The dynamic linkages of fiscal and current account deficits: New evidence from five highly indebted European countries accounting for regime shifts and asymmetries

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Abstract

This article provides new empirical evidence on the long-term relationship between the fiscal and current account imbalances, of five European economies under financial market pressure and insolvency; Portugal, Ireland, Italy, Greece and Spain. We attempt to re-evaluate the dynamic linkages between the twin-deficits allowing for the presence of structural breaks and asymmetries. The evidence is in favour of the "twin deficits hypothesis". More insight is further provided through the magnitude and significance of the asymmetric linkages between the twin deficits in the long-run time horizon. Our findings indicate that fiscal deficit decreases have a greater impact on the current account deficit rather than the opposite.

Keywords: Fiscal Deficit, Current Account Deficit, Twin Deficits, Structural Breaks, Asymmetric Cointegration.

JEL Classification: C22, E62, F32, H62

1. Introduction

Quite recently, several economies worldwide along with certain European ones, have experienced a remarkable deterioration in their fiscal and current account imbalances. This fact, along with the current global crisis, has contributed much into rekindling the issue of possible causal linkages between the fiscal and current account deficits; widely known as "the twin deficits hypothesis". Excessive deficits may result in insolvency, reflecting inability of the government to stabilize its public debt ratio and to repay its debts which is, to some degree, the case for several European economies. The latter being characterized as heavily indebted are Portugal, Ireland, Italy, Greece and Spain.

According to the "twin deficits hypothesis", an increase (decrease) in the fiscal deficit causes an increase (decrease) respectively in the current account deficit. Such a relation could be shortly explained through the following mechanism: an increase in the fiscal deficit of an economy leads to an increase in the aggregate demand and the domestic interest rates. Conditional on the degree of openness, higher interest rates raise the economy's exchange rate, leading to more expensive exports and cheaper imports, ending up with deterioration in the current account deficit.

The aforementioned issue has been a subject of controversy among economists through the last decades. Nevertheless, no consensus exists until today as to whether the fiscal deficit causes the current account deficit or vice versa. Darrat (1988), Abell (1990), Bahmani-Oskooee (1992, 1995), Normandin (1999), Vamvoukas (1999), Salvatore (2006) and many other economists argue in favour of the Keynesian rationale, that the two deficits are closely linked and that the fiscal deficit causally affects the current account deficit. Another view, known as "the Ricardian Equivalence", supports that the two deficits are not causally connected (Miller and Russek, 1989; Enders and Lee, 1990; Kim, 1995). Furthermore, Kim and Roubini (2008) suggest that a "twin divergence" seems to be more probable than a "twin deficit", when the endogenous movements of the fiscal and the current account deficit are taken into consideration.

In an interesting paper, Bagnai (2006) stated that the most recent empirical analyses on the linkages between the two deficits agree broadly on the following; firstly, the majority of macroeconomic models support that there is a causal relationship directed from the fiscal to the current account deficit; secondly, the relationship between the two deficits may differ in the short- and in the long-run time horizon depending upon the long-run properties of the deficit series involved (Normandin, 1999; Kraay and Ventura, 2002); and thirdly, the long-run relationship appears rather weak and/or is affected by the presence of structural breaks.

The importance of structural breaks has been recognized by many studies, though only few of them have seriously considered the issue of structural breaks through formal tests (Hatemi and Shukur, 2002; Bagnai, 2006; Grier and Ye, 2009; Holmes, 2011). As Gregory and Hansen (1996a, b) show, ignoring the presence of a structural break in the long-run relation might result in the acceptance of the null hypothesis of no cointegration between the examined variables, even though a long-run relation may actually exist.

In addition, the majority of the research efforts to model the “twin deficits hypothesis” have been conducted in a linear framework. Interestingly, many macroeconomic variables incorporate nonlinear properties, especially in the area of business cycles (Neftci, 1984; Falk, 1986) and hence, since deficits are usually driven by economic activity they should also be expected to exhibit nonlinearities. This fact possibly implies that linear models might not be efficient to explore the relationship between fiscal and current account imbalances providing misleading evidence. More specifically, in the presence of asymmetries, the response of the current account deficit to positive shocks in the fiscal balance might differ from the response to negative shocks.

The aim of this article is to provide more insights on the dynamic linkages between the twin deficits by targeting upon five European countries that are faced with fiscal and current account insolvencies; Portugal, Ireland, Italy, Greece and Spain. We allow for possible sources of nonlinearities such as the presence of structural breaks in the long-run relationship between the fiscal and current account imbalances, as well as the potential asymmetric linkages between the two deficits towards the long-run equilibrium. To this direction, we employ the Gregory and Hansen (1996a, b) residual-based cointegration methodology, which accounts for one possible break, endogenously determined, and the asymmetric cointegration methodology suggested by Schorderet (2003). The asymmetric cointegration methodology employs the analysis of multivariate combinations between positive and negative components of the two deficits. To our knowledge, this approach enriches the relevant international empirical literature on the twin deficits, particularly for the examined group of countries.

