

## **Assessing Long-Term Fiscal Dynamics: Evidence from Greece and Belgium**

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*We use a Three-Stage Least Square (TSLS) method and a system of equations to assess long-term fiscal developments for two European countries: Greece and Belgium. Using annual data from 1971-2010, we examine the responsiveness and persistence of government expenditure and revenue in order to infer about the sources of fiscal behaviour. Empirical findings suggest that (i) in Greece, contrary to Belgium, government expenditures and revenues are not affected by policies which either increase or decrease output, (ii) Greek and Belgian government expenses and revenues are largely determined by their own lagged values, (iii) in Belgium contrary to Greece, government revenues exhibits higher responsiveness than government expenditure and (iv) in Greece there is no structural change in the fiscal dynamics, whereas in Belgium expenditures' responsiveness to GDP increases over time.*

**JEL Codes:** E62 and H50

### **1. Introduction**

Over the last decades, several studies have addressed the issue of the sustainability of public finances, usually assessing whether government expenditures and revenues display a sustainable equilibrium pattern. The issue is important since any inadequate fiscal policy may destabilize the relationship between government expenditures and revenues, producing conditions for potential “fiscal deterioration” and lack of public finances sustainability.

In this paper we contribute to the literature by using an approach developed by Afonso and Sousa (2011) to assess fiscal developments in Greece and Belgium. The two countries are almost identical in terms of population (approximately 11 million people) while also maintaining public sectors of significant size. In year 2010, the public debt over Gross Domestic Product (GDP) accounted for 142% in Greece versus 99% in Belgium. At the same time, Greece is a typical representative of the European periphery, whereas Belgium ranks among the richer members of European Union (EU), with GDP per capita amounting to 160% of the one of Greece.

Our analysis examines to what extent two main characteristics of fiscal policy behaviour, i) the sensitivity of fiscal variables to economic developments and ii) the dependence of fiscal behaviour on its own past developments, impact on the patterns of both

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government spending and revenue, thereby determining conditions of fiscal sustainability or fiscal deterioration. In order to address our problem and following the empirical works by Afonso et al. (2008) and Fatas and Mihov (2003), we decompose government expenditure and government revenue into two components: (i) responsiveness, that is the response of fiscal policy to output and (ii) persistence, that reflects the likely autocorrelation on budgetary policy decisions. We improve upon the work of Afonso et al. (2008) who extend the analysis of Fatas and Mihov (2006) by using the instrumental variables method, but estimate separately the equations for government expenditure and revenue. Given that we are interested to test whether and to what extent the time-varying behaviour of the fiscal policy characteristics may simultaneously influence the patterns of both expenditure and revenue and eventually determine conditions of fiscal deterioration, we estimate a system including both the expenditure and revenue equations. To this purpose we use annual data from 1971-2010 taken from national accounts.

The rest of the paper is structured as follows. Section 2 presents a brief review of the related empirical literature. Section 3 describes the model to be estimated and the methodology used to assess fiscal developments. Section 4 presents the data and discusses the empirical results for assessing fiscal deterioration or fiscal improvement. The last section provides concluding remarks.

## 2. Literature Review

Unit root and cointegration tests are commonly used to examine the sustainability of public finances and the possibility of fiscal deterioration if past fiscal policies are to be kept in the future. The analyses focus on testing if the first differences of the debt series are stationary or if the government expenditures and revenues are cointegrated. Common practice is to interpret rejection of these tests as evidence against either strong or weak fiscal sustainability, depending on how far from unity is the coefficient for government expenditures in the cointegration relationship between government expenditures and revenues. Such analyses have been carried out on a country basis (Hamilton and Flavin, 1986; Trehan and Walsh, 1991; Ahmed and Rogers, 1995; Quintos, 1995).

More recently fiscal developments have also been assessed for the OECD and EU country groupings, given that several economic and econometric arguments support the use of panel analysis for such purpose. Afonso and Rault (2007) used first and second generation panel unit root tests as well as panel cointegration techniques that allow for correlation to be accommodated both within and between units.

The long-term (cointegration) relationship between primary budget balances and government debt, basically a fiscal reaction function, also provides evidence on the sustainability features of public finances. However, it has been argued that the rejection of sustainability based on standard cointegration tests is invalid because the present-value borrowing constraint could be satisfied even if government expenditures and revenues are not cointegrated or deficit and debt are difference-stationary (Bohn, 2007).

