A Further Inquire about the Sustainability of Fiscal Policy in the EU

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Abstract

We analyse the sustainability of fiscal policy in EU15 countries in line with the recent literature on fiscal reaction functions. We test for a positive response of the primary surplus to accumulated debt using a baseline reaction function, and we check for robustness considering alternative specifications, estimation techniques, and possible structural breaks. We also estimate a Bayesian version of the baseline model as a way to provide an endogenous mechanism to analyse time variation in the response of governments to debt. We suggest that the posterior distribution of this model is a sensible indicator to assess the sustainability position of countries. Our conclusion is that the response to debt has fluctuated over the sample 1977-2005, but sustainability has been prevalent in EU15.

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Introduction

The Stability and Growth Pact (SGP) is one of the main pillars of the Economic and Monetary Union (EMU). It was agreed with the aim of setting a proper balance between fiscal discipline and the macroeconomic stabilization role of fiscal policy. It was conceived as a discipline device which should ensure budgetary balances close to balance or in surplus, while keeping gross debt at low levels in terms of GDP.

Since the very moment of its conception the Pact has been the subject of numerous criticisms, which would suggest more or less drastic reforms of the institutional framework of the EU Member States (see, among many others, Brunila and Martinez-Mongay, 2002; Buti et al., 2003, 2005). The debate on the drawbacks, challenges and possible reforms of the Pact significantly gathered momentum in 2002, when budgetary developments in some Member States, especially in Germany and France, put the Pact under serious stress. The final trigger for reform took place in November 2003 when the ECOFIN Council refused to adopt the recommendations by the European Commission to step up the excessive deficit procedure for France and Germany (see, for instance, Buti, 2006).

In a communication adopted in September 2004 the European Commission put forward a series of proposals to introduce changes in the Pact (European Commission, 2004). These mainly aimed at avoiding pro-cyclical policies, better defining the medium-term objective of fiscal policy, giving greater prominence to the debt criterion, considering economic circumstances in the implementation of the excessive deficit procedure and improving governance and enforcement. Taking the Commission communication as a starting point, the ECOFIN Council of March 2005 reached an agreement to introduce changes in the Pact. Where necessary, legislative changes were proposed in both its preventive (surveillance and coordination of economic policies basically through the assessment of convergence

and stability programs) and corrective (excessive deficit procedure) arms (Council, 2005). The legislative process ended in July 2005.
One of the most recurrent critical issues on the Pact was based on an apparently excessive focus on short-term objectives for the budget deficit, which might not only create incentives for creative accounting and the recourse to one-off deficit-reducing measures, but also to almost fully disregard debt developments, and so to inadequate handling of long-term sustainability issues.

Disregard of the issue of public debt was considered as a clear limitation of the original SGP (Buti et al., 2005). Consequently, taking more into consideration public debt and long-term sustainability when assessing budgetary positions was broadly shared by policy makers as one of the lines along which the Pact should be reformed. The agreement reached at the ECOFIN in March 2005 gave a more prominent role to debt in the preventive arm by differentiating medium-term budgetary objectives across Member States on the basis of their potential growth and debt levels. Also, structural reforms with positive effects on long-term fiscal sustainability have to be taken into consideration when assessing the adjustment path toward the medium-term objective, when considering deviations from the target, and when evaluating the deficits exceeding the 3% of GDP limit.

The Council also called for giving a stronger weight to public debt in the implementation of the Pact, but was not able to agree on, for instance, a minimum debt reduction for countries with very high debt ratios (Buti et al., 2005). In terms of the role of debt and sustainability, the reform of the Pact also appears limited when compared with some proposals made during the long debate on the Pact, such as the Permanent Balance Rule by Buiter and Grafe (2003) and the Debt Sustainability Pact by Coeuré and Pisani-Ferry (2003). The permanent budget balance is given by the difference between the constant long-run average future values of tax revenue and government spending. The rule proposed by Buiter and Grafe (2003) was to keep the permanent budget adjusted for inflation and real growth in balance or

surplus. For countries with debt levels below 50% Coeuré and Pisani-Ferry (2003) proposed to give them the choice of opting out the corrective arm (the excessive deficit procedure) and adopt a so-called Debt Sustainability Pact, according to which countries should submit a five-year budgetary program with a debt ratio target for the period.

However, if the concern is government solvency such debt criteria impose unnecessary constraints on fiscal policy on the basis of debt ceilings (as the Pact also does) or relationships between the components of the budget and ad-hoc discount factors. Where government solvency is concerned, this paper emphasizes that sufficient conditions for solvency are rather weak, while, as general rule, it does not appear that sustainability has been in danger during the last 30 years in Europe.

Specifically, this paper analyzes sustainability within the framework of the recent literature on fiscal reaction functions, which provides a convenient framework to assess fiscal sustainability. This literature investigates the type of fiscal flow reaction (viz. the primary surplus) to public debt accumulation that would guarantee fiscal sustainability. Bohn (1998) and Canzoneri et al. (2001) have developed and applied this approach for the US case. Ballabriga and Martinez-Mongay (2003, 2005) have estimated the reaction of the primary surplus to debt levels for the EU Member States. In the line of Canzoneri et al (2001), Ballabriga and Martinez-Mongay (2003) focused on the Fiscal Dominance versus Monetary Dominance debate. They estimated fiscal and monetary policy reaction functions and found supportive evidence of a Monetary Dominance regime in the EU Member States. The second paper, published in 2005, put the emphasis on fiscal sustainability, and in this sense is closer to Bohn (1998). By fine-tuning the estimation of the fiscal reaction functions reported in 2003, the paper provided evidence of the existence of a structural policy shift in the run-up to the euro (after 1995), which enhanced sustainability.

On theory grounds, Ballabriga and Martinez-Mongay (2005) has been criticized for seemingly discarding the distinction between ad hoc sustainability and model-based sustainability as discussed in Bohn (2005). On empirical grounds, the availability of additional sample evidence allows to confront the existence of the sustainability-enhancing impulse associated to the run-up to the euro with a potential post-EMU fatigue, which would have shown up after 1999. Furthermore, the ad hoc dummy-modelling approach for the 'euro' impulse can be complemented with an endogenous mechanism for structural shift detection.

Within this framework, the objective of this paper is to develop further the assessment of the sustainability of EU public finances. Alternative theoretical and empirical approaches in the literature to assess the sustainability of public finances are discussed in section 2. Section 3 takes a first descriptive look at the evolution of gross debt series in 14 Member States (EU-15 except Luxembourg), the US and Japan over the period 1977-2005. Section 4 presents alternative estimates of the reaction of the primary surplus to debt levels and concludes that a positive reaction of the former to the latter is rather ubiquitous both across countries and over time. This section also presents evidence of a series of structural breaks in such a response, which can be associated to the adoption of the Maastricht Treaty and the convergence criteria after 1992, to the launching of the euro after 1995, and to the adoption of the euro after 1999. Moreover, a positive response of the primary surplus to debt levels is robust with respect to alternative specifications and estimation methods. Comparing the posterior distributions generated by the pre-Maastricht, Maastricht and EMU sub-sample periods, section 5 considers Bayesian-modelling as a systematic endogenous mechanism to explore potential structural breaks in the response of the primary surplus to debt levels. Section 6 concludes.

How to assess the Sustainability of Fiscal Policy

Definition of sustainability

In line with standard practice in dynamic optimization models, we term fiscal policy as sustainable when government debt issuing policy does not use Ponzi financing schemes, i.e. financing strategies consisting in rolling over a given initial level of debt that would never be repaid. The absence of Ponzi schemes in debt policy is a general equilibrium condition required by rational private sector agents in order to be willing to lend to the government. A no-Ponzi scheme condition guarantees that the government inter-temporal budget constraint (IBC) is satisfied, so that its outstanding debt is backed by future primary surpluses.

Formally, a no-Ponzi scheme condition takes the form of a transversality condition (TC) whereby the discounted value of debt issued infinitely far in the future is zero. In stochastic economies, IBCs and TCs take the algebraic form of expectations of products of the discount factor and the components of the government budget equation. As we discuss below, this fact turns out to be relevant to distinguish between existing approaches in the literature to assess the sustainability of fiscal policy.

To make explicit the IBC and TC expressions we start out from the budget equation for period t

$$d_{t-1} = (s_t + d_t)\beta_t \qquad (1)$$

where d is the stock of debt at the end of the period, s is the primary surplus, both as a percentage of GDP, and β is the discount factor. Forwarding expression (1) one period, iterating forward T periods and taking expectations conditional on information at time t (E_t) gives

$$d_t = E_t \sum_{j=1}^{T} \left(\alpha_{tj} s_{t+j}\right) + E_t \left(\alpha_{tT} d_{t+T}\right) \qquad \text{with} \quad \alpha_{tj} = \prod_{j \geq 1} \beta_{t+j} \tag{2}$$

Taking finally the iteration to the limit and given convergence of the discounted sum, we get

$$d_t = E_t \sum_{j=1}^{\infty} \left(\alpha_{tj} s_{t+j}\right) + \lim_{T \to \infty} E_t \left(\alpha_{tT} d_{t+T}\right) \tag{3}$$

which shows that

$$d_t = E_t \sum_{j=1}^{\infty} \left(\alpha_{tj} s_{t+j}\right) \Leftrightarrow \lim_{T \to \infty} E_t \left(\alpha_{tT} d_{t+T}\right) = 0 \tag{4}$$

The right hand side term in (4) is the TC that excludes Ponzi schemes, so that the discounted value of debt issued infinitely far in the future is zero, and the left term is the government IBC, which states that outstanding debt is backed by future primary surpluses. Bohn (1995) has shown that conditions of type (4) apply to a wide range of general equilibrium stochastic models, providing therefore a rather general test for fiscal sustainability.

A key characteristic of condition (4) is that in a general equilibrium stochastic setting the discount rate α depends on the risky rate of return, which in turn depends on the intertemporal marginal rate of substitution of consumers (Bohn 1995). This means that we should expect in general a non-zero correlation[1] between α and fiscal variables s and d, and implies therefore that the factorization of expression (4) as discounted values of expected fiscal terms is generally incorrect. This complicates the empirical testing of fiscal sustainability.

Testing sustainability

[1] In particular, all three may depend on aggregate output.

The most common empirical approach in the literature to test fiscal policy sustainability is based on the analysis of the time series properties of fiscal data. Influential papers in this stream of the literature are Hamilton & Flavin (1986), Trehan & Walsh (1988, 1991) and Quintos (1995).

This approach rewrites (4) in the form

$$d_t = \sum_{j=1}^{\infty} (1+r)^{-j} E_t\left(s_{t+j}\right) \Leftrightarrow \lim_{T\to\infty} (1+r)^{-T} E_t\left(d_{t+T}\right) = 0 \qquad (5)$$

where r is usually interpreted as the difference between the expected return on government debt and the growth rate of GDP. Then unit roots and co-integration conditions on fiscal debt and deficit guaranteeing that this version of the government IBC holds are derived and tested.

But versions of type (5) are problematic. A first problem is that (5) factorizes the product of the discount rate and fiscal variables, ignoring that the discount factor may be correlated with the primary surplus and debt, as we have just mentioned. The choice of this discount factor is a second controversial feature of this empirical approach, since, as we have also mentioned, the proper discount factor in an stochastic setting is the risky rate of return (i.e. the return of state-contingent claims), not the rate of safe assets. The arbitrariness of both the factorization and the choice of the discount factor has motivated the distinction (Bohn, 2005a) between ad hoc sustainability, based on (5), and model-based sustainability, based on (4).

The third characterizing feature of this approach is that it tests (5) by testing for unit roots and cointegration among debt and the components of the budget deficit. However, the order of integration of debt seems to be irrelevant, as any debt series that are stationary after any finite number of differencing operation would satisfy (5) (Bohn,

2005b), rendering the order of integration of government debt as uninformative for fiscal policy sustainability.

A more recent and promising alternative empirical approach to sustainability testing is provided by the literature on fiscal reaction functions. This literature investigates the type of flow reaction to government debt accumulation that would guarantee that (4) is satisfied. Its main result (Bohn, 1998; Canzoneri et al., 2001) is that a positive response of the primary surplus to debt accumulation is a sufficient condition for sustainability. More precisely, assume that the primary surplus can be written as

$$s_t = \delta_t d_{t-1} + \varphi_t \tag{6}$$

where φ is a bounded component and $\delta_t \geq 0 \ \forall t$ with $\delta_t > 0$ applying infinitely often. Then it can be shown that fiscal policy satisfies the general condition (4).

The intuition of this result is that by adjusting the primary surplus in response to debt developments the government reduces the exponential growth of debt by a factor δ relative to the discount rate, which is sufficient to satisfy the TC in (4).

Government Debt Accounting

The evolution of government debt is the bottom line reference for the sustainability of fiscal policy. In this section we take a look at debt developments in the EU-15 Member States, excluding Luxembourg, during the sample period 1977-2005, with the US and Japan as background references. A debt accounting exercise is also performed, which provides an illustrative first contact with fiscal data.

Fiscal developments

While in 1977 debt levels measured in terms of GDP were close to or well below the 60% Maastricht reference value, 15 years later, in the aftermath of the adoption of the Maastricht Treaty, seven European countries, as well as the US and Japan, were recording debt levels above such a reference value (Table 1). In three of them (Belgium, Greece and Italy), gross government debt had jumped above 100% of GDP, while in Ireland the figure was higher than 90%. In the rest of the countries debt had also increased, and it was approaching the 60% level in the cases of Spain and Portugal. Until the first half of the nineties, just after the formal launching of the euro, the upward trend continued in most of the countries in the sample. Only Ireland, Finland and to a lesser extent Belgium and the Netherlands had managed to curve rising debt levels. As a result, all the countries in the sample, except the UK, were recording debt levels close to or well above the 60% reference value by the middle of the past decade.

The mid-1990s mark a turning point in debt developments in most EU countries, as well as in the US. Only in Germany, Greece and France were the debt ratios still on an increasing path. Between 1996 and 1999 debt had decreased by around 8 percentage points of GDP per year in Ireland, by 4½ in Belgium and by between 3 and 4 points in the Netherlands, Portugal, Finland, Denmark and Sweden. Debt reduction was also sizeable in Spain, Italy and the UK. Similar debt-decreasing trends seem to be still in motion in the current decade, albeit at a slower pace. However, debt has continued to increase in Germany and France, while the downward trends have been reversed in Portugal and the US. In Japan, debt levels have not ceased to increase, especially since the early nineties on the back of a strong expansionary fiscal policy.

Table 1. Gross debt developments 1977-2005 (% of GDP)

	1977	**78-93***	1993	**94-96***	1996	**97-99***	1999	**00-05***	2005
Belgium	58.7	**4.5**	130.5	**-1.2**	126.9	**-4.4**	113.6	**-3.4**	93.3
Germany	26.8	**1.2**	45.8	**4.2**	58.4	**0.6**	60.2	**1.3**	67.7
Greece	20.1	**5.6**	110.1	**0.4**	111.3	**0.3**	112.3	**-0.8**	107.5
Spain	12.9	**2.8**	56.9	**3.3**	66.7	**-1.7**	61.6	**-3.1**	43.2
France	19.1	**1.5**	43.7	**4.6**	57.6	**0.2**	58.3	**1.5**	67.2
Italy	54.7	**3.8**	114.9	**1.9**	120.6	**-2.3**	113.7	**-1.2**	106.4
Ireland	58.5	**2.1**	92.6	**-6.7**	72.4	**-8.1**	48.1	**-3.4**	27.6
Netherlands	37.8	**2.3**	74.8	**-0.9**	72.1	**-3.9**	60.5	**-1.3**	52.9
Austria	28.5	**2.0**	60.4	**2.4**	67.6	**-0.4**	66.5	**-0.6**	62.9
Portugal	30.3	**1.7**	58.2	**0.6**	59.9	**-2.9**	51.4	**2.1**	63.9
Finland	7.8	**3.0**	56.1	**0.2**	56.7	**-3.6**	46.0	**-0.9**	40.5
Denmark	13.8	**4.0**	77.0	**-2.6**	69.2	**-3.9**	57.4	**-3.6**	35.9
Sweden	26.7	**2.7**	70.6	**0.8**	73.0	**-3.6**	62.2	**-2.0**	50.3
UK	60.8	**-0.8**	47.5	**1.6**	52.2	**-2.4**	44.9	**-0.2**	43.5
US	46.9	**1.8**	75.4	**-0.7**	73.4	**-3.1**	64.1	**0.4**	66.4
Japan	34.9	**2.5**	74.9	**6.3**	93.9	**10.6**	125.7	**5.9**	161.1

* Average of the annual changes in % of GDP over the period, including the extremes of the interval

Such debt developments are associated to soaring deficits and interest payments, and resulted in a perverse feedback between higher deficits, higher debt levels, higher interest payments and back to higher deficits, while primary surpluses plummeted (Table A1 in appendix A).

Already in the second half of the 1970s, the size of the general government deficits in percentage of GDP were high by international standards in a few EU countries. This was the case of Belgium, Italy, Ireland and Portugal, which, as shown above, recorded high debt increases until the early nineties. However, in a majority of countries, budget balances were below the 3% of GDP threshold and in some cases they were close to balance or in surplus. Deficits soared during the 1980s, and in 1993, in the aftermath of the economic crisis, only Ireland and Denmark were recording deficits below the 3% of GDP. High deficits were also predominant until the mid-nineties, and it was

only after the launching of the euro when countries were able to rein on deficits. Leaving aside Greece (and Japan) no country recorded a deficit above 3% of GDP in 1999. In EMU and underlying the slowdown in debt reduction, deficits have risen again, especially in Germany, Greece, France, Italy, Portugal and the UK,[2] although up to lower levels than in the past, especially than in the first half of the nineties.

