Fiscal deficits under financial pressure and insolvency: Evidence for Italy, Greece and Spain

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Abstract

This article attempts to re-evaluate the sustainability of the fiscal deficit as well as the long-run macroeconomic relationship between government spending and revenues for three South-European economies under financial market pressure and insolvency; Italy, Greece and Spain. The empirical analysis uses annual data from 1970 to 2010 and employs various cointegration techniques to account for possible linear and nonlinear effects in fiscal policy actions. The evidence for all three countries suggests that, allowing for structural break, (i) the fiscal deficits are weakly sustainable in the long-run, (ii) the spend-and-tax hypothesis is supported and (iii) the budgetary adjustment process is asymmetric in Italy and Spain.

Keywords: Fiscal policy, budget deficit, sustainability, revenues, expenditures, structural breaks, threshold cointegration.

JEL Classification: C22, E62, H61, H62.

1. Introduction

The debt and deficit crisis in the European Monetary Union (EMU) has stimulated a tremendous interest over fiscal policy within the EU. International markets are highly volatile and deeply concerned with the deficit levels of these countries being, or not, unsustainable, thus posturing a risk to the whole of Eurozone. Special attention from both researchers and policy makers alike, has been paid by to three South-European countries, Italy, Greece and Spain, which have recently experienced large fiscal imbalances. In particular, the above facts have contributed to rekindling two issues; that of the budget deficit sustainability and the revenue-expenditure nexus.

Unsustainable fiscal deficits reflect the inability of the government to stabilize its public debt ratio and to repay its debts and may result in insolvency. Also, in a monetary union, as is the EMU, fiscal imbalances in one country create negative externalities for the other countries, which may further jeopardize the overall credibility of the common currency. On the other hand, balanced total revenues and expenditures, secure fiscal discipline and monetary policy could be implemented more effectively.

The widely adopted approach for the investigation of fiscal sustainability so far, is based on the present-value borrowing constraint approach (Hamilton and Flavin, 1986). Governments are subject to an Intertemporal Budget Constraint (IBC), which states that the present value of expenditures (current and future) equals the present value of revenues (current and future). A considerable number of empirical efforts have used the IBC approach to examine the issue of the sustainability of fiscal deficits (Trehan and Walsh, 1988 and 1991; Hakkio and Rush, 1991; Tanner and Liu, 1994; Liu and Tanner, 1995; Wu, 1998; Issler and Lima, 2000; Green, Holmes and Kowalski, 2001 among others). Regarding Italy, Greece and Spain, all studied here, evidence in favor of sustainability has been provided by Papadopoulos and Sidiropoulos (1999), De Castro and Hernandez de Cos (2002), Katrakilidis and Tabakis (2006), Arghyrou and Luintel (2007), Bajo Rubio et al. (2010) and Legrenzi and Milas (2011). However, Makrydakis et al. (1999) and Bravo and Silvestre (2002) presented evidence that the fiscal deficit is unsustainable.

Another important aspect of the implementation of an effective fiscal policy, and relevant to the concept of sustainability, is the dynamic relationship between government revenues and expenditures, and more particularly, the direction of causality between them,

well known as the revenue-expenditure nexus[1] (Bohn, 1991; Baghestani and McNown, 1994; Mounts and Sowell, 1997; Ross and Payne, 1998; Garcia and Henin, 1999; Chang et al., 2002). The dynamics of the budgetary process is crucial for countries attempting to adjust their fiscal imbalances and /or maintain budget deficit targets. To put it simply, by identifying the causal ordering, important information is offered to policy makers; that is, the causal variable (either revenues or expenditures) is the one upon which constraints should be applied, in order to reduce/control the government's deficit.

With regard to the revenue-expenditure nexus, the cases of Italy and Spain have been investigated by Owoye (1995), Kollias and Makrydakis (2000), Kollias and Paleologou (2006) and Qwoye and Onafowora (2011) who present evidence in favour of the tax-and-spend hypothesis while Bella and Quinteri (1995), Koren and Stiassny (1998) and Afonso and Rault (2009) support the spend-and-tax approach. As regards the Greek case, most empirical work supports the spend-and-tax hypothesis (Joulfaian and Mookeriee, 1990; Provopoulos and Zambaras, 1991; Kollias and Makrydakis, 1995; Hodroyiannis and Papapetrou, 1996; Vamvoukas, 1997; Afonso and Rault, 2009; Palaiologou, 2013); while in three studies, the evidence supports the fiscal synchronization (Katrakilidis, 1997; Kollias and Makrydakis, 2000; Kollias and Paleologou, 2006).

The majority of empirical studies on the fiscal deficit sustainability and the revenue-expenditure nexus, have adopted time series tools and in particular the cointegration and Granger causality framework. However, all the employed methodologies are able to provide valid inference only under certain assumptions, regarding the integration properties of the studied variables. On the other hand, it is commonly acknowledged that the presence of significant structural breaks may distort the integration properties of the examined series, leading the conventional unit root tests to unreliable inference. This fact results in misspecified dynamic relationships and consequently spurious findings. Gregory and Hansen (1996), show that ignoring the presence of a structural break in the long-run relation, may lead a researcher to accept the null hypothesis of no cointegration between the examined variables even though a long-run relation actually exists. In this direction, only a limited number of research efforts have accounted for possible structural breaks (among them, Payne and Mohammadi, 2006; Baharumshah and Lau, 2007; Kia, 2008; Lusinyan and Thornton, 2009, for sustainability and, Ono 2008; Bajo-Rubio et al., 2010, for the revenue-expenditure nexus).

[1] The revenue-expenditure nexus comprises four hypotheses. Namely, tax-and-spend, spend-and-tax, fiscal synchronization and institutional separation hypothesis. For a detailed account of these see section 2.2.

Quite recently, possible asymmetric effects of taxes on spending and vice versa, have also become an important area of research on fiscal policy (Ewing et al., 2006; Payne et al., 2008; Gil-Alana, 2009; Saunoris and Payne, 2010; Young, 2011; Apergis et al., 2012; Paleologou, 2013). Ewing et al. (2006) suggest several possible reasons for the existence of asymmetries in the budgetary adjustment process. First, fiscal policy makers may respond differently to deficits than surpluses. Second, since the budget and the business cycle are closely connected, asymmetries in the business cycle may be transmitted to the budgetary adjustment process. Third, possible asymmetries may exist in the response of taxpayers to changes in the effective tax rate or the effective tax base. Finally, certain internal and external developments (i.e., asymmetric variations in the exchange rates and interest rates) may influence some elements of tax revenues (i.e., trade tax revenues). The existence of possible asymmetries in the budgetary adjustment process is examined for Greece and Spain in Bajo-Rubio et al. (2006 & 2010), Apergis et al. (2012) and Paleologou (2013), and evidence in favour of significant asymmetries is provided.