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Focusing only on government spending, Fatas and Mihov (2003, 2006) identify three fiscal policy characteristics explaining their evolution: responsiveness, persistence and discretionary. Afonso et al. (2008) extend the analysis of Fatas and Mihov (2006) by estimating separately two regression models relating government expenditures and revenues to the same common set of fiscal policy characteristics defined above. However, the use of a single equation estimation approach does not allow to assess whether, and to what extent, the time-varying behaviour of the fiscal policy characteristics many simultaneously influence the patterns of both expenditure and revenue and change their structural long-run relationship. In this respect, the empirical strategy used in this paper, based on the simultaneous estimation of both expenditure and revenue equations, which helps overcome this problem.

### 3. Methodology

The empirical methodology used to analyse the role of responsiveness and persistence in determining fiscal developments is based on the estimation of the following system of structural equations:

$$\begin{cases} \ln(EXP_{i,t}) = \beta_i^{EXP} + \gamma_i^{EXP} \ln(GDP_{i,t}) + \delta_i^{EXP} \ln(EXP_{i,t-1}) + \varepsilon_{i,t}^{EXP} \\ (t = 1, 2, \dots, T) \\ \ln(REV_{i,t}) = \beta_i^{REV} + \gamma_i^{REV} \ln(GDP_{i,t}) + \delta_i^{REV} \ln(REV_{i,t-1}) + \varepsilon_{i,t}^{REV} \\ (t = 1, 2, \dots, T) \end{cases} \quad (1)$$

Where,

EXP: total real government expenditures,

REV: total real government revenues,

GDP: real Gross Domestic Product,

i: represents the country (i.e. Greece, Belgium),

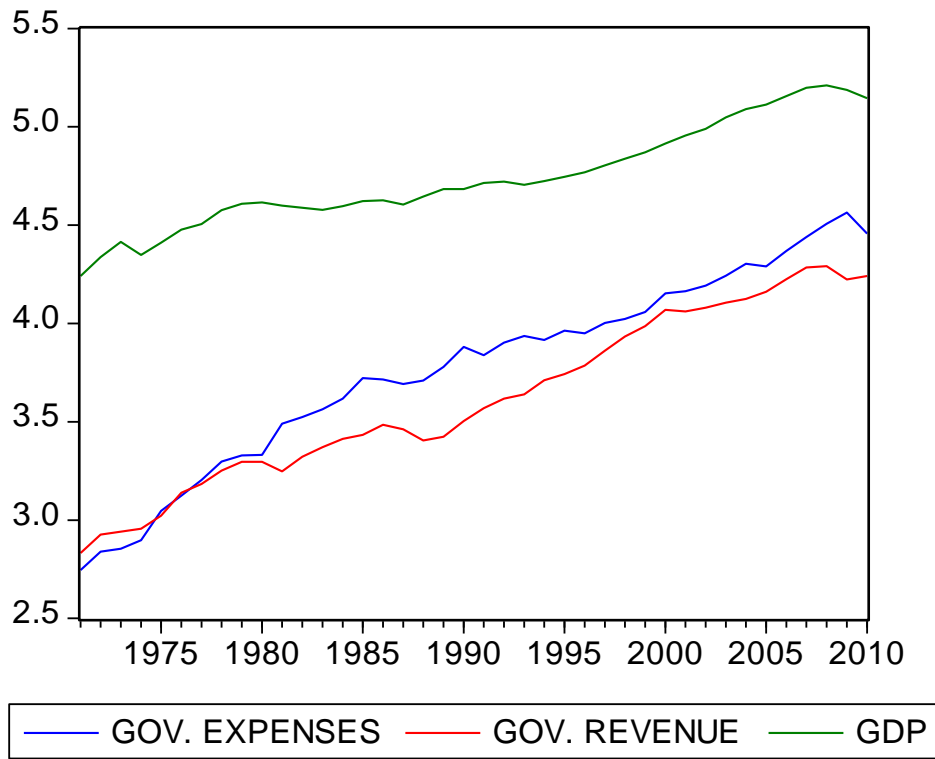
$\gamma_i$ : measures the responsiveness of fiscal policy for each of the two countries,

$\delta_i$ : measures the fiscal persistence, that is, the degree of dependence of the current fiscal behaviour on its own past setting.