A steadily rising debt, combined with high interest rates,[3] put pressure on interest expenditures. In 1977, interest expenditure represented less than 5% of GDP. Only in Belgium, Italy, Ireland and the UK, countries with debt levels above 50% of GDP, interest payments represented more than 3½% of GDP. In countries like Spain or Finland, interest payments were almost negligible (less than 1%). However, 15 years later, in no European country, except in the UK, interest payments were below 3% of GDP, and in the high-debt ones interest expenditure was above (Greece, Italy) or very close to 10% (Belgium). Since then, interest payments have been on a steady downward path. This appears unambiguously linked to the stability-oriented economic policy framework already largely set up in stage 2 of EMU (until the late 1990s), characterized by a better control of inflation, which significantly lowered interest rates in many countries, and a fiscal tightening prompted by the Maastricht criteria and further enhanced by the SGP, which reduced debt levels. In the most recent years, interest expenditure has attained levels well below those corresponding to the early nineties and, in some cases, of the magnitude observed in the late seventies.[4]

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[2] At the moment of writing these countries are in excessive deficit.

[3] For instance, between 1977 and 1993 the implicit interest rate on government debt (the ratio of interest payments to the stock of debt) had increased from 6.5% to 8% in Belgium, from 6 to 11.5 in Greece, from 2 to 9 in Spain, from 6 to 7.5 in France, from 8 to 10 in Italy, or from 4.5 to 10 in Portugal (see table A2 in the appendix A).

[4] In addition, the implicit interest rates on government debt are well below not only those recorded in the early nineties, but also those recorded at the beginning of the sample period (1977). As a matter of fact, the implicit interest rates have converged across euro area Member States to around 4.5% in 2005 (see table A2 in appendix A).

In a majority of countries, primary deficits were contributing to debt accumulation in the late seventies. Only in France, the Netherlands, the Nordic countries, and the UK revenues over weighted primary spending. However, in the early nineties, when both deficits and interest expenditures were at their peaks, a positive reaction of the primary surplus to debt accumulation seems to be predominant. Only in Spain and France, and the US, primary surpluses deteriorated while debt was rising.[5] With the exception of Portugal in the second half of the 90s, and Japan, a general improvement of primary balances over the nineties helped to put debt levels on a downward path. However, in parallel with the reduction of debt levels, primary surpluses have actually worsened during the current decade. This is the case of all the EU countries except Spain, Austria and Denmark, where primary surpluses did not deteriorate while debt fell.

All in all, periods of rising debt appear broadly coincidental with an improvement in primary balances, while primary balances have tended to worsen in parallel with the reduction of debt. Therefore, tables 1 and A1 (in appendix A) seem to suggest that fiscal behaviour in the EU (and probably in the US, but less evident in Japan) has overall been sensitive to debt developments.

Debt accounting

Further insights about government debt developments during our sample period are obtained by performing a simple accounting

[5] Note that a stronger deterioration was recorded in Finland and Sweden. However, the timing in tables 1 and A1 may not be the most appropriate for these two countries. The bulk of the increase in debt levels in Finland took place suddenly in the early 1990s, when after the fall of the soviet regime and the concomitant drastic reduction of Finish exports plunged the country into a recession, the result of which was that the surplus of 5% of GDP recorded in 1990 turned into a deficit of 8% in 1993. In parallel, debt levels rose from 14% of GDP in 1990 to 56% in 1993. Similarly, in Sweden the surplus of 4% recorded in 1990 turned into a deficit of 11% in 1993, with debt going up from 42% to 71%. Also note that the deterioration of the primary surplus in the UK in the late 1980s/early 1990s is associated to a reduction of debt levels from 61% in 1977 to 48% in 1993.

exercise of the sources of debt growth. The exercise highlights the importance of the growth dividend compared to that of the so-called stock-flow adjustments (SFA) as determinants of debt growth.

Expressing the fiscal variables in percentages of GDP, the flow government budget identity for period t can be written as

$$d_t = -s_t + \left(\frac{1+i_t}{1+\lambda_t}\right) d_{t-1} \tag{7}$$

where i is the nominal interest charge in government debt and λ is the nominal GDP growth rate. Subtracting then d_{t-1} in both sides of expression (7) and rearranging terms, we obtain the equivalent expression

$$d_t - d_{t-1} = def_t - \left(\frac{\lambda_t}{1+\lambda_t}\right) d_{t-1} \tag{8}$$

according to which the change in the debt-to-GDP ratio in year t is equal to the budget deficit inclusive of interest payments, $def_t = -s_t + i_t d_{t-1}$, minus the growth dividend, the second term in the right-hand side.

In the real world (7)-(8) do not hold. The reason is that the principles according to which the government deficit and debt are compiled are different. As a result, once it is corrected from the effect of nominal growth, the change in the outstanding stock of debt can be larger or smaller than the deficit (European Commission, 2005: 2.2). One of the main reasons for this comes from the differences in the gross and net recording of transactions with financial assets.[6] Specifically, the government balance is the difference between expenditures and

[6] This is not the only reason (European Commission, 2005: 2.2). The fact that deficits are compiled in accrual terms, while debt is a cash concept also leads to differences between the changes in debt and the deficit in any given year. An additional difference arises from statistical adjustments and valuation effects.

revenues, excluding financial transactions. However, government debt is compiled in gross terms, and it changes when the financial assets of the government change, thus generating an expenditure or revenue flow that does not enter the deficit. When the government accumulates financial assets debt increases above the right-hand side of (8), while the opposite applies for a reduction of financial assets. Such a residual is known as the stock-flow adjustment (SFA). Taking it into account (8) becomes:

$$d_t - d_{t-1} = def_t - \left(\frac{\lambda_t}{1+\lambda_t} \right) d_{t-1} + sfa_t \qquad (9)$$

where SFA is the stock-flow adjustment term in percentage of GDP.

Averaging over the sample period both sides of expression (9) it is possible to obtain the average contribution of each of the right hand side components to the average debt growth, all in terms of GDP. The result is shown in Table 2 for the whole sample period, 1977-2005, and for the first half of it, 1977-1993. Table A3 in appendix A presents the results of the same exercise for different sub-periods between 1994 and 2005.

Considering the whole sample period, the most striking feature in Table 2 is that, as a general rule, the growth dividend has fully offset pervasive budget deficits. The exceptions appear to be Germany, where annual deficits have been around ¼ of a percentage point of GDP higher than the growth dividend, France, with a difference slightly above ½%, and Italy (and Japan), where the difference is around 1%. The table also reveals that SFAs have been important for debt dynamics in an ample majority of the 16 countries in the sample.[7]

[7] As noted in European Commission (2005: 2.2) large SFAs are a source of concern, especially in high-debt countries in deficit. On the one hand, by excessively focusing on deficits, budgetary surveillance may create incentives to shift budget items from deficit ('above the line') to SFAs ('below the line'). On the other hand, large SFAs may be indicative of inconsistent and low-quality budgetary statistics. However, large SFAs may not always be the result of bad fiscal behaviour. It appears that countries with low debt levels and in surplus (see the cases of Finland,

The picture changes slightly if one looks at the first part of the period. Until 1993, the number of countries in which the growth dividend did not compensate for the deficit includes not only France and Italy (and Japan), but also Belgium, Greece, Spain, and the Netherlands. On the other hand, the contribution of SFAs is even greater that in the whole sample period.
Interestingly, both over the full sample and until 1993 the number of countries that managed to maintain primary surpluses is not negligible, although the surpluses were in many cases relatively small. As a matter of fact, primary deficits appear to be the characteristic of only some catching-up countries, such as Greece, Spain and Portugal, where the growth dividend was relatively high.

A drastic reduction of budget deficits below the average growth dividend, which is unambiguously associated to the reduction of debt levels recorded after 1996, is the most salient characteristic of debt dynamics in most EU countries after 1993, and in particular after 1996 (see table A3 in appendix A), once the effects of the 1992-1993 economic crisis had faded out, and the enhanced budgetary surveillance/fiscal discipline framework was in place. Still, favourable developments in SFAs, in many cases reflecting the allocation of privatisations proceeds to redeem debt, had a significant impact on debt dynamics, especially in the second half of the 1990s. During most of the last decade, primary surpluses have been ubiquitous.

Denmark or Sweden in Table 1) would prefer to invest in financial assets rather than to reduce the already low debt.

Table 2. Debt accounting, 1977-2005 and 1977-1993

	Debt (1)	Deficit (2)	Interest burden (3)	Primary balance (4)	Nominal GDP growth (5)	Inflation (6)	Real GDP growth (7)	Stock-flow adjustment (8)
1977-2005								
Belgium	1.23	5.07	7.79	-2.72	-5.09	-2.95	-2.14	1.26
Germany	1.46	2.44	2.81	-0.37	-2.22	-1.25	-0.97	1.24
Greece	3.12	7.73	6.84	0.89	-8.66	-6.82	-1.85	4.05
Spain	1.08	3.14	2.77	0.28	-3.52	-2.31	-1.22	1.46
France	1.72	2.59	2.65	-0.05	-1.95	-1.13	-0.82	1.07
Italy	1.84	7.52	7.58	-0.05	-6.83	-5.26	-1.57	1.15
Ireland	-1.10	3.94	5.36	-1.42	-7.09	-3.80	-3.29	2.04
Netherlands	0.54	2.86	4.56	-1.70	-2.78	-1.37	-1.40	0.46
Austria	1.23	2.54	3.34	-0.79	-2.47	-1.29	-1.18	1.16
Portugal	1.20	5.15	4.61	0.54	-6.11	-4.80	-1.31	2.16
Finland	1.17	-1.47	2.25	-3.72	-1.71	-0.85	-0.86	4.34
Denmark	0.79	0.76	5.32	-4.62	-2.99	-1.92	-1.07	3.02
Sweden	0.84	1.32	4.90	-3.58	-3.46	-2.30	-1.16	2.98
UK	-0.62	2.54	3.58	-1.04	-3.60	-2.51	-1.09	0.45
US	0.70	3.09	2.67	0.41	-2.82	-0.97	-1.85	0.43
Japan	4.51	3.12	1.45	1.67	-2.16	-0.28	-1.88	3.55
1977-1993								
Belgium	4.48	7.75	8.45	-0.70	-5.74	-3.83	-1.91	2.34
Germany	1.19	2.30	2.56	-0.26	-2.91	-1.85	-1.06	1.80
Greece	5.63	8.89	5.56	3.33	-8.17	-7.70	-0.47	4.51
Spain	2.75	3.84	2.22	1.47	-3.23	-2.51	-0.71	2.08
France	1.54	2.14	2.32	-0.17	-1.94	-1.37	-0.56	1.25
Italy	3.76	9.95	7.63	2.32	-8.23	-6.69	-1.54	1.85
Ireland	2.13	7.31	7.21	0.10	-8.05	-5.23	-2.81	2.84
Netherlands	2.31	3.95	4.98	-1.03	-2.56	-1.30	-1.26	0.72
Austria	1.99	2.74	0.00	-0.46	-2.62	-1.61	-1.02	1.84
Portugal	1.74	6.02	5.26	0.76	-8.30	-6.94	-1.36	3.88
Finland	3.02	-1.89	1.62	-3.51	-1.05	-0.83	-0.22	5.74
Denmark	3.95	2.02	6.17	-4.24	-3.28	-2.52	-0.77	5.22
Sweden	2.74	1.95	5.30	-3.35	-3.96	-3.26	-0.70	4.53
UK	-0.83	2.88	4.12	-1.23	-4.54	-3.59	-0.95	0.85
US	1.78	3.86	2.69	1.16	-3.75	-2.18	-1.56	1.56
Japan	2.50	1.11	1.47	-0.36	-3.57	-1.42	-2.14	5.06

(1) Annual average change in the debt-to-DGP ratio (%)
(2) Annual average change in the deficit-to-DGP ratio (%)
(3) Annual average change in interest expenditure (% of GDP)
(4) Annual average change in the primary balance-to-DGP ratio (%) (4)=(2)-(3)
(5) Annual average effect of nominal GDP growth
(6) Annual average effect of inflation
(7) Annual average effect of real GDP growth (7) = (5) - (6)
(8) Annual average stock-flow adjustment (8) = (1) - (2) - (5)

Although informative about debt developments and the contribution of different budget components to debt accumulation, data in tables 1 and 2 convey scarce information about the sustainability of fiscal policy. For example, one might be tempted to interpret the fact that budget deficits have been the norm in our sample as indicative of underlying Ponzi games. However, sustainability conditions impose very weak constraints in the behavior of deficits. As a matter of fact, sustainability is compatible with permanent budget deficits as long as they induce a debt growth rate lower than the discount rate.[8] Similarly, a declining debt/GDP ratio might be seen as indicative of fiscal sustainability, but it is actually compatible with Ponzi schemes whereby the government rolls over a given level of debt when the interest rate on government debt is lower than the GDP growth rate. This analysis above suggests in fact that commonly used fiscal indicators may be misleading as signals of sustainability, and that more formal approaches are needed in order to establish whether a given fiscal policy is sustainable.

Determinants of the Fiscal Primary Surplus

Baseline model

In accordance with the fiscal reaction function approach to sustainability discussed in section 2, we start with the following basic specification of the determinants of the primary surplus

$$s_t = c + \delta\, d_{t-1} + \gamma\, x_t + \rho\, s_{t-1} + \varepsilon_t \qquad (10)$$

The motivation for (10) is to capture the potential response of the primary surplus to debt, while trying to avoid omitted variable bias.

[8] Sustainability is even compatible with policies that may generate primary deficits on average, as for example fiscal policies that targeting debt/output stabilization require a surplus or a deficit depending on output fluctuations.

To that end, we include two components that are considered important in government fiscal behaviour: on the one hand, the response to the cyclical conditions of the economy, as represented by the output gap x; on the other hand, the inertial process typically associated with fiscal policy that is captured by the primary surplus lag. Finally, equation (10) incorporates a random term representing other potential factors affecting the evolution of the primary surplus, as for example non-systematic discretionary policy actions.

Figure 1 plots the three series involved in equation (10) for each one of the 16 countries in the sample. As already pointed out in section 3, there seems to be in a number of countries a positive correlation between the primary surplus and the stock of debt at the end of the previous period. Interestingly, although one would have expected a strong positive correlation between primary surpluses and output gaps, so primary balances would improve in times of positive output gaps, Figure 1 seems to suggest that in a number of countries such an automatic counter-cyclical behaviour of the primary balances has been offset by pro-cyclical discretionary fiscal policies.

Table 3 presents summary statistics related to the estimation of model (10) by ordinary least squares. A positive and statistically significant (at 5% at least) response is observed in Belgium, Spain, Italy, Netherlands, Portugal, Denmark, Sweden, UK and the US. In the rest of the countries, except in Japan, the reaction of the primary balance to debt stocks is either significant at 10% (Ireland and Austria) or non-significant, although the estimate is positive. Only in Japan, the estimate is negative but non-significant. When significant, the reaction of the primary surplus to the output gap is positive, thus pointing to counter-cyclical fiscal policies. This seems to be the case in most EU Member States not in the euro area, as well as Finland, Austria and, to a much lesser extent, Portugal. In Belgium, Germany and Ireland the correlation between the primary balance and the output gap is negative albeit non-significant. Finally, in all the countries, except in Portugal, the inertia is statistically significant, positive indeed and in some cases

relatively strong. In countries like Ireland, Japan and, to a lesser extent, Belgium, UK and US it appears pretty close to 1.

Table 3. Econometric results for the baseline model

	Intercept	DEBT	GAP	$PSUR_{-1}$	R^2	h-Durbin
Belgium	-2.64 0.82***	0.03 0.01***	-0.01 0.13	0.78 0.09***	0.95	-1.73
Germany	-0.11 0.69	0.01 0.02	-0.14 0.10	0.49 0.24**	0.33	-0.54
Greece	-2.48 1.38*	0.03 0.02	-0.08 0.16	0.65 0.13***	0.74	0.01
Spain	-1.50 0.42**	0.04 0.01***	0.19 0.12	0.57 0.18***	0.82	0.001
France	0.04 0.55	0.00 0.01	0.11 0.16	0.59 0.19***	0.48	6.06
Italy	-4.93 1.59***	0.06 0.02***	0.01 0.11	0.61 0.10***	0.92	0.09
Ireland	-1.12 0.98	0.02* 0.01	-0.05 0.11	0.91 0.06***	0.88	0.76
Netherlands	-1.51 1.01	0.04 0.02**	0.26 0.21	0.44 0.21**	0.57	0.98
Austria	-0.63 0.61	0.02* 0.01	0.20 0.10**	0.45 0.16***	0.48	0.68
Portugal	-8.37 -2.80***	0.15 0.05***	0.18 0.10*	0.27 0.16	0.72	2.00
Finland	1.71 0.55***	0.01 0.01	0.51 0.12***	0.51 0.10***	0.78	1.34
Denmark	-0.15 0.62	0.04 0.02**	0.51 0.16***	0.62 0.10***	0.84	2.57
Sweden	-0.82 1.68	0.07 0.03***	1.12 0.31***	0.42 0.14***	0.84	2.41
UK	-5.48 1.61***	0.12 0.03***	0.25 0.12**	0.77 0.09***	0.78	1.34
US	-2.08 0.98**	0.04 0.02**	0.33 0.07***	0.74 0.10***	0.79	2.68
Japan	0.03 0.47	-0.00 0.01	0.02 0.11	0.93 0.08***	0.86	1.78
The sample period is 1997-2005.						

Models estimated by OLSQ with heteroskedastic-consistent standard errors;
'***' significant at 1%; '**' significant at 5%; '*' significant at 10%;

In general, and given its simplicity, the explanatory power of the model is relatively good. In any case, it is comparable or better than other estimates in the literature, such as Ballabriga and Martinez-Mongay (2003) or Bohn (2005). The explanatory power is high in Belgium, Greece, Spain, Italy, Finland, Denmark, Sweden, UK, US and Japan, where 75% or more of the variability of the primary surplus within the sample period is explained by the stock of debt, the output gap and the inertia. However, in some cases, such as Germany, France and Austria the explanatory power of the model is lower. In addition, although in many countries the model passes the usual specification tests, in others, such as Belgium, France, Portugal, Denmark, Sweden, US and Japan, the h-Durbin statistic suggests a clear departure from the white noise hypothesis for the residuals.

