)

Country	Primary balance (% GDP)	[t-stat] (prob.)	1%	5%	10%	Public debt (% GDP)	t-stat (prob.)	1%	5%	10%
Portugal 1980:2012	Level with constant	[-1.63] (0.45)	-3.67	-2.96	-2.62	Level with constant and trend	[-0.46] (0.98)	-4.27	-3.57	-3.21
	1st difference	[-5.32] (0.00)	-2.64	-1.95	-1.61	1st difference	[-3.38] (0.00)	-2.64	-1.95	-1.61
Finland 1980:2012	Level with constant	[-2.00] (0.28)	-3.65	-2.95	-2.61	Level with constant	[-2.18] (0.21)	-3.66	-2.96	-2.61
	1st difference	[-5.86] (0.00)	-2.64	-1.95	-1.61	1st difference	[-3.70] (0.00)	-2.64	-1.95	-1.61
Sweden 1993:2012	Level with constant	[-2.41] (0.15)	-3.83	-3.02	-2.65	Level with constant and trend	[-3.26] (0.00)	-4.28	-3.56	-3.21
	1st difference	[-3.76] (0.00)	-2.69	-1.96	-1.60	1st difference	[-2.97] (0.00)	-2.69	-1.96	-1.60
UK 1986:2012	Level with constant	[-2.49] (0.18)	-3.72	-2.98	-2.63	Level with constant	[-2.20] (0.20)	-3.72	-2.98	-2.63
	1st difference	[-3.31] (0.00)	-2.66	-1.95	-1.60	1st difference	[-1.63] (0.09)	-2.66	-1.95	-1.60
						2nd difference	[-3.71] (0.00)	-2.66	-1.95	-1.60
Note: For ADF test, constant and/or trend were considered accordingly.										

The stationarity issues of the time series considered make difficult the use of fiscal reaction function in its original form. Based on the results of ADF test, FRF may be applied only in the case of Germany and for a significance level of 10%. For a better estimation, business cycle is added, ($\hat{y}_t$). Considering what McConnel and Brue (1996) argued about the delayed response of fiscal policy, lagged values of $\hat{y}_t$ is taken into account. The results of OLS estimation is given in the table below:

Table 2 Fiscal reaction function in the case of Germany

Variable	Coefficient	Std. Error	t-Statistic	Prob.
p(-1)	0.317611	0.136162	2.332597	0.0274
b(-1)	-0.005167	0.013880	-0.372259	0.7126
y(-2)	-0.194389	0.093188	-2.085994	0.0466
C	20.26900	9.576758	2.116478	0.0437
R-squared				0.252646
F-statistic				3.042492
Prob(F-statistic)				0.045955
Note: $\hat{y}_t$ is level stationary at 10% significance; *C*, constant.				

Following the statistical results, it can not be discussed the response of the German government to increasing public debt. Primary balance positive depends on its own level from previous year. The negative correlation with the gap reveals that German fiscal policy is pro-cycle and, therefore, sustainability issues in the long run can be encountered.

In the case of Belgium, Denmark, Ireland, Greece, Spain, Italy, Portugal, Finland, and Sweden, primary balance and public debt are I(1) and Johansen cointegration test and Vector Error Correction Mechanism (VECM) further run. Following Burger, Stuart, Jooste and Cuevas, 2011, equation (7) can be used as an error-correction term that allows for the long run equilibrium.

Johansen cointegration test (see Table 3A in the Appendix A) indicates the long run equilibrium relationship between primary balance and public debt in the test case of Belgium, Denmark, Ireland, Spain, Portugal and Sweden. Unlike, for Greece, Italy, and Finland failed to reject the null hypothesis of none cointegration equation. The situation is not so difficult in Finland's case, considering the low ratio of public debt and high primary surplus during 1980:2012. The situation looks much worrier for Greece and Italy taking into consideration large public debt-to-GDP ratios and primary deficits or low primary surpluses. Using equation (4) as a fiscal rule, one can estimate the primary surplus that stabilizes public debt for Finland, Greece and Italy, and compare it to the actual primary balance. The results are presented in the table below:

Table 3 The stabilizer primary balance (I)

Country	**The stabilizer primary balance (p^*)**	**The actual primary balance (p)**
Finland 1975:2012	0.47	3.74
Greece 1988:2012	2.72	-0.61
Italy 1980:2012	2.67	-0.61
Note: p^* is estimated using eq.(4) and average annual data from Table 2A in the Appendix A *p:* annual average primary balance available from Eurostat.		

