FISCAL POLICY AND INTEREST RATES IN EUROPE

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Introduction

The appetite for fiscal discipline has been steadily declining among most industrial countries. Even after controlling for cyclical effects, budgetary balances have been deteriorating both in the US and in Europe. In Japan, a string of large fiscal imbalances has severely undermined the sustainability of the fiscal stance.

In the past, fiscal profligacy would have been punished by markets with higher interest rates and, in some cases, also exchange rate depreciation. However, in after EMU's Europe, exchange rate markets no longer discipline the fiscal behaviour of national governments. Perhaps more crucially, even the interest rate punishment to fiscal indiscipline is highly uncertain. On the policy side, finance ministers in Europe do not seem excessively concerned that toying with the Stability and growth pact could in the end undermine its credibility and trigger higher interest rates. Similarly, the current US administration has openly and repeatedly questioned the existence of a significant link between fiscal policy and interest rates (Council of Economic advisers, 2003). Academic opinions are also quite divided. Theory does not offer a clear-cut answer as to the effects of budget deficits on interest rates. Empirical evidence is not of much help either in resolving theoretical ambiguities. In the case of Europe, existing evidence (Bernoth *et al*., 2003; Codogno *et al*., 2003; Afonso and Strauch, 2003) points to a significant but quantitatively small effect of fiscal policy, with a one per cent increase in the deficit to GDP ratio raising interest rates on government bonds by less than 10 basis points. While not negligible, this effect is substantially smaller than that estimated in the US literature (Gale and Orszag, 2002), a difference that still begs for an explanation.

The purpose of this paper is to take a close look at the link between fiscal policy and interest rates in the European context. Contrary to the US, the link between fiscal policy and interest rates has not been subject to much investigation, particularly after EMU. Lack of sufficiently long series goes some way in explaining this omission. However, the policy relevance of the interest rate fiscal policy nexus is as high in Europe as in the US. First, Europe as a whole is a large player in world capital markets. Hence, fiscal policy in the EU can have a non negligible impact on international interest rates. Second, the Stability and Growth pact notwithstanding,

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lack of fiscal rigor has been a pervasive feature in most EU countries. However, domestic interest rates do not seem to have been much affected, at least so far. Third, and perhaps more crucially, an analysis of the European case is needed to better inform the ongoing debate on the Stability and Growth pact (SGP, henceforth).

A key issue is whether domestic fiscal policies affect mainly country spreads or have a substantial effect on the average level of the Euro area interest rates. This question has a significant bearing on how to reform the SGP. Indeed, if the budgetary stance of individual countries affects mainly country spreads there will be less reasons for concerns that fiscal slippages in one EMU member will spill over into higher interest rates for the union as a whole. Hence, the case for binding fiscal at the Euro area level would be less compelling. However, if interest rates are largely determined at the European level, expansionary fiscal policy in one country will affect interest rates in other member countries. For a proper working of the currency union, this negative externality will then have to be internalized through some mechanisms such as the SGP. A related question is whether such an externality may be relatively stronger for high-debt countries, presumably reflecting market concerns about a bail-out of an insolvent government, and whether therefore high-debt countries should be treated less leniently by a reformed SGP.

The remainder of the paper is organized as follows. In the next section we briefly review the theoretical underpinning of the budgetary deficit interest rates nexus. In section 2, we take a first look at the data, while in section 3 we describe our data sources, derive our estimating equation, and report the econometric estimates. In section 4 we take a closer look at the issue of sustainability for high-debt countries. Policy implications and conclusions are presented in the final section.

1. A brief theoretical interlude

Theory does not offer a clear-cut answer as to the effects of budget deficits on interest rates. The standard text book model predicts that either a tax cut or an increase in public spending will boost aggregate demand, shift the IS curve to the right, and raise interest rates. Admittedly, even in the basic IS-LM model, fiscal policy has no effect on interest rates in a small economy which is fully open to capital flows. Extending this model to a two-country set-up yields however a number of useful insights. First, fiscal policy recovers a role in the determination of interest rates. Second, and more crucially for the purpose of this paper, a fiscal expansion in one country will be associated with higher interest rates in the other country as well.

Unfortunately, the predictions of the basic open economy model are not particularly robust. In particular, a tax cut will not affect interest rates if, for a given volume of public spending, consumers fully anticipate the future tax burden associated with the shift from tax to debt financing. Households will simply save the

increase in disposable income brought about by the tax cut, in anticipation of a higher tax burden in the future. This is known in the literature as Ricardian equivalence. Similarly, an increase in public spending will leave interest rates unchanged if consumers are forward looking and government spending is a perfect substitute for private goods. Again, households will respond to the fiscal expansion by cutting spending and increasing saving. In sum, the fall in public saving, whether brought about by an increase in spending or by lower taxes, will be simply offset by the compensating behaviour of private agents. Hence, in this set up, fiscal policy in any one country will have no spill over effects on other countries.

Fiscal policy however recovers a role in the determination of interest rates if the standard conditions for Ricardian equivalence are not met, namely if agents are liquidity constrained, have limited horizons, or taxes are distortionary. Extending the non Ricardian model to a two country set up shows that here too fiscal policy in any one country will spill over to the other country as well.

Interestingly enough, fiscal policy also recovers a role in a pure Ricardian setting if government spending is assumed to provide no utility to consumers (or, less strongly, if the marginal utility of private consumption is independent of government spending). In the appendix, we illustrate a simple two country, two period model, where consumer intertemporal utility is isoelastic, the government budget is balanced in an intertemporal sense, and there is no investment. We show that a temporary increase at time 1 in government spending in any one country will lower domestic saving and raise global interest rates. The intuition is simple. The temporary increase in public spending leads to an equivalent reduction in public saving. Private consumption falls and private saving increases, since households anticipate a future increase in the tax burden. However, private consumption will fall by less than the increase in government spending (and in future taxes) since households will typically smooth their consumption path over time. Accordingly, the increase in private saving will not fully offset the fall in public saving. Hence, aggregate saving will decline in the first period and, under standard stability conditions, interest rates will rise both in country 1 and in country 2.

This simple example illustrates two important results. First, even in a Ricardian model, a temporary increase in government spending will lead to a fall in domestic saving provided that private and publicly provided goods are not perfect substitutes.[1] Second, fiscal spillovers may be important. An expansionary fiscal policy in country 1 will raise interest rates for country 2 as well. The welfare impact will be negative if country 2 is a net borrower (its terms of trade would then deteriorate). Moreover, in a more general model where initial public debt holdings are positive and taxes are distortionary, the increase in interest rate will negatively affect the budgetary situation in country 2, possibly forcing it to raise (distortionary)

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[1] Note that, in a Ricardian setting, a tax financed temporary increase in government spending would lead to an identical fall in domestic saving and an increase in interest rates. Accordingly, budget deficits may not be a sufficient statistics of the fiscal policy stance.

taxes. The net welfare impact may then be negative even country 2 is a net lender and its terms of trade have improved.

More crucially for the purpose of this paper, the discussion so far shows that, while an expansionary fiscal policy in one country may have no impact on its spreads (in the model, absent default risk, spreads are identically equal to zero!), it will nonetheless, in a large class of models, affect the aggregate level of interest rate. As we shall see later, most of the literature, particularly in Europe, has focussed on the impact of fiscal policy on spreads, thereby neglecting a relevant channel through which the budget affects the economy.

2. A first glance at the data

Empirical evidence is not of much help in resolving theoretical ambiguities. Many studies find a significant effect of fiscal policy on (real) interest rates. Others however come to the opposite conclusion.[2]

The diversity of findings is not too surprising, however, if we consider that the relationship between fiscal policy and real interest rates has not been particularly smooth. Figure 1 reports the behaviour of real interest rates since the early Eighties for the average of the G7 countries together with the ratios of public debt and the budget deficit to GDP. We see how in the early Eighties the deterioration of the debt and the deficit indicators coincided with a substantial increase in real interest rates. Indeed, between the late Seventies and the early Eighties, real interest rates rose from 0.8 per cent in 1977-79 to almost 6.5 per cent in 1982-85. During the same period, the debt to GDP ratio went from 44 to 52.5 per cent and the public sector deficit deteriorated from 2.5 to 4.5 per cent of GDP. From 1985 onwards, however, real interest rates on government debt have been on a downward trend, despite the continuing rise in the burden of debt. Presumably, the fall in real interest rates was related to the marked improvement in the budget deficit after 1983 (Figure 1). Yet, interest rates kept falling even after 1989, when the budget deficit soared again from 2 to almost 5 per cent of GDP. Most likely, financial markets were only mildly concerned by the budget deterioration during this period, as it was attributed mainly to the temporary slowdown of the economy and did not reflect a structural