This article attempts to investigate the sustainability of the fiscal deficit as well as, the dynamic relationship between government revenues and expenditures and finally, to draw some policy lessons from the fiscal policy followed in three South-European countries under financial pressure and insolvency, namely, Italy, Greece and Spain. We examine two important and related issues; that is, fiscal sustainability and the revenue-expenditure nexus. We focus on the following questions: First, are the fiscal deficits of the examined countries sustainable? Second, do spending increases lead to revenue increases or *vice versa*? Third, are there any asymmetries in the budgetary adjustment process? In this direction, we contribute to the relevant discussion by applying several advanced time-series methodologies, aiming at a more clear insight and robust inference. More particular, we employ the conventional single-equation cointegration techniques of Engle-Granger (1987) and ARDL (Pesaran and Shin, 1999; Pesaran et al., 2001), as well as the Johansen's ML methodology (Johansen, 1988; Johansen and Juselius, 1990) that is based on a VAR framework. Additionally, to account for the distortion of reliable inference under the possible presence of structural breaks, the Gregory and Hansen (1996) cointegration methodology is applied. At the final step, in order to account for possible nonlinearities and apply the TAR and MTAR threshold cointegration methodologies (Enders and Granger, 1998; Enders and Siklos, 2001). If cointegration is confirmed, appropriate error correction specifications are used to test for short-run Granger causality along with the adjustment process of revenues and expenditures towards the long-run equilibrium.

The article is structured as follows: The second section presents the inter-temporal budget constraint framework for analyzing budget deficit sustainability and the revenue-expenditure nexus. The third section presents the data, methodology and empirical results; while the last section provides a summary and relative conclusions along with certain policy implications.

2. Budget deficit sustainability and the revenue-expenditure nexus

2.1 Budget deficit sustainability

The most common definition of sustainability is based on the concept of inter-temporal budget constraint (IBC), which states that the present value of debt, at the limit, tends to zero; accordingly, fiscal policy is sustainable if the IBC is expected to hold in present value terms. Let us suppose that the deficit is financed with government bonds, maturing in one year. This means that in every time period, the government faces the following budget constraint:

$$GG_t + (1+r_t)B_{t-1} = R_t + B_t \qquad (1)$$

where GG_t is the public spending not including debt servicing costs, r_t is the real interest rate per period, B_t is the stock of government debt and R_t is government revenues. This equation indicates that government's payment in terms of spending and the real interest rate are constrained by its receipts in the form of revenues and debt default. Equation (1) is then rewritten for subsequent and infinite periods, and solved to produce the present value budget constraint, expressed by Equation (2) below:

$$B_{t-1} = \sum_{s=1}^{\infty} \frac{1}{(1+r)^{s+1}} (R_{t+s} - E_{t+s}) + \lim_{s\to\infty} \frac{B_{t+s}}{(1+r)^{s+1}} \qquad (2)$$

where $E_t = G_t + (r_t - r)B_{t-1}$, and r_t is the real interest rate which is stationary with mean r. In order to achieve a sustainable fiscal policy, the intertemporal budget solvency requires that the Non-Ponzi Game (NPG) condition holds. This implies that the second term on the right-hand side of Equation (2) goes to zero at the limit:

$$\lim_{s\to\infty} \frac{B_{t+s}}{(1+r)^{s+1}} = 0 \qquad (3)$$

Equation (3) states that the present value of the stock of public debt tends to zero. In this case, the government must achieve future budget surpluses equal, in present-value terms, to the current value of the stock of public debt. Simply put, as long as the stock of public debt grows at a rate that is on average less than the growth rate of the economy (proxied by the real interest rate), the IBC would be satisfied, and the budget deficit would be sustainable.

According to Hakkio and Rush (1991), it is possible to assess fiscal policy sustainability through the cointegration framework. To do so, Equation (2), after imposing condition (3), can be rewritten as below:

$$G_t - R_t = \sum_{s=1}^{\infty} \frac{1}{(1+r)^s} (\Delta R_{t+s} - \Delta E_{t+s}) \qquad (4)$$

where $G_t = GG_t + r_t B_{t-1}$ is the public spending including interest payments on the debt and Δ denotes first differences. In Equation (4), the right-hand side variables are I(0), implying that the left-hand side must be stationary as well. In practice, if G_t and R_t are both I(1) and cointegrated, then the right-hand side of Equation (4) has to be also stationary. Accordingly, the procedure to assess fiscal sustainability simply requires the estimation of the following cointegration regression:

$$R_t = a_0 + \beta_1 G_t + u_t \qquad (5)$$

where a_0 and β_1 are the cointegrating parameters and u_t is the error term.

Following Quintos (1995), we can distinguish between three cases:

i) The deficit is "strongly" sustainable, if and only if the I(1) processes R_t and G_t are co-integrated and $\beta_1 = 1$. "Strong" sustainability means that the IBC holds and at the same time, the undiscounted debt process B_t is I(1).

ii) The deficit is "weakly" sustainable, if the I(1) processes R_t and G_t are co-integrated and $0 < \beta_1 < 1$. Hakkio and Rush (1991), demonstrate that $0 < \beta_1 < 1$ is a sufficient criterion for sustainability. However, as the government spends more than it receives in revenues, the risk to default increases and is forced to offer higher interest rates in order to service its debt. Therefore, this form of sustainability is incompatible with the government's ability to market its debt in the long-run.

iii) The deficit is unsustainable if $\beta_1 \leq 0$. B_t is magnified at a rate that is equal or higher than the growth rate of the economy, and the limiting term (Equation 3) is violated.