The existence on none cointegration relationship between the cyclically adjusted primary balance and public debt does not endanger fiscal sustainability in the long run given that the stabilizer primary surplus is below the actual primary surplus. Even if it has

a growing public debt-to-GDP ratio, government has the ability to generate the required surpluses as to meet the payment obligations.

The situation is more complex and difficult for Greece and Italy. During the analyzed period, the actual primary surplus was below its stabilizer level. Consequently, the movements of cyclically adjusted primary balance and public debt are not able to respond to the magnitude of the disequilibrium, and the system will not return to the long-run equilibrium that can harm fiscal sustainability in the long run.

For the cases of Belgium, Denmark, Ireland, Spain, France, Portugal and Sweden, Johansen cointegration test reject the null hypothesis and accepts for one cointegration equation between primary balance and public debt. Hence, the movements of the primary balance in response to changes of public debt in the short term will lead to an equilibrium relationship between the two variables considered. VECM results are presented in Table 4A in the Appendix A. Nevertheless, t-values disclose statistical significance of cointegration equation only for the case of Belgium, Denmark and Spain and these are further discussed.

The parameter estimates from Table 4A in the Appendix for Belgium and Denmark imply that the long-run primary balance-to-GDP ratio that the government ran exceeded the primary balance-to-GDP ratio required to stabilize debt and to ensure sustainability only in the case of Denmark, but not for Belgium, too, where the stabilizer primary balance is above the actual primary balance (see Table 4).

Table 3 The stabilizer primary balance (II)

Country	**The stabilizer primary balance (p^*)**	**The actual primary balance (p)**
Belgium 1980:2012	2.65	2.09
Denmark 1980:2012	1.95	3.86
France 1980:2012	0.80	-0.76
Spain 1995:2012	-0.05	-0.10
Note: p^* is estimated using eq.(4) and average annual data from Table 2A in the Appendix A *p:* annual average primary balance available from Eurostat.		

The error-correction term for the primary balance-to-GDP ratio equation indicates a fiscal response (see also Figure 2B in the Appendix B) to deviations from the long-run relationship equal to -0.631 (Belgium), and equal to -0.034 (Denmark). Thus, a little more than a half of the deviation is corrected in the first period after the deviation occurs (Belgium), and less in the Denmark's case. The speed of adjustment differs and this reaction can be interpreted as normal taking into account that Denmark's actual primary balance is higher than the required one. Moreover, for Denmark, error-correction term accounts also for the business cycle. The positive coefficient of y shows a pro-cyclical fiscal policy.

In the cases of Spain and France, the cointegration equation shows an opposite response of the government than expected. The parameter estimates that the government ran primary deficit rather than surplus, and the required primary balance is above the actual one (see results in the Table 4). But even if test show the existence of an error-correction term the t-values reject its significance (Spain) and, thus, the government response is not relevant (see also Figure 2B in the Appendix B). For France, the speed of adjustment is not sufficient to achieve the required primary surplus. This can cause difficulties in the long run taking into account that actual primary deficit is larger than it is required to be during the analyzed time.

For the cases of the Netherlands, Austria and United Kingdom where unit root test reveals confusing results that make difficult the use of fiscal reaction function in its original form or testing for cointegration, and for the cases of Ireland, France, Portugal and Sweden where tests show no statistical significance of the cointegration equation, equation (4) is applied to test for the fiscal rule. The results are presented below:

Table 4 The stabilizer primary balance (III)

Country	The stabilizer primary balance (p^*)	The actual primary balance (p)
Ireland 1985:2012	-0.75	0.57
Netherlands 1980:2012	1.21	1.20
Austria 1980:2012	0.38	0.46
Portugal 1980:2012	1.29	-0.66
Sweden 1993:2012	1.00	2.06
UK 1986:2012	1.20	-0.56
Note: p^* is estimated using eq.(4) and average annual data from Eurostat *p:* annual average primary balance available from Eurostat.		