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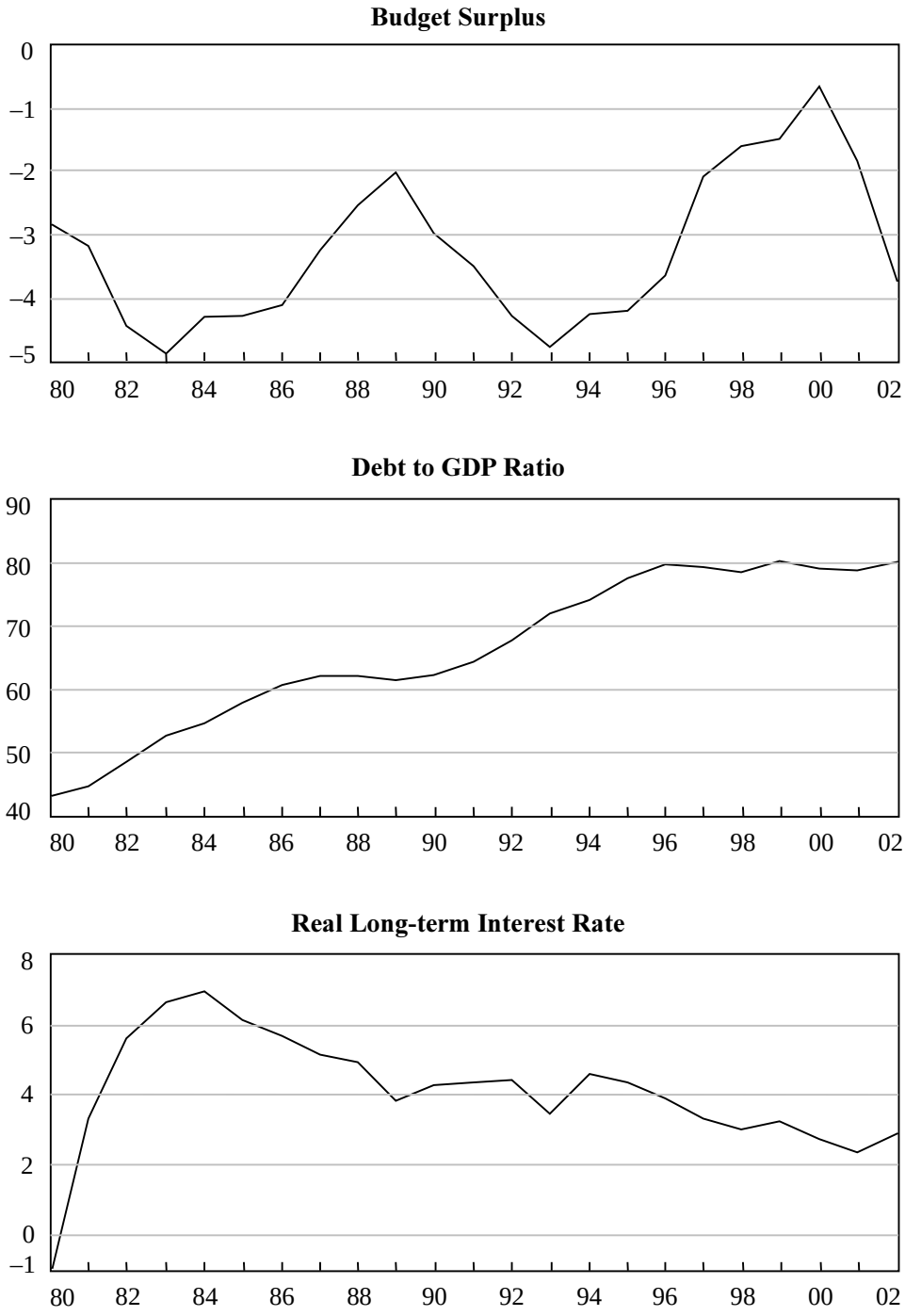
[2] Evans (1985, 1987a, 1987b) and Barro and Sala-i-Martin (1994) do not find any significant effects of fiscal policy on interest rates. More recent evidence, however, has cast serious doubts on the absence of a link between fiscal policy and interest rates. Gale and Orsvag (2002) argue in their literature review that previous evidence about the lack of an impact of the current budgetary stance on the level of interest rates is at best misleading. In the context of forward looking financial markets, what truly matters is the medium and the long run stance of fiscal policy. Empirical evidence provides strong support to such a claim. Studies (Canzoneri *et al.*, 2002) that use projected budget deficits – using either commercial or official projections – tend to find a highly significant relationship with the level of interest rates, thereby confirming the early finding of Feldstein (1986). Moreover, as underscored by Canzoneri *et al.* (2002), it is also necessary to control for the stance of monetary policy. The main effect of fiscal policy will be felt on the spread between short and long-term rates and, more generally, on the term structure of interest rates rather than simply on the level at any point of time of such rates.

Figure 1

Fiscal Indicators and Interest Rates for G7 Countries



worsening of the fiscal position. Finally, in the second half of the Nineties the continuing decline in real interest rates was associated with a stabilization of the debt ratio and a marked improvement of the budget situation.

Figure 1 also shows the pronounced deterioration in the fiscal position of the G7 countries after 2000. Surprisingly enough, this evolution has been accompanied only by a relatively modest increase in the level of real interest rates. This evolution stands in sharp contrast with the events in the early Eighties, when the interest rate response to fiscal indiscipline was extremely pronounced. We will return to this puzzle in the concluding section of the paper.

Turning to the Euro zone, *i.e.* the main focus of this paper, the basic facts about fiscal policy and interest rates are described in Figure 2. The debt to GDP ratio rose from 35 percent in 1980 to 76 percent in 1996 and has basically stabilized since then. Real interest rates on the other hand have followed quite a different pattern. They rose quite steadily, from 1.6 percent to 6.7 percent, between 1980 and 1991 and have been on a downward path afterwards. In 2002 however, real interest rates increased again. The behaviour of interest rates closely mirrors the (cyclically adjusted) deficit. Figure 2 suggests that the steady improvement in the fiscal balances from 1990 to 2000 is likely to have played a substantial role in facilitating the decline of real interest rates during that period.

Figure 3 shows the correlation between real interest rates and public debt stocks at the country level. The relationship is not particularly strong. There is little indication that low debt to GDP ratios are associated with low real interest rates, neither before the advent of EMU (Figure 3a) nor afterward (Figure 3b). Similarly, even nominal interest rates seems to bear no clear relationships with the level of debt. In Figure 4 we focus on one single year, 2002, to avoid blurring the picture. We see that Belgium has a substantially higher debt burden that Austria, Spain, Portugal, Finland, and Ireland, but significantly lower costs of servicing its long run bonds.

Summing up so far, the link between interest rates and fiscal policy is not easy to detect. First, simply relating debt and real interest will not work. There are too many instances where rising debt ratios have coincided with falling real interest rates. Even at the cross country level, debt ratios and real interest rates show little correlation. This does not mean of course that debt stocks have no effect on real interest rates. There may be many confounding factors that blur the simple correlation between debt and interest rates. Moreover, markets may be concerned about future levels of debt and will, as a result, focus mainly on current and expected deficits. Finally, current deficits may have a different impact depending on the initial level of debt. A fiscal expansion will be more of a concern in a high-debt country like Italy, where public debt is well above 100 per cent of GDP than say in the Netherlands where the debt to GDP ratio is still below the 60 per cent mark.

Figure 2

Real Interest Rates, Debt and Primary Surplus in the Euro zone

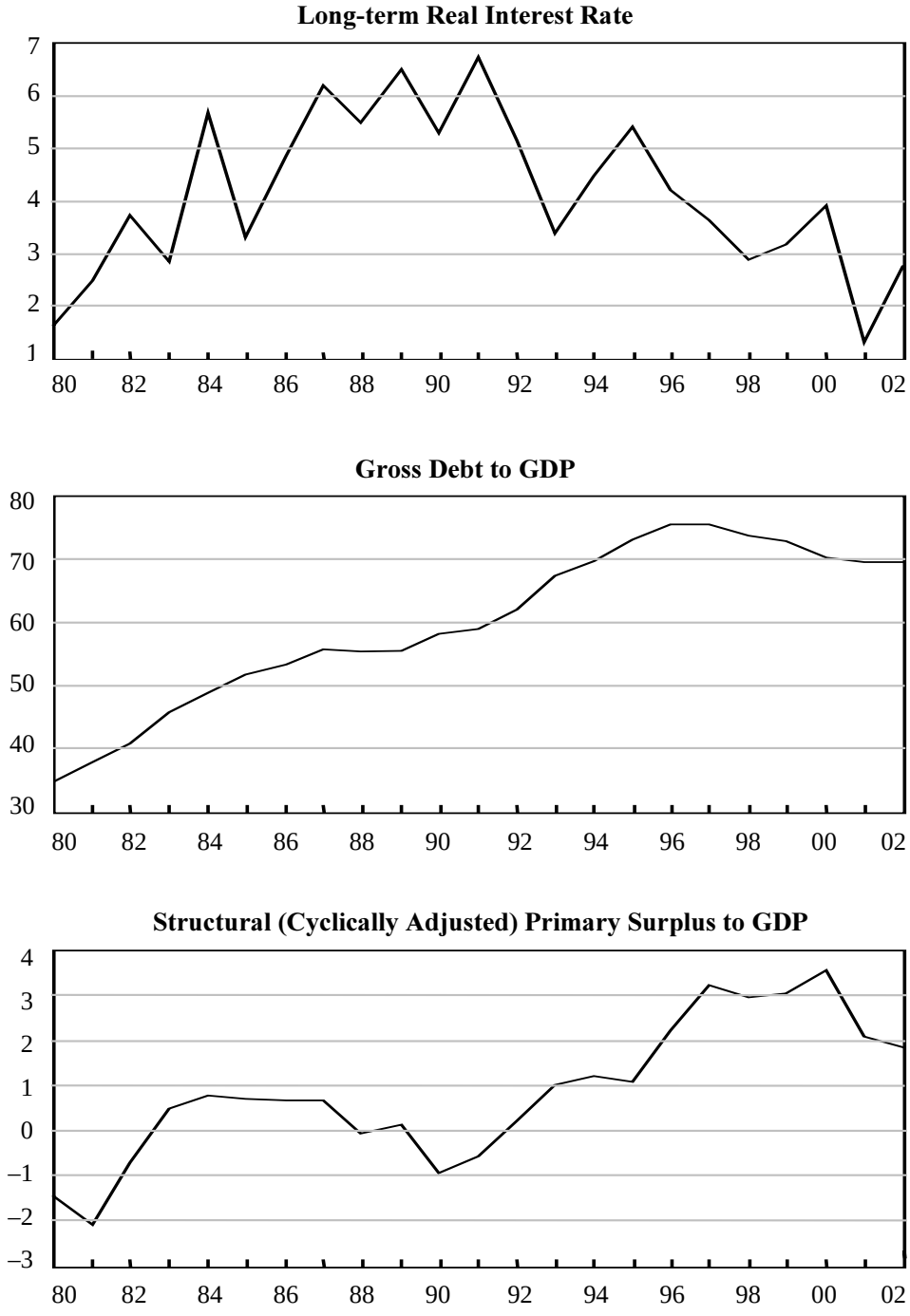
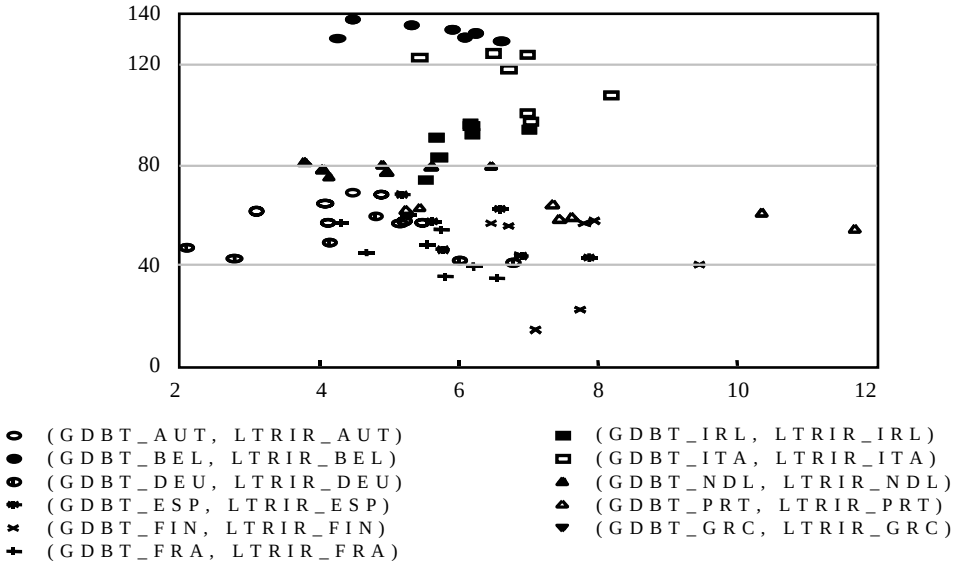