The rest of the article is structured as follows: the second section presents the twin deficit debate accompanied by a brief review of the relevant empirical literature; the third section focuses upon the asymmetric cointegration methodology applied, while the fourth section reports the empirical findings. Finally, the fifth section provides a short summary and conclusions.

2. The Twin-Deficits debate and a brief review of the empirical literature

The causal link between fiscal deficit and current account deficit can be exemplified via looking at Equation (1), which relates the current account balance $(X - M + R)$ to the fiscal balance $(T - G)$ through the difference between private saving and investment, providing the framework to investigate the link between the two deficits.

$$(X - M + R) = (S - I) + (T - G) \qquad (1)$$

where: X stands for exports of goods and services, M stands for imports of goods and services, R for net transfers abroad, S for private saving, I for private investment, T for direct taxes on households and firms by the government and finally, G stands for government expenditure.

Following Equation (1), a rise in fiscal deficit, with $(S - I)$ remaining constant, affects the current account deficit positively. The mechanism is that fiscal deficits increase domestic interest rates, whereas higher interest rates attract foreign capital. In such a case, the domestic currency is appreciated, leading to an increase in the current account deficit. The resulting deterioration is strongly relevant to the economy's degree of openness.

Another view of the "twin-deficit hypothesis" grounds on the argument that in order for it to hold, saving and investment should not be linked, implying that increases in private saving may not be sufficient to offset the effects of increased fiscal deficits (Afonso and Rault, 2008).

In contrast, the well-known "Ricardian equivalence" argues that current higher fiscal deficits are perceived from consumers as postponed higher future taxes and therefore, when the government reduces taxes (or increases spending) *ceteris paribus*, consumers increase saving to ease the payment of the expected higher future taxes. In this case, both consumption and investment remain unaffected, and the current account balance remains stable (Barro, 1989).

Kim and Roubini (2008) on the other hand, stress the issue of endogenous movements of the fiscal and the current account deficit and suggest that a "twin divergence" is also probable; the current account deficit can improve when the fiscal deficit worsens. These findings are attributed to two factors; first, a partial Ricardian movement of private saving (private saving increases) and second, an investment crowding out effect (investment declines) caused by an increase in the real interest rate. Moreover, when the two balances are affected by an output and/or a productivity shock, "twin divergence" also seems to be more likely. A similar, though weaker, finding applies when they consider “exogenous” fiscal shocks.

The “twin deficits hypothesis” has long been a subject of extensive study in the field of empirical macroeconomics. The applied methodologies vary from Ordinary Least Squares (OLS) regressions to VAR estimations and cointegration analysis. Earlier studies usually applied OLS regressions to cross-country data (Bernheim, 1988) with their majority reporting a significant positive relationship between the two deficits. Some studies (Andersen, 1990) did not manage to confirm the existence of such a causal relationship. From the 90’s until now, many researchers applied VAR models to examine the potential relationship between the two deficits (Abell, 1990; Enders and Lee, 1990; Bachman, 1992; Rosenweig and Tallman, 1993; Normandin, 1999; Kim and Roubini, 2008). These studies have provided rather mixed results, though a great portion of them confirmed the “twin-deficits hypothesis” for several countries. However, the most widely used method to examine the twin-deficits relationship is that of cointegration analysis (Miller and Russek, 1989; Bachman, 1992; Dibooglou, 1997; Leechman and Francis, 2002). Surprisingly though, the evidence has not been entirely in favour of a positive relationship between the two deficits.

Over the last years several researchers have used even more advanced cointegration techniques, being able to account for possible structural breaks and thus to identify more accurately the existence of a long-run relationship between the two deficits (Bagnai, 2006; Grier and Ye, 2009). A step further, Holmes (2011) examined the relationship in question by means of the threshold cointegration approach, allowing for different regimes in the short-run dynamics. He concluded in favor of a positive causal long-run relationship.

Summing up, the literature on the “twin deficits hypothesis” has employed a wide range of different econometric techniques, reporting a variety of different findings. However, in the vast majority of this literature there is an apparent omission of two factors that might be crucial when examining the dynamic linkages between the two deficits; the presence of structural breaks, as well as that of asymmetries. This might be a serious reason for the mixed, in general, results on the twin-deficits relationship.

3. The asymmetric cointegration methodology

Granger and Yoon (2002) introduced the term “hidden cointegration” to identify the dynamics between data components. Two time series have hidden cointegration if their positive and negative components are cointegrated. They also showed that standard linear (symmetric) cointegration is a special case of hidden cointegration and in turn, hidden cointegration is simply a case of nonlinear cointegration. At a later paper, Schorderet (2003) proposed a bivariate asymmetric cointegrating regression to analyze hidden cointegration, where only one component of each series appears in the cointegrating relationship.