The comparison of the above results shows some difficulties in the case of Portugal and UK, considering that the actual primary balance is below the required one. For Sweden and Ireland, even if t-values reject the significance of cointegration, government has the ability to generate primary surplus larger than the required one. This conclusion also confirms the situation of Austria and the Netherlands.

4. Concluding remarks

Recent studies have brought into attention the increasing public debt within the advanced economies. Along with population ageing, pro-cyclical fiscal policy and fiscal sustainability issues, governments have to take actions as to restore fiscal deficit and public debt stock to acceptable levels. In this context, the aim of the paper was to investigate European governments' response to increasing public debt, making use of the fiscal reaction function. The empirical evidence showed that fiscal reaction function in its original form can be applied only for the case of Germany. But statistical tests reveal no significant reaction of the primary balance to increasing public debt at one year, only that German fiscal policy is pro-cyclical. Significant cointegration test gives some insights about the long run relationship between cyclically adjusted primary balance and public debt-to-GDP ratio for Belgium, Denmark, France and Spain. The error-correction term

reveals the speed of adjustment in terms of government ability to run primary surplus as to meet the fiscal rule implied by the stabilizer primary balance for Belgium and Denmark. In the cases Spain and France the reaction is opposite as expected, implying that the government ran primary deficit rather than surplus, and the required primary balance is above the actual one. For the rest of countries, fiscal rule analysis was accomplished and showed for Greece, Italy, Portugal, UK some difficulties of government response, considering that the actual primary balance is below the required one. For Sweden and Ireland, the government has the ability to generate primary surplus larger than the required one and this conclusion is also valid for Austria and the Netherlands.

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APPENDIX A

Table 1A Descriptive statistics for public debt (% GDP) before and after Maastricht Treaty (MT)

Country	Average All Data	Standard deviation All Data	Average Before MT	Standard deviation Before MT	Average After MT	Standard deviation After MT
Belgium	97.6	25.7	89.3	29.9	107.3	15.6
Denmark	47.7	21.9	43.6	26.5	52.2	14.9
Germany	46.3	15.2	31.5	9.3	62.6	8.3
Ireland	68.7	27.8	77.2	23.3	55.9	29.8
Greece	70.3	41.4	36.8	21.1	106.3	18.9
Spain	40.4	19.4	26.7	13.9	55.3	10.9
France	48.5	20.4	28.7	6.4	63	11.7
Italy	89.0	27.0	68.3	19.7	112.4	6.7
Netherlands	60.5	12.9	59.8	15.5	60.7	10.3
Austria	58.9	18.2	37.8	15.3	65.6	3.5
Portugal	51.0	17.8	39.8	15	60.5	12.9
Finland	29.2	18.2	13.7	7.1	46.6	7.1
Sweden	47.5	15.0	41.7	14.2	55.1	13.2
UK	52.7	13.5	53.7	12.1	49.6	15.1

Source: author's estimation based on annual data for public debt-to-GDP ratio available from Eurostat
Note: All data- data spanned between 1970-1992 with some exceptions (Denmark-1971; France-1977; The Netherlands-1975; Portugal-1973); Before Maastricht Treaty (MT)-data spanned between 1970-1992 with some exceptions (Denmark-1971; France-1977; The Netherlands-1975; Portugal-1973); After Maastricht Treaty (MT)-data spanned between 1993-2012

Table 2A Average implicit interest rate on public debt, public debt growth, GDP growth rate

	Implicit interest rate (i, %)	Public debt growth (θ, %)	GDP growth (g, %)	$\theta > g$	$i > g$
Belgium 1971:2012	7.4	8.1	6.7	Yes	Yes
Denmark 1973:2012	10.1	12.5	6.6	Yes	Yes
Germany 1971:2012	6.3	10.5	6.6	Yes	No
Ireland 1985:2012	6.1	8.4	7.1	Yes	No
Greece 1988:2012	8.9	10.8	6.0	Yes	Yes
Spain 1995:2012	5.4	6.9	5.5	Yes	No
France 1978:2012	6.5	10.1	5.2	Yes	Yes
Italy 1980:2012	8.5	8.1	5.7	Yes	Yes
Netherlands 1976:2012	7.3	7.7	6.0	Yes	Yes
Austria 1976:2012	6.3	9.9	6.3	Yes	No
Portugal 1977:2012	9.5	10.9	6.6	Yes	Yes
Finland 1975:2012	8.1	13.0	6.5	Yes	Yes
Sweden 1993:2012	5.1	1.8	3.5	No	Yes
UK 1971:2012	7.7	7.5	7.0	Yes	Yes

Source: author's estimation based on annual data available from Eurostat
Note: Implicit interest rate is derived as nominal interest expenditure divided by previous period debt stock.