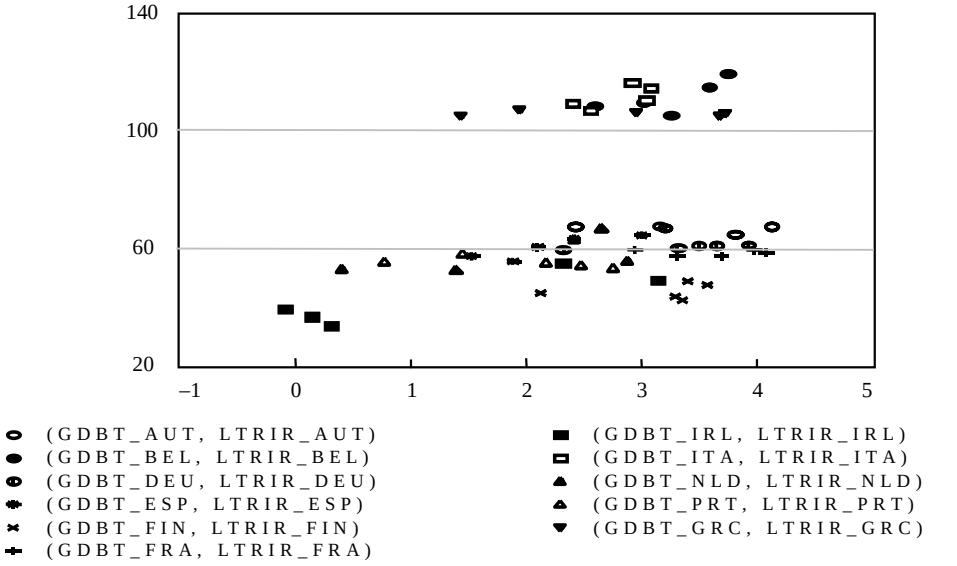
Figure 3

Debt and Real Interest Rates for EMU Members

a) 1990-1996



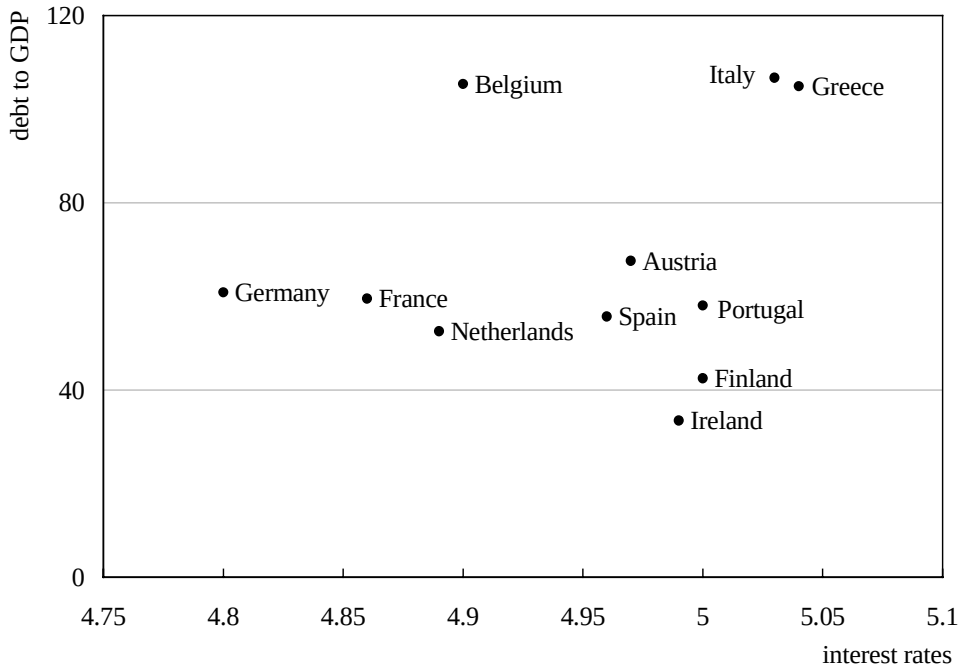
b) 1998-2002



Legend:
GDBT_i: Gross debt to GDT in country i
LTRIR_i: Long-term real interest rate in country i

Figure 4

Interest Rates and Public Debt



Hence, empirical analysis should control for both types of indicators[3] and perhaps also their interaction. Second, the cursory overview of the data show that focussing on unadjusted deficits is bound to be inadequate. We have seen how between 1989 and 1992 the average deficit in the G7 countries rose quite markedly while interest rates continued their downward course. Most likely, markets attributed the worsening of the fiscal situation to the (temporary) effect of the economic slowdown. Similarly, in the Euro zone interest rates started falling in 1990 despite a substantial deterioration in the fiscal balance. The link between interest rates and fiscal deficits reappears when one controls for the cyclical position of the economy (Figure 2).

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[3] The conclusions of the literature remain indeed quite diverse as to which fiscal variable truly matters. While Barro and Sala-i-Martin (1994) fail to find any significant effect of either debt or deficits on world interest rates, Tanzi and Lutz (1993) conclude that either one, but not both, play a significant role in the determination of global interest rates. Focussing on the US, Feldstein (1986) concludes that (expected) deficits are all that matters, with public debt having no explanatory power. More recent evidence (Muhleisen and Towe, 2004) comes to the opposite conclusion. They show that the key fiscal variable in the determination of US and global interest rates is (net) debt. This finding is somewhat surprising given that debt has kept rising during most of the Nineties while interest rates, and deficits, have started falling since at least the mid-Eighties (Figure 1). However, Muhleisen and Towe (2004) do not assess the relative contribution of these two fiscal indicators.

3. Fiscal policy and interest rates in EMU

The empirical literature on the link between interest rates and fiscal policy in Europe is not as developed as that in the US. Moreover, most (recent) contributions have focussed on micro analyses of the behaviour of spreads (Bernoth *et al.*, 2003; Codogno *et al*., 2003) or on event analyses (Afonso and Strauch, 2003). The main conclusion that emerges from such literature is that fiscal policy, however measured, matters but its effects are quite small, namely a one per cent increase in the deficit to GDP ratio would raise interest rates on government bonds by around 10 basis points. While not negligible, this effect is substantially smaller than that estimated in the US literature. However, as noticed in the previous section, it only focuses on spreads (most of these papers rely on the interest rate swap spreads) and overlook therefore the aggregate impact that higher deficits in one country may have on the *level* of interest rates, both nationally and for the currency union as a whole.

These are key questions for policy purpose. If for instance Gale and Orszag (2002) findings for the US – according to which a one per cent increase in the budget deficit is associated with an interest rate hike of 50-70 basis points – applied to Belgium or to Italy (where the debt GDP ratio is basically double the US), then a one percent increase in the primary deficit would be associated with an almost equally large rise in the interest bill. Under this scenario, fiscal profligacy would obviously become a much less palatable option. If, on the other hand, most of the interest rate impact of fiscal policy was felt at Euro area level, then markets would be quite ineffective in inducing budgetary discipline. More generally, whether expansionary fiscal policies in one (large) EMU country would result either in higher interest rates for the area as a whole or in a higher country spread has an obvious bearing on the much debated need for fiscal coordination in Europe.

a) The estimating equation

We follow much of the literature in assuming that real interest rates are determined by the interaction of aggregate saving and investment. In a closed economy context, for instance, private investment (I^{pr}) is identically equal to the sum of private (S^{pr}) and the excess of public saving over public investment, *i.e.* the budget surplus (B):

$$I^{pr} = S = S^{pr} + B \tag{1}$$

In what follows we normalize both saving and investment by GDP and assume that investment and saving are both a function of (real) interest rates. An increase in the level of real interest rates is associated with a fall in investment and, possibly, a rise in saving (Figure 5). The equilibrium is at point A where real interest rates have adjusted to ensure the equality of investment and total saving. A fiscal expansion will be associated with a fall in B, an upward shift in the saving schedule and a consequent rise in the level of real interest rates.