Robustness checks

Taken at face value, Table 3 raises some doubts about the sustainability of fiscal policies in Germany, Greece, France, Ireland, Austria, Finland, and, indeed, Japan, where a positive and significant reaction of the primary balance to the stock of debt has not been estimated. However, according to section 2 the reaction of the primary surplus to debt levels does not need to be positive all the time, while the descriptive analysis carried out in section 3 suggests that fiscal policy has changed over the sample period, in particular after 1993 once the convergence criteria entered into force. Therefore, there is a case to explore possible structural breaks, as well as non-linearity (Bohn 2005), in the response of the primary balance to the stock of debt. In addition, the fact that the fiscal policy stance may have an impact on the cycle would imply that output gaps may be partially determined by the primary surplus, thus leading to simultaneity biases (Ballabriga and Martinez-Mongay, 2003), which might put into

question the estimation method and advocate for instrumental variable methods. Alternatively, it might also call for the substitution of the contemporaneous output gap by the lagged one in order to avoid simultaneity. Finally, the parameters in specification (10) can be seen as a linearization of the parameters in a partial adjustment non-linear model, in which the actual responses of the primary balance to the debt and the output gap are the estimated in (10) divided by the complement of the inertia (Ballabriga and Martinez-Mongay, 2005). This would ask for a non-linear estimation of (10). Alternatively, one could consider a linear specification in which the inertia is absent.

Table 4 contains the result of the analysis of robustness of the estimates of the primary surplus reaction to debt against the above alternative specifications of the reaction function. In all cases, the table shows the estimate of the coefficient of debt and its heteroskedastic-consistent standard error.[9] The first column reproduces the results for the baseline model (10) in Table 3. The second column presents the baseline model estimated by instrumental variable methods. Following Ballabriga and Martinez-Mongay (2003), the instrument for the contemporaneous output gap for each country is a sort of country-specific international gap estimated on the basis of the bilateral trade-weighted average of the output gaps of the rest of the OECD countries. Overall, the potential simultaneity bias seems to be negligible. France, where the estimate shifts from positive to negative but remains non-significant, the Netherlands, where it decreases, and Portugal, where it increases but remains positive and significant, are the only differences with respect to the OLSQ estimation. Similarly, dealing with potential simultaneity bias, by substituting the contemporaneous gap with the lagged one (third column), leaves results basically unaffected, with just a reduction in the size and significance (10%) of the coefficient in Portugal.

The four column considers the effects of dropping inertia in (10). As a general rule, the reaction of the primary surplus to debt becomes

[9] Detailed estimates are available upon request.

larger in many countries, and significant in Greece and Austria. However, it decreases in Portugal and becomes non-significant in Sweden and the UK. Moreover, usual tests indicate the presence of significant misspecification errors. The estimation of the baseline model by non-linear methods (fifth column) does not change the conclusions of the baseline model either, since the non-linear estimates are very close to the linear ones in the first column of Table 4 after being divided by $(1-\rho)$ with ρ as estimated in the fourth column of Table 3. Similarly, estimation of the model by non-linear two-stage least squares (instrumental variables with the international gap as the instrument for the contemporaneous gap, column sixth) gives debt reactions which are equal to those in the second column of Table 4 when divided by $(1-\rho)$.

Columns 7 to 12 deal with possible specification bias linked to non-linearities and structural breaks in the response to debt. Only Greece, Ireland and Denmark (and the US) appear sensitive to the inclusion of the square of the deviation of the debt with respect to its sample average (column DEBT2). The consideration of dummies that take value 1 from 1993 onwards (DUM93), from 1996 (DUM96) or from 2001 (DUM01), individually or combined, has significant effects on the estimates of the reaction to debt in several countries, with interesting implications about the effects on fiscal behaviour of economic integration in the EU. This seems to be the case in at least Germany, Greece, Spain, Ireland, Austria and Finland. As shown below, in most euro area countries the introduction of structural breaks leads to an increase of the reaction to debt after 1993 and/or 1996, while in some cases the response falls after 2001. Also, the consideration of structural breaks has significant impacts in the US and Japan. More detailed estimation results for models with structural breaks are provided below.

To assess the impact of the large and relatively omnipresent and persistent SFAs showed in section 3, the baseline model has been re-estimated by including a sort of 'gross primary surplus' obtained by

subtracting the SFAs, calculated for each year in the debt accounting exercise (see Table 2) to the recorded primary surplus. The result is the primary surplus that would have been compiled if positive SFAs had been considered as primary expenditures, while negative SFAs had been accounted as revenues. The results of re-estimating (10) with this gross primary balance is presented in Table 5 in the rows labelled 'GPSUR'.

Table 4. Estimates of the response of the primary surplus to debt in alternative models

	Baseline OLSQ	Baseline IV	OLSQ GAP_{-1}	OLSQ Static	Baseline Non-linear	Baseline NL2SLS (IV)	DEBT2	DUM93	DUM96	DUM01	DUM93 DUM01	DUM96 DUM01
Belgium	0.03 0.01***	0.03 0.01***	0.03 0.01***	0.11 0.01***	0.15 0.04***	0.14 0.04***	0.03 0.01**	0.04 0.01***	0.05 0.01***	0.04 0.01***	0.05 0.01***	0.05 0.02***
Germany	0.01 0.02	0.01 0.02	0.01 0.02	0.02 0.02	0.01 0.04	0.02 0.04	0.01 0.02	0.05 0.03	0.04 0.03	0.06 0.03**	0.10 0.03***	0.06 0.03**
Greece	0.03 0.02	0.03 0.02*	0.03 0.01**	0.07 0.01***	0.08 0.03***	0.08 0.03***	0.06 0.02***	0.01 0.03	0.03 0.02	0.04 0.02**	0.00 0.03	0.04 0.02
Spain	0.04 0.01***	0.04 0.01***	0.04 0.01***	0.06 0.01***	0.09 0.03***	0.10 0.04***	0.04 0.01***	0.03 0.02	0.02 0.01*	0.04 0.01***	0.03 0.02	0.02 0.01**
France	0.00 0.01	-0.01 0.01	0.01 0.01	-0.01 0.01	0.00 0.03	-0.02 0.01	-0.00 0.01	0.05 0.04	-0.02 0.03	0.01 0.01	0.06 0.05	-0.02 0.03
Italy	0.06 0.02***	0.06 0.02***	0.06 0.02***	0.14 0.01***	0.14 0.02***	0.14 0.02***	0.09 0.02***	0.06 0.02***	0.06 0.02***	0.05 0.02***	0.05 0.02***	0.06 0.02***
Ireland	0.02 0.01*	0.02 0.02	0.01 0.01	0.03 0.02	0.22 0.17	0.24 0.17	0.03 0.01**	0.02 0.02	0.03 0.01**	0.01 0.02	0.02 0.03	0.04 0.02
Netherlands	0.04 0.02**	0.03 0.02*	0.04 0.02**	0.06 0.02***	0.08 0.03***	0.10 0.05**	0.04 0.02**	0.04 0.02**	0.05 0.02***	0.04 0.02*	0.03 0.02	0.04 0.02*
Austria	0.02 0.01*	0.02 0.01*	0.03 0.01*	0.04 0.01***	0.04 0.02**	0.04 0.02**	0.03 0.02	0.03 0.02 **	0.01 0.01	0.02 0.01	0.04 0.01***	0.01 0.02
Portugal	0.15 0.05***	0.19 0.06***	0.03 0.01*	0.04 0.01***	0.20 0.05***	0.21 0.04***	0.23 0.04***	0.16 0.05***	0.17 0.05***	0.16 0.05***	0.16 0.05***	0.17 0.05***
Finland	0.01 0.01	0.01 0.01	0.02 0.02	-0.02 0.02	0.02 0.03	0.02 0.02	0.01 0.02	-0.26 0.09***	0.00 0.02	0.01 0.02	-0.26 0.09***	0.00 0.03
Denmark	0.04 0.02***	0.04 0.02***	0.05 0.02**	0.08 0.02***	0.11 0.03***	0.15 0.05***	0.05 0.02*	0.05 0.02***	0.05 0.02*	0.05 0.02***	0.07 0.02***	0.05 0.02***
Sweden	0.07 0.03***	0.07 0.02***	0.09 0.02***	0.05 0.04	0.12 0.05***	0.13 0.07**	0.09 0.03***	0.09 0.03**	0.06 0.03 *	0.07 0.03**	0.07 0.04*	0.04 0.03
UK	0.12 0.03***	0.12 0.03***	0.13 0.04***	0.08 0.05	0.53 0.21***	0.50 0.19***	0.10 0.03***	0.15 0.03***	0.14 0.03***	0.10 0.05**	0.12 0.04***	0.10 0.04**
US	0.04	0.04	0.04	0.05	0.14	0.17	0.05	0.02	0.04	0.04	-0.02	0.01

	0.02**	0.02***	0.02**	0.03**	0.07**	0.10*	0.01***	0.02	0.02**	0.01**	0.02	0.02
	-0.00	-0.00	-0.00	-0.04	-0.03	-0.02	-0.00	0.05	0.02	-0.01	0.05	0.01
Japan	0.00	0.00	0.00	0.01***	0.07	0.07	0.01	0.01***	0.02	0.01	0.01***	0.03

***' significant at 1%; '**' significant at 5%, '*' significant at 10%

Table 5. Robustness with respect to the SFAs. Baseline models

	Model	Intercept	DEBT	GAP	$PSUR_{-1}$	R^2	h-Durbin
Belgium	GPSUR	-7.77**	0.08**	-0.18	0.73***	0.85	-2.42
	NDEBT	*-3.52***	*0.04***	*-0.00*	*0.75***	*0.92*	*-1.62*
Germany	GPSUR	-4.49***	0.08***	-0.14	0.13	0.24	-0.20
	NDEBT	*-0.03*	*0.01*	*-0.14*	*0.50*	*0.29*	*-0.48*
Greece	GPSUR	-9.33**	0.07*	0.35	0.13	0.29	-0.31
	NDEBT	*-2.89*	*0.03*	*-0.15*	*0.62***	*0.74*	*-0.22*
Spain	GPSUR	-4.44***	0.09***	0.53**	0.24	0.70	1.06
	NDEBT	*-1.65***	*0.04***	*0.17*	*0.55***	*0.85*	*0.16*
France	GPSUR	-0.81	0.58	0.38**	0.20	0.26	2.06
	NDEBT	*0.30*	*-0.01*	*0.16*	*0.55***	*0.51*	*6.38*
Italy	GPSUR	-9.16***	0.10***	0.34**	0.47***	0.91	0.18
	NDEBT	*-5.76***	*0.06***	*0.01*	*0.57***	*0.92*	*0.13*
Ireland	GPSUR	-3.28	0.05*	0.24	0.66***	0.50	-2.65
	NDEBT	*-0.98*	*0.02*	*-0.03*	*0.90***	*0.87*	*0.73*
Netherlands	GPSUR	-4.20***	0.09***	0.34	0.38**	0.69	-0.28
	NDEBT	*-1.95***	*0.05***	*0.20*	*0.49***	*0.66*	*1.08*
Austria	GPSUR	-5.68***	0.10***	0.07	0.20	0.47	1.57
	NDEBT	*-0.54*	*0.02*	*0.19**	*0.46***	*0.48*	*0.80*
Portugal	GPSUR	-13.6***	0.23**	0.35	0.44***	0.59	-0.82
	NDEBT	*-7.59***	*0.14***	*0.13*	*0.38*	*0.65*	*1.98*
Finland	GPSUR	-3.18***	0.10***	0.82**	0.21	0.66	2.93
	NDEBT	*1.94****	*0.02*	*0.63****	*0.39****	*0.82*	*1.14*
Denmark	GPSUR	-4.37*	0.12***	1.31***	0.45***	0.79	0.41
	NDEBT	*-0.35*	*0.05****	*0.47****	*0.61****	*0.83*	*2.88*
Sweden	GPSUR	-15.4***	0.32***	1.81***	0.00	0.88	-0.71
	NDEBT	*-1.50*	*0.09****	*1.25****	*0.37****	*0.88*	*2.36*
UK	GPSUR	-6.59***	0.15***	0.39*	0.67***	0.72	0.47
	NDEBT	*-7.63****	*0.17****	*0.28****	*0.79****	*0.85*	*0.37*
US	GPSUR	-7.97***	0.13***	0.24	0.51***	0.62	0.06
	NDEBT	*-2.36***	*0.04***	*0.29****	*0.75****	*0.81*	*2.40*
Japan	GPSUR	-1.48	0.00	-0.01	0.67***	0.55	-0.71
	NDEBT	*0.27*	*-0.01*	*0.02*	*0.90****	*0.88*	*1.95*

'***' significant at 1%; '**' significant at 5%, '*' significant at 10%

Alternatively, model (10) has been re-estimated by re-calculating the stock of debt net of SFAs to obtain the stock of debt that would have prevailed had the SFAs been zero. The results are shown in Table 5 in the rows labelled 'NDEBT'. Leaving aside the fact that the reactions of the 'gross primary surplus' to gross debt tend to be higher than that of the standard primary surplus, be it to gross or 'net' debt, the main conclusions of Table 3 remain unaltered.

Finally, the main conclusions of Table 3 also remain when a country-specific selection model is carried out, so that for each country the model with the best adjustment power and the least misspecification error is chosen, as shown in Table 6.[10]

[10] Notice that some models (Belgium, France, Italy, see Table 6) include an intervention in 1993 (i.e. a variable that takes value 1 in that year 0 elsewhere) with no significant impacts as regards the reaction of the primary surplus to debt levels. This intervention tries to deal with a large increase in debt levels observed in many countries in 1993, which appear to be associated to the application of the statistical regulations adopted in connection with the fiscal Maastricht criteria with a view to providing rigorous criteria to compile deficit and debt levels in the Member States. As shown by the large SFAs recorded that year, such debt increases were not associated to increases in the deficit and/or the reduction of the growth dividend. In the case of Germany, the intervention takes place in 1995, when the new "Erblastentilgungsfonds" (administered by the federal level) took over the debt from the Treuhandanstalt, which privatized the assets of the former East-Germany and accumulated debt in order to make the companies fit for privatization (or cover the social payments if companies were liquidated). The new fund also took over a debt stock of about 7%. While they do not have a significant impact on the estimates of debt reaction, the inclusion of such interventions improve the adjustment and the specification tests.

Table 6. Refined estimates

	Intercept	DEBT	GAP	$PSUR_{-1}$	Maastricht	Launching of the euro	EMU	Adj. R^2	DW/ h-Durbin
Belgium (1a)	-3.73 1.06***	0.04 0.01***	0.13 0.12	0.57 0.14***		0.01 0.004***		0.93	-1.74
Germany (1b)	-2.25 1.00**	0.07 0.03**	-0.10 0.08	0.34 0.09***			-0.04 0.01***	0.55	-0.66
Greece	-2.85 1.23**	0.02 0.01	0.18 0.17	0.44 0.15***	0.03 0.01*** (2)			0.77	-1.38
Spain	-1.20 0.34***	0.02 0.01*	0.32 0.09***	0.26 0.14*		0.03 0.01***		0.87	0.69
France (1a)	-2.44 0.89***	0.11 0.03***	0.26 0.12**	0.18 0.15	-0.06 -0.02***		-0.02 0.01***	0.70	1.96
Italy (1a)	-4.69 1.57***	0.06 0.02***	0.01 0.10	0.67 0.11***			-0.01 0.003***	0.93	-1.16
Ireland	-2.63 1.17**	0.03 0.01**	-0.06 0.10	0.82 0.06***		0.03 0.01***		0.88	1.04
Nether-lands	-1.96 0.98**	0.05 0.02***	0.30 0.19	0.22 0.19		0.02 0.006***		0.64	1.49
Austria	-0.32 0.57	0.01 0.01	0.17 0.09*	0.32 0.15**		0.01 0.006*		0.57	-0.70
Portugal (1c)	-13.0 2.52***	0.23 0.04***	0.20 0.08**	0.22 0.15				0.72	1.45
Finland (1d)	2.17 052***	0.00 0.01	0.45 0.09***	0.52 0.07***				0.82	-1.20
Denmark	-0.15 0.62	0.04 0.02***	0.51 0.16***	0.62 0.10***				0.82	2.93
Sweden (1d)	-0.94 1.52	0.07 0.02***	0.95 0.29***	0.54 0.14***				0.85	1.52
UK (1c)	-4.03 1.74**	0.10 0.03***	0.23 0.09***	0.78 0.09***				0.83	-0.84
US (1c)	-3.37 0.98***	0.05 0.01***	0.40 0.08***	0.72 0.09***				0.83	1.25
Japan	-2.87 0.52***	0.05 0.01***	0.16 0.09*	0.60 0.05***	-0.04 0.004***			0.95	-0.09

(1a) The model includes an intervention in 1993 to correct for the effect of large statistical revisions of debt levels that took place in such a year;
(1b) The model includes an intervention in 1995 when the debt rose by almost 8 percentage points ¾ of which was explained by a stock-flow adjustment;
(1c) The model includes a non-linear term, positive in the cases of Portugal and the US and negative in the UK;
(1d) The model includes a dummy taking value 1 between 1990 and 1992, the coefficient of which is negative and significant at 1% (-0.15) in Finland and at 5% (-0.05) in Sweden;
(2) The dummy takes value 1 between 1993 and 2000;
Standard errors are shown below the parameter estimate: '***' significant at 1%, '**' significant at 5%, '*' significant at 10%.