Following Schorderet (2003), we consider the decomposition of a time series X_t into positive and negative partial sums (X_t^+ and X_t^-):

$$X_t^+ = \sum_{i=0}^{t-1} 1\{\Delta X_{t-i} \geq 0\}\Delta X_{t-i} \tag{2}$$

and

$$X_t^- = \sum_{i=0}^{t-1} 1\{\Delta X_{t-i} < 0\}\Delta X_{t-i} \tag{3}$$

where $1\{\cdot\}$ is an indicator function taking the value 1 if the event in brackets occurs and zero otherwise, while Δ denotes first-differences.

Suppose now that we have two integrated time series X_{1t} and X_{2t} and we define X_{1t}^+, X_{1t}^-, X_{2t}^+ and X_{2t}^-, according to Equations (2) and (3); and, that there exists a linear combination z_t between X_{1t}^+, X_{1t}^-, and X_{2t}^+, X_{2t}^- such that:

$$z_t = \beta_1 X_{1t}^+ + \beta_2 X_{1t}^- + \beta_3 X_{2t}^+ + \beta_4 X_{2t}^- \tag{4}$$

If there exists a vector $\beta' = (\beta_1, \beta_2, \beta_3, \beta_4)$ with $\beta_1 \neq \beta_2$ or $\beta_3 \neq \beta_4$ (and also β_1 or $\beta_2 \neq 0$ and β_3 or $\beta_4 \neq 0$) such that z_t is a stationary process then, X_{1t} and X_{2t} are asymmetrically cointegrated. The underlying idea is that the relationship between several economic variables might not remain the same whenever they increase or decrease. Moreover, setting $\beta_1 = \beta_2$ in Equation (4), can be utilized to model the asymmetric response of X_{1t} to X_{2t} in the sense that X_{1t} reacts differently to positive or negative changes of X_{2t}. Setting also $\beta_3 = \beta_4$, in addition to setting $\beta_1 = \beta_2$, yields the classical cointegration relation examined by Engle and Granger (1987), as a specific case of no asymmetry.

Let us suppose now that only one component of each time series appears in the cointegrating relationship (4):

$$X_{1t}^+ = \beta^+ X_{2t}^+ + z_{1t} \tag{5}$$

or

$$X_{1t}^- = \beta^- X_{2t}^- + z_{2t} \tag{6}$$

which can be rearranged as[1]:

$$z_{1t} = X_{1t}^{+} - \beta^{+} X_{2t}^{+} \tag{7}$$

or

$$z_{2t} = X_{1t}^{-} - \beta^{-} X_{2t}^{-} \tag{8}$$

Schorderet (2003) suggested that due to the nonlinear properties of z_{1t} and z_{2t}, the OLS estimators of Equations (7) and (8), although consistent, are likely to be biased in finite samples. Consequently, he proposed to estimate by OLS the following alternative models:[2]

$$X_{1t}^{-} + \Delta X_{1t}^{+} = \beta^{-} X_{2t}^{-} + \varepsilon_{1t} \tag{9}$$

or

$$X_{1t}^{+} + \Delta X_{1t}^{-} = \beta^{+} X_{2t}^{+} + \varepsilon_{2t} \tag{10}$$

which can be rearranged as:

$$\varepsilon_{1t} = X_{1t}^{-} + \Delta X_{1t}^{+} - \beta^{-} X_{2t}^{-} \tag{11}$$

or

$$\varepsilon_{2t} = X_{1t}^{+} + \Delta X_{1t}^{-} - \beta^{+} X_{2t}^{+} \tag{12}$$

According to Schorderet (2003), since the regressor (X_{2t}^{+} or X_{2t}^{-}) has a linear time trend in mean, the OLS estimates of Equations (11) and (12) are asymptotically normal (West, 1988) and the usual statistical inference can be applied. Accordingly, by applying the traditional Engle and Granger procedure to Equations (11) and (12), we can test the null of no cointegration against the alternative of asymmetric cointegration.

4. Empirical results

The data employed in the empirical analysis were collected from the OECD database and are of annual frequency, covering the period 1971-2009 for Italy, 1975-2009 for Ireland, Greece and Spain, and 1977-2009 for Portugal. The variables examined are the government's primary deficit[3] (*BB*) and the current account balance (*CA*), both as percentages of GDP. Figs 1 to 5, present the evolution of the government primary balance and the current account balance, as percentages of GDP, for all five countries, over the examined periods.

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[1] See Granger and Yoon (2002).

[2] For a more detailed derivation of these alternative models, see Schorderet (2003).

[3] Although the government deficit is rather more broadly used in the respective literature, we use the primary budget balance considering that it proxies discretionary fiscal behaviour, avoiding potential simultaneity effects (Corsetti and Muller, 2006; Kim and Roubini, 2008; Bluedorn and Leigh, 2011; Theofilakou and Stournaras, 2012).