Figure 5

The Saving Investment Determination of Real Interest Rates

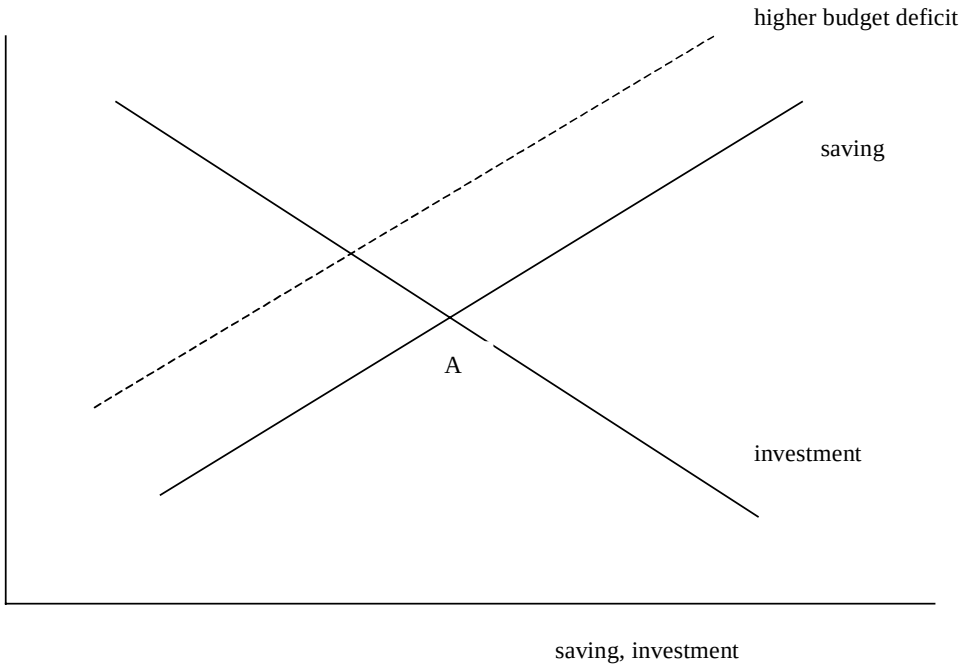

Figure 5 establishes a neat link between fiscal policy and real interest rates. However, as noticed before, it is essential to allow for the fact that such a relationship is sometimes obscured by a number of confounding effects. First, changes in productivity and, more generally in investment profitability may result in an outward shift of the investment schedule, thereby leading to higher interest rates, independently of any change in the fiscal stance. Looking at the Eighties, Blanchard and Summers (1984) conjectured that high interest rates in that period were mainly due to a significant increase in future investment profitability. Their conjecture was subsequently supported by Barro and Sala i Martin (1990) who identified a strong role for stock market prices – a proxy of anticipated investment profitability – in affecting world interest rates. Second, changes in interest rates may also reflect shifts in factors other than fiscal policy affecting private saving, such as demography, cyclical conditions and expected growth rates.[4] Third, fiscal policy

[4] The impact of higher profitability and growth on real interest rates is *a priori* ambiguous. In the standard setting of Figure 5, an increase in expected profitability would shift the investment schedule to the right and result in higher interest rates. However, if sustainability considerations (see section 5) are paramount, faster growth would lead to lower real interest rates.

may have an indirect effect on interest rates by affecting growth rates. As shown by Kneller *et al.* (1999) the growth impact of fiscal policy will typically be a function of the composition of both tax and expenditure variables. Finally, as just noticed, cyclical conditions affect both saving decisions and the link between interest rates and the budget. A cyclical downturn may result both in a deterioration of the budget balance and, through a monetary policy response, a fall in interest rates, thereby producing a negative correlation between budget deficits and interest rates (Laubach, 2004).

We therefore extend the simple model where investment and saving decisions respond only to interest rates in several directions.

First, we assume that investment depends on profitability (ρ), the output gap (*i.e.* the difference between actual, y, and potential output, y^*), expected inflation (π^E), and the real interest rate ($i - \pi^E$), where i, the nominal interest rate has been deflated by expected inflation (π^E). An increase in profitability and a rise in the output gap are expected to increase investment. For a given level of the real interest rate, the effect of π^E on investment is however ambiguous, since a rise in expected inflation should boost the value of tax deductions, but also erode the real value of depreciation allowances (Feldstein, 1986).

Second, private saving is assumed to be a function of the output gap, the real interest rate, expected inflation, net public saving (*i.e.* the budgetary balance), and possibly other variables that reflect the fiscal policy stance (D). The ratio of private saving to GDP is expected to be a positive function of the output gap (households will largely save a temporary rise of income) and, under standard conditions, a positive function of the real interest rate. The impact of expected inflation is instead unclear. In general, higher inflation discourages saving, since tax liabilities are typically a function of nominal interest income. However, higher inflation could be associated with an increase in precautionary saving. In addition, households may be prompted to increase their (measured) saving simply to restore the real value of their financial assets following a rise in inflation. By and large, therefore, the impact of expected inflation on private saving remains ambiguous.

Combining and solving the saving and investment equations yields the reduced form solution for the real interest rate:

$$i - \pi E = f(y - y^*, \pi E, B, D, \rho, MC) \qquad (2)$$

Equation (2) is the basis for our empirical work. An increase in the output gap should boost both saving and investment. Its effects on the real interest rate is therefore *a priori* ambiguous. Similarly, the impact of an increase in expected inflation on either saving or investment and hence on the real interest rate cannot be signed *a priori*. Also, an increase in profitability should be associated with a rise in real interest rates, unless as noticed earlier, the resulting acceleration in growth improves the long run sustainability of the budget. Finally, a fiscal policy expansion, as measured by B and D, should lead to higher interest rates.

The choice of fiscal policy indicators (*D* and *B*) is key. As noticed earlier, empirical analysis so far has been unable to cast much light on the issue. What is clear however is that, *a priori*, both stock (*i.e.* the level of public debt) and flow variables (*i.e.* the deficit) should matter. Why public debt should matter is easy to see. In a non Ricardian world, a large stock of public debt may be seen as adding to households wealth and would therefore depress saving and raise interest rates. The introduction of a flow variable is more controversial theoretically, but can be defended on several grounds. First, quite trivially, deficits, when properly measured, provide a link between debt stocks at different points of time. Second, and more crucially, expected future deficits are key in determining debt dynamics. Forward looking households are therefore likely to change their saving behaviour in anticipation of the future tax liabilities associated with a higher stock of debt. Third, debt dynamics is obviously linked to long run sustainability. If current deficits indicate that fiscal conditions are unsustainable, households will most likely adjust their saving and spending behaviour in response. Notice that even allowing for both debt and deficit effects may not be sufficient to fully describe the stance of fiscal policies. Indeed, as noticed before, a tax financed temporary increase in government spending, with no effect therefore on the budget balance, may nonetheless affect private saving[5] and the level of interest rates. Households may indeed respond to higher taxes today by decreasing saving so as to smooth consumption intertemporally. For this reason, in the empirical analysis below, we add to the list of fiscal indicators also the level of government consumption.[6]

We have also added to equation 2 an additional variable (*MC*) to capture monetary conditions. While monetary policy is the key determining factor of short run interest rates, fiscal policy will mainly affect the spreads between long and short term rates (Canzoneri *et al.*, 2002).

Equation 2 will be estimated on a panel of 11 EMU members (excluding Luxembourg, but including Greece) from 1979 to 2002. However, when applied to the case of EMU, it needs to be modified in some important respects. Indeed, in a currency or, more generally, in a financially integrated area, real interest rates will be a function not only of domestic variables but also of financial conditions for the area as a whole. To capture this factor, we add to equation (2) a measure of the average (GDP-weighted) real interest rate for the currency area as a whole, with the average EMU interest rate being defined so as to exclude the country concerned.[7] We must also allow for the fact that the average EMU interest rate is an endogenous variable as well, whose determination should follow closely the specification of

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5 Under the usual assumption that government spending is not a perfect substitute for private consumption.

6 A higher level of unproductive government consumption and distortionary taxation may however depress growth. If this effect is strong enough, interest rates may fall rather than rise.

7 An alternative approach would simply add to equation 2 the difference between each country's regressor and the corresponding variable at the EU level. Given that the two approaches are bound to be equivalent, in what follows we only take the first route.

equation 2. Accordingly, in this specification, we end up estimating a system of 12 equations, one for each EMU member[8] and one at the Euro zone level.

$$(i - \pi E)i = fi[yi - yi^*, \pi iE, Bi, Di, \rho i, MCi, (i - \pi E)\text{emu} - i] \qquad i=1,\ldots,11 \qquad (3)$$

$$(i - \pi E)\text{emu} = \text{femu}[y\text{emu} - y\text{emu}^*, \pi\text{emu}E, B\text{emu}, D\text{emu}, \rho\text{emu}, MC\text{emu}, (i - \pi E)\text{us}] \qquad (4)$$

Note that in equation 4 we allow for the fact that EMU is not a financially closed area by introducing a variable representing international financial conditions. To this effect, we add the level of US real interest rates ($i_{us} - \pi^{E}_{us)}$ to the list of explanatory variables in equation 4.