If the whole period is considered (see column 'DEBT' in table 6) there is no country for which a negative and statistically significant reaction to debt has been estimated. Moreover, in some euro area countries such as Belgium, Greece, Spain, Ireland, the Netherlands and Austria, the reaction of the primary balance to the stock of debt was increased either after 1993, thus linked to the adoption of the Maastricht Treaty and the convergence criteria, or after 1996, thus in the aftermath of the formal launching of the euro at the end of 1995. As a result, a non-significant reaction in Greece and Austria became significant during the nineties, thus fulfilling the sustainability condition (6). In the case of Spain, a relatively weak response became much stronger after 1996. In France, the positive and relatively large response of the primary balance to debt was halved after 1993, but still leaving it to a size comparable to that estimated for other countries (around 0.05). In Japan, the change in fiscal policy that occurred after the crisis of the early nineties has totally offset the secular positive reaction of the primary surplus to debt.

Interestingly, in a number of countries, namely Germany, Greece, France and Italy, there is some evidence of a sort of EMU fatigue, which has lowered the reaction of the primary surplus to debt during the 2000s. The reduction appears sizeable in Germany, as well as in France, where it added to that taking place after 1993. The reduction has also been important in Greece, where the positive reaction of 0.03 that prevailed during the nineties left way to the behaviour already observed in the seventies and the eighties.

All in all, after controlling for breaks in the baseline model (Table 3), Table 6 confirms that the fulfilment of the sustainability condition given by (6) has been general across the sample.[11] Greece and Finland seem to be the only outstanding exceptions. However, in the latter

[11] Implicit in our analysis is the assumption that debt and primary surplus have the same order of integration. Appendix B reports unit root tests results which fail to display unambiguous statistical evidence in this sense. However, our sample size is too small for this matter and we take this as inconclusive evidence.

case, one should bear in mind that the events of the period 1990-1992, when the effects of the fall of the former USSR and the 1992 crisis overlapped prompting a dramatic increase of debt levels (see section 3), make the estimation of reaction function for this country very difficult. In addition, the primary surplus has started to fall only recently while its debt has been on a downward path since 1993, which does not point precisely to an unsustainable fiscal behaviour. On the other hand, we should not forget that our requirement for sustainability is a sufficient but not a necessary condition.

A Closer look at the Response of Primary Surplus to Debt

The analysis in section 4 provides robust evidence supporting the conclusion that most EU countries can be characterized as having a positive response of the primary surplus to debt accumulation over the full sample period. It also allows to identify some significant shifts in the response of some countries as the economic and monetary integration process in Europe has evolved, indicating the existence of some degree of time variation in that response.

However, the analysis of last section does not allow to trace with some precision that degree of time variation. This is so because it cannot provide relatively precise estimates of the value of the response in small sub-samples, due to the lack of degrees of freedom. It provides estimates of the average response for the overall sample period, which is then permanently corrected with ad hoc dummy effects after specific sample events. But it does not provide a systematic updating mechanism to obtain explicit probability distributions of the primary surplus response to debt for different (small) sub-sample periods. Explicit characterization of these distributions would be helpful for a systematic investigation of the statistical evolution of time variation over the sample.

This section gives a step in this direction by specifying and estimating a Bayesian version of our basic model (10), which avoids ad hoc permanent corrections of the response to debt accumulation. A Bayesian updating scheme is a sensible approach in our small sample setting, where low degrees of freedom and difficulties to apply asymptotic results or to establish long run statistical properties of time series make questionable the application of classical econometric methods.

Model (10) has a vector autoregressive form with government debt and output gap as exogenous variables. This allows a straight application of the Bayesian Vector Autoregressive (BVAR) methodology.[12] BVAR models are well designed to handle the trade-off between over and under parameterization in contexts of limited size samples, providing an objective scheme for the updating of prior estimates.

The specification of prior beliefs is in fact the critical point once we move to a Bayesian framework. With long samples the prior effect on posterior estimates is negligible because sample information ends up shaping the final results. However, with small samples the prior might be the determinant factor (arguably leading to ad hoc final results when prior information is ad hoc). This would be the case if the specified prior is so tight (very small variance) that final results are unaffected by sample observations. On the other extreme, a too loose (large variance) prior could lead to very volatile posterior estimates, largely affected by new sample observations, as it is the typical case in a context of scarce degrees of freedom. Ideally we want a not too loose/not too tight prior. A prior that deals with the degrees of freedom problem but that it is at the same time sensitive to new sample observations that call for its modification. This is one of the underlying principles in BVAR models. A second principle is that the

[12] For a description of the methodology see e.g. Doan, Litterman & Sims (1986) and Ballabriga (1997).

prior odds are tilted towards own lags, which have a higher prior variance.

With these principles in mind our prior specification treats the parameter vector in (10), β = (ρ, δ, γ, c), as a multivariate normal with independent components and the following mean vector and covariance matrix

$$\overline{\beta} = \begin{pmatrix} \hat{\rho} \\ \hat{\delta} \\ 0 \\ 0 \end{pmatrix} \quad ; \quad \text{cov}(\beta) = diag[0.5\hat{\sigma}_{\varepsilon} \quad 0.01(0.5\hat{\sigma}_{\varepsilon}) \quad 0.01(0.5\hat{\sigma}_{\varepsilon}) \quad 40(0.5\hat{\sigma}_{\varepsilon})] \quad (11)$$

where $\hat{\rho}$ and $\hat{\delta}$ are the least square estimates in Table 6 and $\hat{\sigma}_{\varepsilon}$ is the least square estimate of the error term variance in an autoregressive regression of the primary surplus with one lag, a scaling factor helpful to control for the units of measurement of variables.

In line with BVAR models, the covariance in (11) gives more weight to the own lag coefficient (50% of the error term variance) than to the coefficients of other variables (1% of the own lag coefficient variance), and specifies a flat prior for the constant term. As for the prior mean vector, a common practice in the BVAR literature is to specify a prior mean equal to one for the own first lag and equal to zero for the rest of the coefficients in the equation. The vector in (11) incorporates a slight deviation from this practice by taking as useful prior information the estimates in Table 6 for the inertia component and, our focus of attention, the reaction to debt accumulation.

Our objective is to compare the posterior distribution of the primary surplus response to debt across different sub-samples. To that end, we combine according to Bayes rule the prior information in (11) with each of the following three sub-sample periods: 1977-1991, 1992-1999, 2000-2005. Doing this we can assess the extent to which the information in each of these sub-periods is compatible with the

estimates for the overall sample response in Table 6. The resulting posterior densities are reported in Table 7, with the corresponding graphical representation in Figure 2.

Table 7. Posterior distributions for δ

	1977-1991		1992-1999		2000-2005	
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**	**Mean**	**Standard Deviation**
B	0.05	0.022	0.02	0.019	0.04	0.027
D	0.07	0.043	0.04	0.023	0.02	0.010
GR	-0.02	0.035	0.07	0.049	0.00	0.032
E	0.04	0.025	0.04	0.043	0.02	0.015
F	0.07	0.028	0.07	0.032	0.04	0.042
I	0.04	0.020	0.03	0.032	0.02	0.014
IRL	0.06	0.027	0.00	0.020	0.10	0.041
NL	0.04	0.020	0.01	0.033	0.05	0.057
A	0.03	0.018	0.01	0.040	0.02	0.044
P	0.15	0.058	0.11	0.008	0.10	0.070
FIN	0.05	0.105	0.06	0.046	0.11	0.031
DK	0.08	0.038	0.01	0.015	0.05	0.075
S	0.10	0.051	0.10	0.097	0.09	0.056
UK	0.05	0.039	0.16	0.053	0.10	0.029
US	0.01	0.026	0.03	0.016	0.03	0.045
JP	0.05	0.017	-0.02	0.028	-0.02	0.030

A general feature of the information in the table is that it conveys evidence of time variation in the response to debt accumulation in most countries. More specifically, we detect a rather clear shift across sub-periods of the posterior distribution in the cases of Belgium, Germany, Greece, France, Ireland, Netherlands, Finland, Denmark, UK and Japan. The rest of the countries in the panel seem to display more stability. On the other hand, in most euro area countries the shift in the posterior may be associated with the economic and monetary integration effects modelled as dummy effects in Table 6. Only in the cases of Spain and Austria the integration effects identified in Table 6 are non-visible in Table 7.

Looking at particular countries, some interesting features are noteworthy. First, the results for Germany and France nicely reflect the progressive deterioration of fiscal discipline across sub-periods, especially in the case of Germany. Second, the posterior is centred on a non-positive mean in the cases of Greece (except in 1992-99) and Japan (except in 1977-91). Third, Finland now displays a progressive and significant improvement in terms of the sustainability of its fiscal policy. The difficulties visible during the period 1977-91 are overcome in the following two sub-periods, ending with a current sound fiscal position. This is in sharp contrast with the overall conclusion in Table 6.

Overall, Table 7 conveys a similar qualitative message that Table 6: The response of the primary surplus to accumulated debt has been generally positive across countries and sub-sample periods, except in Greece and Japan. This result reinforces the robustness of the conclusion that fiscal policy has been sustainable in EU15 countries during the last 30 years.

Conclusions

This paper analyses the sustainability of EU15 public finances in line with the recent literature on fiscal reaction functions. According to this approach a positive response of the primary surplus to debt accumulation is sufficient for sustainability in a wide range of dynamic stochastic general equilibrium models, thus providing a rather general condition for testing the sustainability of fiscal policy.

Our baseline fiscal reaction function specification assumes that the primary surplus responds to debt accumulation and to the output gap, and also incorporates the lagged surplus to capture fiscal inertia. The estimation of this baseline model for the sample period 1977-2005 suggests that a positive response to debt accumulation is quite

widespread, thus indicating that fiscal policy is sustainable in most countries.

A main concern of the paper is the robustness of this result. Therefore, we consider several alternatives to our baseline in order to investigate the potential existence of simultaneity bias, the effect of including and excluding different explanatory variables, and the effect of specifying a non-linear fiscal reaction function. The qualitative baseline result is robust to these changes. We also explore the existence of structural breaks in the response to debt through the inclusion of ad hoc dummy effects associated with specific events along the process of economic and monetary integration in the European Union. This analysis does not change the qualitative baseline result, but reveals the existence of a Maastricht/euro-launching positive correction in the response to debt in many countries, and the existence of a "Maastricht fatigue" in some of them, indicating time variation in the response of governments to debt accumulation.

Another main concern of this paper is to provide an alternative to ad hoc dummies in order to investigate this time variation in the response to debt accumulation from a more systematic perspective. In this respect, we argue that a Bayesian approach provides a sensible endogenous updating scheme in our small sample context, and we estimate a Bayesian version of the baseline model for three different sub-samples: 1977-1991, 1992-1999, 2000-2005. We find that the posterior distribution has tended to shift across sub-samples in most countries, which supports the hypothesis of a time varying response to debt. The comparison of posteriors provides an explicit characterization of this time variation, and indicates that a positive posterior mean for the response to debt accumulation is pervasive. This enhances the robustness of our results.

From a policy perspective, we see two messages from our analysis. First, if sustainability is the issue, there is no clear reason for concern. The evidence for last 30 years suggests that, with the exception of

Greece, EU15 governments have tended to apply a fluctuating but generally positive primary surplus adjustment in response to debt accumulation. This is sufficient to guarantee the sustainability of fiscal policy.[13] Second, the posterior distribution from our Bayesian analysis provides a sensible, easy-to-update indicator for the evolution of the sustainability position of countries. A country with a posterior centred around a non-positive response for a given number of periods could be called for a fiscal correction on sustainability grounds.

Finally, a comment on follow-up research. A natural direction for further work in the issue of sustainability is to try to specify and estimate a model with time varying coefficients. This may require longer samples. A successful attempt though would generate time series for the response of the primary surplus to debt accumulation, thus providing the raw material that would allow moving from the objective of testing sustainability, the focus of this paper, to the objective of identifying its potential determinants.

[13] Although the size of response is also relevant in order to exclude explosive debt/GDP ratios.

Appendix A. Complementary Tables

Table A1. Government balances, interest payments and primary surpluses* 1977-2005

Government balances (net lending in % of GDP)*									
	1977	**77-93****	**1993**	**93-96****	**1996**	**96-99****	**1999**	**99-05****	**2005**
Belgium	-5.6	**-7.8**	-7.0	**-4.8**	-3.8	**-1.8**	-0.5	**0.0**	-0.1
Germany	-2.4	**-2.3**	-3.4	**-3.1**	-3.3	**-2.4**	-1.5	**-2.5**	-3.3
Greece	-2.5	**-8.9**	-13.6	**-10.3**	-7.4	**-5.4**	-3.5	**-4.9**	-4.4
Spain	-0.6	**-3.8**	-6.6	**-6.1**	-4.9	**-3.0**	-1.2	**-0.3**	1.1
France	-0.8	**-2.1**	-5.6	**-5.0**	-4.1	**-2.8**	-1.7	**-2.7**	-2.9
Italy	-6.9	**-10.0**	-9.1	**-8.1**	-6.9	**-3.7**	-1.7	**-2.8**	-4.3
Ireland	-6.9	**-7.3**	-2.3	**-1.5**	-0.1	**1.5**	2.4	**1.4**	1.0
Netherlands	-0.8	**-4.0**	-3.0	**-3.0**	-1.7	**-0.7**	0.6	**-0.7**	-0.3
Austria	-2.2	**-2.7**	-4.1	**-4.4**	-4.0	**-2.6**	-2.3	**-1.3**	-1.6
Portugal	-3.8	**-6.0**	-5.6	**-5.3**	-4.5	**-3.4**	-2.7	**-3.6**	-6.0
Finland	5.4	**1.9**	-7.8	**-5.6**	-3.5	**-0.4**	1.6	**3.5**	2.4
Denmark	-0.6	**-2.0**	-2.8	**-2.1**	-1.1	**0.6**	2.2	**2.4**	4.7
Sweden	1.6	**-2.0**	-11.4	**-7.7**	-2.8	**0.1**	2.3	**1.9**	2.7
UK	-3.2	**-2.9**	-7.7	**-6.0**	-4.2	**-1.3**	1.1	**-0.9**	-3.5
US	-2.1	**-3.9**	-4.9	**-3.5**	-2.2	**-0.4**	0.9	**-2.1**	-4.1
Japan	-2.8	**-1.1**	-2.4	**-4.0**	-5.1	**-5.4**	-7.2	**-6.9**	-6.1
Interest expenditure (% of GDP)									
	1977	**77-93*****	**1993**	**93-96*****	**1996**	**96-99*****	**1999**	**99-05*****	**2005**
Belgium	3.8	**8.4**	10.3	**9.3**	8.5	**7.6**	6.9	**5.8**	4.5
Germany	1.7	**2.6**	3.1	**3.4**	3.5	**3.3**	3.1	**3.0**	2.8
Greece	1.2	**5.6**	12.6	**12.8**	12.0	**10.1**	8.4	**6.5**	4.8
Spain	0.3	**2.2**	4.9	**5.0**	5.2	**4.4**	3.5	**2.7**	1.8
France	1.1	**2.3**	3.3	**3.5**	3.6	**3.3**	3.0	**2.9**	2.7
Italy	4.3	**7.6**	11.7	**11.1**	11.3	**8.9**	6.7	**5.7**	4.7
Ireland	4.9	**7.2**	6.2	**5.3**	4.5	**3.5**	2.4	**1.5**	1.2
Netherlands	2.9	**5.0**	5.8	**5.5**	5.3	**4.8**	4.3	**3.1**	2.4
Austria	1.8	**3.2**	4.2	**4.1**	3.9	**3.7**	3.5	**3.3**	2.9
Portugal	1.4	**5.3**	5.7	**5.6**	5.1	**3.9**	3.0	**2.9**	2.7
Finland	0.8	**1.6**	4.5	**4.7**	4.2	**3.7**	3.0	**2.3**	1.6
Denmark	1.7	**6.2**	7.2	**6.4**	5.7	**4.8**	4.1	**3.1**	2.1
Sweden	2.4	**5.3**	5.8	**6.3**	6.5	**5.7**	4.7	**3.0**	1.9
UK	4.3	**4.1**	2.8	**3.3**	3.7	**3.5**	2.9	**2.3**	2.2
US	1.6	**2.7**	3.4	**3.4**	3.4	**3.1**	2.7	**2.1**	1.8
Japan	0.5	**1.5**	1.2	**1.3**	1.3	**1.4**	1.5	**1.5**	1.6

Primary surpluses*									
	1977	**77-93****	**1993**	**93-96****	**1996**	**96-99****	**1999**	**99-05****	**2005**
Belgium	-1.7	**0.7**	3.4	**4.5**	4.7	**5.8**	6.4	**5.8**	4.5
Germany	-0.7	**0.3**	-0.2	**0.2**	0.2	**0.9**	1.7	**0.5**	-0.5
Greece	-1.3	**-3.3**	-1.0	**2.5**	4.6	**4.6**	4.9	**1.6**	0.5
Spain	-0.1	**-1.5**	-1.7	**-1.1**	0.4	**1.4**	2.3	**2.4**	2.9
France	0.3	**0.2**	-2.3	**-1.5**	-0.4	**0.5**	1.2	**0.2**	-0.2
Italy	-2.6	**-2.3**	2.5	**3.0**	4.3	**5.2**	4.9	**2.8**	0.4
Ireland	-2.0	**-0.1**	3.9	**3.8**	4.4	**5.0**	4.8	**2.9**	2.2
Netherlands	2.1	**1.0**	2.8	**2.5**	3.6	**4.1**	4.9	**2.4**	2.2
Austria	-0.5	**0.5**	0.1	**-0.4**	-0.1	**1.1**	1.2	**2.0**	1.2
Portugal	-2.4	**-0.8**	0.1	**0.4**	0.6	**0.4**	0.3	**-0.7**	-3.3
Finland	6.1	**3.5**	-3.3	**-0.9**	0.6	**3.3**	4.6	**5.8**	4.1
Denmark	1.2	**4.2**	4.4	**4.3**	4.6	**5.5**	6.3	**5.4**	6.8
Sweden	4.0	**3.3**	-5.6	**-1.5**	3.7	**5.8**	7.0	**5.0**	4.6
UK	1.1	**1.2**	-4.9	**-2.7**	-0.5	**2.1**	4.1	**1.5**	-1.3
US	-0.6	**-1.2**	-1.5	**0.0**	1.2	**2.7**	3.6	**0.0**	-2.3
Japan	-2.3	**0.4**	-1.2	**-2.7**	-3.7	**-4.0**	-5.8	**-5.5**	-4.4