Table 3A Johansen cointegration test

Belgium

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.583374	33.05433	25.87211	0.0054
At most 1	0.173621	5.911750	12.51798	0.4716
Trace test indicates 1 cointegrating eqn(s) at the 0.05 level				

Denmark

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.660718	43.68662	25.87211	0.0001
At most 1	0.279870	10.17801	12.51798	0.1193
Trace test indicates 1 cointegrating eqn(s) at the 0.05 level				

Ireland

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.445119	21.25481	20.26184	0.0364
At most 1	0.204267	5.940782	9.164546	0.1953
Trace test indicates 1 cointegrating eqn(s) at the 0.05 level				

Greece

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.280626	8.311344	15.49471	0.4327
At most 1	0.031482	0.735735	3.841466	0.3910
Trace test indicates no cointegrating at the 0.05 level				

Spain

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.795457	27.89538	20.26184	0.0036
At most 1	0.144854	2.503738	9.164546	0.6768
Trace test indicates 1 cointegrating eqn(s) at the 0.05 level				

France

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.566269	33.73307	25.87211	0.0043
At most 1	0.223402	7.837794	12.51798	0.2652
Trace test indicates 1 cointegrating eqn(s) at the 0.05 level				

Italy

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.292962	19.61225	25.87211	0.2462
At most 1	0.248724	8.865443	12.51798	0.1888
Trace test indicates no cointegrating at the 0.05 level				

Portugal

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.518601	27.20942	25.87211	0.0339
At most 1	0.136416	4.546596	12.51798	0.6622
Trace test indicates 1 cointegrating eqn(s) at the 0.05 level				

Finland

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.276497	14.19814	20.26184	0.2760
At most 1	0.125720	4.164986	9.164546	0.3881
Trace test indicates no cointegrating at the 0.05 level				

Sweden

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.552662	21.62362	20.26184	0.0323
At most 1	0.327579	7.143681	9.164546	0.1190
Trace test indicates 1 cointegrating eqn(s) at the 0.05 level				

Table 4A VECM

Belgium

Cointegrating Eq:	CointEq1	
p(-1)	1.000000	
b(-1)	-0.081384	
	(0.01757)	
	[-4.63102]	
C	6.594941	
Error Correction:	Δ(*p*)	Δ (*b*)
CointEq1	-0.631097	-0.605164
	(0.14069)	(0.40305)
	[-4.48582]	[-1.50147]
Δ (*p*(-1))	-0.206364	0.230722
	(0.11662)	(0.33409)
	[-1.76959]	[0.69060]
Δ (*b*(-1))	-0.190206	0.380838
	(0.07876)	(0.22563)
	[-2.41506]	[1.68789]
C	0.397714	0.153682
	(0.20259)	(0.58039)
	[1.96313]	[0.26479]
R-squared	0.580009	0.594920

Denmark

Cointegrating Eq:	CointEq1	
p(-1)	1.000000	
b(-1)	-1.080525	
	(0.31478)	
	[-3.43267]	
C	57.51105	
Error Correction:	Δ (*p*)	Δ (*b*)
CointEq1	-0.034167	0.089936
	(0.01910)	(0.04487)
	[-1.78860]	[2.00456]
Δ (*p*(-1))	0.054981	0.318466
	(0.06208)	(0.14580)
	[0.88571]	[2.18434]
Δ (*b*(-1))	0.054981	0.318466
	(0.07876)	(0.22563)
	[-2.41506]	[1.68789]
C	-29.34170	135.7625
	(17.9802)	(42.2295)
	[-1.63189]	[3.21488]
y	0.294958	-1.369962
	(0.18100)	(0.42511)
	[1.62960]	[-3.22261]
R-squared	0.283187	0.664395