In this set-up, domestic fiscal policies affect interest rates through two channels. First, there is a direct impact on spreads. Expansionary fiscal policy should raise domestic spreads with respect to the prevailing rates in the remainder of the area. This effect is captured in equation 3, through the coefficients on B_i and D_i. Second, a fiscal expansion in one country will affect both the deficit and the debt stock for the Euro zone as a whole and hence the area level of interest rates. This is the spillover effect, that was described in section 2. The size of this effect will largely be a function of the relative size of the country. It is captured in equation 4 by the coefficient of B_{emu} and D_{emu}.

b) The data

Most of the data come from the OECD. As a measure of the interest rate on the stock of public debt, we use the yield to residual maturity on 10 years government bonds. The output gap also comes from the OECD. Expected inflation is computed separately for each country, and for the EMU as a whole, from a simple ARIMA process. For most countries, an ARMA (1, 1) process described the inflationary process quite well. Profitability is measured by the real (*i.e.* deflated by expected inflation) return on the stock market.

We have added to equations 3-4 a variable to capture the monetary policy stance. Under the assumption that Central Banks control short term interest rates, we have used the three month real money market rate as an indicator of monetary conditions.

The selection of fiscal policy indicators was relatively harder. As noticed earlier, there are good reasons in favour of having both a stock and a flow indicator. However, we still need some guidance as to which indicator to select. Concerning debt, one would in principle favour a net measure, that deducts government assets from government liabilities. Muhleisen and Towe (2004) and Orr and Conway (2002) use such an indicator. Unfortunately, existing measures of government assets are not easily comparable among countries and their availability

[8] In the actual estimation, we drop one country equation (Austria) to allow for the fact that the aggregate EMU equation is a combination of the individual countries' equations.

is relatively restricted. There are in addition unresolved conceptual and definitional issues (Elmendorf and Mankiw, 1999). For these reasons, in what follows, we rely on a more standard gross debt indicator. The choice of the deficit variable also raises a set of thorny issues. Just using current deficits is likely to be inappropriate for at least two reasons. First, measured deficits reflect not only the fiscal policy stance, but also factors such as the business cycle. As noticed earlier, relying on cyclically unadjusted fiscal indicators may introduce a spuriously negative correlation between budget deficits and interest rates. Second, measured deficits depend on the level of the interest rate and, hence, suffer from an endogeneity problem. To address the latter problem, we focus on the primary surplus, thereby excluding interest payments. To cope with the former issue, we rely on a cyclically adjusted measure of the deficit, that corrects actual deficits for the effects of cyclical fluctuations. In the end, therefore, we rely on the cyclically adjusted primary surplus.[9] We use the OECD indicator of the output gap as a measure of cyclical conditions and European Commission estimates of the elasticity of budgetary conditions to the cycle. Figure 6 shows how the cyclically adjusted deficit compared to the unadjusted measure.

c) Estimation results

Estimation results are presented in Table 1. The sample covers the period 1979-2002. All current EMU countries, with the exception of Luxembourg, are included. Incomplete data availability, particularly at the beginning of the sample, means that the panel is unbalanced. For the purpose of estimation, we define a system of 11 equations (one for each of the 10 EMU country[10] and one for EMU as a whole) and impose the equality of the slope coefficients, while allowing intercepts to differ across countries.[11] The system is then estimated through three stage least square. This procedure is designed to allow for the contemporaneous correlation of the error terms among the 11 equations. It is therefore more efficient than a standard fixed effect procedure (Arellano, 1987). It also controls for the possible endogeneity of most regressors in equations 3-4 (such as the EMU real interest rate, the real return on the stock market, the real short term interest rate, inflation, and the output gap).[12]

We first present the estimates for the 1979-98 period, *i.e.* before the advent of EMU, with a view to assessing the behaviour of interest rates before the introduction of the common European currency. The results are presented in

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[9] We use actual fiscal balances, but plan to extend the empirical analysis to assess the role of expected future deficits.

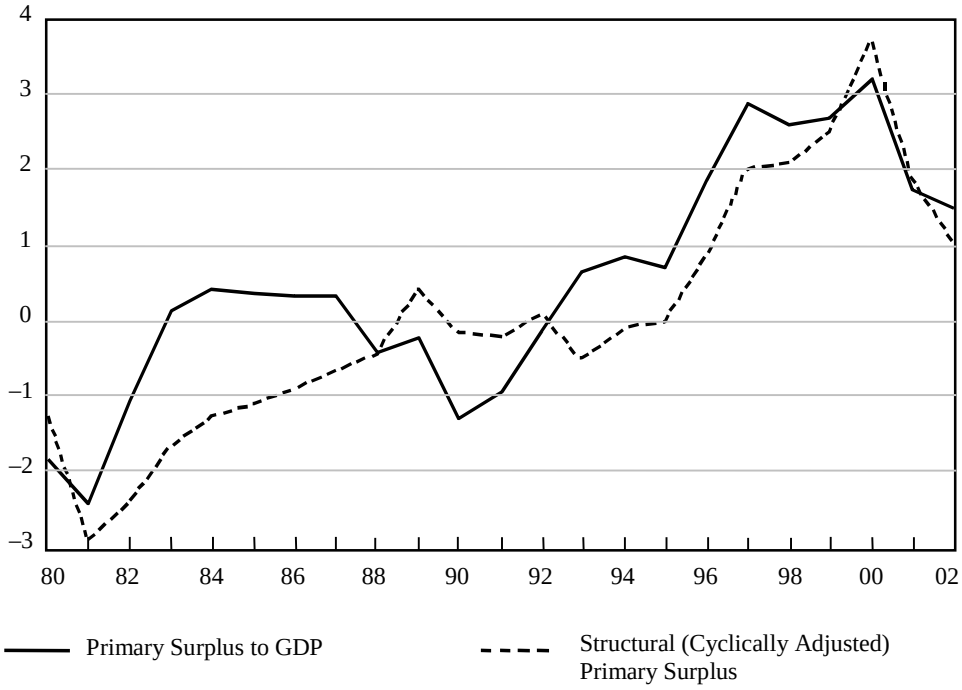
[10] Recall that we have excluded one country (Austria) from the system.

[11] We allow however the slope coefficients on fiscal variables to differ between the EMU as a whole and the rest of the system. By allowing the coefficients on B_i (D_i) to differ from that of B_{emu} (D_{emu}) we can indeed compare the effects of fiscal policy on country's spreads versus those on the Euro zone level of interest rates.

[12] As instruments, we use the price of oil, its lagged value, the cyclically adjusted primary surplus and the lagged values of the explanatory variables.

Figure 6

Actual and Cyclically Adjusted Primary Surplus for the Euro Zone



column 1. Let focus first on the impact of fiscal variables. Three facts stand out. First, fiscal balances (as measured by the cyclically adjusted primary surplus) matter. The coefficient on individual country and the EMU primary surplus are both negative (a higher primary surplus is associated with a lower real interest rate) and statistically significant. Second, the quantitative impact of deficits is much stronger at the EMU than at the national level. The coefficient on the EMU fiscal balance suggests that a one percent fall in the primary surplus boosts real interest rates by 41 basis points. The effect of an analogous change at the country level is substantially smaller, less than 5 basis points. Accordingly, the impact of expansionary fiscal policy in one country will not be seen much in the level of its spreads (our estimates in this regards do not differ substantially from those in Codogno *et al.,* 2003, or in Bernoth *et al*., 2003), but will have a definite and more substantial impact on the aggregate level of interest rates. Interestingly enough, here too our estimates are not far off the mark from those of the US literature (Gale and Orswag, 2002). Third, the debt stock plays no role at the country level, but once again is quite significant for EMU as a whole.

Table 1

The Determinants of Real Interest Rates in the Euro Zone

	(1)	(2)	(3)	(4)	(5)
	3SLS	3SLS	3SLS	2SLS	3SLS
Short term real rate	0.54 (17.0)	0.56 (16.6)	0.54 (18.5)	0.51 (10.9)	0.56 (25.3)
$(i - \pi^E)_{EMU-i}$	0.24 (5.06)	0.23 (4.6)	0.25 (5.7)	0.31 (4.04)	0.27 (7.27)
$PSSTR_i$	–0.043 (2.8)	–0.045 (2.75)	–0.046 (3.01)	–0.043 (1.16)	–0.034 (3.32)
$GDBT_i$	0.003 (0.74)	0.003 (0.72)	-	0.007 (0.95)	0.002 (0.67)
$GDBT\ D_{\text{high debt}}$	-	-	0.002 (1.73)	-	-
π^E_i	–0.08 (2.9)	–0.08 (2.9)	–0.08 (3.44)	–0.076 (1.70)	–0.08 (3.78)
$(y - y^*)_i$	–0.13 (4.9)	–0.15 (4.86)	–0.12 (4.36)	–0.10 (2.61)	–0.12 (5.34)
ρ_i	0.01 (0.7)	–0.002 (1.04)	0.000 (0.35)	0.002 (0.84)	–0.001 (0.85)
$PSSTR_{EMU}$	–0.41 (4.7)	–0.36 (3.72)	–0.40 (4.90)	–0.49 (1.76)	–0.35 (4.07)
$GDBT_{EMU}$	0.058 (5.5)	0.056 (4.79)	0.058 (5.52)	0.07 (2.02)	0.050 (4.38)
$(i - \pi^E)_{US}$	0.25 (6.4)	0.24 (5.69)	0.24 (6.21)	0.31 (2.38)	0.22 (5.46)
GCON	-	–0.07 (1.41)	-	-	-
sample	1979-1998	1979-1998	1979-1998	1979-1998	1979-2002

Legend:
i: nominal interest rate
π^E: expected inflation
PSSTR: cyclically adjusted primary surplus/GDP
GDBT: gross domestic public debt/GDP
$y - y^*$: output gap
ρ: stock market real return
*D*1999: dummy variable (1 from 1999, 0 otherwise)
$D_{\text{high debt}}$: dummy variable for high-debt countries

Overall, these results suggest that spillovers are paramount in transmitting the effects of national fiscal policies. The impact on country spreads of high deficits and of debt is either quantitatively small or not significantly different from zero. The impact of fiscal policies is much more pronounced at the level of EMU, as ought to be expected in a financially integrate area. One simple interpretation is that fiscal policies affect the aggregate saving investment balance for the EMU as a whole.