[Figures 1 to 5 here]

Prior to modelling the time series data, we determine the order of integration of the variables. Three tests are complementary used to examine the stationarity properties of the levels and first differences of the fiscal balance and the current account balance; the augmented Dickey-Fuller test (ADF) (1979), the Phillips-Perron test (PP) (1988) and the Kwiatkowski-Phillips-Schmidt-Shin test (KPSS) (1992). The null hypothesis under the ADF and PP tests is the presence of a unit root while under the KPSS test is a trend stationary process. The reported results in Table 1, panel A, suggest that all series are non-stationary when tested in level form. When they are considered in first-difference form (panel B), all of them are found stationary and, hence, they can be described as integrated of order one, I(1).

[Table 1 here]

Since the conventional tests are of low power, and the presence of significant structural changes may bias the results in favor of the null hypothesis of a unit root, we additionally apply unit root tests that allow for one break in the series, namely the Lee and Strazicich LM test (2004). This procedure allows for an unknown structural break under both the null and the alternative hypothesis. The test is applied under model specification A, which allows for a change in the level of the series. The results, presented in Table 2, suggest that all the examined variables are I(1). Having confirmed the robustness of our inference on the stationarity properties of the examined series, through the use of both conventional and LM unit root tests with breaks, we can proceed with testing for possible cointegration.

[Table 2 here]

Actually, we proceed by applying standard linear cointegration tests between the two deficit series, using model (13) presented below. We employ the ADF test, the PP test, and the Johansen's trace test (Johansen, 1988; Johansen and Juselius, 1990), all of which are based on the null of no cointegration. ADF and PP critical values for cointegration tests are given in MacKinnon (1991). For the Johansen's trace test, the critical values are reported in Johansen and Juselius (1990). Regarding the ADF test, the chosen optimal lag structure is based on the Akaike Information Criterion (AIC) while for the PP test the Newey-West (1994) data-based automatic bandwidth parameter method is used. More particularly, we test for cointegration using the following Equation:

$$CA_t = \alpha + \beta BB_t + \varepsilon_t \qquad (13)$$

According to the results, reported in Table 3, both the ADF and the PP tests accept the null of a unit root and support lack of cointegration (although, the case of Italy being very close to the 10% could be characterized marginal) while the Johansen's trace test detects evidence of cointegration only for Spain. The overall evidence is rather not clear and could be attributed to the fact that the usual concept of cointegration is probably too restrictive. Thus, there is a need for further investigation, accounting for the possibility of significant structural breaks in the examined cointegrating relationships.

[Table 3 here]

To this direction, we proceed by applying the residual based Gregory and Hansen cointegration test (1996a, b) which assumes the null hypothesis 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. Gregory and Hansen (1996a, b) proposed four model specifications of structural change: (i) level shift; (ii) level shift with trend; (iii) regime shift (both level shift and slope coefficients can change) and (iv) full structural break (a trend shift as well as a regime shift).

In this paper we employ models (i), (ii) and (iv). More specifically, the tested models are presented below:

$$CA_t = a_1 + a_2 D_t + \beta_1 BB_t + \varepsilon_t \tag{14}$$

$$CA_t = a_1 + a_2 D_t + \beta_1 BB_t + \beta_0 t + \varepsilon_t \tag{15}$$

$$CA_t = a_1 + a_2 D_t + \beta_1 BB_t + \beta_2 BB_t D_t + \beta_0 t + \beta_3 t D_t + \varepsilon_t \tag{16}$$

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

where D_t^τ is a dummy variable defined as, $D_t^\tau = 0$ for $t < \tau$ and $D_t^\tau = 1$ for $t \geq \tau$ 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, t represents a time trend and β_3 represents the change in trend after the break.

In general, comparing the evidence from the simple linear models reported in the previous section with those that account for structural breaks, it is obvious that by ignoring the possible presence of a significant structural break we may obtain spurious evidence regarding the existence of cointegration between the examined series, for the majority of the countries under investigation. More particularly, the testing models that account for a level break and for a level break and trend provide similar evidence for all countries. Actually, they reveal cointegration for Portugal, Greece and Spain, though there is complete lack of cointegration in the cases of Ireland and Italy. Furthermore, when accounting for a regime shift, the full structural break model with trend confirms cointegration in the cases of Portugal, Ireland and Greece but not for the cases of Italy and Spain.

[Table 4 here]

Regarding the expected structural changes we should note that in the relevant literature, several studies identified either exogenously or endogenously break dates that coincide with the 1992 Maastricht treaty, as well as the adoption of the new Euro currency (Holmes et al., 2010; Brissimis et al., 2012). The Maastricht treaty imposed a restrictive fiscal stance, by forcing governments to run a budget deficit of no more than 3% of GDP as a precondition to enter EMU.

In our analysis, the majority of the break dates are detected in the mid-1990s, a time interval between the two aforementioned institutional changes. Furthermore, Greece reports breaks in 1985 and 1987, which could be attributed to a devaluation of the national currency in 1985 and the stabilization program implemented by the Greek socialist government for the period 1985-1987 (Manessiotis and Reischauer, 2001) and finally, only Spain features a break date that post-dates the adoption of the Euro, indicating that the new currency may have caused significant impacts on the country's "twin deficit" relationship, with a time lag.

