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Interest Rates, Exchange Rates and Fiscal Policy in Europe

Ray Barrell, James Sefton and Jan In't Veld

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National Institute of Economic and Social Research
2 Dean Trench Street
Smith Square
London
SW1P 3HE.

Abstract

RAY BARRELL, James Sefton, Jan in't Veld, *'Interest Rates, Exchange Rates and Fiscal Policy in Europe*, National Institute of Economic and Social Research, 2 Dean Trench Street, Smith Square, London SW1P 3HE.

This paper addresses the issue of fiscal solvency and the debt sustainability in a potential European Monetary Union using a forward looking, estimated neoclassical model of the World Economy. The implications of fiscal shocks to the European economies is analysed. Money base targetting is used in combination with a set of fiscal closure rules that ensure that the "no Ponzi-games" condition holds. The model as a result has a saddlepath and it is possible to solve with forward looking expectations. After discussing model properties the paper offers a suggestion for standardised analysis of fiscal policy on forward looking models. Changes in the target government deficit and debt ratios have sustained but ultimately transitory effects on output and unemployment. However, the costs of a contraction are not negligible. The paper draws some conclusions on the effects of the Maastricht fiscal solvency criteria.

This paper was presented at the Macro-Economic Modelling Bureau at Warwick, July 1993. We would like to thank participants for their comments. We would also like to thank Andy Blake, John Bradley, Martin Weale, Peter Westaway, John Whitley and Guglielmo Caporale for useful discussion on these topics.

The Maastricht Treaty sets out clear guidelines for the operation of fiscal policy in a potential monetary union. If the transition process towards monetary union is unabatedly continued the policies that would have to be adopted would, beyond doubt, be contractionary. The effects of adopting these rules will depend in part on how monetary policy is operated in Europe. In particular if interest rates fall in response to a fiscal contraction, then the effective exchange rate of the ECU could fall, and this could help offset the contractionary effects of the fiscal stance. This paper attempts to assess the potential relationship between fiscal policy, the interest rate and the exchange rate in Europe.

The first section of this paper discussed the implications of the Maastricht criteria on the present and future conduct of fiscal policy in Europe. This discussion highlights the importance of solvency in the operation of fiscal policy.

This issue has until very recently been given only cursory attention in large-scale macro models. The central part of this paper therefore addresses this point with reference to the National Institute Global Econometric Model, NIGEM. The second section analyses fiscal solvency and the implementation of fiscal closure on macro models; the third section examines the related issues of interest rates exchange rates[1] and monetary policy. The fourth section compares our approach to those of IMF's multimod, and the fifth suggests a consistent way of analysing fiscal policy ie a forward-looking model.

The analysis and the presented simulations are designed to throw light on the fiscal policy debate. Our conslusions aim to illustrate this and particularly emphasise the contractionary nature of the Maastricht criteria.

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1 These issues are further addressed in appendix 1.

Fiscal Policy in Europe

The Maastricht Treaty sets a limit on both government debts and deficits (60 percent and 3 percent of nominal GDP respectively), and these have to be achieved by the end of the decade. It is not clear why such definite criteria have been set, except as a part of a political bargain between the signatories of the Treaty. If it is accepted that borrowing to finance government investment is justifiable, and if nominal growth is 5 percent per annum, then the Maastricht criteria fit with a government investment to GDP ratio of 3 percent.

Table 1: Gross Public Debt in 1992

(percentage of nominal GDP)

	1985	1990	1992
Germany	42.5	43.6	43.2
France	45.4	46.6	51.6
Italy	84.3	100.5	108.1
UK	52.7	34.7	41.0
Belgium	122.6	131.2	135.3
Netherlands	67.9	76.1	77.0
Denmark	64.1*	59.5*	62.4*
Ireland	107.9	101.7	96.8
Spain	48.8*	44.2*	51.9*

Note: For Denmark and Spain, including public sector mutual indebtedness

Source: OECD, Economic Outlook

Table 2: Government Deficits in 1992

(percentage of GDP)