Ireland

Cointegrating Eq:	CointEq1	
p(-1)	1.000000	
b(-1)	-0.027627	
	(0.02445)	
	[-1.12983]	
C	0.962295	
Error Correction:	Δ(*p*)	Δ (*b*)
CointEq1	-1.009694	0.400552
	(0.32733)	(0.49166)
	[-3.08464]	[0.81469]
Δ (*p*(-1))	-0.098859	-0.000421
	(0.18678)	(0.28056)
	[-0.52927]	[-0.00150]
Δ (*b*(-1))	-0.500254	0.953458
	(0.21048)	(0.31615)
	[-2.37673]	[3.01584]
C	-0.123040	-0.140583
	(0.97694)	(1.46741)
	[-0.12594]	[-0.09580]
R-squared	0.373707	0.540711

Spain

Cointegrating Eq:	CointEq1	
p(-1)	1.000000	
b(-1)	0.050501	
	(0.01734)	
	[2.91191]	
C	-3.045128	
Error Correction:	Δ(*p*)	Δ (*b*)
CointEq1	-0.276661	-0.729371
	(0.53114)	(0.72137)
	[-0.52088]	[-1.01110]
Δ (*p*(-1))	0.563899	-0.958051
	(0.31495)	(0.42775)
	[1.79041]	[-2.23973]
Δ (*b*(-1))	0.053588	0.296021
	(0.26131)	(0.35490)
	[0.20507]	[0.83409]
C	-0.158822	0.089905
	(0.50363)	(0.68400)
	[-0.31535]	[0.13144]
R-squared	0.345007	0.815724

France

Cointegrating Eq:	CointEq1	
p(-1)	1.000000	
b(-1)	0.023856	
	(0.01238)	
	[1.92730]	
C	-1.309514	
Error Correction:	Δ(*p*)	Δ (*b*)
CointEq1	-0.405597	-0.729817
	(0.22159)	(0.59079)
	[-1.83038]	[-1.23533]
Δ (*p*(-1))	0.130912	0.152321
	(0.19289)	(0.51425)
	[0.67870]	[0.29620]
Δ (*b*(-1))	0.006145	0.308632
	(0.08057)	(0.21482)
	[0.07627]	[1.43672]
C	-0.058792	1.545811
	(0.23464)	(0.62557)
	[-0.25057]	[2.47106]
R-squared	0.178080	0.272885

Portugal

Cointegrating Eq:	CointEq1	
p(-1)	1.000000	
b(-1)	0.016255	
	(0.03175)	
	[0.51193]	
C	-0.457215	
Error Correction:	Δ (*p*)	Δ (*b*)
CointEq1	-0.506326	-0.568170
	(0.23217)	(0.42881)
	[-2.18089]	[-1.32499]
Δ (*p*(-1))	0.101521	0.062537
	(0.17803)	(0.32883)
	[0.57024]	[0.19018]
Δ (*b*(-1))	0.098885	-0.009670
	(0.13492)	(0.24920)
	[0.73292]	[-0.03881]
C	-8.515356	85.21459
	(18.8857)	(34.8822)
	[-0.45089]	[2.44292]
y	0.084745	-0.836504
	(0.18767)	(0.34662)
	[0.45157]	[-2.41329]
R-squared	0.352081	0.345229