Concerning the other variables, we find that short term interest rates have, as expected, a positive impact on long-term rates. Hence, at least in the short run, the impact of expansionary fiscal policies on long-term rates may be muted if meanwhile the Central Bank pursues expansionary monetary policies. Both higher (expected) inflation and a larger output gap have a negative impact on long-term real interest rates. The latter result suggests that the impact on saving of cyclical conditions is more pronounced than that on investment. The former can be interpreted as saying that tax considerations are not paramount in determining the impact of expected inflation on real interest rates. Otherwise, the coefficient would have been most likely positive (Feldstein, 1986) to the extent that the interactions between the tax system and inflation penalize saving. The main effect of high inflation is probably to boost precautionary saving and hence to lower interest rates. Saving may also rise, as noticed before, if inflation erodes the real value of financial assets. Finally, the real return on the stock market has no influence on long-term real interest rates. High profitability should shift the investment curve and lead to higher interest rates. At the same time, it may improve the growth prospects and alleviate market concerns about debt sustainability. Alternatively, the high volatility of the stock market may explain our finding that profitability has no statistically significant impact on real interest rates. As shown by Galeotti and Schiantarelli (1994), investment reacts quite strongly to fundamental changes in stock market valuations, but is not significantly affected by fads. In addition, the high correlation among the US and the EU stock markets means that most of the effect of stock market valuations is already captured by the real interest rate in the US which in turn significantly affects that in the EU.

In columns 2 and 3, we extend the model in two different directions. First, we check whether the composition of government spending matters after controlling for the budget balance. We add therefore government consumption to the list of explanatory variables. We find no significant effect neither at the country nor at the EMU level (column 2). Second, we check whether debt stocks matter only for high-debt countries (Belgium, Greece and Italy in the Nineties, where the debt to GDP ratio was steadily above the 100 percent mark). The effect is small, but close to statistical significance (column 3). We shall return to the issue of high-debt countries in the following section of the paper.

Finally, in column 4 we estimate equations 3-4 using this time a two stage least squares procedures. This is because the three stage least square procedure, while more efficient, will spread any specification errors in a single equation to the whole system. The two stage least square procedure, while less efficient, is less vulnerable to this kind of problems. By and large, the econometric estimates do not

differ substantially (column 4). Interestingly enough, fiscal variables at the Euro zone level have now higher coefficients compared to column 1.

A key issue is whether the behaviour of interest rates has changed since the onset of EMU.[13] The number of sample observations since 1999 is clearly inadequate to provide a fully satisfactory test of such an hypothesis. As an alternative, we estimate our system from 1979 until 2002, to include the EMU period (column 5). The results do not differ in any substantial way from those for the shorter sample, suggesting that the effects of EMU, if any, were not paramount, confirming the finding of Bernoth *et al.* (2003). Of course, it could well be that the estimates over the full sample, from 1979 to 2002, resent disproportionately from the early pre-EMU period. We test, therefore, for a structural break in the equations, by adding time dummies for each year after 1998. The Wald test provides no evidence of a structural break. We also test for a break in some of the coefficients, particularly those associated with fiscal policies. We first check whether the coefficients on the primary surplus at the country level ($PSSTR_i$) exhibits a break after 1998. We interact $PSSTR_i$ with a dummy variable (D1999) that takes a value of 1 after 1998 and zero otherwise. The estimates provide no support for this hypothesis.[14] We also test whether the debt and the deficit variables at the EMU level ($GDBT_{EMU}$ and $PSSTR_{EMU}$) should be included in the list of potentially unstable coefficients. Again, the estimates offer little or no support to the hypothesis of a structural break after the onset of EMU.[15]

4. Are high-debt countries different?

The estimates in Table 1 suggest that, at least in some respects, high-debt countries behave differently. This is not totally surprising, once we consider that concerns about long run sustainability are likely to be disproportionately larger for countries with an initially high stock of debt. Furthermore, if considerations about sustainability are pervasive, then also the effect of flow variable should be more

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[13] In deriving equation 2 (the reduced form solution for real interest rates), we assumed the economy to be financially closed. The estimating equations (eqs. 3-4) are however consistent also with an open economy set up where real interest rates are determined by the combination of uncovered interest parity, purchasing power parity, and a risk premium. Indeed, combining uncovered interest parity, dynamic PPP and a risk premium (φ) yields:

$$(i - \pi^E) = (i^* - \pi^{E*}) + (e^E - \pi^E + \pi^{E*}) + \varphi$$

where the second term is the expected real depreciation. Fiscal indicators (B, D) are assumed to affect both the risk premium and the expected real depreciation, while other variables (the output gap, expected inflation, the profitability of investment) influence mainly ($e^E - \pi^E + \pi^{E*}$). The same set of factors should be at work, albeit at a different degree, both before and after EMU. Our econometric strategy is as follows. First, we estimate eqs.3-4 from 1979 to 1998. Second, we assess whether the estimates are stable after the onset of EMU, namely when the system is estimated over the full period 1979-2002. We expect to find substantive changes in the behaviour of the risk premium, in particular for high-debt countries. However, EMU may also have affected the behaviour of the term premium, and this would be reflected in a change in the coefficient of short term (real) interest rates.

[14] The p-value of the coefficient on $D1999 \times PSSTR_i$ is equal to 0.58.

[15] The p-values are equal to 0.29 and 0.91 for the two coefficients, respectively.

pronounced. Indeed, while an increase in deficit in a low debt economy may not raise excessive concerns, the same will not apply to a country where the debt to GDP ratio is say above the 100 percent mark (Drudi and Prati, 2000).

For the purpose of illustration, let consider the following simple model. Consider a stationary economy where both inflation and the output growth rate are equal to zero.[16] The rate of change in the level of debt is by definition equal to the budget deficit, which is in turn equal to sum of the primary deficit (*i.e.* the budget deficit net of interest payments) and total interest payments. The debt stock will then be unchanged if the primary surplus is equal to the interest bill. We define the debt stabilizing primary surplus (ps^*) as the level of the primary surplus that is consistent with a constant stock of debt. Clearly, the debt stabilizing primary surplus is equal to the value of interest payments, which is in turn identically equal to the nominal interest rate times the stock of debt. The difference between ps^* and the actual value of the primary surplus (ps) measures the fiscal adjustment required to stabilize the stock of debt. If ps^* is greater than ps then the stock of debt is on a rising path. The larger the difference between ps^* and ps the more demanding is the fiscal adjustment required to stabilize the stock of debt.

To determine the level of the interest rate, we proceed as follows. We assume that investors believe that if the adjustment required to stabilize the debt (namely $ps^* - ps$) is too large (*i.e.* greater than an exogenous threshold k) the risk of default will rise. They will then charge a relatively high interest rate on the government's debt.

The model leads to an obvious circularity between the debt stabilizing primary surplus and the interest rate. If interest rates are high, so will the debt stabilizing primary surplus. Conversely, if the debt stabilizing primary surplus is large, then the default risk and the interest rate will also be high. There may multiple equilibria where both the interest rate and the debt stabilizing primary surplus are either high or low.

For the purpose of this paper, the crucial observation is that changes in the primary surplus (ps), may have a different impact on interest rates depending on the initial level of the debt. Consider Figure 7. The r_1r_2 schedule paints the relationship between the interest rate and the primary surplus. If the difference between the debt stabilizing primary surplus (ps^*) and the actual surplus (ps) is larger than a critical threshold (k, in the figure), interest rates will rise from r_1 to r_2. The other two schedules (labeled the low and the high b, respectively) show how the debt stabilizing primary surplus rises with the interest rate. The slope of the schedule is a function of the debt to GDP ratio, with a higher debt stock being associated with a flatter schedule.[17]

We can now examine the effect of a fall in the primary surplus, ps. As ps declines, the discontinuity point in the r_1r_2 schedule shits to the left. For a high-debt

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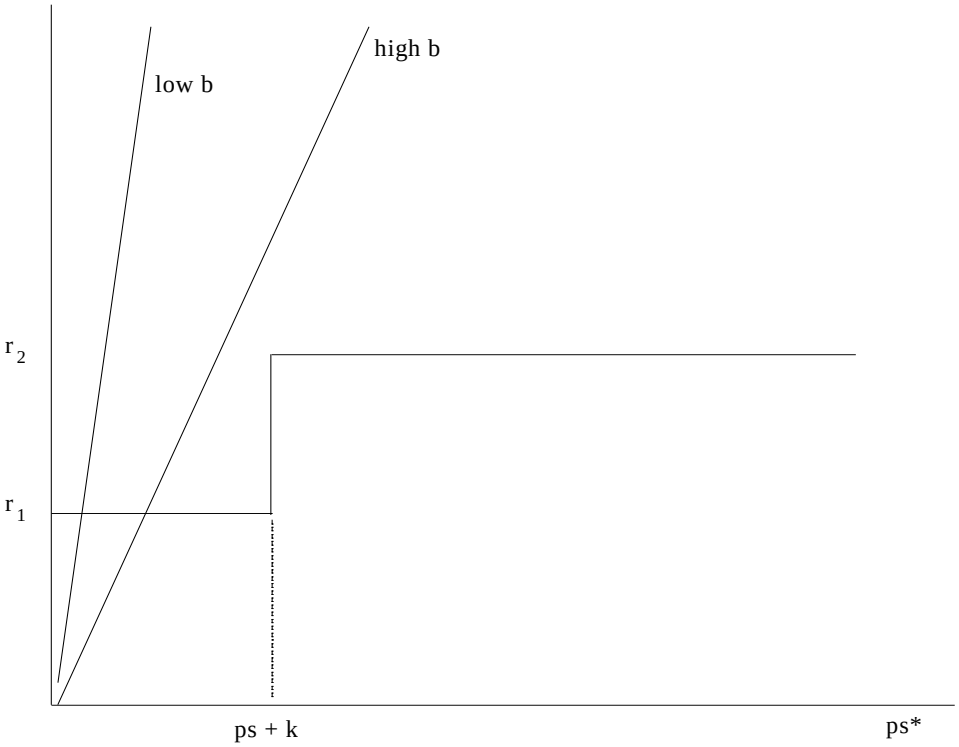
[16] In appendix C we consider the more general case where both inflation and output growth are positive.