Although the findings obtained from the Gregory and Hansen tests are in general very informative, we further proceed with the investigation, by allowing for possible asymmetries in the examined relationship. To test so, we apply asymmetric cointegration tests (Schorderet, 2003) focusing on the detection of long-run linkages between only the positive or the negative components of the examined series. On this direction, we estimated the following two models, in accordance with Equations (9) and (10):

$$CA_t^+ + \Delta CA_t^- = \alpha^+ + \beta^+ BB_t^+ + \varepsilon_{1t} \quad (17)$$

$$CA_t^- + \Delta CA_t^+ = \alpha^- + \beta^- BB_t^- + \varepsilon_{2t} \quad (18)$$

As stated earlier in the methodology section, by applying the traditional Engle and Granger procedure to Equations (17) and (18), we can test the null of no cointegration against the alternative of asymmetric cointegration (Schorderet, 2003). Accordingly, we test for possible asymmetric long-run equilibrium relationships by applying the traditional ADF and PP unit root tests on the residuals (ε_{1t} and ε_{2t}) from Equations (17) and (18) and also perform the Johansen's trace test for robustness. Table 5, reports the results from cointegration tests separately for the positive (Equation 17) and negative (Equation 18) components of the examined series. More specifically, the ADF test rejects the null of a unit root and reveals cointegration between the positive components of the two deficit series for all countries except Ireland, while regarding the negative components, cointegration is confirmed only for Italy, Greece and Spain. The PP test, confirms cointegration between the positive components for the cases of Portugal, Italy and Spain. Regarding the negative components of the two deficit series, cointegration is confirmed only for Italy and Greece. Concerning Ireland, neither the ADF test, nor the PP test, reject the null of a unit root, indicating lack of cointegration. On the other hand, Johansen's trace test indicates asymmetric cointegration in all tested relationships, with the only exception being the case of Spain for the relationship between the positive components of the two deficits.

[Table 5 here]

The estimated long-run relationships are presented in Table 6. It should be noted that in the relationships of the form (17) and (18), the examined original variables have been modified and expressed in terms of partial sums. This fact does not permit interpretation of the estimated long-run coefficients in the usual way. With respect to the coefficients β^{+} and β^{-}, there is an obvious difference, indicating asymmetric effects from the fiscal deficit to the current account deficit. In general, the β^{-} coefficients are greater than the respective β^{+}, with Ireland being the only exception, suggesting that an asymmetry phenomenon exists. In particular, the results reveal that the current account deficit reacts asymmetrically to changes of the fiscal deficit; decreases in the fiscal deficit cause a greater impact on the current account deficit than increases.

[Table 6 here]

5. Summary and conclusions

In this article, we empirically examined the relationship between the fiscal and current account deficits, aiming at validating the "twin deficits" hypothesis. For that purpose, we used data from Portugal, Ireland, Italy, Greece and Spain, over the period 1971-2009. The analysis employed a battery of different time series techniques, both linear and asymmetric, designed to account for possible structural shifts and asymmetric causal effects between the explored deficit series.

In almost all cases, in the linear testing framework, the findings suggest lack of cointegration. However, the results obtained from the application of the Gregory and Hansen cointegration methodology (that accounts for level, slope and trend regimes) reveal that the twin deficits hypothesis holds for Portugal, Ireland, Greece and Spain. Regarding the asymmetric cointegration method, the overall evidence supports the existence of asymmetric long-run effects. Our results indicate that negative fiscal shocks dominate the positive ones, regarding the effect on the current account deficit; that is, a decrease in the fiscal deficit has a greater impact on the current account deficit rather than the opposite. More importantly, the overall findings indicate that ignoring the presence of structural breaks and asymmetries, one might obtain spurious evidence regarding the existence of a long-run relation between the examined variables.

To sum up our findings, we could argue that they provide additional useful insights into the debate regarding the causal linkage between the twin deficits. Furthermore, the identification of asymmetric linkages provides a probably more effective policy tool to confront and possibly control the excessive fiscal and current account imbalances in the examined countries, supporting the efforts towards solvency and exit from the severe current crisis. More particularly, our results regarding the impact on the current account deficit, demonstrated that the decreases in the fiscal deficit dominate increases. This finding validates the view that only through restrictive fiscal policy governments could maintain the external position and enhance the growth performance of the economy.

Nevertheless, the problem of fiscal and current account deficits probably requires a mixed policy approach that should combine both fiscal and monetary policy measures. However, the examined countries, due to their participation in the Eurozone, have abolished a very important policy tool; that is, the depreciation of their currency. In addition, they have only just begun to bring about genuine fiscal reforms. On the other hand, controlling the excessive fiscal and current account imbalances in a monetary union such as the Eurozone, may require the reassessment of the institutional framework for financial stability in these countries, in the context of a European macroprudential policy. Further possible suggestions regarding the improvement of the fiscal and current account imbalances may involve tax reforms, decreases in government spending, reforms in the labor and capital markets and productivity-based improvements in competitiveness.

