Public solvency of PIIGS: a matter of discipline or mostly confidence?

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Abstract

The aim of this paper is to test the fulfilment of the intertemporal budget constraint for the case of some peripheral European Monetary Union (EMU) countries: Greece, Portugal, Ireland, Italy and Spain (PIIGS), on which, and particularly after the 2007 financial crisis, hangs the shadow of "default". To this end, we analyze firstly the univariate properties of the fiscal variables allowing for multiple structural breaks. Secondly, we estimate a fiscal reaction function, whose magnitude and size signals the government's commitment to a sustainable fiscal path. Furthermore, we compare the differential effects of PIIGS with a panel of 16-countries during 1970-2012 and the effect of the Great Recession on public solvency.

Keywords: fiscal sustainability, panel unit roots, multiple structural breaks, fiscal reaction function, Great Recession

Paper Type Research paper

JEL Classification: E62, H62, H63, H69

"But this long run is a misleading guide to current affairs. In the long run we are all dead." (Keynes, 1923)

1. Introduction

Over the last decades many countries have gradually increased public sector spending and size, leading in most of the cases to a significant accumulation of public debt, either measured in absolute terms or relative to GDP. This unprecedented process of public debt accumulation questions the sustainability of budgetary imbalances of these countries after the Great Recession. Particularly in Greece, Portugal, Ireland, Italy and Spain (PIIGS), where the crisis of confidence in the solvency of their public accounts has generated episodes of elevated risk premiums on its sovereign debt.

Public bodies like the Organization for Economic Cooperation and Development[1] (OECD) expressed their concern about the implications from possible bankruptcy of PIIGS[2] on the balance sheet of European banks from 2012. The OECD highlights the difficulty of a "fiscal consolidation over a period of weak economic growth", to achieve the "necessary structural adjustments in the labour market, and retirement systems to ensure sustainable growth over a period of budgetary restraint" as well as reforms to "improve competitiveness in some countries in a short period of time".

[1] The financial needs of PIIGS would be practically covered by the guarantee of 750 billion agreement between Brussels and the International Monetary Fund (IMF).

[2] Daniel Vernet (24 April 1997). "L'Allemagne au coeur du débat français". Le Monde. "que l'argot communautaire a affublés d'un sobriquet peu élégant dans sa signification anglaise : « pigs », pour Portugal, Italy, Greece, Spain."

The aim of this paper is to test the fulfilment of the IBC, focusing our attention on the case of the peripheral EMU countries PIIGS, who suffered a dramatic increase of sovereign debt spreads since 2007. In a monetary union context, his increasing spread reflects either a default (or liquidity) risk, or perhaps an over-reaction in a "panic flight to safety" to bonds issued by a few countries singled out as a "safe havens" (de Grauwe, 2009).

An extant body of literature before us has analysed the sustainability of public finances. The seminal work of Hamilton & Flavin (1986) gave way to research on the government's intertemporal budget constraint (IBC henceforth) to test the long-run sustainability of fiscal policy. This popular approach focuses on the stochastic behaviour of fiscal variables and particularly, in the order of integration of public deficit and debt variables, and co-integration relationships between public revenues and expenditures. However, recent advances in the econometrics of non-stationary panel data methods have shifted the attention to the inclusion of structural breaks in the variables in panel data analysis, and different treatments of cross-section dependence among the individuals of the panel[3].

This research extends the existing literature on fiscal sustainability by analysing the fiscal reaction function (Bohn, 1998). Imperfect foresight allows investors to anticipate the commitment of governments to sacrificing financial resources in order to keep fiscal variables "close or inside" a sustainable path. We inspect the corrective response in primary deficit to debt accumulation, along with the reaction to interest spending increase.

[3] Alongside them, other huge piece of research has focused on the optimality taxes and revenues flows from the perspective of tax smoothing or in the rules versus discretion debate in fiscal policies.

The remainder of the paper is organized as follows: section 2 reviews the literature on IBC, section 3 describes the model, section 4 the empirical strategy and describes the data, section 5 discusses the results and finally section 6 concludes.

2. Background

During recent decades, economists and policymakers' concern about public finances and debt has grown proportionally to their absolute and relative size. In particular, the sustainability of government's budget is a key issue for policy-makers, particularly for EMU countries, who have "tied their hands" (Giavazzi & Pagano, 1988).

A sustainable fiscal policy allows the debt-to-GDP ratio to converge back to its initial level after some variation occurred (Blanchard, Chouraqui, Hagemann, & Sartor, 1991). Public debt is sustainable, "when it satisfies the solvency condition without a major correction" (Hostland & Karam, 2005). Forward-looking debt solvency, however, implies that future primary surpluses (determined in last instance by future behaviour of government expenditures and revenues, mainly tax income) pays back the principal plus interests. Therefore, public debt sustainability includes the ability of a country to meet its debt obligations without requiring debt relief or bail-out. This clearly formalized solvency definition implies serious implementation difficulties (Wyplosz, 2007).