[17] For simplicity, figure 7 is drawn for the case where $n = 0$.

Figure 7

A Framework for Debt Sustainability



country, this means that the interest rate may well rise from r_1 to r_2. For a low debt country, the fall in the primary surplus will have to be proportionately larger for the interest rate to increase. In general, a given change in the primary surplus will have no impact on the interest rate for low debt countries if it does not also affect the interest rate of a high-debt country.

Of course, the model is too simple. For instance, interest rates may rise continuously in response to the imbalance between the actual and the debt stabilizing primary surplus. However, it conveys a simple message, namely that the effect of fiscal policies may be non linear (Giavazzi, Jappelli and Pagano, 2000, and Drudi and Prati, 2000). One simple way to capture this non linearity, which is fully consistent with our model, is to add to the list of explanatory variables the following term:[18]

[18] See Blanchard (1993) for an in-depth discussion of forward looking indicators of fiscal policy.

$$\Psi = (ps^* - ps)\, b \tag{13}$$

Even if debt stabilizing primary surplus (ps^*) is greater than the actual primary surplus (ps), and the associated debt dynamics is at least locally explosive, the effects on interest rates will be muted provided that the debt to GDP ratio (b) is close to zero. Conversely, if ps^* rises above ps even by a small margin, the impact on interest rate will be disproportionately large if the initial debt to GDP ratio is high. In other words, a tendency for the debt to GDP ratio to increase will be of much greater concern to financial markets if the initial debt ratio is already relatively high.

Figure 8 shows the empirical relationship between real interest rates and the Ψ variable for EMU countries. In contrast to figure 3, there seems to be now a positive correlation between real interest rates and this new indicator of fiscal sustainability. As expected, the relationship is substantially stronger for high-debt countries (Figure 8b). To assess more formally the role of fiscal sustainability we need to turn to econometric analysis.

In Table 2, we report the estimates of equations 3-4 with the addition of the interaction term, Ψ. Given that the stock of debt had no impact for low debt countries, we add this new term only to the equation for high-debt countries. We define as high-debt countries all the cases where the debt to GDP ratio is higher than 100 percent for more than 3 years. Given this definition, the high-debt country sample includes Belgium, Greece, and Italy for most of the Nineties.

In column 1 we report the results for the pre-EMU from 1979 to 1998. The results mirror those in Table 1, except for the fact that the Ψ variable is included and is statistically different from zero. Its coefficient is positive, as expected. Ceteris paribus, an increase in the debt stabilizing primary surplus or a fall in the actual primary surplus should, for a given stock of debt, boost interest rates. We find again that standard fiscal indicators, such as the debt to the GDP ratio or the cyclically adjusted primary surplus, work their way on interest rates mainly at the level of the Euro zone. The effect on domestic spreads remain quite limited, confirming the findings of Table 1.

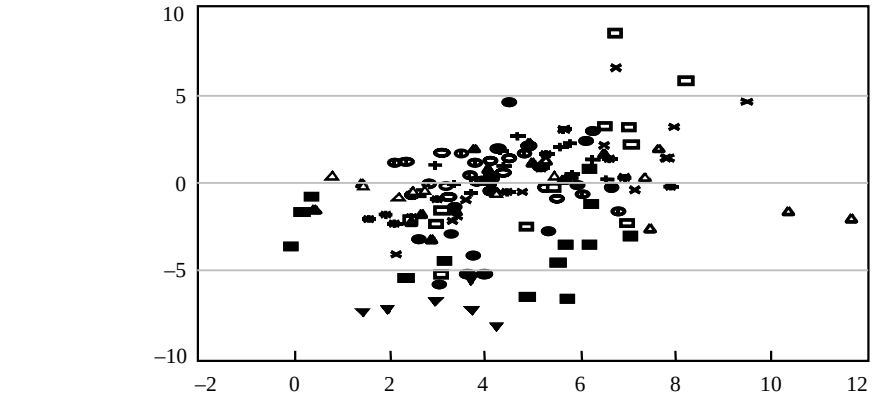
In column 2 we report the two stage least squares estimates. Again, the main difference with the three stage least squares procedure is that most of the coefficients lose some of their statistical significance. In column 3, we test whether sustainability considerations, as measured by the variable Ψ (properly redefined at the Euro area level by aggregating all high-debt countries), has an additional impact on the Euro zone level of interest rates. The results provide no support to this notion, suggesting therefore that sustainability considerations matters only, or mainly, for domestic spreads in high-debt countries.

In column 4 we extend the sample to the post-EMU period, until 2002. As in Table 1, there is little evidence of a structural break after the onset of EMU, except however for the coefficient on Ψ which is now much smaller and statistically insignificant. We have therefore reestimated the model, allowing the coefficient on

Figure 8

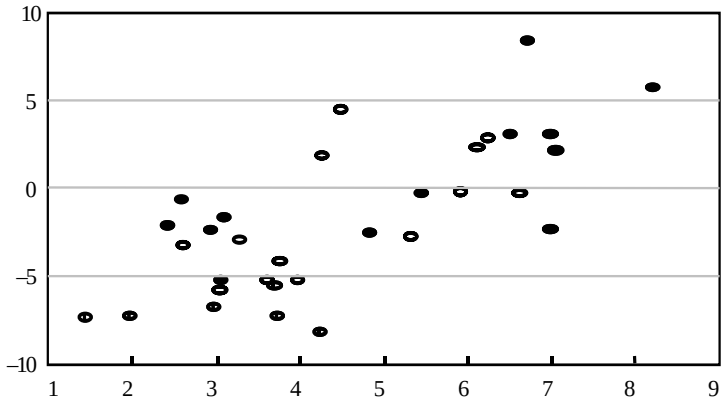
Debt Sustainability and Real Interest Rates for EMU Members

a) Full Sample



(PSVAR_AUT, LTRIR_AUT)
(PSVAR_BEL, LTRIR_BEL)
(PSVAR_DEU, LTRIR_DEU)
(PSVAR_ESP,LTRIR_ESP)
(PSVAR_FIN, LTRIR_FIN)
(PSVAR_FRA, LTRIR_FRA)
(PSVAR_IRL, LTRIR_IRL)
(PSVAR_ITA, LTRIR_ITA)
(PSVAR_NLD, LTRIR_NLD)
(PSVAR_PRT, LTRIR_PRT)
(PSVAR_GRC, LTRIR_GRC)

b) High-debt Countries



(PSVAR_BEL, LTRIR_BEL)
(PSVAR_ITA, LTRIR_ITA)
(PSVAR_GRC, LTRIR_GRC)

Legend:
PSVAR: (ps* – ps) x debt to GDP ratio
ps*: debt stabilizing primary surplus
ps: current primary surplus
LTRIR: long-term real interest rate

Table 2

Debt Sustainability and Real Interest Rates in the Euro Zone

	(1)	(2)	(3)	(4)	(5)	(6)
	3SLS	2SLS	3SLS	3SLS	3SLS	3SLS
Short term real rate	0.51 (22.7)	0.50 (10.8)	0.51 (17.0)	0.56 (23.6)	0.57 (24.2)	0.57 (24.3)
$(i - \pi^E)_{\text{EMU}-i}$	0.24 (4.77)	0.32 (4.18)	0.25 (4.81)	0.25 (6.14)	0.26 (6.32)	0.27 (6.58)
$PSVAR_i\ D_{\text{high debt}}$	0.12 (4.82)	0.13 (2.09)	0.13 (4.91)	0.03 (1.03)	-	-
$PSVAR_i\ D_{\text{high debt}}\ D_{99}$	-	-	-	-	0.06 (1.98)	0.06 (1.94)
$PSSTR_i$	–0.037 (2.16)	–0.039 (1.05)	–0.038 (2.19)	–0.034 (2.31)	–0.032 (2.25)	–0.036 (2.50)
$GDBT_i$	0.001 (0.25)	–0.005 (0.61)	0.001 (0.24)	–0.002 (0.59)	0.001 (0.54)	0.002 (0.64)
π^E_i	–0.076 (2.75)	–0.077 (1.76)	–0.075 (2.71)	–0.76 (3.52)	–0.69 (3.22)	–0.07 (3.30)
$(y - y^*)_i$	–0.11 (3.96)	–0.10 (2.43)	–0.11 (3.81)	–0.11 (4.76)	–0.12 (4.95)	–0.12 (5.00)
ρ_i	–0.005 (1.94)	–0.002 (0.61)	–0.003 (1.76)	–0.002 (1.28)	–0.001 (1.19)	–0.001 (1.18)
$PSVAR_{\text{EMU}}\ D_{\text{high debt}}$	-	-	–0.02 (0.55)	-	-	0.12 (2.16)
$PSSTR_{\text{EMU}}$	–0.40 (4.50)	–0.50 (1.78)	–0.39 (4.23)	–0.33 (3.70)	–0.33 (3.76)	–0.26 (3.20)
$GDBT_{\text{EMU}}$	0.06 (5.38)	0.07 (2.04)	0.06 5.23)	0.049 (4.09)	0.049 (4.25)	0.046 (4.41)
$(i - \pi^E)_{\text{US}}$	0.25 (6.41)	0.31 (2.44)	0.25 (6.02)	0.22 (5.13)	0.22 (5.32)	0.19 (4.93)
Sample	1979-1998	1979-1998	1979-1998	1979-2002	1979-2002	1979-2002

Legend: see Table 1.
PSVAR: (ps^* – ps)* debt/GDP.