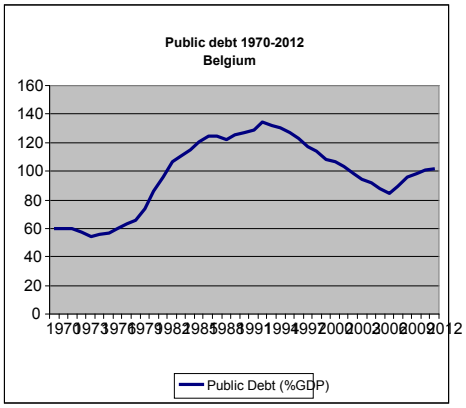
Sweden

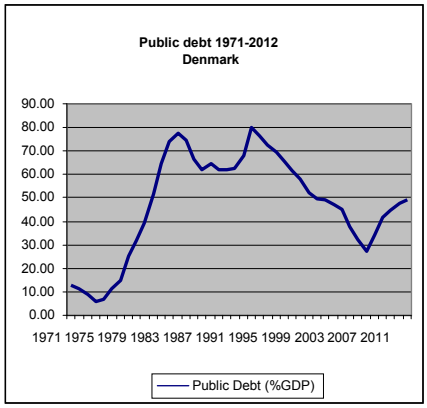
Cointegrating Eq:	CointEq1	
p(-1)	1.000000	
b(-1)	-0.065985	
	(0.03694)	
	[-1.78642]	
C	0.869988	
Error Correction:	Δ(*p*)	Δ (*b*)
CointEq1	-0.632339	-0.413358
	(0.17838)	(0.45986)
	[-3.54493]	[-0.89888]
Δ (*p*(-1))	0.175913	0.280209
	(0.19125)	(0.49305)
	[0.91980]	[0.56832]
Δ (*b*(-1))	-0.172841	-0.042190
	(0.11005)	(0.28371)
	[-1.57057]	[-0.14871]
C	-0.198942	-2.060824
	(0.35982)	(0.92762)
	[-0.55289]	[-2.22163]
R-squared	0.480071	0.077131
prob (); t-stat []		

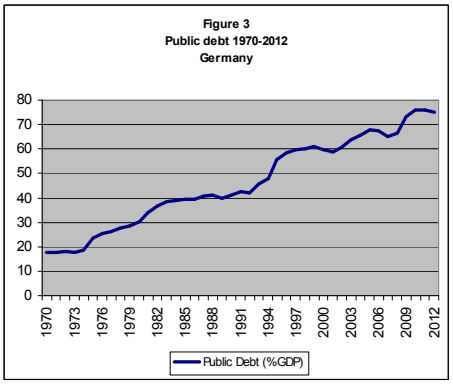
Note: prob (); t-stat []

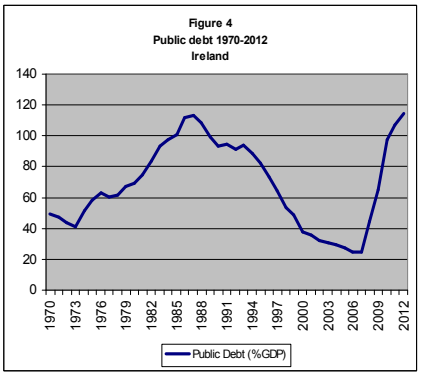
APPENDIX B

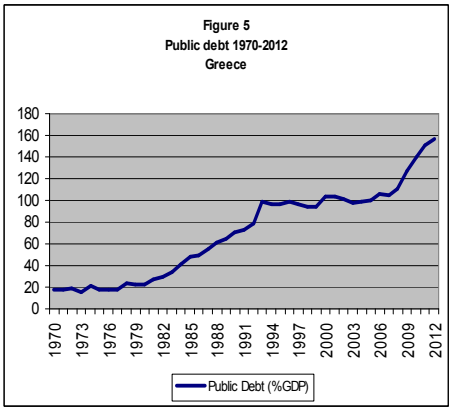
Figure 1B Public debt in the European Union countries

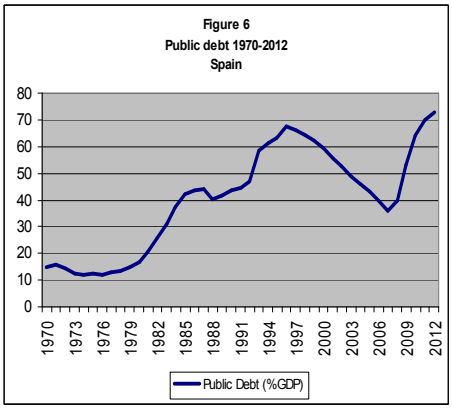












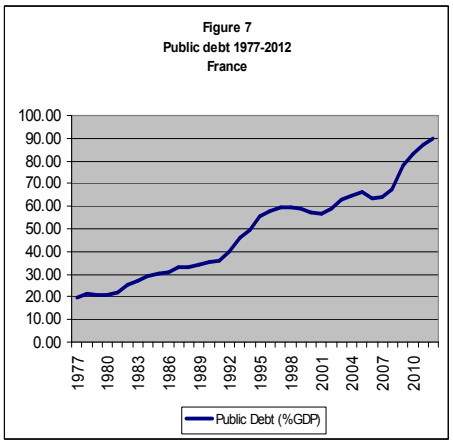


Figure 7
Public debt 1977-2012
France
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004
2007
2010
Public Debt (%GDP)