Moreover, scholars distinguish between a sustainable path and the "perceived-by-the market sustainability" and its implications on the ability to finance current deficits, the risk premium required and even credit rationing and serious liquidity problems. Consequently, financial markets risk aversion (or risk perception) may rule

out fiscal trajectories which otherwise appear to be sustainable (Pinheiro, 2012). As a result, the interest on the sovereign debt may rise sharply while market access closes.

Empirical studies on sustainability of public finances start at the late eighties and early 90 (e.g., Hamilton & Flavin, 1986; Wilcox, 1989; Trehan & Walsh, 1988, 1991; Hakkio & Rush, 1991). Hamilton & Flavin (1986) is perhaps the best-known earliest attempts to test the Government IBC. Applying the Flood & Garber (1984) test for price bubbles to the IBC for the post-war United States, the authors test for the bubble term value, suggesting that a stationary public debt is sufficient (but not necessary) condition for sustainability of fiscal policy.

A second bulk of papers (e.g., Wilcox (1989), Hakkio & Rush (1991)), interpret Present Value Tests as tests of the sustainability of current fiscal policy. Trehan and Walsh (1988, 1991) developed an alternative framework to test the IBC fulfilment through the presence of a long-run cointegration relationship between government revenues and expenditures. Haug, (1995) applied this cointegration framework to the US federal budget in the 80's, and Smith and Zin (1991) to the Canadian Federal Budget. More recently, under the same framework, unit root and cointegration developments have focused on the possible existence of structural changes affecting the variables, such as in the works of Quintos (1995), Martin, (2000) or Tamarit, Esteve, and Camarero, (1998) for the Spanish case. Bajo-Rubio, Diaz-Roldan and Esteve (2008) re-examine the sustainability of US budget deficits. They use the econometric approach developed by Bai and Perron (1998, 2003), that allows testing endogenously for the presence of multiple structural changes.

Recently, other papers have incorporated panel data cointegration and unit root tests. In this direction, Afonso and Rault (2010) test for the sustainability of public

finances in the EU-15 over the period 1970–2006 using stationary and cointegration analysis. Byrne, Fiess, and MacDonald (2008) use the procedure suggested by Bai and Ng (2004) to find evidence of a cointegration relationship between primary surplus and debt for emerging and industrialised countries. The authors find a common stochastic trend related to global liquidity, as suggested in Eichengreen and Hausmann (1999).

Recent advances in panel cointegration techniques allow to determine endogenously structural breaks in the IBC (Bai and Carrion-i-Silvestre 2009; Banerjee and Carrion-i-Silvestre 2006; Camarero, Carrion-i-Silvestre, and Tamarit 2013). However, Bohn, (1998, 2007)[4] remarks that only the IBC fulfilment imposes very weak econometric restrictions. He suggests that the debt series, or both the revenue and the with-interest spending series, might be stationary after any finite number of differencing operations. Moreover, he shows that the sustainability test developed by Quintos (1995) is misleading to determine whether the necessary or sufficient condition holds based on the coefficient of a cointegration vector. Instead, Bohn (2007) states that all cointegrating conditions are merely "sufficient" for transversality.

3. The intertemporal budget constraint model

Compliance with government IBC imposes long-term restrictions on the behaviour of government revenues and expenditures (including debt interest). These constraints impose that debt cannot deviate from the path marked by the first. The Government Budget Identity states the government budget constraint in a period is determined by the evolution of public debt stock (McCallum, 1984) namely,

[4] Bohn (2007) proposes the policy reaction function approach developed by Bohn (1998). However, Bohn's (1998) approach may not be suitable for dealing with the long-run relationship between government revenues and expenditures.

$$B_t = G_t - T_t + (1 + r_t) \times B_{t-1}, \quad [1]$$

where B_t is the public debt stock at year t, G_t represents government primary expenditure (excluding debt interest); r_t is the interest rate on public debt at the beginning of the period, T_t represents the revenues of the period.

In this context, the total government expenditure including debt interests, CG_t, is:

$$CG_t = G_t + r_t \times B_{t-1}. \quad [2]$$

In this simple framework, the accumulation of debt results in the primary deficit and the burden of interest on the debt balance at beginning of period, as follows:

$$\Delta B_t = B_t - B_{t-1} = G_t - T_t + r_t \times B_{t-1}. \quad [3]$$

For convenience, the debt level can be re-expressed as follows:

$$B_t = \rho_t (T_{t+1} - G_{t+1} + B_{t+1}) \quad [4]$$

where $\rho_t = \frac{1}{(1+r_{t+1})}$.