2.2 The revenue-expenditure nexus

Four alternative hypotheses can be found in the relevant literature regarding the revenue-expenditure nexus[2]; tax-and-spend, spend-and-tax, fiscal synchronization and institutional

[2] See Payne (2003) for a review of the empirical literature concerning the revenue-expenditure nexus.

separation. The tax-and-spend approach, set forth by Friedman (1978), argues that increases in state taxes will lead to increases in expenditures, such that budget deficit's reduction becomes unlikely. This tax-and-spend hypothesis is supported by the existence of unidirectional causality from revenues (i.e., taxes) to expenditures (i.e. spending). Consequently, imposition of higher taxes in order to restrict the size of the budget deficit would rather raise it instead (Friedman, 1978). On the other hand, the Buchanan and Wagner (1978), version of the tax-and-spend hypothesis argues that increasing tax revenues reduces government expenditures via fiscal illusion; that is, the public perceives the use of indirect (rather than direct) taxation to finance government spending as being cheaper, even though they are paying for this spending through inflation, crowding out of the private sector and higher interest rates. This latter version of the tax-and-spend hypothesis is supported by a negative unidirectional causality from taxes to spending.

The spend-and-tax hypothesis states that spending decisions are made first and the adjustments in tax revenues are following second (Roberts, 1978). As a fact, then, Peacock and Wiseman (1979) argue that during a crisis period, temporary increases in government spending will lead to a permanent tax increase. However, in the context of the Ricardian equivalence framework advanced by Barro (1979), expenditures are financed by higher future taxes and, the budget deficit reduction can be achieved only through reductions in expenditures. Whatever the case, the spend-and-tax hypothesis leads to the existence of a positive unidirectional causality from government spending to revenues.

Under the fiscal synchronization hypothesis decisions on revenues and expenditures are made simultaneously (Musgrave, 1966; Meltzer and Richard, 1981). This hypothesis implies the existence of a bi-directional causality between revenues and expenditures. Finally, the institutional separation approach suggests the absence of any causal relationship among the two variables, due to the institutional separation of allocation and taxation functions of the government (Wildavsky, 1988; Hoover and Sheffrin, 1992; Baghestani and McNown, 1994).

3. Data, methodology and empirical results

The data employed in the empirical analysis are annual, covering the period 1970-2010 for Italy, Greece and Spain and have been collected from OECD database. The examined variables are government revenues (R) and government expenditures (G) both scaled by GDP. Their evolution in the examined countries is presented in Figures 1 to 3, and from a simple visual inspection, it is evident that all three countries have experienced persistent

fiscal imbalances over the past decades. Since the 1970's Italian and Greek government expenditures constantly appear higher than revenues. The relevant gap, although shrunk around the year 2000 as a result of the efforts to qualify for the EMU, it further widened afterwards. Regarding Spain, the same pattern appears, temporarily interrupted with a surplus between 2005 and 2007.

[Figures 1 to 3 here]

It is common practice in the first step of the econometric analysis to test for the integration properties of the involved variables in order to avoid the known problem of "spurious regression". In this context, three types of unit root tests are complimentary used to examine the integration properties of government revenues (*R*) and government expenditures (*G*); namely, the PP test (Phillips-Perron, 1988), the DF-GLS test (Elliott et al., 1996) and the KPSS test (Kwiatkowski et al., 1992). The null hypothesis in PP and DF-GLS tests is the presence of a unit root while in KPSS is that of a trend stationary process. The results, reported in Table 1, suggest that all variables are nonstationary in levels while, they turn stationary in first differences and thus they can be described as integrated of order one, I(1).

[Table 1 here]

According to Engle and Granger (1987), two or more nonstationary series of the same order of integration, possibly, share a common trend, implying that between them there is a causal relationship with the causality running at least towards to one direction. Moreover, as stated earlier in section 2, evidence of cointegration is a prerequisite for budget deficit sustainability (Hakkio and Rush, 1991). So, in the next step of the analysis we proceed by testing for a possible long-run relationship between revenues and expenditures and infer regarding the sustainability of each one of the Italian, Greek and Spanish budget deficits. To this direction, and aiming at robustness, we employ four cointegration methodologies; the residual-based Engle-Granger (1987) test, the Johansen's trace test (Johansen, 1988; Johansen and Juselius, 1990), the ARDL bounds approach (Pesaran and Shin, 1999; Pesaran et al., 2001) and finally, the residual-based test with one structural break of Gregory and Hansen (1996). All the above tests are based on the null of no cointegration.

More particularly, we test for cointegration using the following general model:

$$R_t = \alpha_1 + \beta_1 G_t + e_t \qquad (6)$$

The results from the Engle-Granger and Johansen cointegration tests are presented in Table 2 and both suggest that the null hypothesis of no cointegration between *R* and *G* cannot be rejected.

[Table 2 here]

However, in both the aforementioned conventional cointegration tests, the evidence of cointegration is strictly based on the properties of the examined series, and, is considered of low power in small samples. Thus, we proceed by implementing the ARDL approach to cointegration (Pesaran and Shin, 1999; Pesaran et al., 2001) which is considered the most efficient cointegration technique in small samples (Romilly et al., 2001) as is ours with 41 annual observations. In the context of the ARDL cointegration method, we estimate Equation (7) below:

$$\Delta R_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i \Delta R_{t-i} + \sum_{i=0}^{q} \beta_i \Delta G_{t-i} + \theta_1 R_{t-1} + \theta_2 G_{t-1} + e_t \qquad (7)$$

As suggested by Pesaran et al. (1999) and Pesaran et al. (2001), in model (7), the null hypothesis of no cointegration can be tested by means of a modified *F*-test (denominated F_{PSS}) on the joint hypothesis that the coefficients of the lagged level variables are jointly equal to zero ($\theta_1 = \theta_2 = 0$). The test procedure involves the comparison of the F_{PSS} value with two critical bounds. If the empirical value of the F_{PSS} statistic exceeds the upper bound there is evidence of a long-run equilibrium relationship; if it lies below the lower critical bound the null cannot be rejected; if it lies between the critical bounds the test is inconclusive. Table 3 contains the empirical values of the F_{PSS} statistic which turned out to be 3.903, 1.661 and 3.711 for Italy, Greece and Spain, respectively. In all cases the F_{PSS} values are below the lower critical bound, suggesting that the null of no cointegration cannot be rejected.