* A minus sign represents a deficit

Averages of the balances recorded during the period including the two extreme years of the time interval

Averages of the interest expenditure recorded during the period including the two extreme years of the time interval

Averages of the balances recorded during the period including the two extreme years of the time interval

Source: European Commission

Table A2. Implicit interest rates of gross government debt 1977-2005

	1977	77-93**	1993	93-96**	1996	96-99**	1999	99-05**	2005
Belgium	6.5	**8.1**	7.9	**7.2**	6.7	**6.3**	6.0	**5.6**	4.8
Germany	6.2	**6.7**	6.9	**6.5**	6.0	**5.6**	5.2	**4.8**	4.2
Greece	6.1	**9.4**	11.5	**11.7**	10.8	**9.0**	7.5	**5.9**	4.5
Spain	2.2	**5.6**	8.7	**8.2**	7.9	**6.8**	5.6	**5.0**	4.2
France	6.0	**8.0**	7.5	**7.0**	6.3	**5.7**	5.1	**4.7**	4.0
Italy	7.8	**9.6**	10.2	**9.4**	9.3	**7.6**	5.9	**5.3**	4.4
Ireland	8.3	**8.4**	6.7	**6.4**	6.2	**5.9**	5.0	**4.3**	4.2
Netherlands	7.7	**8.3**	7.7	**7.6**	7.4	**7.3**	7.1	**5.8**	4.6
Austria	6.2	**6.8**	6.9	**6.3**	5.8	**5.6**	5.3	**5.0**	4.5
Portugal	4.5	**9.7**	9.9	**9.4**	8.5	**7.0**	5.9	**5.2**	4.2
Finland	9.8	**9.2**	8.0	**8.3**	7.4	**7.2**	6.5	**5.2**	4.1
Denmark	12.5	**11.5**	9.3	**9.0**	8.2	**7.6**	7.1	**6.5**	6.0
Sweden	9.0	**10.4**	8.2	**8.7**	8.9	**8.3**	7.5	**5.6**	3.9
UK	7.1	**8.3**	5.9	**6.5**	7.0	**7.1**	6.5	**5.7**	5.0
US	3.4	**4.6**	4.5	**4.6**	4.6	**4.5**	4.2	**3.5**	2.7
Japan	1.4	**2.2**	1.6	**1.5**	1.4	**1.3**	1.2	**1.0**	1.0

** Averages of the ratio of the interest expenditure to debt recorded during the period including the two extreme years of the time interval

Table A3. Debt accounting, 1994-1996, 1997-1999 and 2000-2005

	Debt (1)	Deficit (2)	Interest burden (3)	Primary balance (4)	Nominal GDP growth (5)	Inflation (6)	Real GDP growth (7)	Stock-flow adjustment (8)
1994-1996								
Belgium	-1.19	4.08	8.89	-4.81	-4.44	-1.65	-2.79	-0.83
Germany	4.20	3.04	3.44	-0.40	-1.60	-0.74	-0.86	2.76
Greece	0.40	9.26	12.89	-3.63	-11.49	-9.39	-2.10	2.63
Spain	3.27	5.91	5.01	0.90	-3.73	-2.33	-1.40	1.08
France	4.63	4.80	3.57	1.23	-1.48	-0.68	-0.80	1.31
Italy	1.89	7.74	10.93	-3.20	-7.29	-5.19	-2.10	1.45
Ireland	-6.73	1.24	4.98	-3.75	-8.02	-1.89	-6.13	0.05
Netherlands	-0.88	2.97	5.41	-2.44	-3.49	-1.34	-2.15	-0.35
Austria	2.42	4.57	0.00	0.54	-2.60	-1.14	-1.46	0.45
Portugal	0.60	5.14	5.58	-0.44	-4.13	-2.48	-1.65	-0.41
Finland	0.21	4.84	4.76	0.09	-3.09	-1.09	-2.00	-1.54
Denmark	-2.62	1.93	6.20	-4.27	-3.79	-1.14	-2.65	-0.76
Sweden	0.78	6.49	6.43	0.06	-3.75	-1.69	-2.06	-1.96
UK	1.56	5.43	3.41	2.02	-2.79	-1.25	-1.54	-1.08
US	-0.65	2.96	3.44	-0.48	-1.86	0.66	-2.51	-1.76
Japan	6.34	4.51	1.28	3.23	-1.02	0.48	-1.50	2.85
1997-1999								
Belgium	-4.45	1.12	7.31	-6.19	-4.78	-1.52	-3.26	-0.79
Germany	0.58	2.09	3.29	-1.20	-1.37	-0.24	-1.13	-0.15
Greece	0.33	4.78	9.43	-4.65	-8.95	-5.35	-3.60	4.50
Spain	-1.72	2.41	4.10	-1.69	-4.23	-1.58	-2.65	0.10
France	0.22	2.45	3.24	-0.79	-2.04	-0.37	-1.67	-0.19
Italy	-2.29	2.55	8.08	-5.52	-4.48	-2.49	-1.99	-0.37
Ireland	-8.10	-2.03	3.19	-5.23	-8.47	-2.83	-5.64	2.40
Netherlands	-3.88	0.39	4.64	-4.25	-4.14	-1.41	-2.73	-0.13
Austria	-0.38	2.18	0.00	-1.44	-2.02	-0.20	-1.82	-0.54
Portugal	-2.86	3.05	3.45	-0.40	-4.19	-1.96	-2.23	-1.72
Finland	-3.58	-0.69	3.56	-4.25	-3.66	-1.15	-2.51	0.77
Denmark	-3.93	-1.19	4.54	-5.74	-2.69	-1.04	-1.65	-0.04
Sweden	-3.60	-1.07	5.39	-6.47	-3.10	-0.77	-2.33	0.58
UK	-2.44	0.34	3.38	-3.04	-2.77	-1.28	-1.49	-0.01
US	-3.12	-0.16	3.02	-3.19	-1.81	1.23	-3.04	-1.14
Japan	10.59	5.52	1.40	4.11	0.61	0.36	0.26	4.46

2000-2005								
Belgium	-3.38	-0.08	5.61	-5.69	-3.83	-1.95	-1.88	0.53
Germany	1.26	2.70	2.96	-0.26	-1.12	-0.42	-0.69	-0.32
Greece	-0.80	5.17	6.16	-0.99	-8.41	-3.90	-4.51	2.44
Spain	-3.07	0.14	2.54	-2.40	-3.87	-2.11	-1.76	0.66
France	1.49	2.84	2.84	0.01	-2.18	-1.08	-1.09	0.82
Italy	-1.23	3.02	5.51	-2.48	-4.05	-2.86	-1.19	-0.20
Ireland	-3.41	-1.27	1.36	-2.63	-3.37	-1.40	-1.96	1.22
Netherlands	-1.26	0.94	2.89	-1.95	-2.32	-1.56	-0.76	0.12
Austria	-0.59	1.16	0.00	-2.08	-2.23	-1.09	-1.14	0.47
Portugal	2.09	3.72	2.85	0.87	-2.21	-1.64	-0.57	0.57
Finland	-0.92	-3.81	2.14	-5.94	-1.80	-0.63	-1.17	4.69
Denmark	-3.59	-2.42	2.88	-5.30	-1.96	-1.16	-0.80	0.79
Sweden	-1.97	-1.87	2.75	-4.62	-2.16	-0.80	-1.36	2.06
UK	-0.23	1.21	2.25	-1.04	-1.92	-0.89	-1.03	0.48
US	0.39	2.59	2.05	0.54	-1.34	0.34	-1.68	-0.86
Japan	5.91	6.90	1.49	5.41	-0.37	2.06	-2.43	-0.61

(1) Annual average change in the debt-to-DGP ratio (%); (2) Annual average change in the deficit-to-DGP ratio (%); (3) Annual average change in interest expenditure (% of GDP); (4) Annual average change in the primary balance-to-DGP ratio (%) (4)=(2)-(3); (5) Annual average effect of nominal GDP growth; (6) Annual average effect of inflation; (7) Annual average effect of real GDP growth(7) = (5) - (6); (8) Annual average stock-flow adjustment (8) = (1) - (2) - (5)

Appendix B. Unit Root Tests

The comparison of developments in government gross debt over the last 10 years (see figure below) reveals that debt growth has been entirely nominal in Belgium, Spain, Ireland, Italy, Netherlands, Finland and Sweden, and has been real in Germany, Greece, France, Austria, Portugal, UK, US and Japan. Both when measured in nominal and real terms, gross government debt appear to behave as integrated series in a majority of countries. As a matter of fact the usual unit root tests are not able to reject the null of unit root for both nominal and real debt.[14]

When debt levels are scaled by GDP a somewhat different picture emerges. After being on a rising path, the debt-to-GDP ratio attained a maximum in most countries around the mid-nineties and has been on a descendent path since them. The clearest exceptions appear to be Germany and France (and Japan). Yet, as shown in Table B1, the usual unit root tests, including that by Kwiatkowski et al (1992), where the null hypothesis is mean or trend stationary when the residuals are assumed to be AR(1)[15] fail to present unambiguous statistical evidence against the existence of a unit root in the debt-to-GDP ratios.

[14] Results available on request.
[15] The Barlett window, $1 - s/(l + 1)$, in the test is calculated for $l=1$ (then $s=1$).

Table B1. Unit root tests for gross debt series in % of GDP, 1977-2005

	η_μ (1)	η_τ (2)	W-S (3)	ADF (4)	PP (5)
B	0.60	0.37	-1.71	-2.88	-0.86
D	1.46	0.10*	-2.04	-2.83	-8.77
GR	1.44	0.30	-0.63	0.25	0.64
E	1.15	0.28	-1.27	-1.44	0.74
F	1.50	0.14*	-1.46	-3.14°	-8.18
I	1.28	0.32	-0.67	-1.39	-0.93
IRL	0.79	0.36	-1.33	-2.81	-2.53
NL	0.44*	0.37	-2.86	-3.18°°	-1.74
A	1.36	0.33	-0.25	-0.64	-0.86
P	0.62	0.29	-1.65	-3.74°°	-4.74
FIN	1.15	0.15*	-2.02	-2.21	-5.38
DK	0.35*	0.29	-1.08	-2.35	-3.66
S	0.46*	0.19	-2.15	-2.70	-5.91
UK	0.75	0.13*	-2.63	-3.08	-8.44
US	0.83	0.33	-2.18	-2.29	-2.94
JP	1.32	0.31	-1.32	-3.25	-2.24

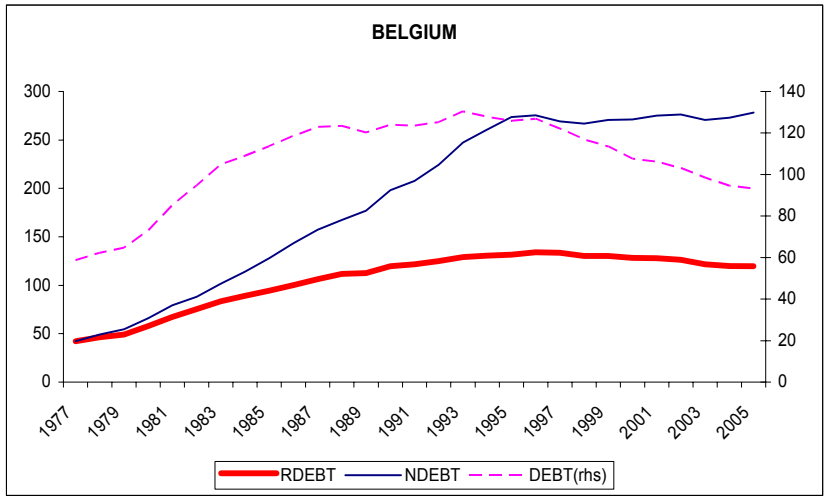
(1) Test of Kwaikowski et al (null hypothesis mean-stationary): critical value at 5% 0.46
(2) Test of Kwaikowski et al (null hypothesis trend-stationary): critical value at 5% 0.15
(3) Weighted-Symmetric (null hypothesis unit root)
(4) Augmented Dickey-Fuller (null hypothesis unit root)
(5) Phillips-Perron (null hypothesis unit root)
'*' The null of mean/trend-stationary can be accepted at 5%
'°°°' The null unit root can be rejected at 1% ('°°' 5%, '°' 10%)

Table B2 reports unit root test results for the primary surplus scaled by GDP with only marginally more consistent results across alternative tests.

Table B2. Unit root tests for gross primary surplus series in % of GDP, 1977-2005

	η_μ (1)	η_τ (2)	W-S (3)	ADF (4)	PP (5)
B	1.30	0.23	-1.70	-1.20	-4.92
D	0.19*	0.14*	-2.48	-2.19	-12.6
GR	0.77	0.17	-1.74	-1.97	-6.95
E	1.03	0.12*	-2.19	-3.94°°	-10.1
F	0.08*	0.06*	-3.73°°°	-3.73°°	-10.5
I	1.18	0.19	-1.10	-0.71	-3.02
IRL	0.94	0.28	-1.49	-1.30	-4.60
NL	0.54	0.12*	-3.11°°	-3.08	-11.1
A	0.64	0.06*	-2.77	-2.47	-12.7
P	0.48	0.28	-1.30	-0.75	-4.76
FIN	0.14*	0.14*	-2.13	-1.92	-8.76
DK	0.34*	0.16	-2.47	-2.48	-7.83
S	0.11*	0.08*	-3.56°°	-3.22°	9.69
UK	0.11*	0.07*	-3.76°°°	-3.37°°	-9.22
US	0.24*	0.12*	-3.36	-3.22°°	-7.07°
JP	0.70	0.30	-2.02	-2.35	-3.84