Following Quintos (1995), we assume that the real interest rate is stationary process around its mean, $\bar{r}$. Thus, Government Primary Expenditure results in:

$$G_t^O = G_t + (r_t - \bar{r}) \times B_{t-1}. \quad [5]$$

Consequently, the process of accumulation of debt is:

$$\Delta B_t = B_t - B_{t-1} = G_t^O - T_t + r \times B_{t-1}, \quad [6]$$

and therefore, the stock of public debt in year t results:

$$B_t = \rho_t \times E_t[T_{t+1} - G_{t+1} + B_{t+1}]. \quad [7]$$

Solving recursively [7] by forward substitution, the Government's IBC- equivalent to the expected present value constraint- is as follows,

$$B_t = \sum_{i=1}^{\infty} \rho^i \times E_t(T_{t+1} - G_{t+i}). \quad [8]$$

To avoid explosive debt behaviour such as "Ponzi game", the fiscal sustainability requires the transversality condition to be satisfied:

$$\lim_{n\to\infty} \rho^n \times E_t(B_{t+n}) = 0. \quad [9]$$

Most studies test government debt sustainability applies time series analysis to test this transversality condition. If the stochastic processes in [9] is consistent with the intertemporal budget constraint, that the current market value of the debt must equal the discounted sum of expected future surpluses.

We go beyond previous studies following Bohn's (2007) argument on the cointegration approach for judging the sustainability of public debt. Bohn (2007) suggests that all of the sustainability conditions, be they strong, weak, or absurdly weak, imply the transversality condition and the IBC.

Consequently, we focus our analysis on the primary surplus. If it responds positively to an increase in debt then, even under uncertainty conditions, the government's fiscal policy reaction function can be viewed as sustainable. Such a test reduces to examining whether $\alpha > 0$ in the equation

$$Sur_t = \alpha B_t + \delta Z_t + \varepsilon_t = \alpha B_t + \mu_t, \quad [10]$$

where Sur_t is primary surplus, Z_t is a vector of determinants of the primary surplus and μ_t is an error term. We expect $\alpha > 0$ in case of budget sustainability.

In this framework, if both debt and primary surplus are nonstationary, while μ_t is stationary, equation [10] is equivalent to the cointegration test suggested by Trehan and Walsh (1988). However, if they are found to be stationary, to avoid biased coefficient estimates, we need to take into account potential determinants of primary surplus[5].

4. Empirical strategy and data analysis

In this section we describe our empirical approach and conduct a set of tests for the span of data available. First we undertake unit root tests for all the fiscal variables involved (all of them related to GDP). Variables analysed include General Government Total Expenditure (G), General Government Expenditure excluding interest payments (CG), General Government total revenues (R), Interest payments (I), General Government Primary Surplus (DEF), General Government Net Surplus (D) and Gross Debt (B). Hatano (1999) suggests testing that the interest rate is stationary around its mean, before we implement the unit-root tests for the fiscal variables.

Following Bai and Carrion-i-Silvestre (2009), we implement unit root tests in panel data allowing for the presence of multiple structural changes and common dynamic factors in all variables considered. In essence, non-compliance of the hypotheses of the sustainability of public finances implies the need for discretionary action.

After analysing the univariate properties of the variables, we test the existence of relationships between them. Empirical literature on fiscal sustainability has tested, for

[5] Bohn applies this framework to post-war U.S. data, finding evidence that $\alpha > 0$, and suggesting that U.S. fiscal policy had been sustainable.

industrialised or developing countries, and in European or wider contexts, co-integration, or long term relationships between fiscal revenue and expenditure data. Instead, we will focus on the existence of a fiscal reaction function, whose existence and size will indicate government's commitment to re-conduce debt accumulation inside a sustainable path.

4.1. Empirical strategy

Since Trehan and Walsh (1988, 1991), "traditional" approach to test the IBC fulfilment has involved a co-integration vector between government revenues and expenditures, which implies the stationarity of public deficit path,

$$G_t + r_t \times B_{t-1} - R_t, \qquad [11]$$

and

$$R_t = \alpha + \beta \times CG_t + u_t. \qquad [12]$$

In this context, after imposing the cointegration vector (1,-1), deficit would be sustainable if $0<\beta\leq 1$.

Research in testing for cointegration in a dynamic panel data set has evolved rapidly, making available a wide range of alternative tests, most of them based on testing for a unit root in the residuals of a panel cointegrating regression. As in unit root, most tests employed by the literature, attempting to distinguish between spurious and co-integrated processes will tend to favor the spurious model when the true process is subject to structural breaks but is otherwise co-integrated within the break regimes.

Another important problem is that the first generation of tests was unable to handle the possibility of both cross-sectional dependence and heterogeneous breaks,

which is likely to be the case in practice. Both aspects have been tackled by the panel data tests developed in Banerjee and Carrion-i-Silvestre (2013).They generalize the class of panel co-integration tests to allow for multiple, heterogeneous and endogenously determined structural breaks and cross-section dependence. The procedure is an extension of the approach by Bai and Ng (2004).

To sum up, contrary to what was expected, most of the sustainability tests described before have not been able to reject IBC's fulfilment, despite the fact that perceived sovereign risk spreads have reached significant values, particularly in peripheral EMU countries, such as Greece, Portugal or Spain. A possible explanation to this fact could be a myopic behaviour of markets, unable to anticipate the long-term path of fiscal variables, but to capture government reactions to short-run fiscal cross-roads.