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Table 1. Unit root and stationarity tests on individual series

Panel A: Series in levels

Country	Variable	ADF	k	PP	KPSS
Portugal	BB	-2.3477[c]	0	-2.1584[c]	0.3009[c]*
	CA	-2.6640[c]	1	-2.4814[c]	0.2182[c]**
Ireland	BB	0.2628[c]	0	0.21877[c]	0.3049[c]*
	CA	-1.3083[c]	0	-1.6942[c]	0.2951[c]*
Italy	BB	-1.5613[c]	0	-1.7710[c]	0.2215[c]*
	CA	-2.7202[c]	0	-2.8060[c]	0.1490[c]***
Greece	BB	-1.0124[c]	0	-1.1139[c]	0.1986[c]**
	CA	-2.4065[c]	1	-2.0952[c]	0.3016[c]*
Spain	BB	-1.5978[c]	1	-1.0049[c]	0.6563[b]*
	CA	-3.0276[b]	1	-2.5151[c]	0.2330[c]*

Panel B: Series in first differences

Country	Variable	ADF	k	PP	KPSS
Portugal	ΔBB	-5.2280[c]*	1	-6.7523[c]*	0.0471[c]
	ΔCA	-4.5076[c]*	1	-4.8008[c]*	0.0409[c]
Ireland	ΔBB	-3.4090[a]*	1	-3.5053[c]**	0.1015[c]
	ΔCA	-5.1919[c]*	0	-5.5082[c]*	0.1486[c]
Italy	ΔBB	-6.7353[c]*	0	-7.0223[c]*	0.1225[c]
	ΔCA	-6.3333[c]*	0	-6.0459[c]*	0.0509[c]
Greece	ΔBB	-4.8359[c]*	0	-4.9903[c]*	0.1265[c]
	ΔCA	-4.6930[c]*	0	-4.7829[c]*	0.0360[c]
Spain	ΔBB	-2.3962[a]**	0	-2.4362[a]*	0.1688[c]
	ΔCA	-3.5104[a]*	1	-2.9726[a]*	0.0504[c]

Notes: Δ denotes first-differences. ADF, PP and KPSS denote the Augmented Dickey-Fuller unit root test, the Phillips-Perron unit root test and the Kwiatkowski-Phillips-Schmidt-Shin stationarity test, respectively. ([a]): Model without constant or deterministic trend, ([b]): Model with constant, without deterministic trend, ([c]): Model with constant and deterministic trend. k denotes the optimal lag structure of the ADF test which is chosen based on the Akaike Information Criterion. The respective critical values for the ADF, the PP and the KPSS tests used, are 95% simulated critical values using 1000 replications and were generated using Microfit 5.0 (Pesaran and Pesaran, 2009). *, ** and *** denote significance at the 1, 5 and 10%, levels, respectively.

Table 2: Univariate LM unit root tests with one structural break

	Series in levels				Series in first differences			
Country	Variable	T_b	k	LM statistic	Variable	T_b	k	LM statistic
Portugal	BB	1985	0	-2.704	ΔBB	1989	0	-6.071*
	CA	1995	1	-2.970	ΔCA	1986	0	-8.905*
Ireland	BB	2001	1	-2.031	ΔBB	2006	0	-4.509*
	CA	1986	0	-1.461	ΔCA	1993	0	-4.002**
Italy	BB	1991	0	-1.770	ΔBB	1991	0	-7.565*
	CA	1992	0	-2.813	ΔCA	1996	0	-6.987*
Greece	BB	1993	0	-1.624	ΔBB	1989	0	-4.473*
	CA	2005	0	-2.668	ΔCA	2006	0	-4.686*
Spain	BB	1983	1	-1.889	ΔBB	2006	0	-3.311***
	CA	2006	0	-1.824	ΔCA	1993	1	-3.269***

Notes: Δ denotes first-differences. T_b denotes the time of break while k denotes the lag length. The respective 1%, 5% and 10% critical values are -4.239, -3.566 and -3.211, respectively (Lee and Strazicich, 2004). *, ** and *** denote significance at the 1, 5 and 10%, levels, respectively.

Table 3. Linear cointegration tests

Equation (13): $CA_t = \alpha + \beta BB_t + \varepsilon_t$

	Unit root tests on residual series ε_t		Johansen's Trace test
Country	ADF	PP	
Portugal	-2.7961	-2.2430	10.7942 (0.5694)
Ireland	-1.8577	-2.6641	10.8757 (0.5616)
Italy	-3.1163	-3.0219	11.2279 (0.5283)
Greece	-2.1029	-1.3390	15.8243 (0.1861)
Spain	-2.5451	-0.70499	31.1142* (0.008)

Notes: ADF and PP denote the Augmented Dickey-Fuller unit root test and the Phillips-Perron unit root test, respectively. The optimal lag structure of the ADF test is chosen based on the Akaike Information Criterion. The respective 1%, 5% and 10% critical values for the ADF and the PP test for cointegration are -4.12, -3.46, -3.13 (MacKinnon, 1991). The respective p-values for the Johansen's trace test are displayed in parentheses. *, ** and *** denote significance at the 1, 5 and 10%, levels, respectively.