Test of Kwaikowski et al (null hypothesis mean-stationary): critical value at 5% 0.46
(2) Test of Kwaikowski et al (null hypothesis trend-stationary): critical value at 5% 0.15
(3) Weighted-Symmetric (null hypothesis unit root)
(4) Augmented Dickey-Fuller (null hypothesis unit root)
(5) Phillips-Perron (null hypothesis unit root)
'*' The null of mean/trend-stationary can be accepted at 5%
'°°°' The null unit root can be rejected at 1% ('°°' 5%, '°' 10%)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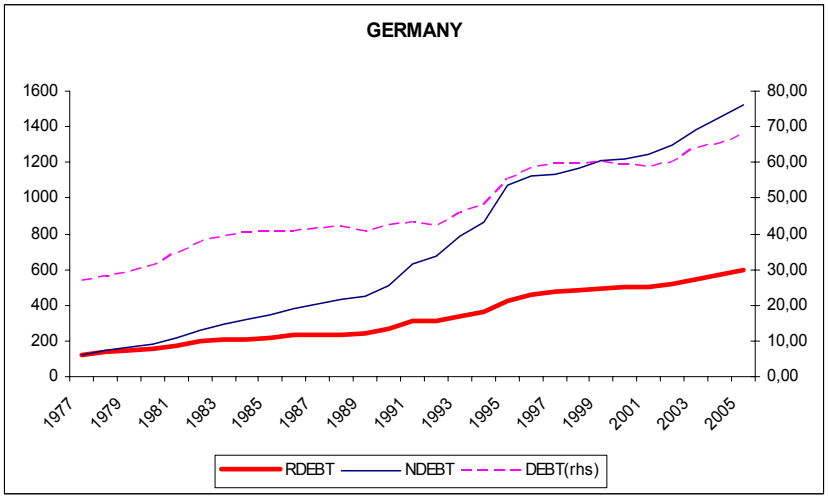
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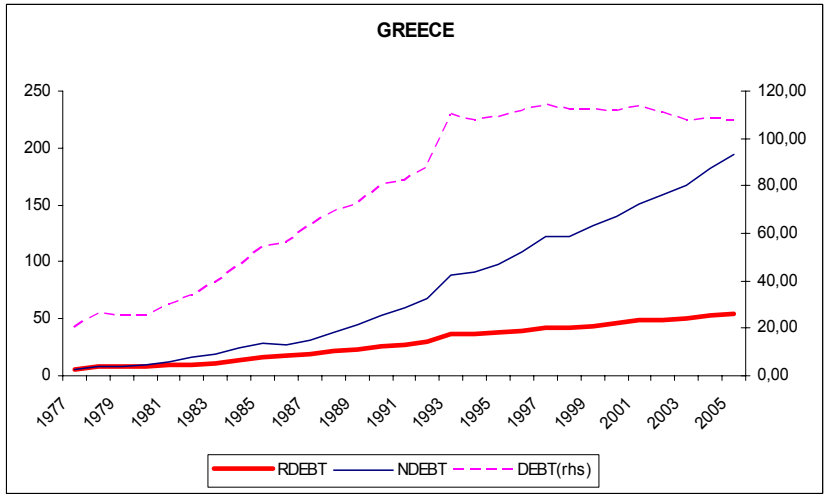
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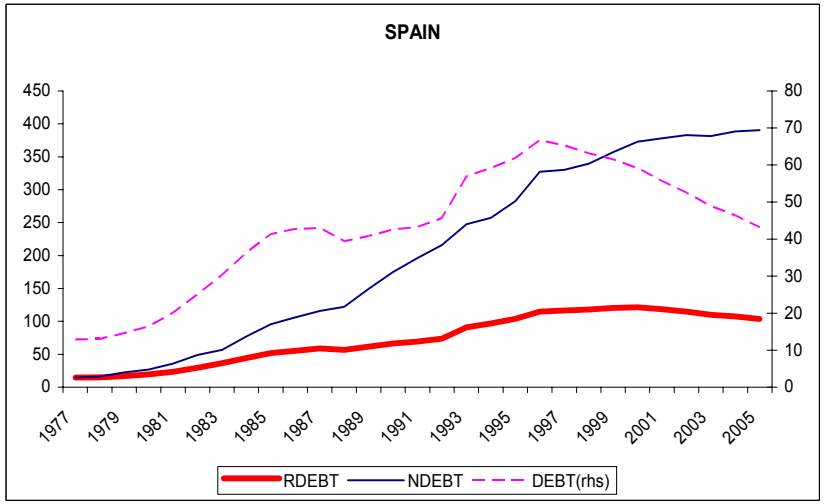
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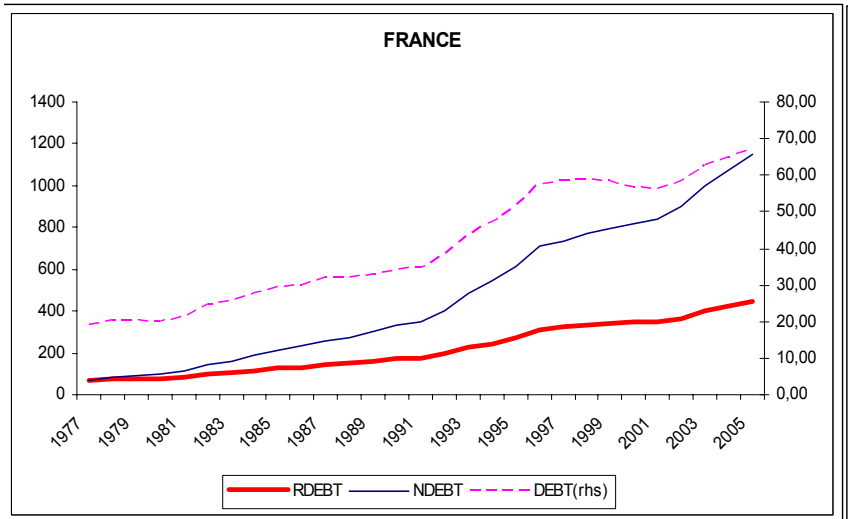
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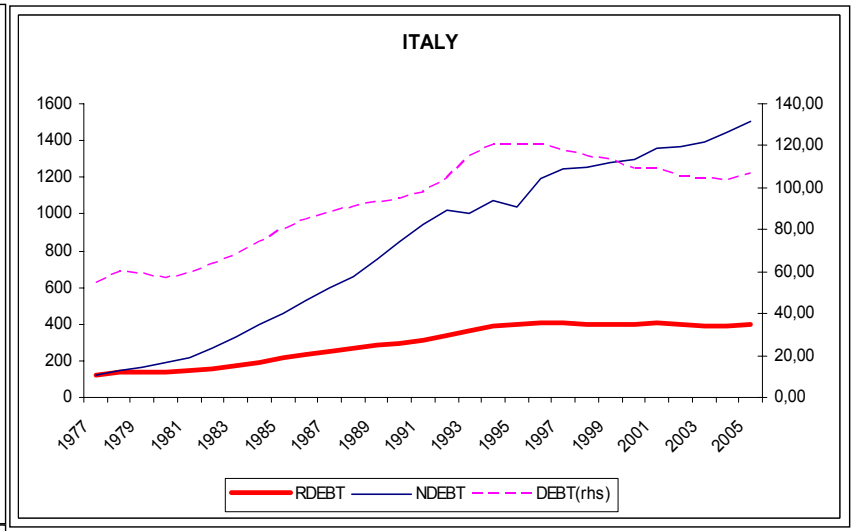
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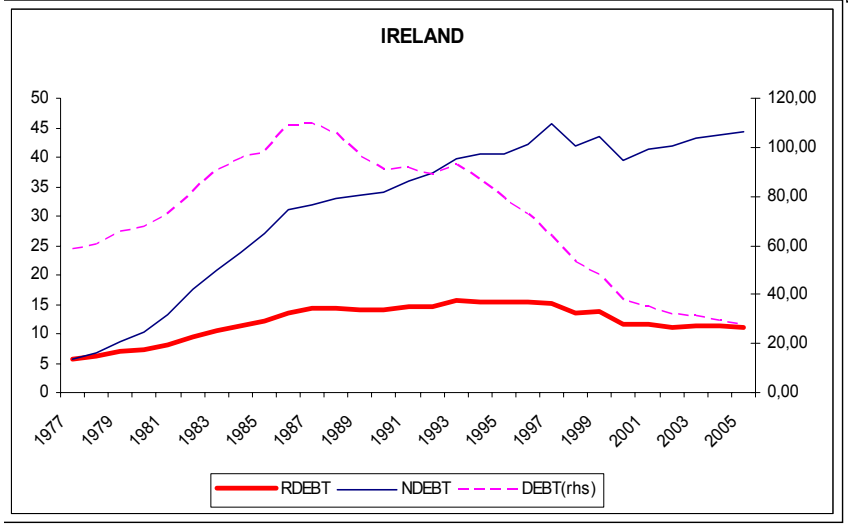
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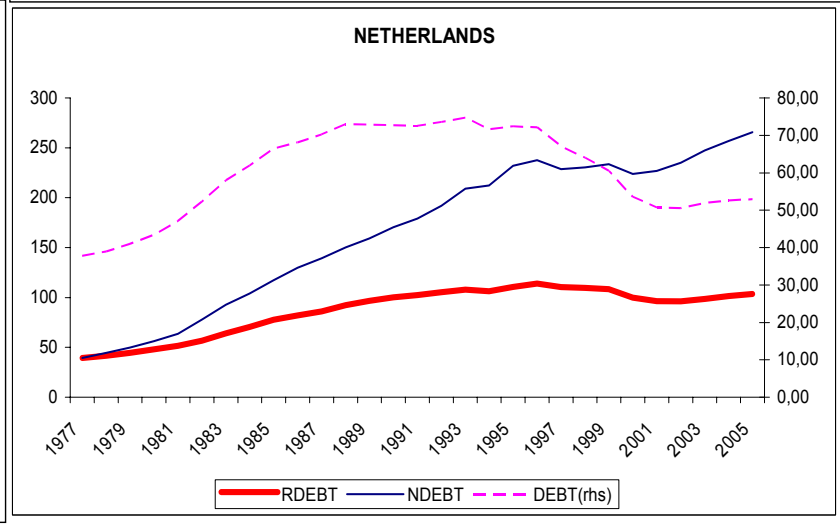
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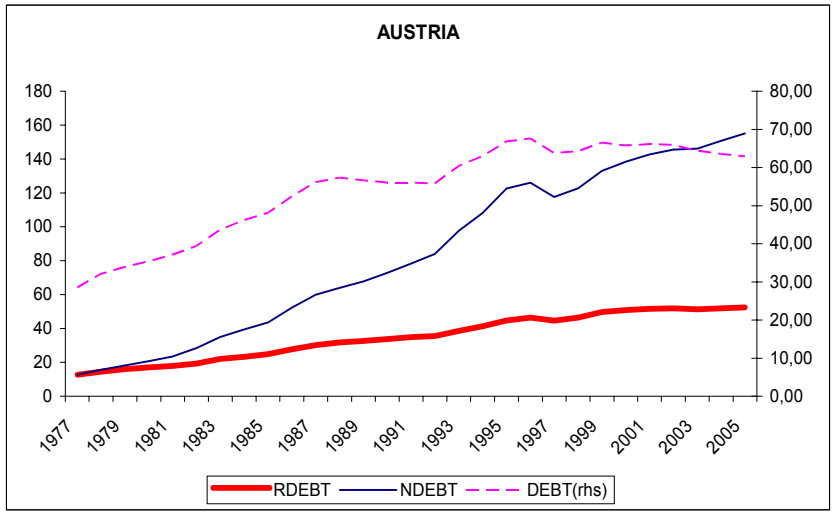
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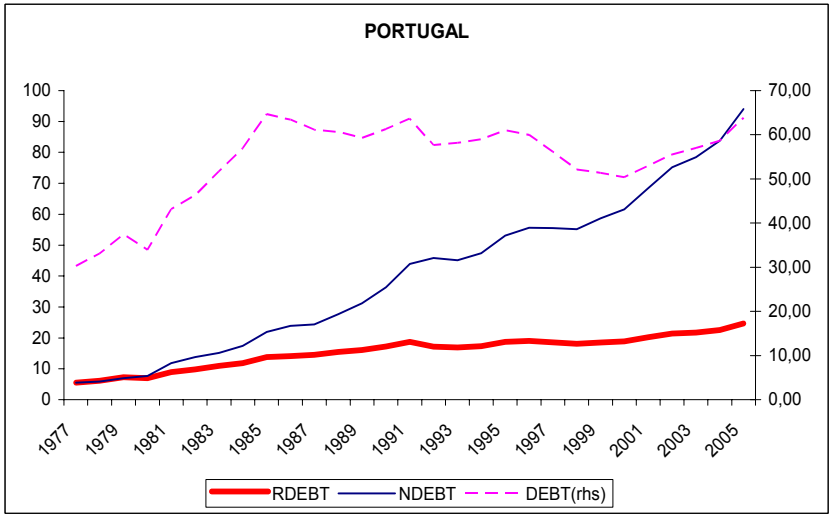
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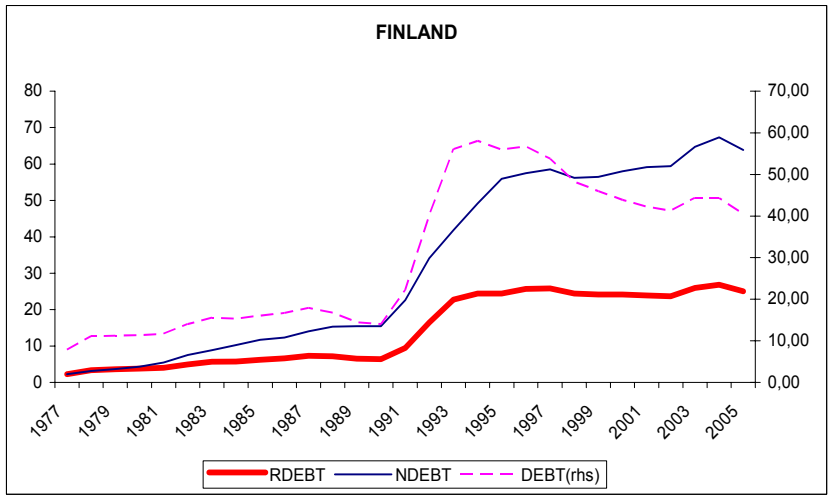
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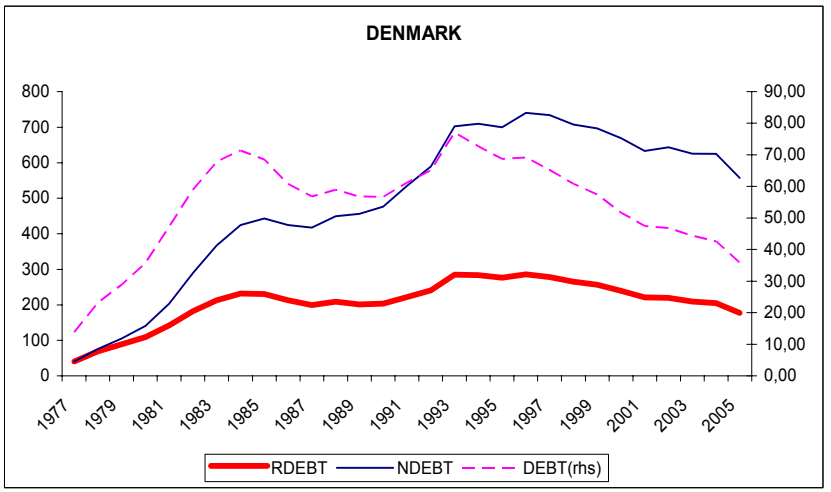
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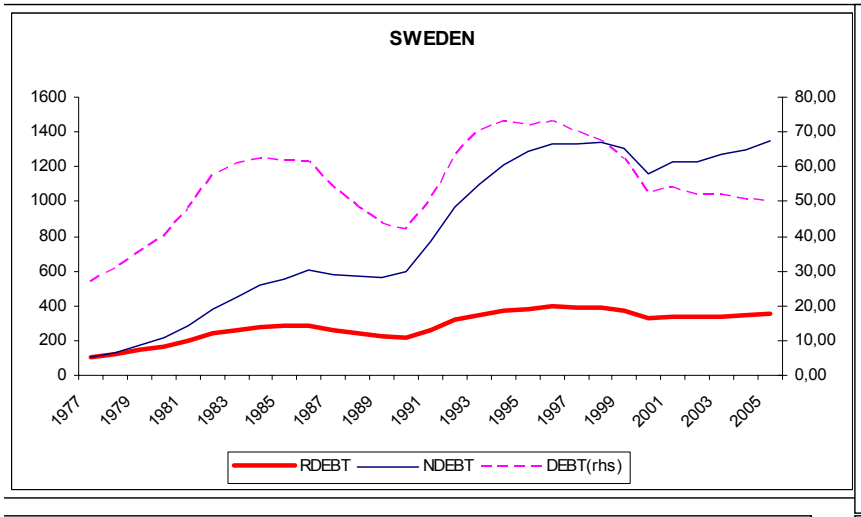
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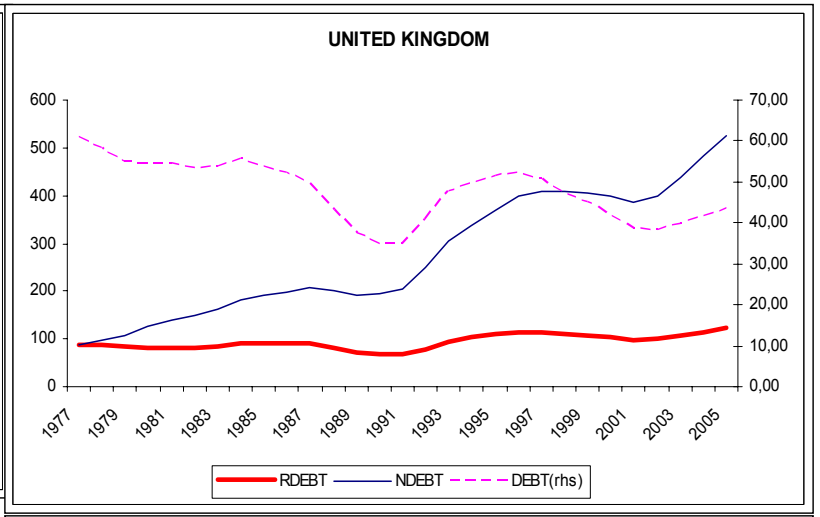
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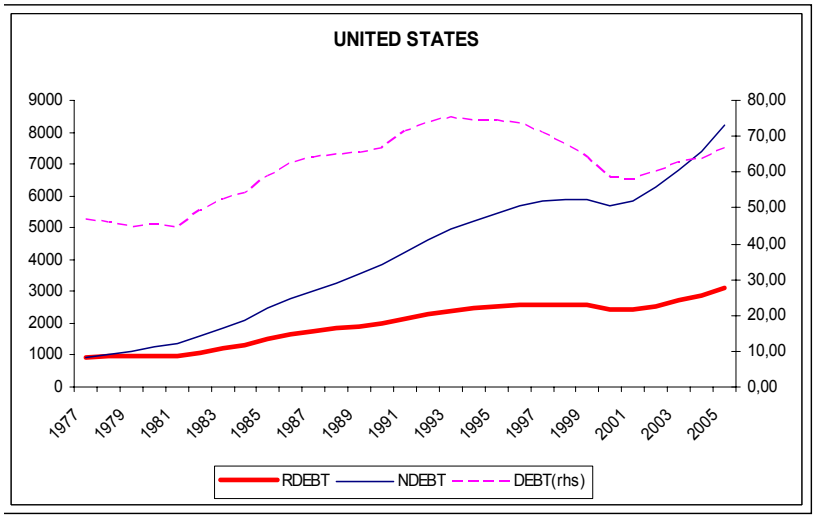
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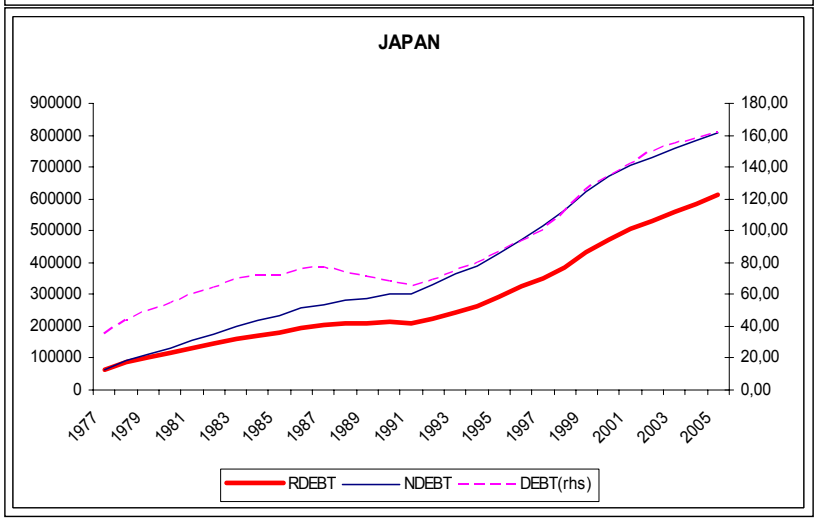
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RDEBT
NDEBT
DEBT(rhs)