So, instead of testing for long-term relationships, we will test the existence of fiscal reaction functions in the line of Bohn approach to fiscal sustainability. We think this can be an interesting contribution, due to the fact that if government reacts to debt increase adjusting primary surplus, it is in fact signalling the markets its ability to re-conduct its fiscal stance to a sustainable path.

Additionally to debt, we will introduce other possible determinants of primary surplus, as interest payments, that could be "crowding-out" other expenditures, when increasing due to rise of public debt level and/or its current cost.

We interpret interest payments as a result of earlier decisions in the accumulation of debt. It is therefore appropriate to consider the reaction of the primary balance, both to debt increase and to interest spending, both related to GDP. Our intention is testing for fiscal policy responses (in terms of primary surplus variation)

caused by a long-term determinant (that is, responding to Gross debt increases) or a short-term motivation (accommodating interest payments increase in total budget deficit). Following the literature (and in particular as recommended by Bohn (1998) we have introduced the relative weight of cyclical component to GDP.

The panel specification is estimated using with country and year fixed-effects:

$$\text{Primsurplus}_t = \alpha \text{Grossdebt}_{t-1} + \delta_1 \text{Cycle}_t + \delta_2 \text{Interest}_t + \varepsilon_t. \qquad [13]$$

Due to the apparent non-stationarity (even after allowing for multiple structural breaks) of the debt-ratio and interest expenditure (both related to Real GDP), together with the stationarity of the Primary surplus to GDP ratio, we can't apply cointegration techniques to test for the fiscal reaction function. To avoid estimating a spurious regression, we have chosen the alternative of differencing the fiscal variables in the fiscal reaction equation as follows:

$$\Delta\text{Primsurplus}_t = \alpha \Delta\text{Grossdebt}_{t-1} + \delta_1 \text{Cycle}_t + \delta_2 \Delta\text{Interest}_t + \varepsilon_t \qquad [14]$$

As Wooldridge (2010) notes, if the data follow unit-root processes and T is large, the "spurious regression problem" that arises in a panel can be avoided by differencing the data, increasing estimation efficiency for our large-T panel.

4.2. Data Analysis

All data are taken from the European Commission AMECO (Annual Macro-Economic Data) database, covering the period 1970–2012. Our panel includes data covering PIIGS, other Eurozone economies (Belgium, Germany, France, Netherlands, Austria, Finland), non-eurozone EU members (Denmark, Sweden and United Kingdom), and two significant industrialised countries (United States and Japan).

INSERT GRAPHS 1, 2, 3 AND 4 HERE

The presence of a break in accounting standards (ESA79 for the period 1970-1995 to ESA95 for subsequent periods), and the German unification forced us to unify the data in the period. As in Paredes, Pedregal, and Pérez (2009), in order to obtain homogeneous levels for the whole period 1970-2012, we removed level discontinuities by applying backwards the growth rates by the series in ESA79 terms (that exclude East Germany) to the levels of the ESA95 series, as it follows in next equation:

$$Y_{t-1}^{ESA95^{*}} = \frac{Y_{t}^{ESA95}}{\left(\frac{Y_{t}^{ESA79}}{Y_{t-1}^{ESA79}}\right)} \qquad [15]$$

We have a reasonable span of data of at least forty years for most of the countries analysed which, according to Shiller and Perron (1985) and Mendoza and Ostry (2008), is sufficient for a robust estimation.

4.2.1. Unit Roots with unknown multiple structural breaks

In this sub-section we study the stationarity of the fiscal series in our country panel, specifically the stock of government debt in real terms and the ratios to GDP of government revenue and government expenditure, using panel unit root approach, which allow notably for cross-country dependence. As in Afonso and Rault (2010), in

order to make the analysis robust, we also compared the results of panel data unit root tests with those obtained with individual unit root tests

As stated in Perron (1989) and related literature, ignoring the eventual presence of structural breaks may lead to misleading conclusions about the order of integration of a time series. As pointed out by Perron (1997), the simple inclusion of a break point in the analysis of integration is sufficient to weaken the evidence for the presence of unit roots in many series of the data used by (Nelson & Plosser, 1982). More recently, (Lluís Carrion-i-Silvestre, Del Barrio-Castro, & López-Bazo, 2005) highlight the possibility of erroneously rejecting the hypothesis of a unit root due to the rigidity of the proposed model under the alternative hypothesis to explain the behaviour of the variable.

On the other hand, (Mills & Crafts, 1996) have expressed the need to design contrast procedures allow more than a structural change as it happens as time periods, there occur facts that decisively determine the long-term behavior economic variables. And moreover, the location of the structural break can reflect either policy regime shifts or significant events that are necessary to be taken into account, and which could be contributing (or disturbing) the return to a sustainable path.

Recent research in the unit root literature has focused on testing the existence and location of multiple structural breaks potentially affecting the level, the slope, or both the level and the slope of a time series. In fact, among the shocks affecting the trajectory of long-term growth in a time series, it is important to distinguish those that, for larger size and less recurrence, are likely to have caused a rupture or structural change, and thus separate the recurrent and low magnitude disturbances, and focus the analysis on the order of integration of variables. In short, this separation between the

random effects will allow us to determine more precisely, if the data generating process is stationary or integrated.