[Table 3 here]

The above reported findings suggest that government revenues and expenditures, in all three countries, are not cointegrated. This further reveals that the budget deficits in all examined countries, are unsustainable. However, as Gregory and Hansen show (1996), ignoring the presence of a structural break in the long-run relation may lead to accept the null hypothesis of no cointegration even though a long-run relation may actually exist. To this direction, we proceed by applying the residual-based cointegration test of Gregory and Hansen (1996) with null hypothesis that of no cointegration against the alternative hypothesis of cointegration with one structural break. The time of the structural change is not known *a priori* and is determined by the data, endogenously. More particularly, Gregory and Hansen (1996) proposed three model specifications of the structural change: (i) level shift; (ii) level shift with trend and (iii) regime shift (both intercept and slope coefficients can change). In the context of our analysis the three models are:

$$R_t = a_1 + a_2 D_t + \beta_1 G_t + e_t \qquad (8)$$

$$R_t = a_1 + a_2 D_t + \beta_1 G_t + \beta_0 t + e_t \qquad (9)$$

$$R_t = a_1 + a_2 D_t + \beta_1 G_t + \beta_2 G_t D_t + e_t \qquad (10)$$

with $t = 1, ..., n$

where D_t^τ is a dummy variable defined as, $D_t^\tau = 0$ for $t \le \tau$ and $D_t^\tau = 1$ for $t > \tau$ and τ indicates the time of the structural break, a_1 is the intercept before the shift, a_2 is the change in intercept due to the shift, β_1 represents the cointegrating slope coefficient, β_2 represents the change in the slope coefficient, and t represents a time trend. To test for cointegration accounting for structural change, the stationarity of the residuals e_t is examined by means of the ADF statistic. The results are reported in Table 4.

[Table 4 here]

More particularly, models (8) and (9) that account for a level break and a level break and trend, indicate lack of cointegration for all countries except for Italy when accounting only for a level break. However, the full structural break model (10) confirms cointegration for all countries. The identified breaks are in 1990 for Italy, in 1995 for Greece and in 1988 for Spain.

In Table 5, we report the estimates of the cointegrating relationships for each country based on Equation (10). In all three countries, we note that the slope coefficients are statistically significant at a less than the 1% significance level, confirming the existence of a long-run equilibrium relationship between revenues and expenditures. The employed dummies for structural breaks are also all found statistically significant in all cases.

At a next step, we test the null $H_0 : \beta_1 = 1$ for the slope coefficient in Equation (10) and infer on the form of sustainability; that is weak or strong. The results presented in Table 5, indicate that the null hypothesis is rejected for all three countries, and therefore the strong condition for sustainability does not hold; the budget deficits in the three countries are weakly sustainable. The above finding is quite important and suggests that the three countries may run sustainable deficits but are likely to face future difficulties in financing their debts. More particularly, the estimates of the long-run coefficients (reported in Table 5, panel A) are 0.636 for Italy, 0.414 for Greece and 0.657 for Spain. We notice that the estimate for Greece is lower compared to those of Italy and Spain, revealing clearly the even worse fiscal discipline of Greece. This fact became clearly obvious right after the global crisis hit the weaker European countries with Greece among them.

Given the relatively small size of our data sample and aiming at the robustness of the obtained results, we further employ the Stock and Watson (1993) dynamic OLS (DOLS) method which is considered to outperform in small samples compared to other conventional cointegration techniques. The DOLS specification is given below:

$$R_t = \alpha_1 + \alpha_2 D_t + \alpha_3 G_t + \alpha_4 (D_t G_t) + \sum_{j=-k}^{k} \beta_j \Delta G_{t-j} + e_t \quad (11)$$

where, in terms of our investigation, coefficient α_2 is the indicator of fiscal sustainability. The estimates from DOLS (Table 5, panel B), further validate the findings from the Gregory and Hansen cointegration technique, producing very similar coefficients. On the basis of our results, when accounting for a structural break, we conclude that there is sufficient evidence of a cointegrating relationship between government revenues and spending, in all three countries.

[Table 5 here]

Our findings, supporting the weak notion of sustainability, are in line with Papadopoulos and Sidiropoulos (1999) and Katrakilidis and Tabakis (2006) for Greece, with De Castro and Hernandez de Cos (2002) and Bajo-Rubio (2010) for Spain, and with Legrenzi and Milas (2011) for Italy.

However, the implementation of an effective fiscal policy may require an even clearer insight on the fiscal dynamics, and in particular, to address the issue of possible asymmetric adjustment of the deficit's components in the long-run equilibrium. Obviously, this is an issue of major importance for fiscal consolidation. The choice between expansionary or restrictive fiscal policy depends on the speed of the response of the fiscal deficit components. In addition, according to Enders and Granger (1998), all unit roots and cointegration tests have low power in the presence of asymmetries. Having confirmed the existence of cointegration with a structural break for Italy, Greece and Spain, we proceed with further testing whether the adjustment process to the long-run equilibrium is in fact symmetric. We apply the methodology proposed by Enders and Granger (1998) and Enders and Siklos (2001) and in particular, we estimate two models which allow for testing of asymmetries and cointegration; the Threshold Autoregressive Model (TAR) and the Momentum Autoregressive Model (MTAR):

$$\Delta \hat{e}_t = I_t \rho_1 \hat{e}_{t-1} + (1 - I_t) \rho_2 \hat{e}_{t-1} + \sum_{i=1}^{n} \alpha_i \Delta \hat{e}_{t-1} + \tilde{v}_t \quad (12)$$

where, $\hat{e}_t$ are the residuals from the Equation (10), $\tilde{v}_t \sim I.I.D(0,\sigma^2)$ and the lagged values of $\Delta\hat{e}_t$ are meant to yield uncorrelated residuals. The Heaviside indicator functions associated with the TAR and MTAR models are given by (13) and (14).

$$I_t = \begin{cases} 1 \, if \; \hat{e}_{t-1} \geq \tau \\ 0 \, if \; \hat{e}_{t-1} < \tau \end{cases} \qquad (13)$$

$$I_t = \begin{cases} 1 \, if \; \Delta\hat{e}_{t-1} \geq \tau \\ 0 \, if \; \Delta\hat{e}_{t-1} < \tau \end{cases} \qquad (14)$$

where, τ is the threshold value and is endogenously determined using Chan's (1993) method[3]. In Equation (12), asymmetric adjustment is implied by different values of ρ_1 and ρ_2.

The TAR specification allows the speed of adjustment to depend on the level of the previous period's (e_{t-1}) budgetary disequilibrium and provides some useful insights on the varying effects of budgetary disequilibrium conditions (surpluses or deficits) on the behaviour of revenues and expenditures. On the other hand, the MTAR model allows the adjustment to depend on the previous period's change in budgetary disequilibrium (Δe_{t-1}) and is particularly useful when the adjustment exhibits more momentum in one direction than the other; revenues and expenditures respond differently to whether or not the surplus/deficit improves of deteriorates.