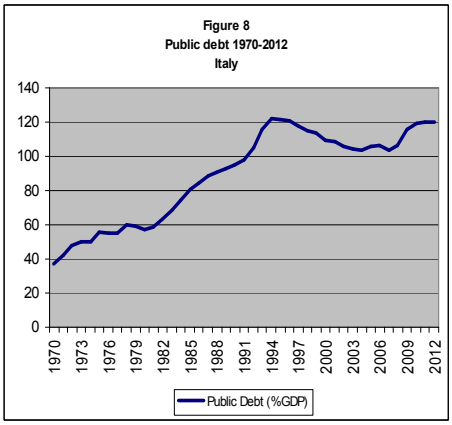


Figure 8
Public debt 1970-2012
Italy
140
120
100
80
60
40
20
0
1970
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
2012
Public Debt (%GDP)

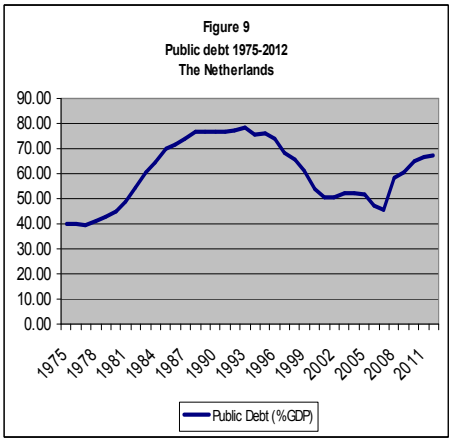


Figure 9
Public debt 1975-2012
The Netherlands
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
1975
1978
1981
1984
1987
1990
1993
1996
1999
2002
2005
2008
2011
Public Debt (%GDP)

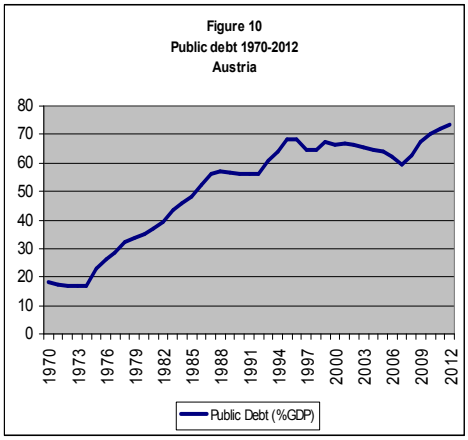


Figure 10
Public debt 1970-2012
Austria
80
70
60
50
40
30
20
10
0
1970
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
2012
Public Debt (%GDP)

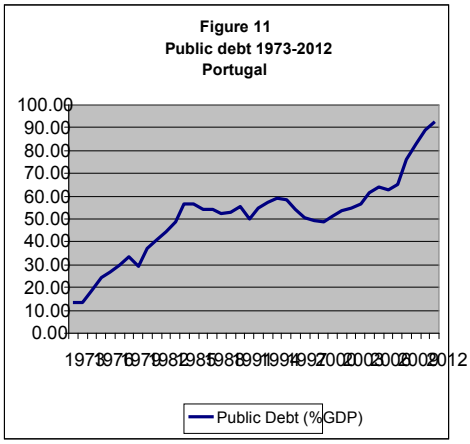


Figure 11
Public debt 1973-2012
Portugal
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Public Debt (%GDP)

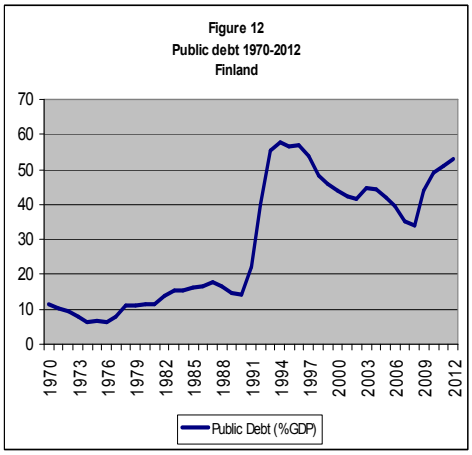


Figure 12
Public debt 1970-2012
Finland
70
60
50
40
30
20
10
0
1970
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
2012
Public Debt (%GDP)