Among others, one of the seminal contributions is Bai and Perron (1998), continued in Bai and Perron (2003a, 2003b). When testing for structural breaks applying (Bai and Perron, 2003a) methodology, we find evidence in favour of multiple breaks for the Gross Debt ratio to GDP series of PIIGS countries in the period 1970-2012, as shown at table 1.

INSERT TABLE 1 HERE

The test described at (Bai & Perron, 2003a)[6] has been adapted to a panel data framework in (Bai & Carrion-i-Silvestre, 2009) both controlling compound effects of structural breaks and common factors on the stationarity analysis of panel data. When conducting this test for our 16-country panel, we also find strong evidence for multiple structural breaks affecting most of fiscal variables analysed, differing in number and position for the particular countries, as shown in Table 2.

INSERT TABLE 2 HERE

Thus far, the panel-based unit root test results are supportive of the unit-root for most of the series, except for the Primary Surplus relative to GDP time series,

[6] GAUSS code can be obtained at Pierre Perron's web page: http://people.bu.edu/perron/code/m-Break.zip

regardless examining conventional or simplified tests designed for the procedure, as shown in Tables 3 and 4.

INSERT TABLE 3 HERE

INSERT TABLE 4 HERE

5. Results and discussion

We have conducted estimations for the whole panel, and for two subsamples of countries, namely, PIIGS and non-PIIGS countries. Concerning the time span, we have also run regressions for the whole period, and for the period 1970-2007. Results are shown in Tables 5, 6 and 7.

INSERT TABLE 5 HERE

INSERT TABLE 6 HERE

INSERT TABLE 7 HERE

Our findings are interesting in some ways:

Firstly, because we find evidence favouring the existence of a fiscal response to all the variables involved in the test for the 16-country panel.

Our second finding is the different response between PIIGS and rest of the countries. In our opinion, this could be due to the fact that PIIGS react in the short run mostly forced by financial constraints, responding more to interest payments increase and less to debt-increase, when compared to the rest of the countries analysed.

A third finding is the less counter-cyclical response showed by PIIGS, whose response to cycle would be inferior to rest of the countries, indicating a lower degree of intertemporal optimisation.

Finally, we identify a change in behaviour after the recent financial crisis. When we break the panel in two sub-periods, namely 1970-2007 and 2008-2012, we find than in general (but in particular in the PIIGS), the countries analysed tend to intensify its myopic behaviour. Maybe this change in the fiscal reaction function has been motivated by the increasing financial constraints in international markets, or barely caused by the EU response to the constraints, and the austerity imposed by German criteria to European member states, in particular PIIGS

6. Conclusions

In this paper we look for evidence on the fulfilment of the intertemporal budget constraint for the case of some peripheral EMU countries, and in particular, for Greece, Portugal, Ireland, Italy and Spain.

To this end, this paper looks into the univariate properties of the fiscal variables for a 16-country panel. Our findings support the unit-root hypothesis for all the series except the Primary Surplus ratio to GDP that would be stationary. Tests also find

evidence for multiple structural breaks in most of the variables involved, indicating both the need to implement correcting pro-active fiscal policies by the different governments, and alternatively, the existence of particular events distorting the path of the fiscal series along time.

The magnitude and size of the fiscal reaction function signals the government's commitment to re-conduce debt accumulation inside a sustainable path. According to our results, we have found evidence of a different behaviour between PIIGS-countries and the whole panel, and also for changes in fiscal behaviour after 2007, due to turbulences and financial restrictions originated after global financial crisis.

Our research highlights the importance of signalling the main commitments of the fiscal policy to the financial markets, not only by reacting to lagged debt, but also in a cyclical context. We also show that most of the countries, and particularly PIIGS countries would have given more importance to "interest spending accommodation" than to lagged debt.

Further research could re-examine the importance short and long term determinants of fiscal behaviour, or the role of credibility and signalling to set a sustainable debt market's perception, and manage sovereign debt spreads, to make sustainable a fiscal policy stance.