Ψ to differ between the pre and the post-EMU period. We find that the coefficient on the sustainability indicator, Ψ, is statistically different from zero only in the pre-EMU period. In column 5, we present therefore the new estimates where the coefficient on Ψ is different from zero only in the pre-EMU period. In line with Table 1, the stability test yields no further indications of a structural break after the onset of EMU.

Finally, in column 6, we test whether sustainability considerations, as measured by the variable Ψ (properly redefined at the Euro zone level by aggregating all high-debt countries), have an additional impact on the area wide level of interest rates after the onset of EMU (recall that in column 3 we found no effect of Ψ on real interest rates before 1999). The results provide considerable support to this conjecture, suggesting therefore that sustainability considerations matters both for domestic spreads in high-debt countries and for the Euro area level of interest rates after the introduction of the common currency. We have also tested whether the results reflect the impact of the level of gross debt at the Euro zone level rather than of sustainability considerations. However, replacing the variable Ψ with the debt to GDP ratio for high-debt countries yields a statistically insignificant coefficient.

Overall, these results show that the interest rate spillover effects of fiscal policies slippages in high-debt countries are relatively larger than the average. Fiscal indiscipline in high-debt countries has a stronger impact on interest rates, which is reflected not only in higher domestic spreads but also, after the onset of EMU, spill over to the area wide level of interest rates. At the same time, however, there is no evidence that high-debt countries *per se* have negative spillovers on the Euro zone level of interest rates. Actually, high-debt countries with sustainable fiscal policies – as defined by a steady reduction in their debt ratios – may have a disproportionate impact in reducing the area wide level of interest rates. If these results are confirmed by further research, the case for treating *all* high-debt countries differently in a rejuvenated version of the Stability and Growth Pact would not seem particularly strong. What is needed is that high-debt countries follow sustainable fiscal policies that ensure a steady decline in their debt to GDP ratio. In other words, most of the attention should be devoted to the dynamics of the debt stock rather than to its level.

5. Conclusions

Peer punishment among EMU members has lost much of its effectiveness since the disparagement of the SGP at the Ecofin meeting in November 2003. Attempts by the Commission to bring new life into the SGP have so far met with little success. Whether fiscal misbehaviour is subject to market punishment is therefore a key issue in the design of the new fiscal architecture that needs to uphold the common currency.

Unfortunately, empirical evidence on the link between interest rates and fiscal policy is rather inconclusive and sometimes even puzzling. Most papers show that

fiscal indiscipline among EMU members is only subject to a relatively mild punishment. A one per cent increase in the deficit to GDP ratio leads to a rise in interest rates of not more than 10 basis points. By contrast, the US literature suggests a much larger impact, a difference that still begs for an explanation.

What this paper shows is that the findings for the US and EMU can, at least partly, be reconciled when one recognizes that an expansionary fiscal policy in one EMU member will have a twofold effect, first on its spreads, and second on the overall level of interest rates for the currency union as a whole. What our results suggest is that the latter effect is much more significant, indicating that there are indeed substantial spillovers, through the interest rate channel, among member countries fiscal policies. A further finding is that for high-debt countries sustainability is a relevant issue. Both the level and the dynamics of public debt stock have a strong influence on their domestic spreads. Moreover, we find some evidence that, after EMU, interest rate spillovers are larger for high-debt countries with unsustainable fiscal policies.

These results underscore the need to revive the Stability and Growth Pact. They also provide some indications as to the desirable avenues of change. The need for both fiscal coordination and fiscal rigour does not arise solely from the desire to allow fiscal policy to play an autonomous role in macroeconomic stabilization, but more fundamentally from the existence of unfavourable interest spillovers among EMU members. At the same time, we find some evidence that the spillover effects are stronger for high-debt countries with unsustainable fiscal policies and, hence, a growing debt burden. Fiscal slippages in such countries are reflected not only in higher spreads on their domestic debt but also on the area wide level of interest rates. Overall, therefore, the suggestion (Sapir *et al.*, 2003) that the "new" stability and growth pact should treat high-debt countries more severely should be amended to apply only to those high-debt countries where lack of fiscal discipline leads to a further increase in their debt ratio. The need for a different treatment for high-debt countries would also arise if concerns about the costs of a bail out of an insolvent government become paramount.

APPENDIX A
INTEREST RATE SPILLOVERS IN A RICARDIAN MODEL

Suppose that government spending provides no utility to consumers (or, less strongly, that the marginal utility of private consumption is independent of government spending). Consider a simple two country, two period model, where consumer intertemporal utility is isoelastic, the government budget is balanced in an intertemporal sense, and there is no investment. We show that a temporary increase at time 1 in government spending in any one country will lower domestic saving and raise global interest rates.

Under the stated assumptions, private consumption at time 1 is simply equal to:

$$C_1 = 1/(1 + (1 + r)^{\sigma-1}\,\beta^{\sigma})\,[Y_1 - T_1 + (Y_2 - T_2)/(1 + r)] \tag{A1}$$

where C_i, Y_i, and T_i denote respectively private consumption, output, and taxes at time i (i = 1, 2), β and σ are the consumer's rate of time preference and the intertemporal elasticity of substitution and r is the real interest rate. Given the government's intertemporal budget constraint:

$$G_1 - T_1 + (G_2 - T_2)/(1 + r) = 0 \tag{A2}$$

we have that:

$$\Delta C_1 = -1/(1 + (1 + r)\,\sigma - 1\,\beta\sigma)\,\Delta G_1 \tag{A3}$$

The change in total domestic saving at time 1 ($S_1 = Y_1 - C_1 - G_1$) will then be equal to:

$$\Delta S_1 = (1/(1 + (1 + r)\,\sigma - 1\,\beta\sigma) - 1)\,\Delta G_1 < 0 \tag{A4}$$

Under the assumption that income effects are not too strong and the equilibrium is well behaved, the fall in country's 1 saving will lead to a higher global interest rate, thereby affecting also country 2.

APPENDIX B
THE DETERMINATION OF THE REAL INTEREST RATE

We assume that real interest rates are determined by the interaction of aggregate saving and investment. In a closed economy context, private investment (I^{pr}) is identically equal to the sum of private (S^{pr}) and the excess of public saving over public investment, *i.e.* the budget surplus (B):

$$I^{pr} = S = S^{pr} + B \tag{B1}$$

In what follows we normalize both saving and investment by GDP. Investment depends on profitability (ρ), the output gap ($y - y^*$), expected inflation (π^E), and the real interest rate ($i - \pi^E$):decisions are specified as follows:

$$I^{pr}/Y = I(\rho, y - y^*, \pi^E, i - \pi^E) \tag{B2}$$

where the nominal interest rate (i) has been deflated by expected inflation (π^E).

Private saving is assumed to be a function of the output gap, the real interest rate, expected inflation, net public saving (*i.e.* the budgetary balance), and possibly other variables that reflect the fiscal policy stance (D):

$$S^{pr}/Y = S(y - y^*, i - \pi^E, \pi^E, B, D) \tag{B3}$$

Substituting equations B2 and B3 into B1 and solving for $i - \pi^E$ yields the reduced form equation for the real interest rate:

$$i - \pi^E = f(y - y^*, \pi^E, B, D, \rho) \tag{B4}$$

Equation (B4) is the basis for our empirical work.

APPENDIX C
DEBT SUSTAINABILITY AND FISCAL POLICY

In a growing economy, the rate of change in the debt to GDP ratio (b') is a function of the real interest rate (r), the rate of growth of the economy (n) and the ratio of the primary surplus to GDP (ps):

$$b' = (r - n)\, b - ps \tag{C1}$$

From equation C1, we see that the debt stabilizing ($b' = 0$) primary surplus is simply $ps^* = (r - n)\, b$. Let also assume that the real interest rate, r, is a function of the risk free rate, r^*, and a default probability, p. With risk neutral investors, we have that:

$$r\,(1 - p) = r^* \tag{C2}$$

The key assumption is about the default probability:

$$p = p_1 \qquad \text{if } ps^* - ps < k \tag{C3}$$

$$p = p_2 \qquad \text{if } ps^* - ps > k$$

and $p_1 < p_2$. In words, if the adjustment required to stabilize the debt ($ps^* - ps$) is too large (*i.e.* greater than an exogenous threshold k) the risk of default will be larger ($p_2 > p_1$) and the interest rate will be higher.

The model leads to an obvious circularity between ps^* and r. If r is high, so will the debt stabilizing primary surplus, ps^*. However, if ps^* is large, then the default risk and the interest rate will also be high. There may be multiple equilibria where both r and ps^* are either high or low.

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