Both TAR and MTAR specifications are examined by testing the null hypothesis of no cointegration $\rho_1 = \rho_2 = 0$ and the null hypothesis of a symmetric adjustment $\rho_1 = \rho_2$ in Equation (12) and using *F*-tests[4]. The results, presented in Table 6, suggest that the null hypothesis of no cointegration is rejected in all cases at a less than the 1% significance level. In addition, the null hypothesis of symmetry is rejected at the 10% significance level using the MTAR specifications for Italy and Spain, but not for Greece, at any level of significance. Furthermore, and given that $|\rho_1| \neq |\rho_2|$ in the MTAR models of Italy and Spain, our findings support evidence of asymmetry revealing that the speed of adjustment is different when the budget is improving, than when the budget is deteriorating. Summing up, the results from the TAR and MTAR specifications support cointegration and also, provide evidence of

[3] Chan's (1993) method arranges the values of $\hat{e}_t$ and $\Delta\hat{e}_t$, for the TAR and MTAR model respectively, in ascending order and discards the smallest and largest 15%. The parameter which yields the smallest residual sum of squares over the remaining sample is the consistent estimate of the threshold.

[4] The *F*-statistics for the null hypothesis of no cointegration ($\rho_1 = \rho_2 = 0$) have a nonstandard distribution and Enders and Siklos (2001) have tabulated the appropriate critical values for both specifications.

asymmetric adjustment to equilibrium for the cases of Italy and Spain, though not in the Greek case.

[Table 6 here]

At the final stage of our analysis and based on the results for symmetric long-run adjustments, we continue by estimating appropriately specified vector error correction models (symmetric for Greece and asymmetric for Italy and Spain). By means of these models, we examine the causal relationship between government revenues and expenditures, in both the long-run and the short-run. The corresponding symmetric and asymmetric bivariate vector error correction models are presented in Equations (15), (16) for Greece and (17), (18) for Italy and Spain, respectively.

$$\Delta R_t = \alpha_0 + \sum_{i=1}^{2} \alpha_i \Delta R_{t-i} + \sum_{i=1}^{2} \beta_i \Delta G_{t-i} + \delta \hat{e}_{t-1} + u_{1,t} \qquad (15)$$

$$\Delta G_t = \tilde{\alpha}_0 + \sum_{i=1}^{2} \tilde{\alpha}_i \Delta R_{t-i} + \sum_{i=1}^{2} \tilde{\beta}_i \Delta G_{t-i} + \tilde{\delta} \hat{e}_{t-1} + u_{2,t} \qquad (16)$$

$$\Delta R_t = \alpha_0 + \sum_{i=1}^{2} \alpha_i \Delta R_{t-i} + \sum_{i=1}^{2} \beta_i \Delta G_{t-i} + I_t \delta_1 \hat{e}_{t-1} + (1 - I_t) \delta_2 \hat{e}_{t-1} + u_{1,t} \qquad (17)$$

$$\Delta G_t = \tilde{\alpha}_0 + \sum_{i=1}^{2} \tilde{\alpha}_i \Delta R_{t-i} + \sum_{i=1}^{2} \tilde{\beta}_i \Delta G_{t-i} + I_t \tilde{\delta}_1 \hat{e}_{t-1} + (1 - I_t) \tilde{\delta}_2 \hat{e}_{t-1} + u_{2,t} \qquad (18)$$

where $\hat{e}_{t-1}$ are the residuals from Equation (10).

The results obtained for the symmetric VECM for Greece are reported in Table 7. Particularly, the error correction term is found negative and statistically significant at the 5% level, indicating that Greek government expenditures have a statistically significant long-run effect on Greek government revenues. Moreover, no short-run causality is detected running from expenditures to revenues or *vice versa*. Therefore, the spend-and-tax hypothesis seems to be the case for Greece.

[Table 7 here]

For Italy and Spain, the results from the asymmetric VECM (Table 8) indicate statistically significant long-run effect from government expenditures to government revenues, supporting the spend-and-tax hypothesis. Both error correction terms are found negative and statistically significant at the 1% level. In both countries, the response of government revenues when the budget is improving (δ_1) is larger (in absolute terms) than when the budget is deteriorating (δ_2). Further, regarding Italy, no short-run causality is

detected running in either direction, while in Spain short-run causality runs only from revenues to expenditures, at the 1% significance level.

[Table 8 here]

The above results indicate that the spend-and-tax hypothesis is the case for all the examined countries, suggesting that spending decisions are made first while the adjustment in tax revenues follows. For Italy, our results are in line with those reported by Bella and Quinteri (1995) and Koren and Stiassny (1998), while for Greece, our findings are in line with Joulfaian and Mookerjee (1991); Provopoulos and Zambaras (1991); Kollias and Makrydakis (1995); Hondroyiannis and Papapetrou (1996), Vamvoukas (1997) and Paleologou (2013).

4. Concluding remarks and policy implications

This article attempted to re-evaluate empirically the issue of fiscal sustainability as well as the government spending and revenues nexus for three South-European economies under financial market pressure and insolvency; Italy, Greece and Spain. The empirical analysis used annual data from 1970 to 2010 and deployed various cointegration techniques to account for possible linear and nonlinear effects in fiscal policy actions.

In the linear testing framework, the conventional single-equation cointegration techniques of Engle-Granger (1987) and ARDL (Pesaran and Shin, 1999; Pesaran et al., 2001) as well as the Johansen's ML approach (Johansen, 1988; Johansen and Juselius, 1990), suggested lack of cointegration, and therefore that the budget deficits under investigation are unsustainable. However, the results obtained from the application of the Gregory and Hansen (1996) cointegration methodology that accounts endogenously for possible level and slope regimes, revealed the existence of a long-run relationship between government revenues and expenditures in all examined countries, with the identified level and slope break dates; 1990 for Italy, 1995 for Greece and 1988 for Spain. Accounting for these structural breaks, the findings from the estimated cointegrating relationships suggested that the sustainability of the fiscal deficits in the examined countries holds only in the weak sense. However, the small slope coefficient in the Greek case raises some serious doubts. This is quite important, since it suggests that these countries may run sustainable deficits but are very likely to face difficulties in financing their debts in the future. This became obvious as soon as the global crisis hit the European countries and Greece most seriously in particular.