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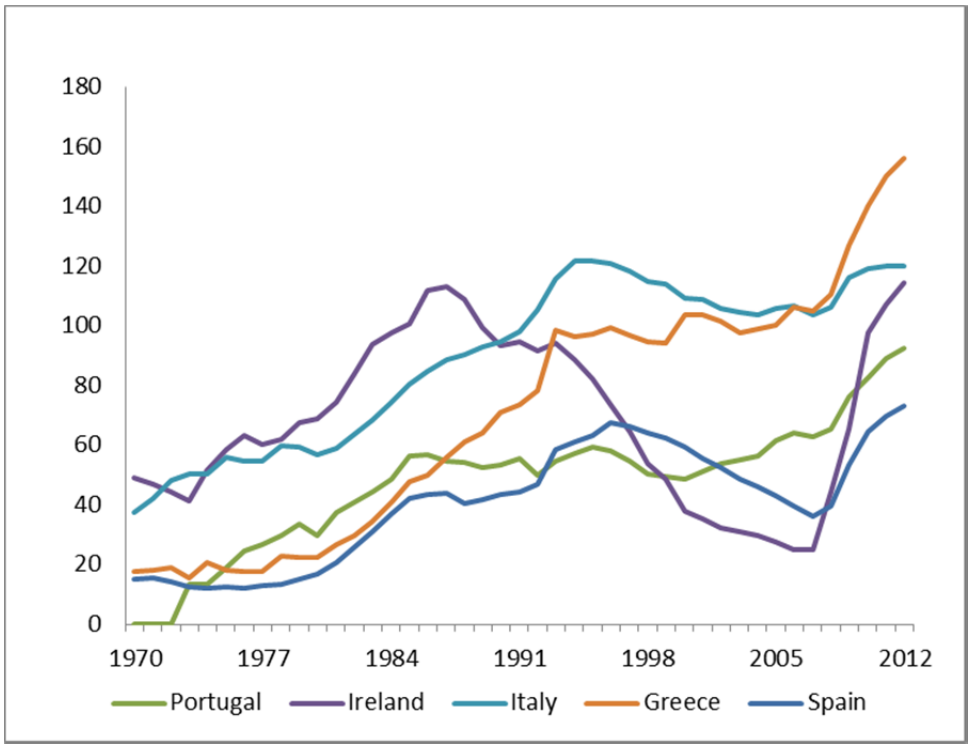
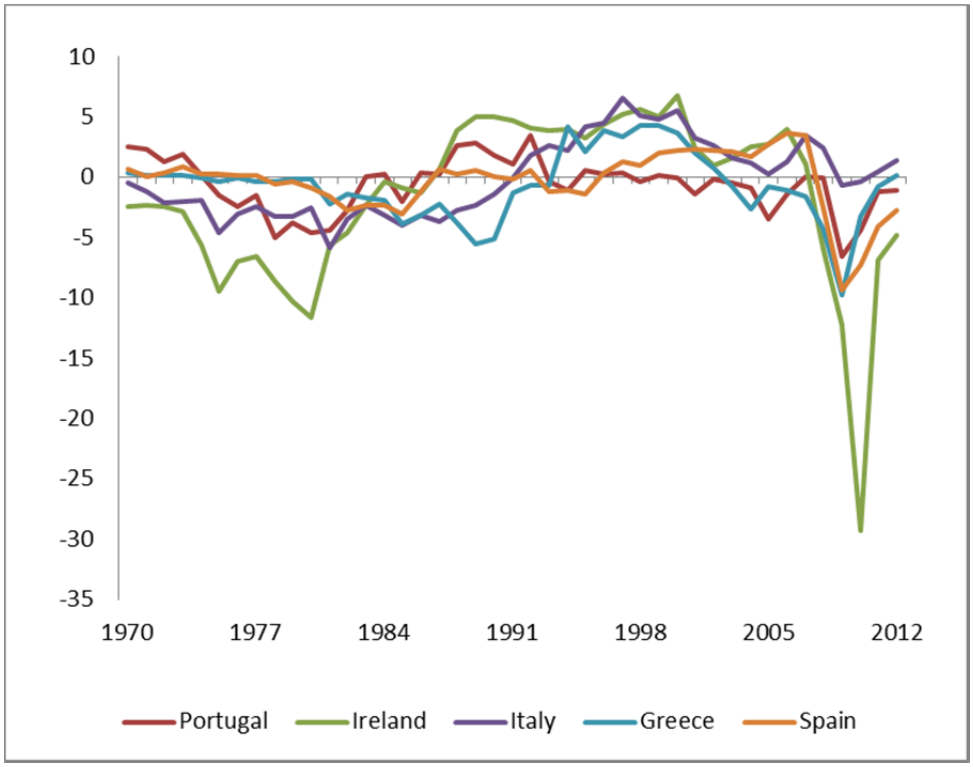
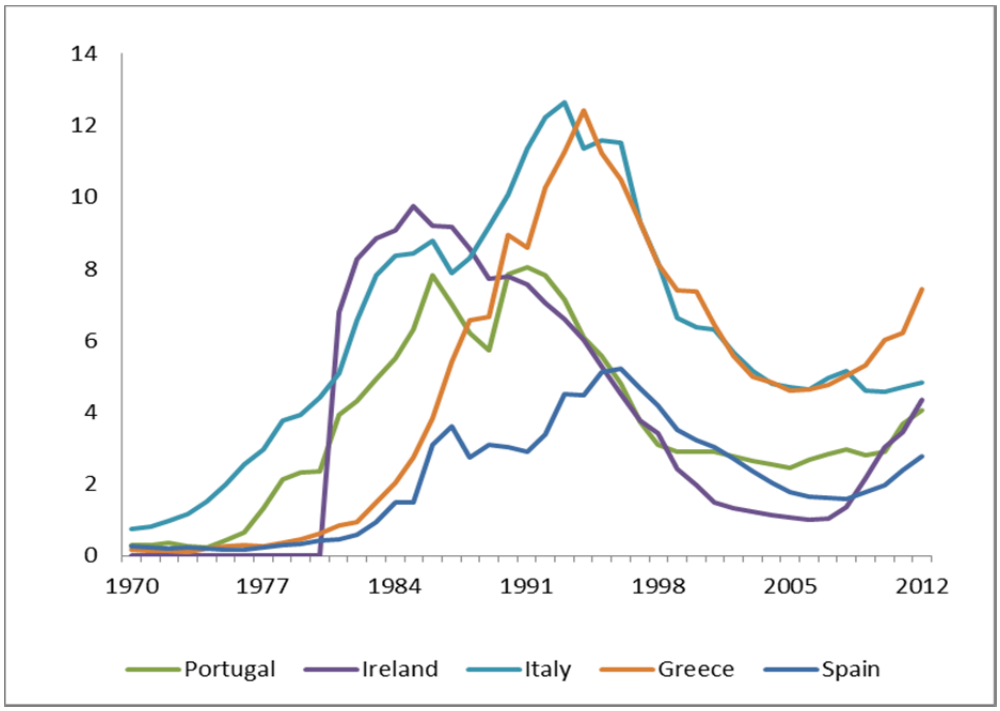
Graph 1 Gross Debt Ratio to GDP PIIGS countries. 1970-2012.