The variables in Equation 1 are expressed in levels (see Figures 1 and 2) for two main reasons. First, as also done by Afonso and Sousa (2011) and Fatas and Mihov (2003, 2006), it is necessary to include in the regressions the level of the current and lagged value of government expenditure and revenue in order to capture the persistence of fiscal policy. Second, once the lagged dependent variable is used in levels, and considering the fact that the series employed are not stationary, the inclusion of output expressed in first differences may lead to a situation where the coefficient of the lagged variable converges to one and the coefficient of the stationary series (output expressed in differences) converges to zero (Wirjanto and Amano, 1996).

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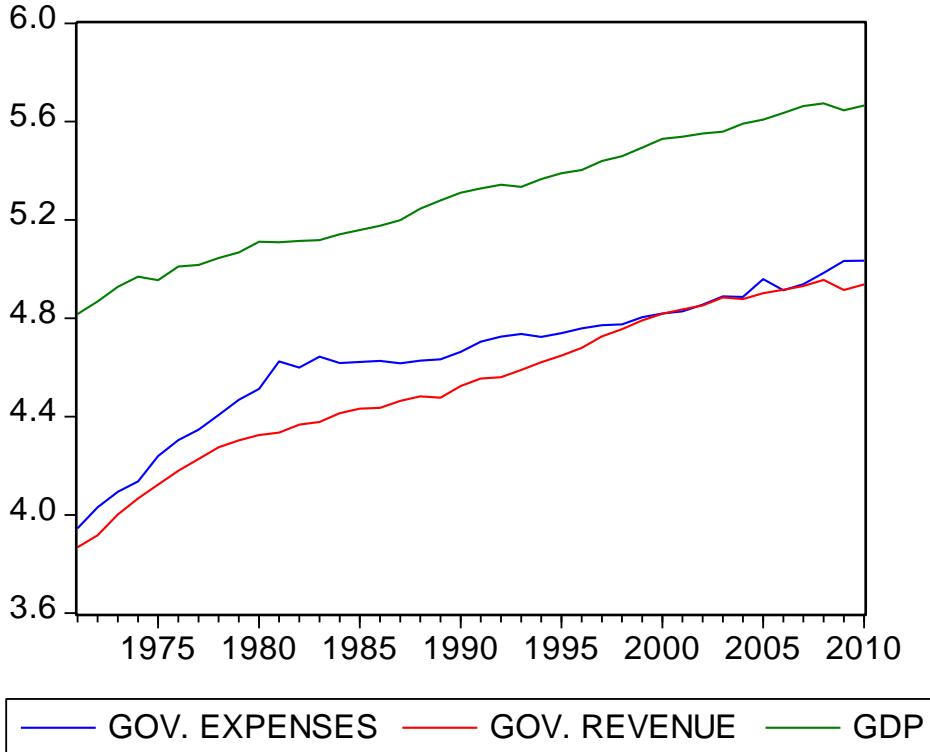
**Figure 1: Greece's government expenditure, government revenues and GDP (1971-2010)**



Source: AMECO

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**Figure 2: Belgium's government expenditure, government revenues and GDP (1971-2010)**



**Source:** AMECO

The estimation of Equation 1 is challenged by the presence of lagged endogenous variables among the explanatory variables. Therefore, we use a Three-Stage Least Square (TSLS) specification (Zellner and Theil, 1962), which provides consistent estimates. In addition, to avoid any endogeneity bias because of the simultaneity in the determination of our variables, GDP is instrumented with two lags of GDP, the index of oil prices [as in Afonso and Sousa (2011) and Fatas and Mihov (2006)] and the lagged value for revenues and expenditures respectively, in the expenditures and revenues equation.

Once system (Equation 1) is estimated for each of the two countries, we compute the corresponding Wald statistics to test the following joint restrictions:

$$H_0 : \delta_i^{EXP} = \delta_i^{REV} \wedge \gamma_i^{EXP} = \gamma_i^{REV} \quad (2)$$

As it is followed by Afonso and Sousa (2011), acceptance of the null hypothesis implies that the behaviour of both government expenditure and revenues evolve dynamically in a way that avoids any structural change of the fiscal position. If the null hypothesis is rejected, this reports structural changes in the fiscal behaviour towards deterioration or improvement. Specifically, in order to assess whether changes in the fiscal position are