Next, we proceed by applying the TAR and MTAR methodologies (Enders and Granger, 1998; Enders and Siklos, 2001) in order to identify possible asymmetries in the

adjustment processes towards budgetary equilibrium. The results, once again, confirmed the existence of cointegration, but revealed asymmetric adjustment processes of the budget deficit to equilibrium in Italy and Spain though not for Greece. In the final stage of the empirical analysis, the evidence from the symmetric and asymmetric error correction models indicated that, in the long-run, expenditures is the driving force, giving support to the spend-and-tax hypothesis, for all three countries**.** On the other hand, short-run causality has been detected only in Spain, directed from revenues to expenditures.

Summing up, our findings provide policy lessons to confront and possibly to control the excessive fiscal imbalances in Italy, Greece, and Spain; thus supporting the efforts towards solvency and exit from the severe current crisis. Fiscal discipline probably requires a rather mixed policy approach that consists of both fiscal and monetary policy measures. Nevertheless, several important issues seem to arise. Firstly, all countries were deprived of monetization when joining EMU and this fact might have played a major role in their budget sustainability; i.e. the monetary financing of deficits (Escario et al., 2012). Also, the existence of a European monetary union not accompanied by a fiscal one means that, the correction of shocks is assigned to the fiscal instruments only, and thus greater pressure is imposed on fiscal policy. Secondly, one can no longer ignore the great structural differences between the countries forming the EMU, and especially those between the northern and southern countries. Perhaps, a European currency mechanism should be implemented to equalize the differences in costs stemming from the different levels of capital and skilled labour among the European countries (Noren, 2011). Third, the current economic crisis in the euro area not only exposed fundamental problems and non-sustainable trends in many EU countries, but also made more obvious just how interdependent the EU's economies are. Recent experience demonstrated that fiscal policies are paradoxically more closely tied together than before via the long-term budget constraints and bailouts are not an implausible scenario anymore. Hence, greater economic policy coordination across EU, accompanied by a fiscal union, will be helpful to address all the above issues. A consolidation effort for financial stability in these countries may therefore require the reassessment of the relevant institutional framework, however in the context of a European macroprudential policy, with clear and binding agreements that make deviations from the agreements less attractive (Ferre, 2008).

Also, in contrast to the Stability and Growth Pact and its reliance on deficit targets, the introduction of new mechanisms focusing upon the expenditure side might help to achieve fiscal discipline without affecting growth negatively (Brück and Zwiener, 2006; Hauptmeier et al., 2011). Accordingly, policy instruments should address the fiscal problems

“at the source”, i.e., to the adjustment of those items of the government budget that produced the build-up of non-sustainable public finances in the first place namely, government spending. Therefore, possible suggestions regarding the improvement of fiscal imbalances may involve foremost tax reforms and decreases in government spending. In this context, only recently, the commitment to achieve a sustainable level of debt has been included in the EU primary policy objectives through a new stricter version of the Stability and Growth Pact; the Fiscal Stability Treaty (March, 2012). With this new treaty the European Commission makes sure that when a country is in crisis, the blame will fall automatically on government spending. Besides, a lasting consolidation requires the correction of the institutional weaknesses that are also major causes of the non-sustainable fiscal path.

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TABLES

Table 1: Unit root and stationarity tests

Country	Variable	PP		DF-GLS		KPSS	
		C	C/T	C	C/T	C	C/T
Italy	R_t	-1.311	-1.083	0.005 (0)	-1.183 (0)	1.331***	0.288***
	ΔR_t	-5.684***	-5.747***	-5.776*** (0)	-5.917*** (0)	0.210	0.088
	G_t	-2.377	-1.576	-0.631 (0)	-1.152 (0)	0.880***	0.332***
	ΔG_t	-5.825***	-6.074***	-5.261*** (0)	-6.089*** (0)	0.453*	0.102
Greece	R_t	-0.469	-2.216	0.234 (0)	-1.867 (0)	1.355***	0.131*
	ΔR_t	-5.723***	-5.641***	-5.724*** (0)	-5.630*** (0)	0.098	0.093
	G_t	-0.926	-2.562	0.259 (0)	-2.792 (0)	1.401***	0.262***
	ΔG_t	-7.988***	-7.992***	-7.552*** (0)	-7.409*** (0)	0.091	0.054
Spain	R_t	-2.076	-0.096	-0.816 (1)	-1.152 (1)	1.106***	0.339***
	ΔR_t	-4.685***	-5.463***	-4.803*** (0)	-5.240*** (0)	0.483*	0.068
	G_t	-1.795	-1.524	-0.574 (1)	-1.381 (1)	0.898***	0.312***
	ΔG_t	-4.172***	-4.199***	-3.987*** (0)	-4.266*** (0)	0.256	0.111

Notes: PP: Phillips-Perron test. DF-GLS: Elliot-Rothenberg-Stock modified Dickey-Fuller test. KPSS: Kwiatkowski-Phillips-Schmidt-Shin test. The optimal lag structure of the DF-GLS test is chosen based on the Akaike Information Criterion and are displayed in parentheses. The respective 1% then 5% and 10% critical values for the PP and the DF-GLS tests are -3.58, -2.93, -2.60 and -4.15, -3.50, -3.18 for models C and C/T respectively. The respective 1% then 5% and 10% critical values for the KPSS test are 0.739, 0.463, 0.347 and 0.216, 0.146, 0.119 for models C and C/T respectively. *** and * denote significance at the 1 and 10% levels, respectively.

Table 2: Engle-Granger and Johansen trace tests for cointegration

Country	Engle-Granger cointegration test	Johansen's trace test
Italy	-1.265	14.58
Greece	-1.974	5.70
Spain	-1.865	9.83

Notes: Lag lengths concerning the Johansen trace tests were determined to be one lag based on the Akaike information criterion. The respective 1%, 5% and 10% critical values for the E-G test for cointegration are -4.12, -3.46, -3.13. The respective 5% and 10% critical values for the Johansen trace test are 17.86 and 15.75.

Table 3: Bounds testing for cointegration

Country	ARDL Model Specification	F_{PSS}	95% Lower Bound	95% Upper Bound	90% Lower Bound	90% Upper Bound
Italy	(1, 0)	3.903				
Greece	(1, 0)	1.661	5.243	6.005	4.241	4.906
Spain	(2, 0)	3.711				

Notes: The ARDL specifications were selected based on the Akaike Information Criterion. The maximum lag was set to 2. The critical value bounds are computed by stochastic simulations using 20000 replications. The ARDL estimations and tests were conducted using Microfit 5.0 (Pesaran and Pesaran, 2009).