Graph 2. Government Primary Surplus Ratio to GDP PIIGS countries. 1970-2012.



Graph 3. Government Interest Spending Ratio to GDP PIIGS countries. 1970-2012.



Graph 4. GDP Cycle component (Hodrick-Prescott) PIIGS countries. 1970-2012.

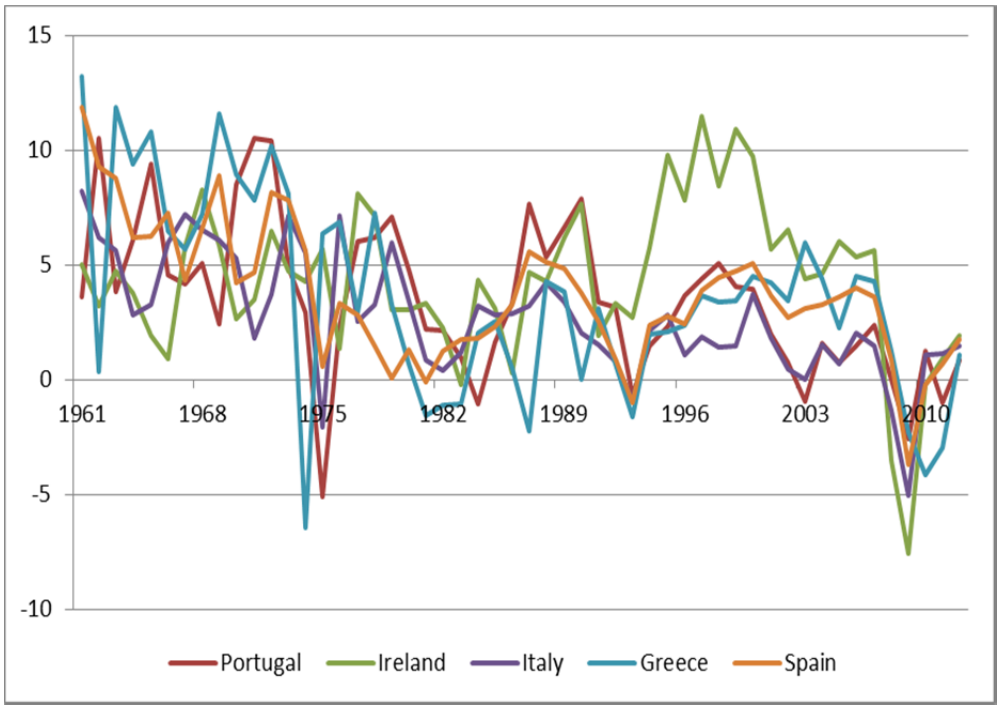


Table 1: Bai&Perron (2003). Gross Debt relative to GDP. Structural Breaks Estimation (BIC estimates), 1970-2012

	Breaks	Years	R^2	Nº obs.
Portugal	3	1978 1984 2006	0.875	40
Ireland	3	1981 1996 2006	0.661	43
Italy	3	1977 1984 1991	0.945	43
Greece	4	1980 1986 1992 2006	0.955	43
Spain	3	1982 1992 2000	0.871	43

Notes. Bai&Perron (2003) estimations allowing for up to 4 structural breaks.

Table 2: Bai&Carrion-i-Silvestre (2009). Variables relative to GDP. Structural Breaks (BIC estimates), 1970-2012.