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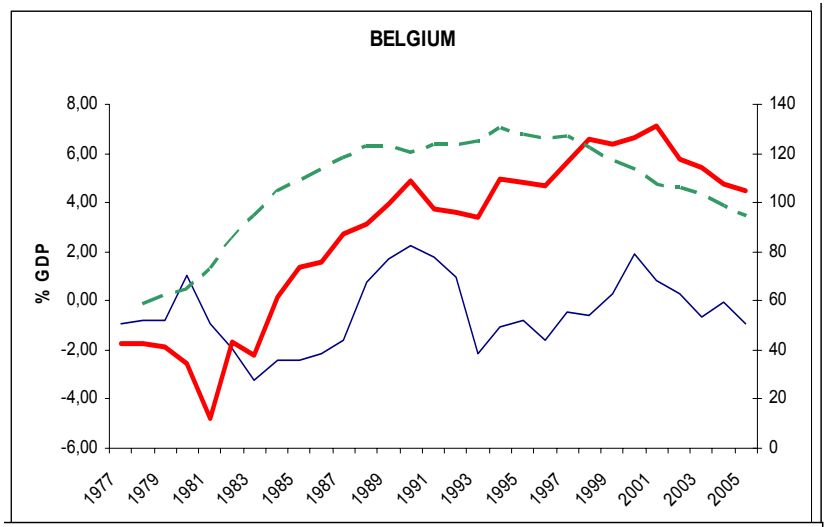
Figure 1

Primary Surplus, Debt and Output Gap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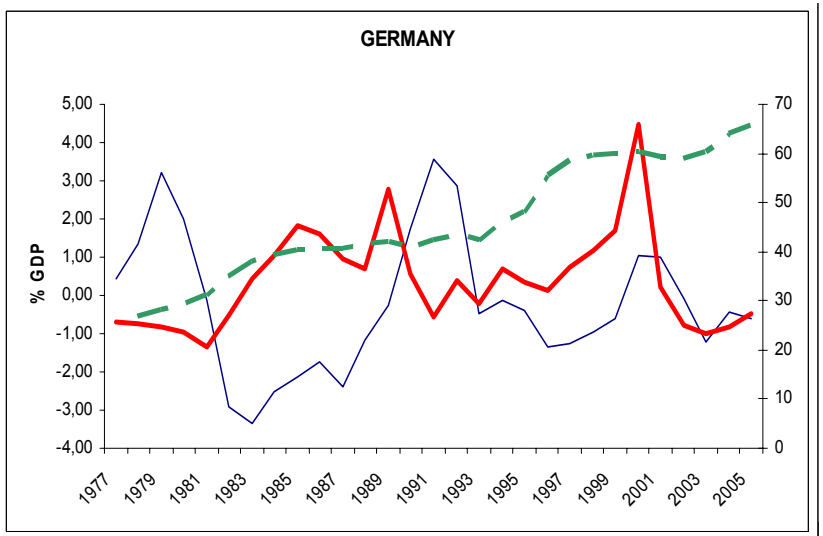
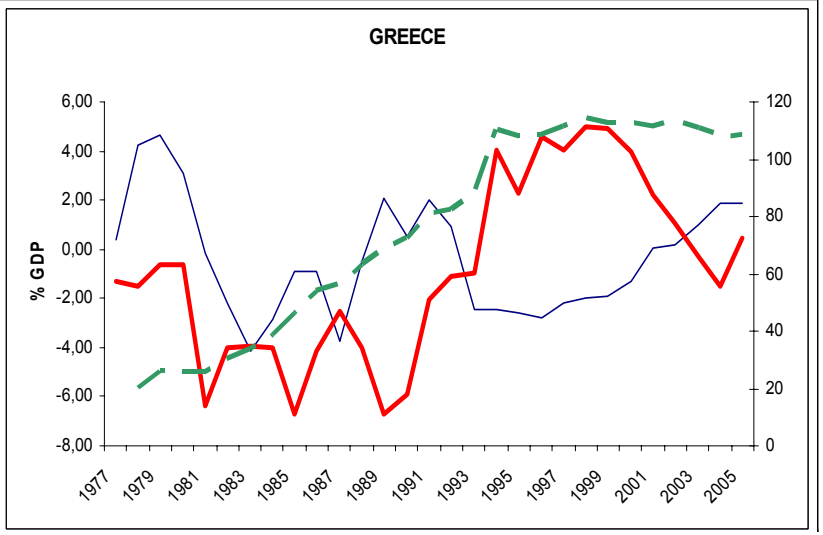
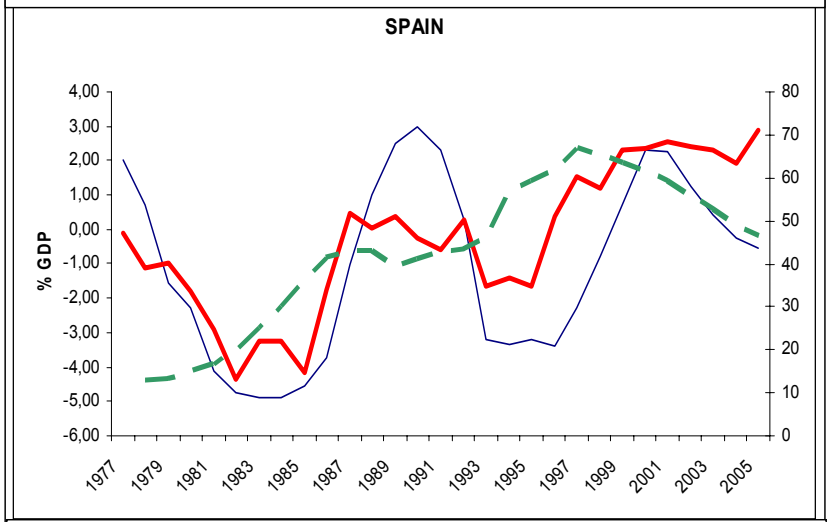
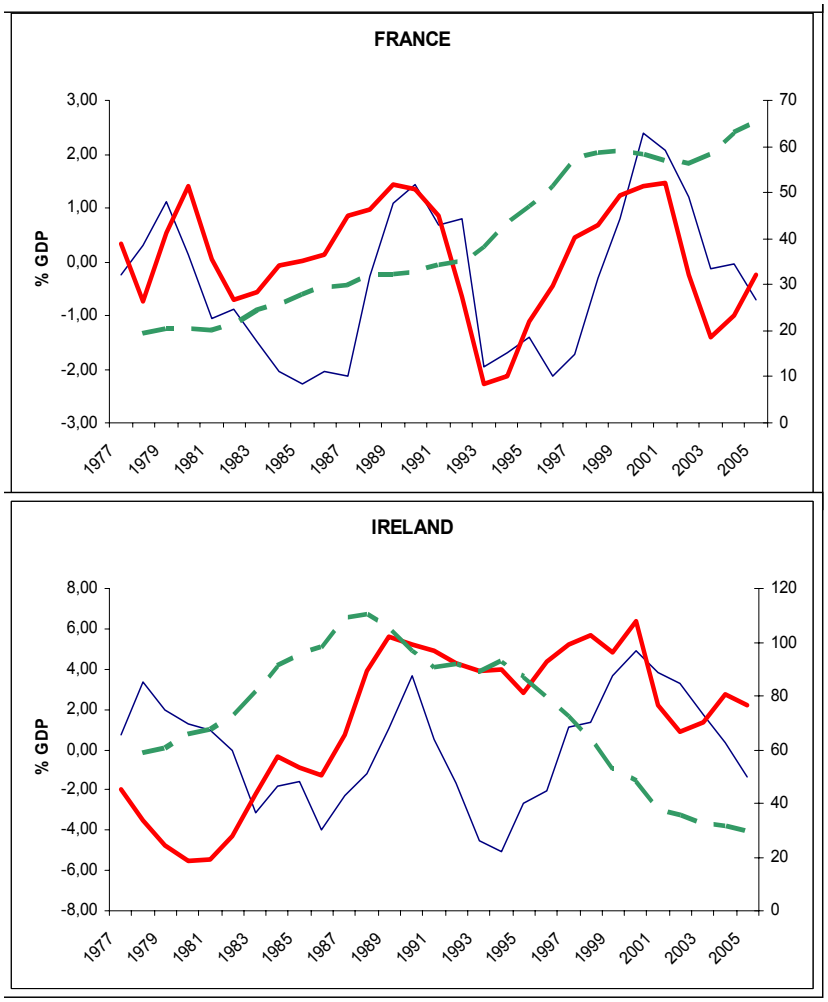
2003
2005

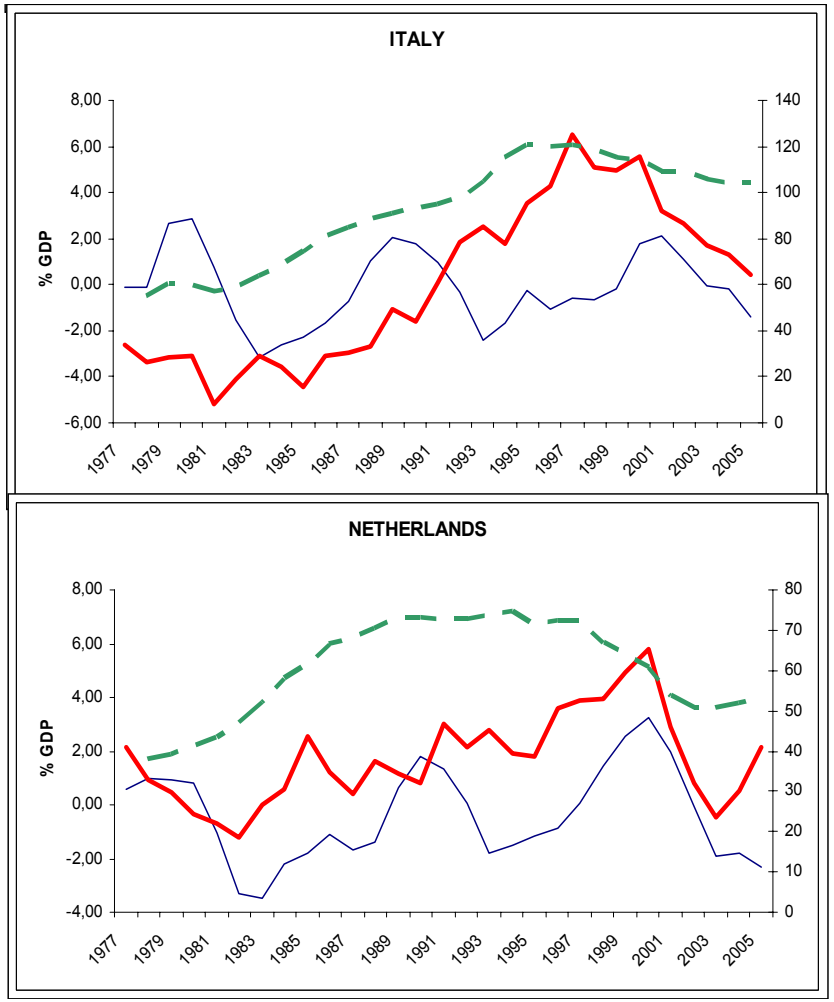

GERMANY
% GDP
5,00
4,00
3,00
2,00
1,00
0,00
-1,00
-2,00
-3,00
-4,00
70
60
50
40
30
20
10
0
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005


GREECE
% GDP
6,00
4,00
2,00
0,00
-2,00
-4,00
-6,00
-8,00
120
100
80
60
40
20
0
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005


SPAIN
% GDP
4,00
3,00
2,00
1,00
0,00
-1,00
-2,00
-3,00
-4,00
-5,00
-6,00
80
70
60
50
40
30
20
10
0
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005


PSUR
DEBT$_{T-1}$ (rhs)
GAP

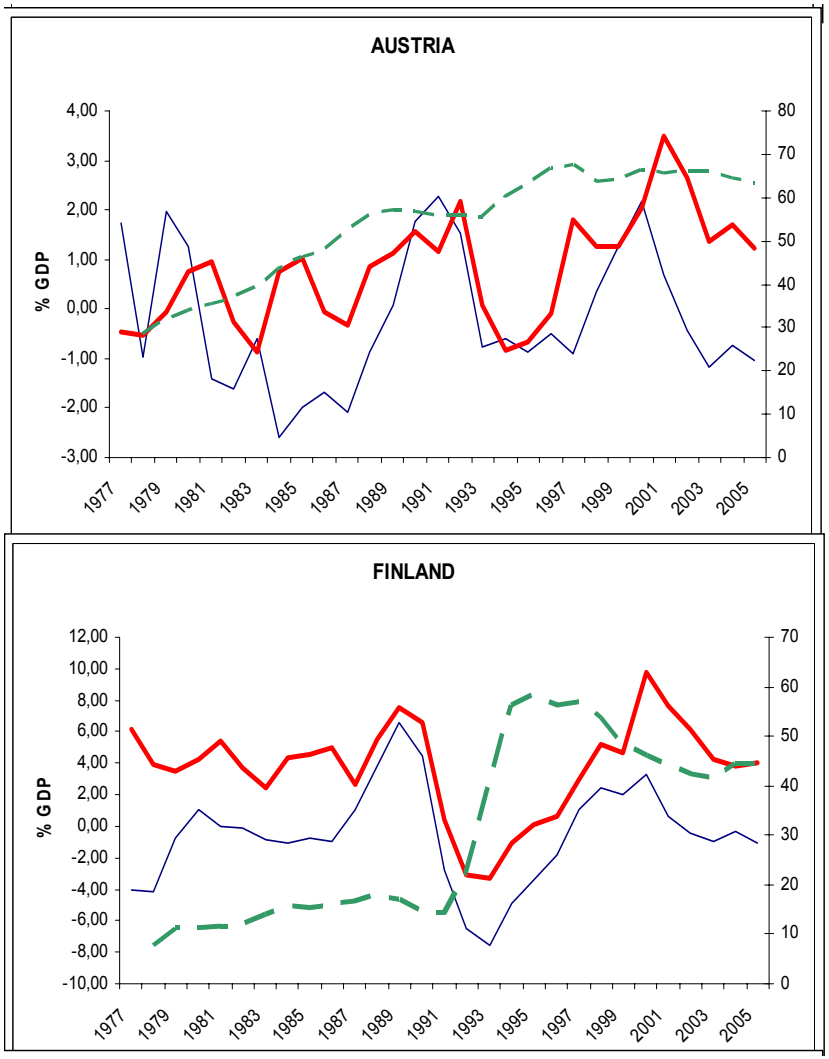

FRANCE
% GDP
3,00
2,00
1,00
0,00
-1,00
-2,00
-3,00
70
60
50
40
30
20
10
0
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005

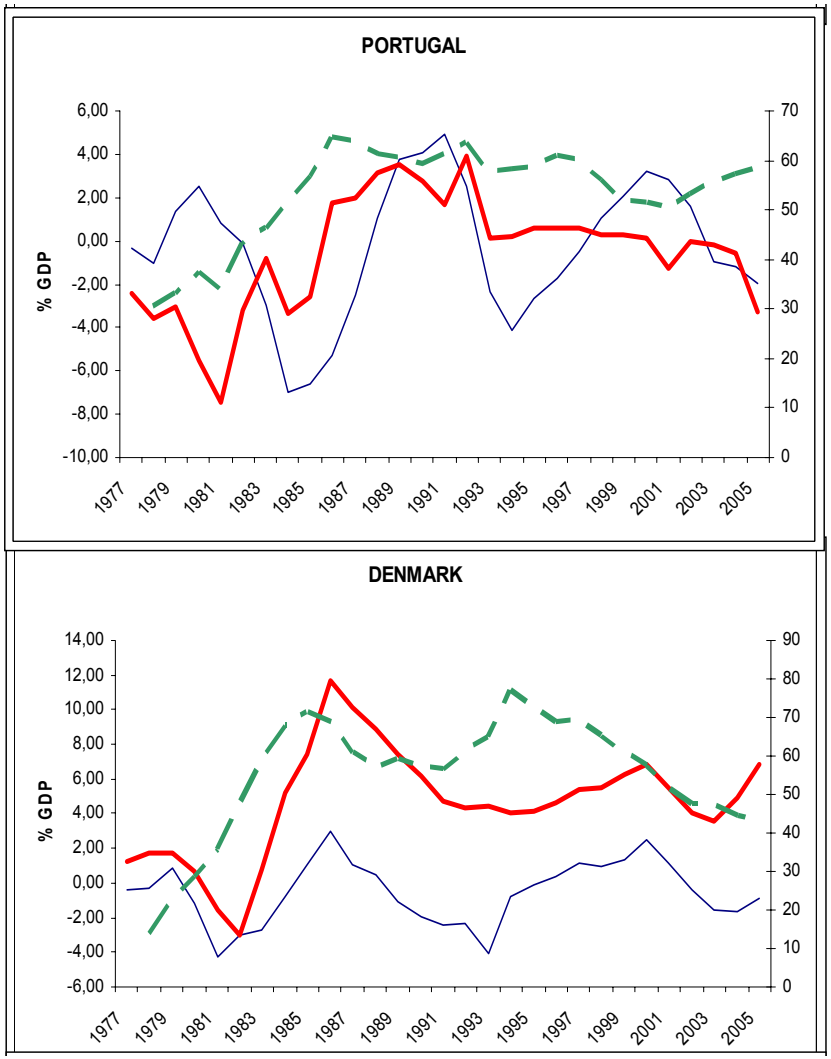

ITALY
% GDP
8,00
6,00
4,00
2,00
0,00
-2,00
-4,00
-6,00
140
120
100
80
60
40
20
0
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005

IRELAND
% GDP
8,00
6,00
4,00
2,00
0,00
-2,00
-4,00
-6,00
-8,00
120
100
80
60
40
20
0
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005

NETHERLANDS
% GDP
8,00
6,00
4,00
2,00
0,00
-2,00
-4,00
80
70
60
50
40
30
20
10
0
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005