Table 4: Gregory and Hansen cointegration tests

Country	Level break, no trend (C)		Level break, trend (C/T)		Full structural break, no Trend (C/S)	
	$t_{\hat{a}}$	T_b	$t_{\hat{a}}$	T_b	$t_{\hat{a}}$	T_b
Italy	-4.900**	1995	-4.224	1993	-5.192**	1990
Greece	-4.447	1995	-4.062	1995	-4.953**	1995
Spain	-4.333	1988	-4.383	1984	-4.960**	1988

Notes: $t_{\hat{a}}$ denotes the minimum ADF test statistic for a unit root and T_b denotes the time of break. The optimal lag length is determined by the Akaike Information Criterion. The critical values were obtained from Gregory and Hansen (1996, p. 109). ** denotes significance at the 5% level.

Table 5: Cointegrating equations

Panel A: OLS estimation

Equation (10): $R_t = a_1 + a_2 D_t + \beta_1 G_t + \beta_2 G_t D_t + e_t$

Country	a_1	a_2	β_1	β_2	T_b	Sustainability Hypothesis ($H_0 : \beta_1 = 1$)
Italy	6.689*** (4.466)	39.492*** (7.171)	0.636*** (19.533)	-0.653*** (-5.915)	1990	$F(1,37)$ = 124.064*** [0.000]
Greece	13.042*** (6.359)	22.257*** (3.084)	0.414*** (5.452)	-0.318** (-2.314)	1995	$F(1,37)$ = 59.363*** [0.000]
Spain	8.521*** (11.753)	28.890*** (2.973)	0.657*** (24.110)	-0.627*** (-2.651)	1988	$F(1,37)$ = 158.236*** [0.000]

Panel B: Stock-Watson Dynamic OLS estimation

Equation (11): $R_t = \alpha_1 + \alpha_2 D_t + \alpha_3 G_t + \alpha_4 (D_t G_t) + \sum_{j=-k}^{k} \beta_j \Delta G_{t-j} + e_t$

Country	(Lags, Leads)	a_1	a_2	a_3	a_4	T_b	Sustainability Hypothesis ($H_0 : \alpha_3 = 1$)
Italy	(0, 0)	5.444*** (3.351)	39.887*** (8.060)	0.666*** (17.906)	-0.666*** (-6.569)	1990	$F(1,35)$ = 80.138*** [0.000]
Greece	(0, 0)	12.790*** (6.666)	20.751*** (2.810)	0.425*** (5.958)	-0.289** (-2.029)	1995	$F(1,35)$ = 64.813*** [0.000]
Spain	(0, 2)	7.654*** (8.112)	19.974*** (8.899)	0.674*** (20.438)	-0.402*** (-9.475)	1988	$F(1,31)$ = 96.997*** [0.000]

Notes: T_b denotes the time of break. The Newey-West heteroscedasticity and autocorrelation consistent SEs are used. The optimal lag and lead length is determined by the Akaike Information Criterion. t-statistics and p-values are displayed in parentheses and brackets, respectively. *** and ** denote significance at the 1 and 5%, levels, respectively.

Table 6: Tests for cointegration and symmetry between government revenues and expenditures

Country	Model	ρ_1	ρ_2	τ	Fc($\rho_1 = \rho_2 = 0$)	Fs($\rho_1 = \rho_2$)	k
Italy	TAR	-1.064***	-0.631***	1.067	14.762***	1.924	0
		(-4.232)	(-3.407)				
	MTAR	-1.270***	-0.638***	0.470	15.878***	3.432*	0
		(-4.389)	(-3.533)				
Greece	TAR	-0.907***	-0.604***	-0.207	12.714***	0.935	0
		(-4.321)	(-2.599)				
	MTAR	-0.934***	-0.517**	-0.666	12.935***	1.688	0
		(-4.648)	(-2.064)				
Spain	TAR	-0.862***	-0.592***	1.911	13.009***	1.251	1
		(-4.675)	(-2.977)				
	MTAR	-0.371	-0.836***	0.755	14.581***	3.139*	1
		(-1.466)	(-5.398)				

Notes: ρ_1 and ρ_2 are parameters of the asymmetric adjustment to equilibrium (Equation 12). τ represents threshold value. Fc($\rho_1 = \rho_2 = 0$) denotes the null hypothesis of no cointegration and the critical values used were obtained from Enders and Siklos (2001, p. 172). Fs($\rho_1 = \rho_2$) denotes the null hypothesis of symmetry. k is the number of lags in the TAR and MTAR specifications. t-statistics are reported in parentheses. *** , ** and * denote significance at the 1, 5 and 10%, levels, respectively.

Table 7: Symmetric Error Correction Models and Granger causality tests for Greece

Equation (15): $\Delta R_t = \alpha_0 + \sum_{i=1}^{2} \alpha_i \Delta R_{t-i} + \sum_{i=1}^{2} \beta_i \Delta G_{t-i} + \delta \hat{e}_{t-1} + u_{1,t}$

α_0	α_1	α_2	β_1	β_2	δ	$H_0 : \beta_1 = \beta_2 = 0$
0.370	0.267**	0.124	-0.082	-0.015	-0.434**	$F(2,31) = 0.222$
(1.429)	(1.969)	(1.047)	(-0.647)	(-0.148)	(-2.427)	[0.801]

Equation (16): $\Delta G_t = \tilde{\alpha}_0 + \sum_{i=1}^{2} \tilde{\alpha}_i \Delta R_{t-i} + \sum_{i=1}^{2} \tilde{\beta}_i \Delta G_{t-i} + \tilde{\delta} \hat{e}_{t-1} + u_{2,t}$

$\tilde{\alpha}_0$	$\tilde{\alpha}_1$	$\tilde{\alpha}_2$	$\tilde{\beta}_1$	$\tilde{\beta}_2$	$\tilde{\delta}$	$H_0 : \tilde{\alpha}_1 = \tilde{\alpha}_2 = 0$
1.147***	-0.048	0.236	-0.336**	-0.321*	-0.051	$F(2,31) = 0.873$
(3.514)	(-0.185)	(1.268)	(-2.363)	(-2.027)	(-0.268)	[0.427]

Notes: The VECM model includes two lags of each variable. The Newey-West heteroscedasticity and autocorrelation consistent SEs are used. t-statistics and p-values are displayed in parentheses and brackets, respectively. *** and ** denote significance at the 1 and 5%, levels, respectively.