Table 4. Gregory and Hansen cointegration tests

Equations (14), (15) and (16)						
Country	Level break, no trend		Level break, trend		Regime and trend shift	
	$t_{\hat{b}}$	T_b	$t_{\hat{b}}$	T_b	$t_{\hat{b}}$	T_b
Portugal	-5.397*	1996	-5.411**	1996	-5.498**	1996
Ireland	-3.779	1983	-3.946	1986	-5.552**	1993
Italy	-4.326	2002	-4.905	1976	-5.432	1992
Greece	-5.430*	1995	-6.207*	1985	-6.898*	1987
Spain	-5.240*	2003	-5.260**	2003	-5.274	1995

Notes: $t_{\hat{b}}$ denotes the ADF* minimum test statistic for a unit root across all possible break points and T_b denotes the time of break. The optimal lag length is determined by the Akaike Information Criterion. Critical values are tabulated in Gregory and Hansen (1996a, 1996b). *and ** denote rejection of the non-cointegration null at the 1 and 5% significance, levels, respectively.

Table 5. Asymmetric cointegration tests

Equation (17): $CA_t^+ + \Delta CA_t^- = \alpha^+ + \beta^+ BB_t^+ + \varepsilon_{1t}$

	Unit root tests on residual series ε_{1t}		Johansen's Trace test
Country	ADF	PP	
Portugal	-3.2125***	-3.2603***	24.7064* (0.0099)
Ireland	-2.5042	-2.7001	28.7412* (0.0020)
Italy	-4.9456*	-4.1671*	17.1532** (0.0262)
Greece	-3.5329**	-3.1074	21.8361** (0.0283)
Spain	-3.1945***	-3.3257***	12.5058 (0.1350)

Equation (18): $CA_t^- + \Delta CA_t^+ = \alpha^- + \beta^- BB_t^- + \varepsilon_{2t}$

	Unit root tests on residual series ε_{2t}		Johansen's Trace test
Country	ADF	PP	
Portugal	1.0069	1.0163	28.0754* (0.0027)
Ireland	-2.3820	-2.2524	23.0271* (0.0185)
Italy	-5.5819*	-5.9731*	26.0044* (0.0007)
Greece	-4.3382*	-3.2955***	31.3852* (0.0007)
Spain	-3.1976***	-1.7994	21.2723** (0.0344)

Notes: ADF and PP denote the Augmented Dickey-Fuller unit root test and the Phillips-Perron unit root test, respectively. The optimal lag structure of the ADF test is chosen based on the Akaike Information Criterion. The respective 1%, 5% and 10% critical values for the ADF and the PP test for cointegration are -4.12, -3.46, -3.13 (MacKinnon, 1991). The respective p-values for the Johansen's trace test are displayed in parentheses. *, ** and *** denote significance at the 1, 5 and 10%, levels, respectively.

Table 6. Long-run asymmetric relationships

Equation (17): $CA_t^+ + \Delta CA_t^- = \alpha^+ + \beta^+ BB_t^+ + \varepsilon_{1t}$

Country	α^+	β^+
Portugal	3.4239 (1.3829)	1.4896* (9.7835)
Ireland	-3.2800 (-1.1187)	1.1065* (6.8534)
Italy	1.3185 (1.2276)	0.68326* (11.7561)
Greece	0.58357 (0.90292)	0.71157* (16.1482)
Spain	4.4967* (7.9697)	0.64334* (10.4208)

Equation (18): $CA_t^- + \Delta CA_t^+ = \alpha^- + \beta^- BB_t^- + \varepsilon_{2t}$

Country	α^-	β^-
Portugal	-0.37457 (-0.21830)	1.9143* (14.5369)
Ireland	-9.1394* (-5.3933)	0.76738* (4.1444)
Italy	-0.53928 (-0.78679)	1.0931* (19.9609)
Greece	1.6099** (1.9054)	1.0803* (16.0208)
Spain	0.66571 (0.38654)	1.1290* (5.1008)

Notes: t-statistics have been corrected where necessary as in West (1988) and are displayed in parentheses. * and ** denote significance at the 1 and 5%, levels, respectively.

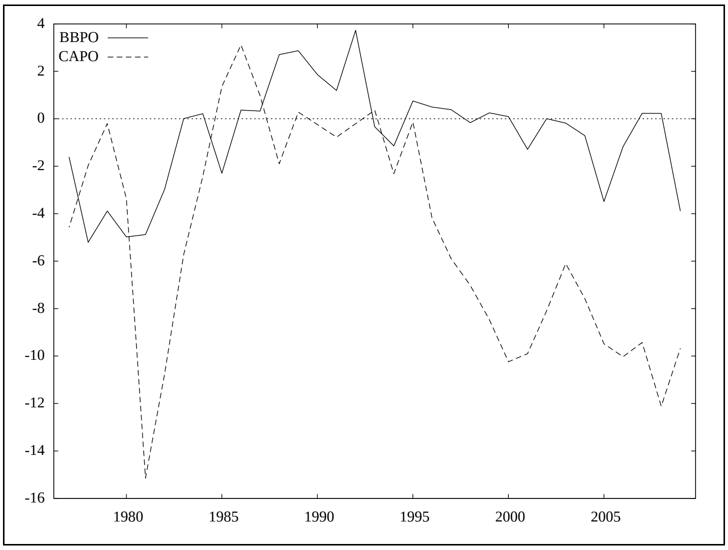

Fig. 1. The evolution of Portugal's government primary balance and current account balance as percentages of GDP (1977-2009).