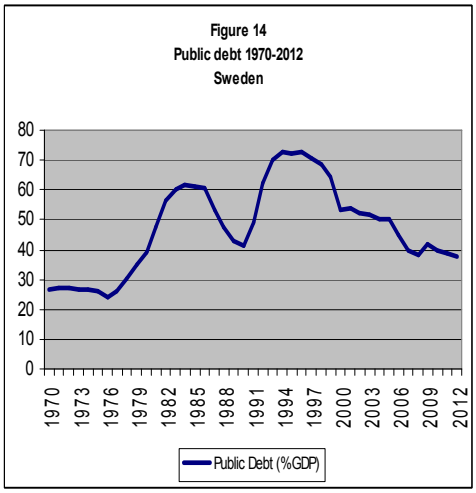


Figure 14
Public debt 1970-2012
Sweden
80
70
60
50
40
30
20
10
0
1970
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
2012
Public Debt (%GDP)

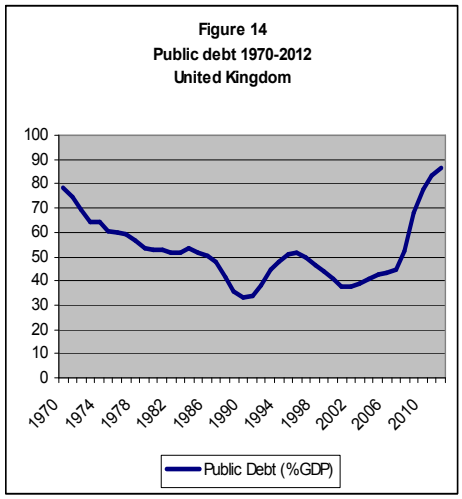
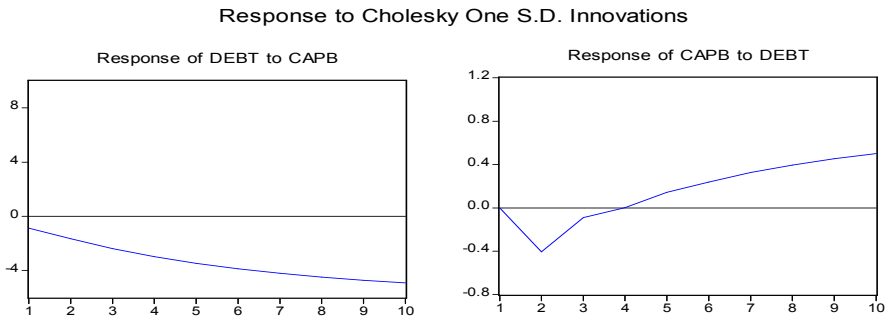


Figure 14
Public debt 1970-2012
United Kingdom
100
90
80
70
60
50
40
30
20
10
0
1970
1974
1978
1982
1986
1990
1994
1998
2002
2006
2010
Public Debt (%GDP)

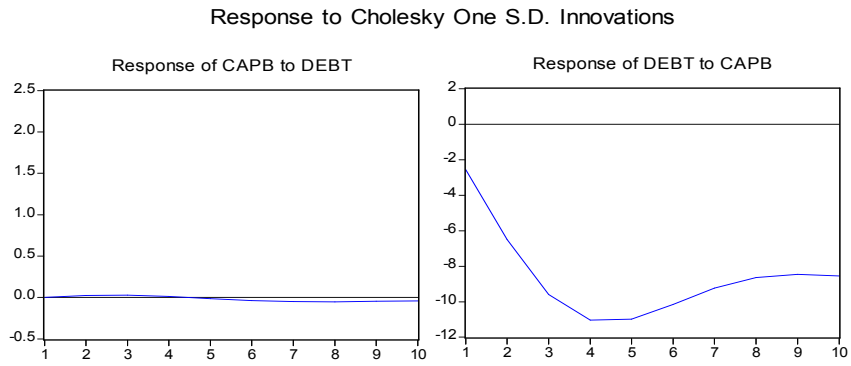
Figure 2B Impulse response

Belgium



Denmark

Spain



Note: CAPB-cyclically adjusted primary balance; DEBT-public debt-to-GDP ratio

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