Table 8: Asymmetric Error Correction Models and Granger causality tests for Italy and Spain

Equation (17): $\Delta R_t = \alpha_0 + \sum_{i=1}^{2} \alpha_i \Delta R_{t-i} + \sum_{i=1}^{2} \beta_i \Delta G_{t-i} + I_t \delta_1 \hat{e}_{t-1} + (1 - I_t)\delta_2 \hat{e}_{t-1} + u_{1,t}$

Country	α_0	α_1	α_2	β_1	β_2	δ_1	δ_2	$H_0 : \beta_1 = \beta_2 = 0$
Italy	0.245	0.235*	0.096	0.016	-0.030	-0.897***	-0.486***	$F(2,31)$ = 0.073
	(1.565)	(2.001)	(0.588)	(0.174)	(-0.319)	(-3.931)	(-2.932)	[0.929]
Spain	0.307**	0.417*	0.165	0.023	-0.075	-0.796***	-0.375*	$F(2,31)$ = 0.177
	(2.049)	(1.900)	(0.950)	(0.215)	(-0.595)	(-2.770)	(-1.845)	[0.838]

Equation (18): $\Delta G_t = \tilde{\alpha}_0 + \sum_{i=1}^{2} \tilde{\alpha}_i \Delta R_{t-i} + \sum_{i=1}^{2} \tilde{\beta}_i \Delta G_{t-i} + I_t \tilde{\delta}_1 \hat{e}_{t-1} + (1 - I_t)\tilde{\delta}_2 \hat{e}_{t-1} + u_{2,t}$

Country	$\tilde{\alpha}_0$	$\tilde{\alpha}_1$	$\tilde{\alpha}_2$	$\tilde{\beta}_1$	$\tilde{\beta}_2$	$\tilde{\delta}_1$	$\tilde{\delta}_2$	$H_0 : \tilde{\alpha}_1 = \tilde{\alpha}_2 = 0$
Italy	0.290	0.243	0.060	-0.046	-0.092	-0.438	-0.080	$F(2,31)$ = 0.919
	(0.883)	(1.355)	(0.251)	(-0.264)	(-0.585)	(-1.651)	(-0.236)	[0.409]
Spain	0.506**	-0.255	0.550***	0.642***	-0.311**	-0.581	0.606**	$F(2,31)$ = 9.174***
	(2.445)	(-0.788)	(4.283)	(3.956)	(-2.136)	(-1.018)	(2.299)	[0.000]

Notes: The asymmetric VECM models include two lags of each variable. The Newey-West heteroscedasticity and autocorrelation consistent SEs are used. t-statistics and p-values are displayed in parentheses and brackets, respectively. *** , ** and * denote significance at the 1, 5 and 10%, levels, respectively.

FIGURES

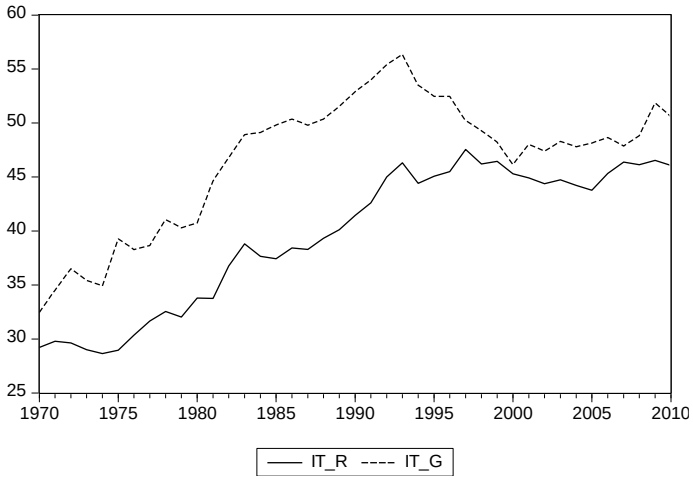

Fig. 1. The evolution of Italy's government revenues and expenditures as percentages of GDP (1970-2010).

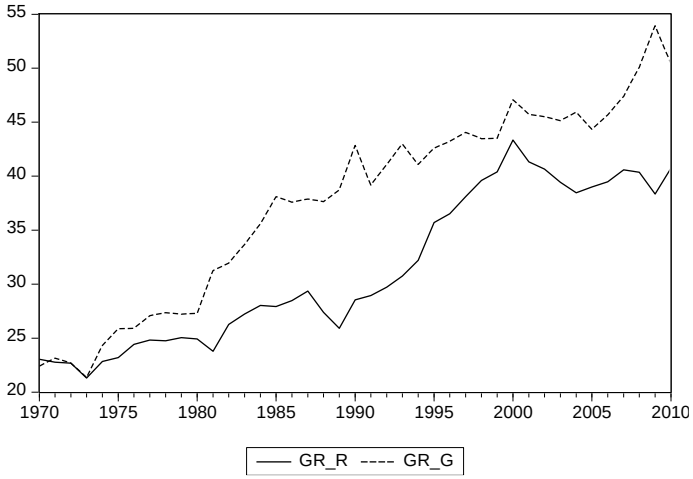

Fig. 2. The evolution of Greece's government revenues and expenditures as percentages of GDP (1970-2010).

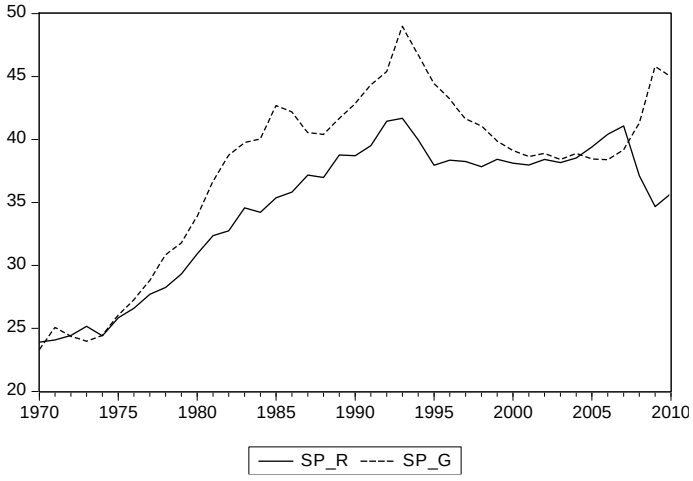

Fig. 3. The evolution of Spain's government revenues and expenditures as percentages of GDP (1970-2010).