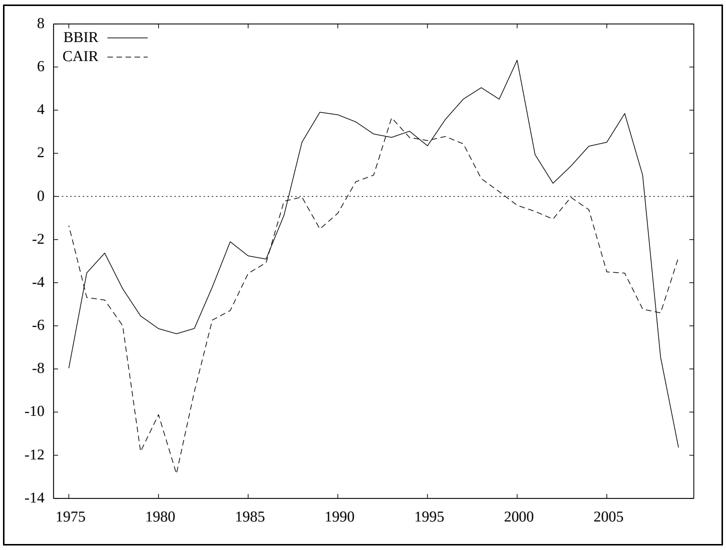

Fig. 2. The evolution of Ireland's government primary balance and current account balance as percentages of GDP (1975-2009).

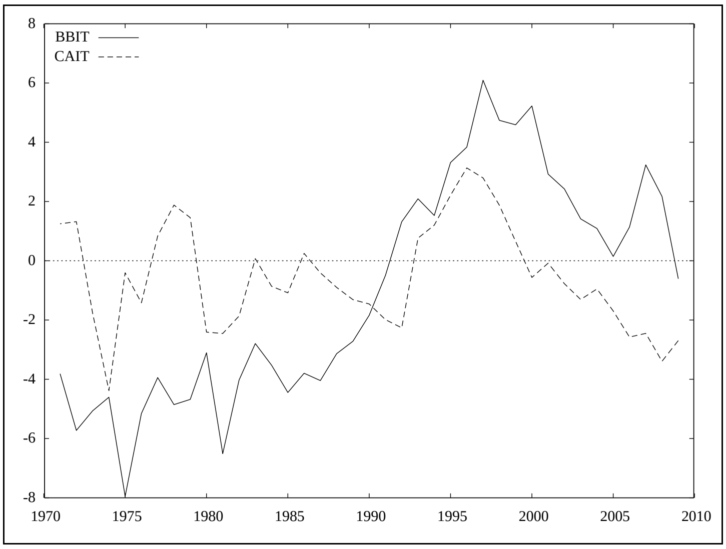

Fig. 3. The evolution of Italy's government primary balance and current account balance as percentages of GDP (1971-2009).

Fig. 4. The evolution of Greece's government primary balance and current account balance as percentages of GDP (1975-2009).

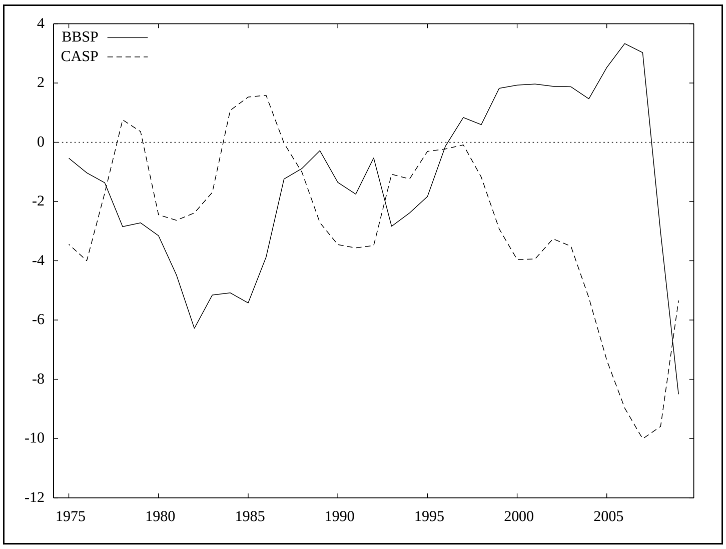

Fig. 5. The evolution of Spain's government primary balance and current account balance as percentages of GDP (1975-2009).