	Gross Debt	Total Expenditure	Total Revenue	Expenditure (no interest)	Interest	Nº obs.
Portugal		1978			1986	40
Ireland	1990 2006		1984		1991 2001	43
Italy	1994	1983	1982	1989	1993 1999	43
Greece	2006	1983 1990	1982 1988 2000	1982 1988	1985 1994 2005	43
Spain	1978 1998 2006	1995		1979 1985		43
Belgium	1979 1985 1993 2006	1981 1994	1979		1990 1996	43
Denmark	1977 1983				1978 1984	42
Germany			1977	1992 1999	1993	43
France		1985				36
Netherlands		1990 1996	1983		1979 1985 1993 2002	38
Austria			1976	1987 1996	1987	43
Finland	1996		1976		1987 1993	43
Sweden	1977 1984 1996	1993			1994	43
United Kingdom	1988 2006			1993	2002	43
United States	1981 1993 2000 2006	1978			1978 1985 1997 2003	43
Japan	1996			1979	1990	43

Notes. Bai&Carrion-i-Silvestre (2009) estimations allowing for up to 4 structural breaks.

Table 3: Panel unit root test results 1970-2012

Variables	Z tests	P (Normal)	Pm (Chi-square)
GrossDebt	-0.90077923***	0.97279896***	39.782392***
Primary Surplus	-2.3667686	3.1179683	56.943746
Surplus	1.1851093***	1.3545549**	42.836439*
Total Expenditure	0.40230397***	-0.85516686***	25.158665***
Exp. Exc. interest.	-0.68346237***	0.15233991***	33.218719***
Total Revenues	-1.5500531**	1.1598376***	41.278701**
Interests	-0.40018170***	1.7242722*	45.794177**

Notes:
(a) Z, P and Pm denote the test statistics developed by Bai and Carrion-i-Silvestre (2009). The 1%, 5% and 10% critical values are: a) for the standard normal distributed Z, -2.326, -1.645 and -1.282; b) for the P(Normal) statistics, 2.326, 1.645 and 1.282, and c) for the chi-squared distributed Pm statistic, 50,89, 46,98 and 40,25, respectively.
(b) the number of common factors is estimated using the Panel Bayesian criterion information in Bai and Ng (2002) with rmax = 3.

Table 4: Panel unit root test results 1970-2012. Simplified tests

Variables	Z tests	P (Normal)	Pm (Chi-square)
GrossDebt	1.6649183**	-0.34936693***	29.205065***
Primary Surplus	-2.3667686	3.1179683	56.943746
Surplus	1.1851093***	1.3545549**	42.836439**
Total Expenditure	1.0284064***	-1.2778853***	21.776917***
Exp. Exc. interest.	-0.64320876***	-0.33644652	29.308428***
Total Revenues	-0.32900713***	0.68302874***	37.464230***
Interests	0.75455682***	-0.26156525***	29.907478***

Notes:
(a) Z, P and Pm denote the test statistics developed by Bai and Carrion-i-Silvestre (2009) of the simplified MSB statistics, respectively. The 1%, 5% and 10% critical values are: a) for the standard normal distributed Z, -2.326, -1.645 and -1.282; b) for the P(Normal) statistics, 2.326, 1.645 and 1.282, and c) for the chi-squared distributed Pm statistic, 50,89, 46,98 and 40,25, respectively.
(b) the number of common factors is estimated using the Panel Bayesian criterion information in Bai and Ng (2002) with rmax = 3.

Table 5. Panel estimation. 1970-2012

	(1) All_countries	(2) All_countries2	(3) No_Piigs	(4) Piigs
LD.GrossDebt	0.0993***	0.110***	0.0701***	0.149***
	(0.0192)	(0.0220)	(0.0173)	(0.0168)
CycletoGDP	0.121**	0.125**	0.170**	0.0549
	(0.0544)	(0.0514)	(0.0557)	(0.0497)
D.Interest	0.240*		-0.192	0.414**
	(0.123)		(0.352)	(0.108)
Observations	630	630	428	202
R^2	0.364	0.362	0.465	0.416

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6. Panel Estimation. 1970-2007

	(1) All_countries	(2) All_countries2	(3) No_Piigs	(4) Piigs
LD.grossdebt	0.0553**	0.0764***	0.0892***	0.0781**
	(0.0241)	(0.0183)	(0.0153)	(0.0280)
cycletogdp	0.133**	0.140**	0.178***	0.0239
	(0.0591)	(0.0519)	(0.0543)	(0.0369)
D.interest	0.413*		-0.353	0.679**
	(0.218)		(0.357)	(0.205)
N	550	550	373	177
R^2	0.299	0.287	0.358	0.433

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7. Panel Estimation. 2008-2012

	(1) All_countries	(2) All_countries2	(3) No_Piigs	(4) Piigs
LD.grossdebt	0.600*	0.588	-0.0209	1.194***
	(0.330)	(0.339)	(0.0700)	(0.172)
cycletogdp	0.0242	0.106	0.125	0.920
	(0.330)	(0.349)	(0.257)	(0.521)
D.interest	-2.677		1.996	-4.831
	(3.163)		(1.131)	(6.240)
N	80	80	55	25
R^2	0.578	0.564	0.869	0.708

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$