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due to differences in responsiveness or persistence between government expenditures and revenues, we test the following single hypothesis:

$$H_0 : \delta_i^{EXP} = \delta_i^{REV} \quad H_1 : \delta_i^{EXP} \neq \delta_i^{REV} \quad (3)$$

$$H_0 : \gamma_i^{EXP} = \gamma_i^{REV} \quad H_1 : \gamma_i^{EXP} \neq \gamma_i^{REV} \quad (4)$$

From the analysis of the single tests and the analysis of the estimates of the parameters, one can obtain three possible outcomes: (i) fiscal deterioration (due to fiscal persistence and/or fiscal responsiveness); (ii) fiscal improvement (due to persistence and/or responsiveness) and (iii) indeterminacy, when government expenditure persistence is higher than revenue persistence ( $\delta_i^{EXP} > \delta_i^{REV}$ ), but expenditure responsiveness is lower than revenue responsiveness ( $\gamma_i^{EXP} < \gamma_i^{REV}$ ), and vice versa ( $\delta_i^{EXP} < \delta_i^{REV}$ ;  $\gamma_i^{EXP} > \gamma_i^{REV}$ ).

## 4. Data Description and Empirical Analysis

In our study we use annual data for Greece and Belgium covering the period 1971-2010. A sub-period from 1971-2000 is also examined (just before the introduction of euro currency) to identify potential structural changes. National currency data for all years before the switch to the euro have been converted using the fixed euro conversion rate to provide comparable series across time. All variables are expressed in natural logarithms of real terms. The data are provided by Bloomberg and the annual national accounts data of the European Commission AMECO (Annual Macro-Economic Data) database. The government finance items are deflated by the GDP deflator (2000=100).

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**Table 1: Estimates through a TSLS method for responsiveness & persistence**

	Responsiveness		Persistence	
	$\hat{\gamma}^{EXP}$	$\hat{\gamma}^{REV}$	$\hat{\delta}^{EXP}$	$\hat{\delta}^{REV}$
<b>GREECE</b>				
<b>Full Sample (1971-2010)</b>	0.127 (1.015) [0.314]	-0.178 (-1.010) [0.316]	0.906 (13.874) [0.000]	1.087 (10.547) [0.000]
<b>Sub-Sample (1971-2000)</b>	0.062 (0.225) [0.823]	-0.241 (-0.436) [0.665]	0.943 (9.593) [0.000]	1.128 (4.423) [0.000]
<b>BELGIUM</b>				
<b>Full Sample (1971-2010)</b>	0.122 (1.842) [0.069]	0.306 (3.559) [0.000]	0.830 (13.045) [0.000]	0.708 (10.122) [0.000]
<b>Sub-Sample (1971-2000)</b>	0.031 (0.410) [0.684]	0.340 (4.417) [0.000]	0.888 (14.395) [0.000]	0.696 (11.647) [0.000]
<b>Notes:</b> 1) t-statistic in parentheses. Probabilities in brackets.				
2) Estimated Equations				
$\left\{ \begin{array}{l} \ln(EXP_{i,t}) = \beta_i^{EXP} + \gamma_i^{EXP} \ln(GDP_{i,t}) + \delta_i^{EXP} \ln(EXP_{i,t-1}) + \varepsilon_{i,t}^{EXP} \\ \text{Instruments : } \ln(GDP_{i,t-1}), \ln(GDP_{i,t-2}), (OILPRICE_t), \ln(REV_{i,t-1}) \\ \ln(REV_{i,t}) = \beta_i^{REV} + \gamma_i^{REV} \ln(GDP_{i,t}) + \delta_i^{REV} \ln(REV_{i,t-1}) + \varepsilon_{i,t}^{REV} \\ \text{Instruments : } \ln(GDP_{i,t-1}), \ln(GDP_{i,t-2}), (OILPRICE_t), \ln(EXP_{i,t-1}) \end{array} \right.$				

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Table 1 summarises the estimates for the coefficients of responsiveness  $\gamma$  and persistence  $\delta$  for each country for the full sample and for the sub-period 1971-2000. We do not estimate separately the sub-period 2001–2010 due to the limited number of observations.

As far as Greece is concerned, the coefficients of responsiveness  $\gamma$  are not statistically significant at all levels of significance, both for the full and the sub periods. Conclusively, changes in GDP do not affect either government expenses or revenues. On the contrary, the coefficients of persistence  $\delta$  are statistically significant at all levels of significance. Moreover, our Wald tests in Table 2 indicate that they are not different than one for both periods we examine. This suggests that government revenues and expenses in Greece have been largely determined by their own lagged values throughout time.