PSUR
DEBT$_{T-1}$ (rhs)
GAP

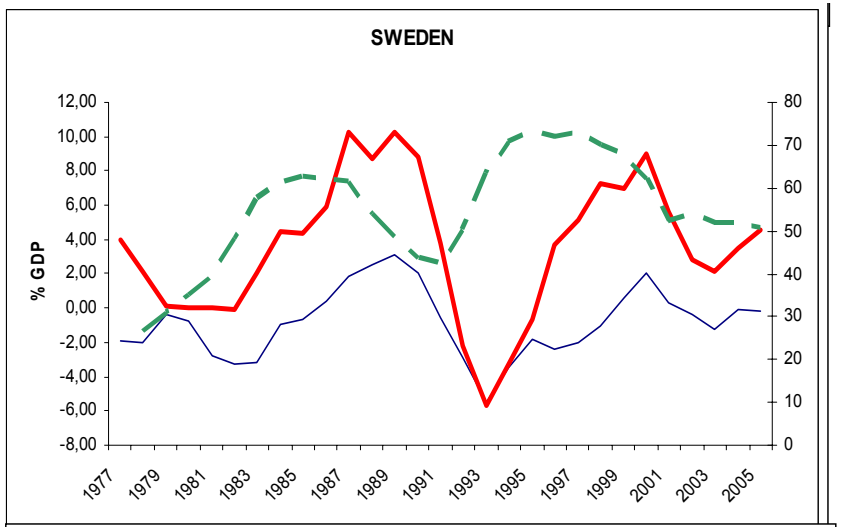

AUSTRIA
% GDP
4,00
3,00
2,00
1,00
0,00
-1,00
-2,00
-3,00
80
70
60
50
40
30
20
10
0
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005

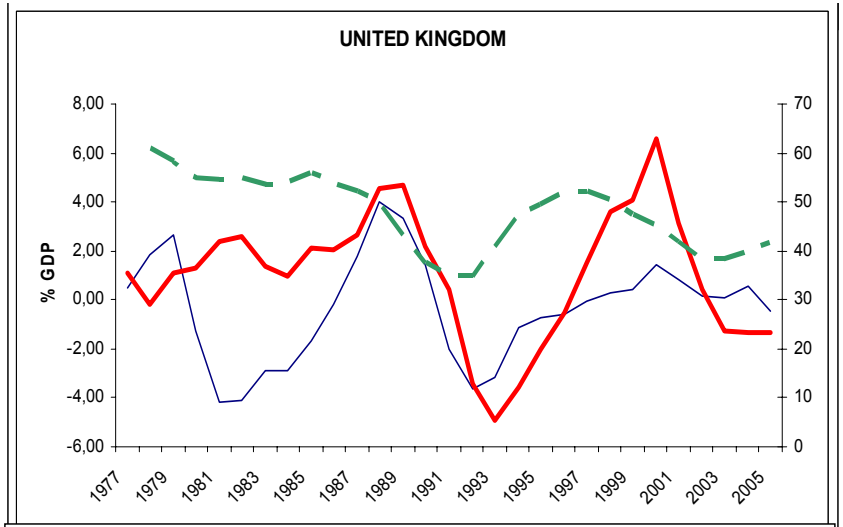

PORTUGAL
% GDP
6,00
4,00
2,00
0,00
-2,00
-4,00
-6,00
-8,00
-10,00
70
60
50
40
30
20
10
0
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005

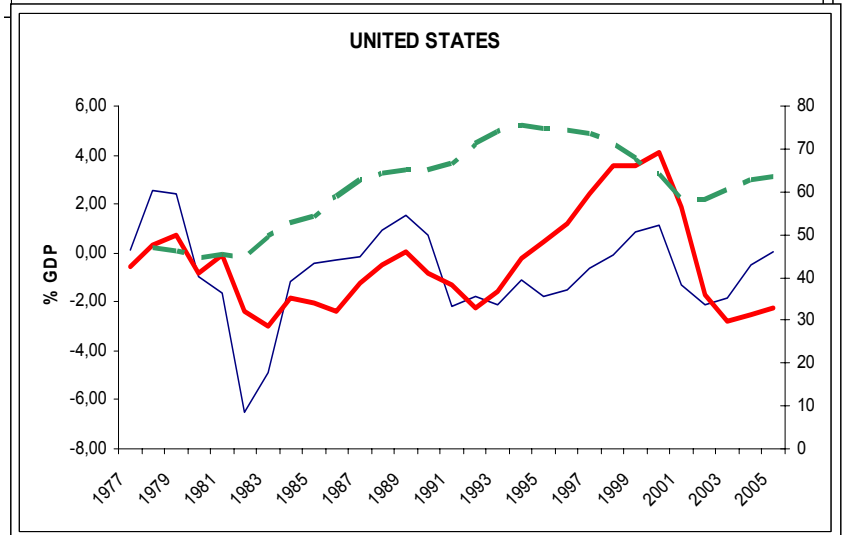
FINLAND
% GDP
12,00
10,00
8,00
6,00
4,00
2,00
0,00
-2,00
-4,00
-6,00
-8,00
-10,00
70
60
50
40
30
20
10
0
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005

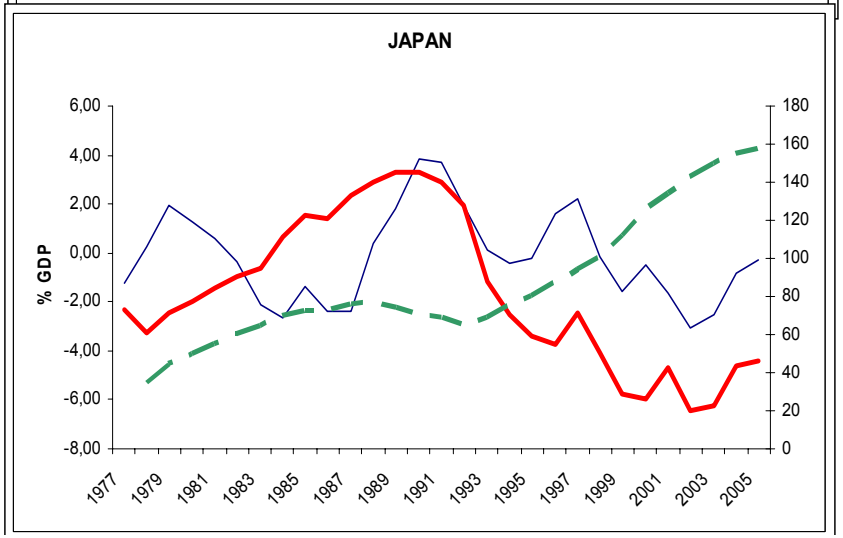
DENMARK
% GDP
14,00
12,00
10,00
8,00
6,00
4,00
2,00
0,00
-2,00
-4,00
-6,00
90
80
70
60
50
40
30
20
10
0
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005


PSUR
DEBT$_{T-1}$ (rhs)
GAP


SWEDEN
% GDP
12,00
10,00
8,00
6,00
4,00
2,00
0,00
-2,00
-4,00
-6,00
-8,00
80
70
60
50
40
30
20
10
0
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005


UNITED KINGDOM
% GDP
8,00
6,00
4,00
2,00
0,00
-2,00
-4,00
-6,00
70
60
50
40
30
20
10
0
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005

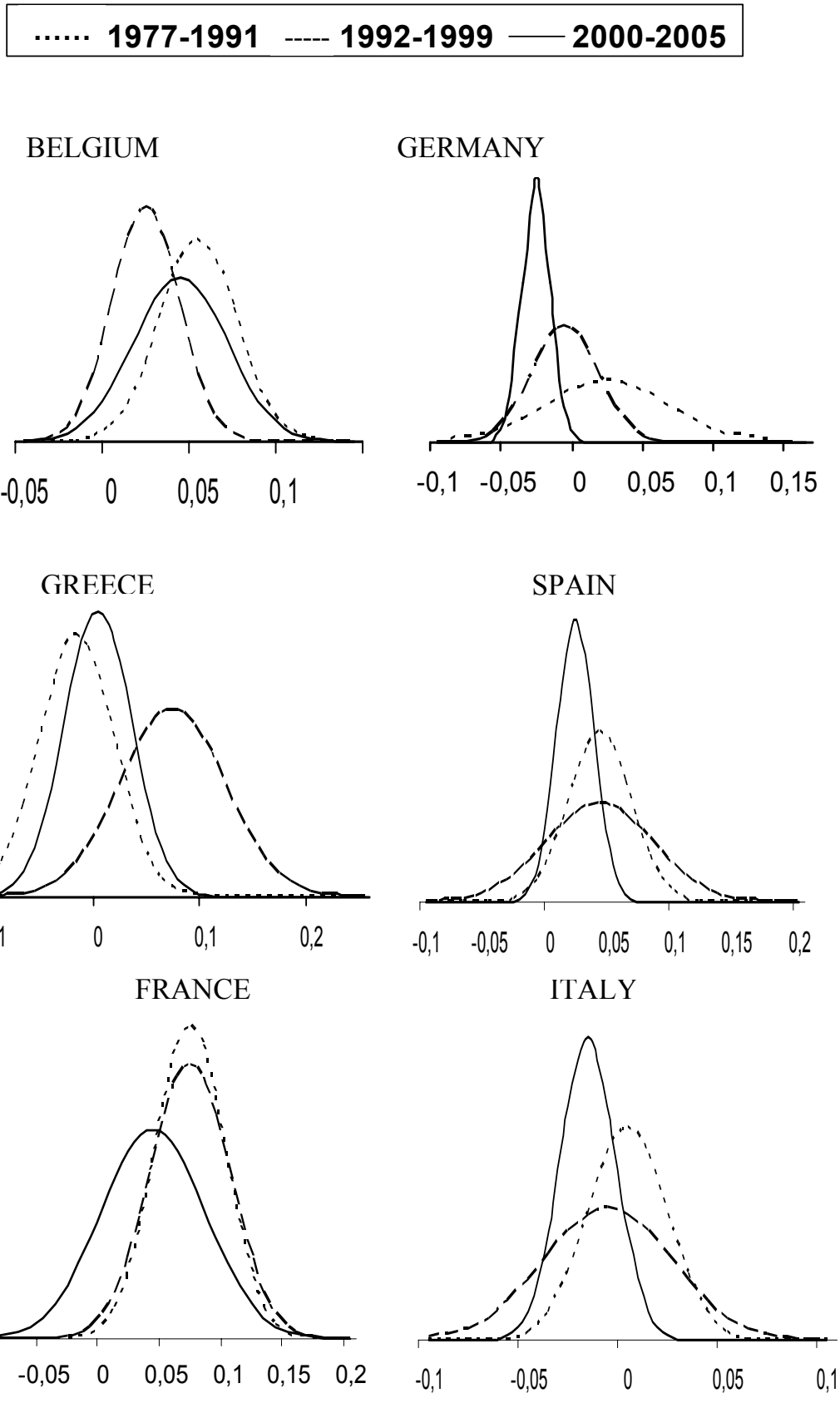

UNITED STATES
% GDP
6,00
4,00
2,00
0,00
-2,00
-4,00
-6,00
-8,00
80
70
60
50
40
30
20
10
0
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005

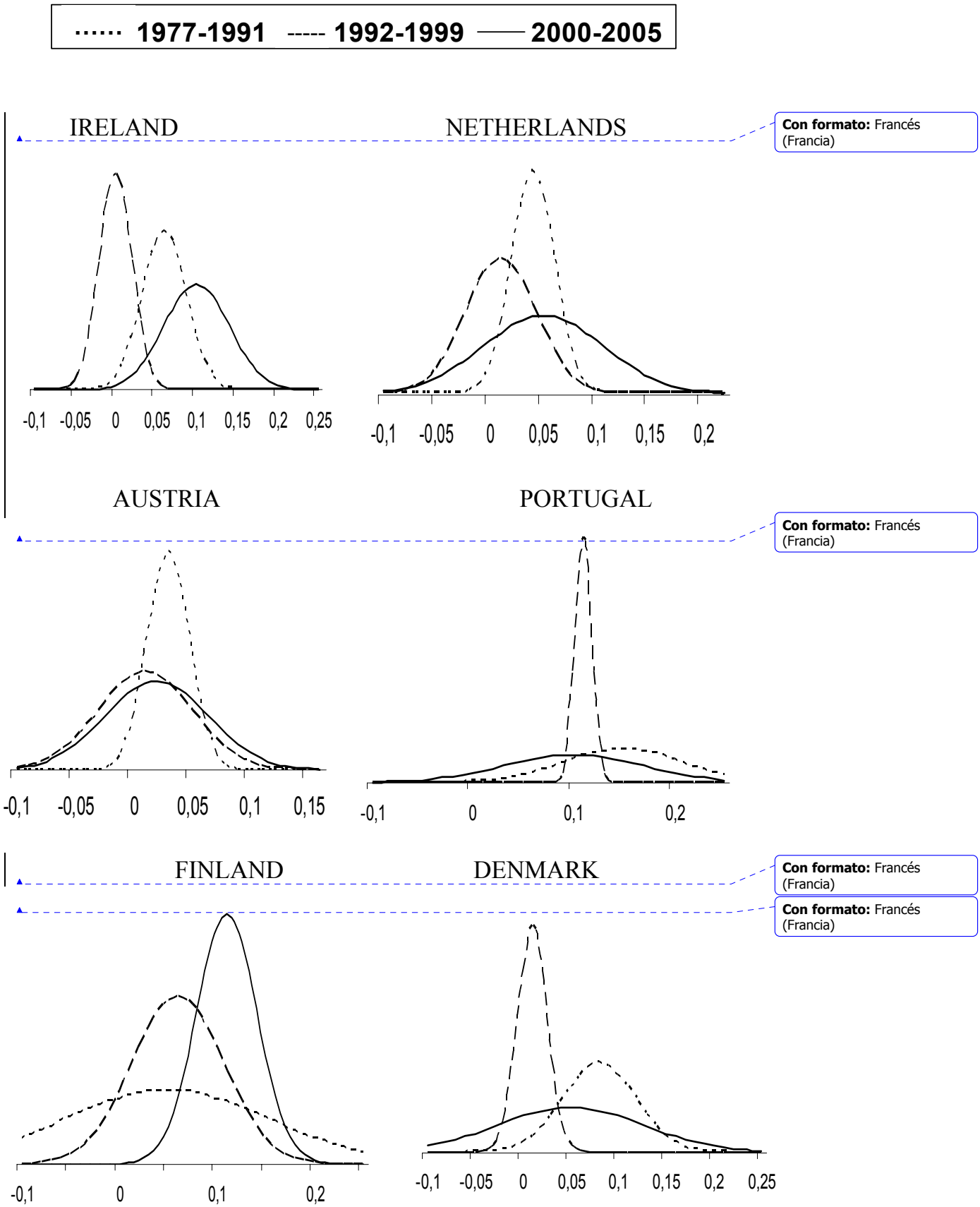

JAPAN
% GDP
6,00
4,00
2,00
0,00
-2,00
-4,00
-6,00
-8,00
180
160
140
120
100
80
60
40
20
0
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005


PSUR
DEBT$_{T-1}$ (rhs)
GAP

Figure 2

Posterior density functions for the response of the primary surplus to debt accumulation


····· 1977-1991 ----- 1992-1999 —— 2000-2005
BELGIUM
-0,05 0 0,05 0,1
GERMANY
-0,1 -0,05 0 0,05 0,1 0,15
GREECE
-0,1 0 0,1 0,2
SPAIN
-0,1 -0,05 0 0,05 0,1 0,15 0,2
FRANCE
-0,1 -0,05 0 0,05 0,1 0,15 0,2
ITALY
-0,1 -0,05 0 0,05 0,1



Con formato: Francés (Francia)

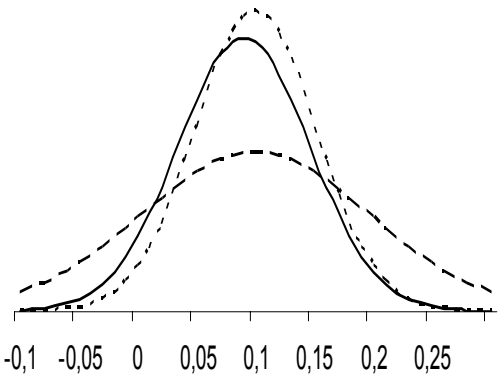
Con formato: Francés (Francia)

Con formato: Francés (Francia)

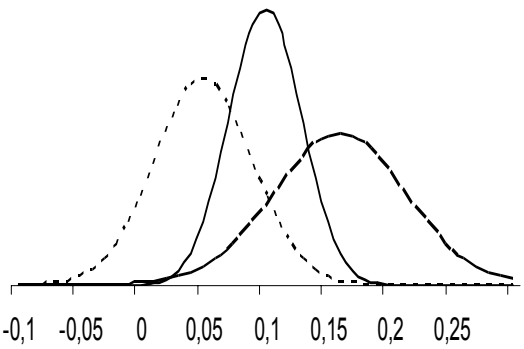
Con formato: Francés (Francia)

····· 1977-1991 ----- 1992-1999 —— 2000-2005

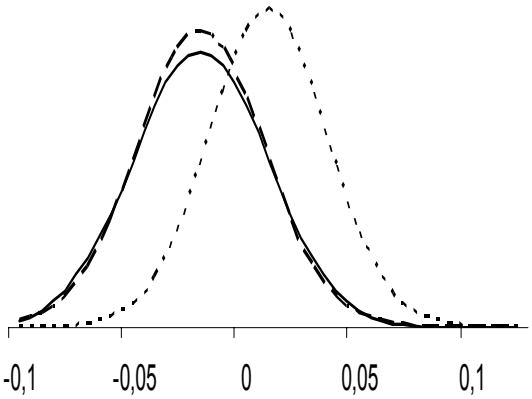
SWEDEN



UNITED KINGDOM



UNITED STATES



JAPAN