<b>Table 2: Wald Tests (Chi-square) for the coefficient <math>\delta</math></b>		
	$W_{\delta}$ ( $\delta^{EXP} = 1$ )	$W_{\delta}$ ( $\delta^{REV} = 1$ )
<b>GREECE</b>		
<b>Full sample</b> <b>(1971 – 2010)</b>	2.069 [0.150]	0.710 [0.399]
<b>Sub-sample</b> <b>(1971 – 2000)</b>	0.339 [0.516]	2.253 [0.615]
<b>BELGIUM</b>		
<b>Full sample</b> <b>(1971 – 2010)</b>	7.143 [0.008]	17.425 [0.000]
<b>Sub-sample</b> <b>(1971 – 2000)</b>	3.291 [0.069]	25.980 [0.000]
<b>Notes:</b> Probabilities in brackets.		



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Belgium displays a coefficient for responsiveness of revenues which is statistically significant at all levels whereas the one for expenses is statistically significant only at the 10% level (Table 1). If we focus on the sub-period until year 2000, the coefficient of responsiveness for expenses becomes zero, thus indicating a structural change over time in the behaviour of fiscal finances. The coefficients of persistence  $\delta$  are statistically significant at all levels for both periods. However, contrary to Greece, our Wald tests indicate that the coefficients are statistically lower to one. Therefore, Belgium, displays a lower persistence than Greece for its fiscal finances. We also conclude in favour of strong responsiveness for its government revenues and weak for its expenses.

Finally, it seems that there has been a structural shift in Belgium with responsiveness in expenses becoming stronger over time. This last proposition is further explored through our Wald tests on Table 3. For the sub-period until year 2000, we reject the null hypothesis for the joint restriction (2), as well as for the single restrictions (3) and (4). For the whole sample, the joint restriction can be accepted only at the 10% level of significance, however the individual restrictions are clearly accepted at any level, accordingly we conclude in favour of acceptance. This suggests a shift from a status where revenues exhibited higher responsiveness and lower persistence ( $\delta_i^{EXP} > \delta_i^{REV}; \gamma_i^{EXP} < \gamma_i^{REV}$ ) to a regime of equal responsiveness and persistence between government revenues and expenses. The direction of the relation between the coefficients does not allow us to infer in favour of either fiscal improvement or deterioration.

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<b>Table 3: Wald Tests (Chi-square) based on Equation (1)</b>			
	$W_\gamma$	$W_\delta$	$W_{joint}$
<b>GREECE</b>			
<b>Full Sample (1971-2010)</b>	2.131 [0.144]	2.346 [0.126]	2.394 [0.302]
<b>Sub-Sample (1971-2000)</b>	0.256 [0.613]	0.485 [0.486]	1.724 [0.422]
<b>BELGIUM</b>			
<b>Full Sample (1971-2010)</b>	2.547 [0.111]	1.480 [0.224]	5.068 [0.079]
<b>Sub-Sample (1971-2000)</b>	7.407 [0.007]	4.533 [0.033]	10.110 [0.006]
<b>Notes:</b> $W_\gamma$ - Wald test for $\gamma^{EXP} = \gamma^{REV}$ . $W_\delta$ - Wald test for $\delta^{EXP} = \delta^{REV}$ . $W_{joint}$ - Wald test for $\gamma^{EXP} = \gamma^{REV} \wedge \delta^{EXP} = \delta^{REV}$ . Probabilities in brackets.			

## 5. Conclusions

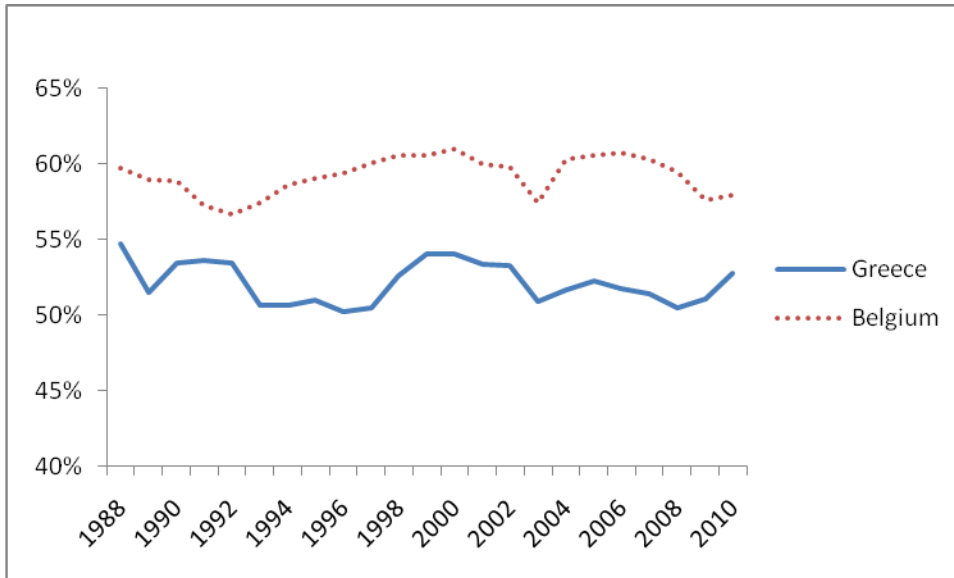
In this article, we use the approach developed by Afonso and Sousa (2011) to assess long-term fiscal developments for Greece and Belgium. We used annual data and a TSLS specification to estimate the responsiveness and the persistence government expenditure and revenue within a system of equations.

The empirical results indicate that in Greece, contrary to Belgium, the government revenues and expenses are not affected by policies which either increase or decrease GDP. It is the structure of the Greek public sector that is pretty much independent of the overall economic activity and which determines the level of government revenues and expenses. This is further outlined in Figures 3 and 4 focusing on the period 1988 onwards when we have a breakdown of government expenses and revenues in categories. Taxes, being significantly dependent on economic output are a lower percentage of government revenues in Greece than in Belgium. At the same time interest

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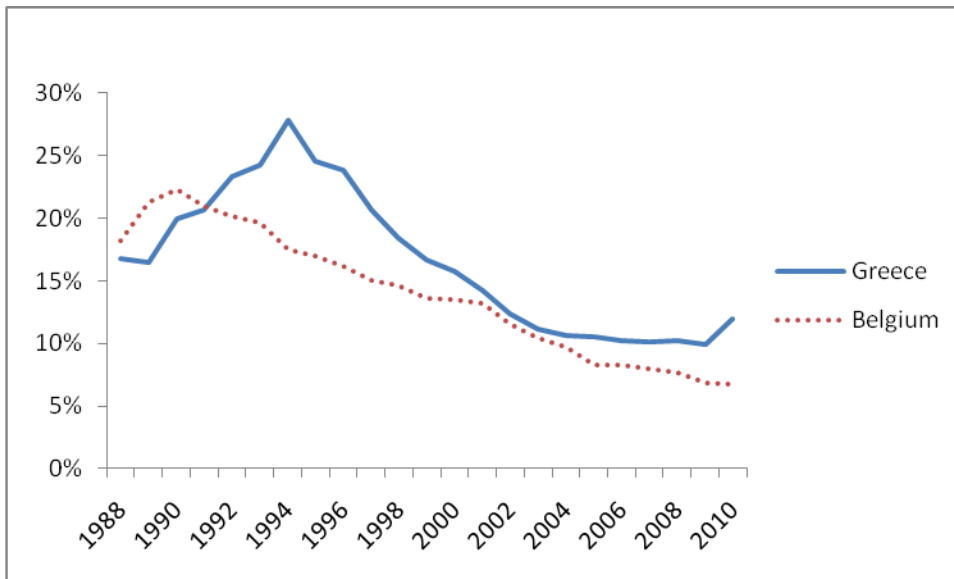
expenses as percentage of total government expenditure, being almost totally independent of economic output, is higher in Greece than Belgium.

**Figure 3: Taxes as % of total government revenues (1988-2010)**



Source: AMECO

**Figure 4: Interest as % of total government expenditures**



Source: AMECO

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Finally for Belgium, our analysis shows an increase in the responsiveness of expenditures through time. In addition, while government spending persistence has been higher than government revenue persistence (also confirmed by the analysis for the sub-period), revenue has been more responsive than spending, which implies an overall balanced behaviour.

The empirical findings of this article add a small piece of evidence to the existing literature, indicating that Greek fiscal authorities might face difficulties in stabilising the economy, as the persistence of government spending is large.

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