	1992
Germany	- 2.8
France	- 3.9
Italy	- 9.5
UK	- 6.7
Belgium	- 6.8
Netherlands	- 3.3
Denmark	- 2.5
Ireland	- 2.8
Spain	- 4.8

Source: OECD Economic Outlook

Several European governments have had difficulty in ensuring that the outstanding stock of government debt has not expanded more rapidly than nominal income. Table 1 gives details of the ratio of the gross stock of debt to nominal income in the members of the European Community. Debt stocks exceed 100% of GDP in Belgium and Italy, and have continued to rise. Although the Netherlands also has a relatively high debt stock, the Dutch do not face such severe fiscal pressures as the other heavily indebted countries as their net debt is much lower[2].

The stock of debt will be rising, at least as a proportion of income, if the ratio of the government deficit to the debt stock exceeds the nominal rate of growth of output in the economy. Table 2 gives government deficits in the same countries. There does appear to have been some attempt to reduce deficits in the Netherlands and Belgium in the recent past, but the Italian deficit has remained large[3]. Deficits in the UK and Germany have risen recently and exceed the Maastricht criterion , but this can be explained by severe recession and by unification respectively.

Fiscal solvency must be taken seriously, and the evolution of Government deficits has to be maintained and measured carefully[4]. A government will only be considered solvent if it is anticipated that it can continue to service the interest on its debt. This requires that the debt does not continually grow as a proportion of national income. However, the path for the debt stock in the future is not always obvious, as policies may change. If the debt expansion stops, then it

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2 Details of debt stocks can be found in Anderton, Barrell and In't Veld (1992).Gross debt stocks may not be the theoretically most relevant definition, but they are used in the Treaty.

3 The significance of the large deficit has increased as inflation has fallen over the last decade, as this has reduced the growth of nominal income and the proceeds of the inflation tax.

4 Blanchard et al (1990) puts forward short, medium and long term measures of solvency, and Caporale (1992) applies cointegration techniques in order to evaluate the sustainability of the past fiscal stance in the European economies.

is possible that a new higher level of sustainable debt has been reached.[5] If, for instance the Italian authorities continued to run a deficit of 10 percent of nominal GDP, and if nominal growth were 6 percent a year in Italy inside a Monetary Union, then the debt stock would stabilise at 166.6% of nominal GDP.

There may, however, be other reasons for imposing fiscal solvency constraints inside a monetary union. In a world where Ricardian equivalence does not hold[6] then an increase in government borrowing to finance current consumption reduces the level of net saving in the economy, and the actions of the government will raise the real interest rate. Thus deficits in one country in a monetary union may affect the real interest rate in other members of the union. This is of course just an example of a pecuniary externality, and as such reflects the operation of the market mechanism. If some people wish to borrow more then the price of funds is bid up in order that they are allocated to the socially most desirable use. This effect on real interest rates is always possible in any type of exchange rate system, but it may be more significant in a monetary union.

In a floating rate system, the nominal interest rate does not have to be the same everywhere, and if fiscal policy in one country raises interest rates then its exchange rate will appreciate[7]. In a fixed rate system this is not possible, and initially the real interest rate in the expanding economy will fall, and real rates elsewhere may rise. These real interest rate (and real exchange rate) differentials will induce factor flows (direct investment and labour) that will eventually remove them. Hence in any fixed rate system a fiscal deficit in one country will raise real interest rates everywhere in the long run. In a

5 See Blanchard et al (1990).

6 Or rather, and more generally, in a world where consumers face a higher rate of interest than does the government. (see Masson et al 1990).

7 This is the standard Mundell Fleming result that is extensively analysed in Frankel and Razin (1987).

potential European Monetary Union, and especially one coupled with the EC's single market programme, the factor flows are likely to be much more rapid than we saw under the Bretton Woods system, and hence the effects of fiscal expansion may be felt everywhere. However, in the short term a fiscal expansion in, say, Italy would cause a real appreciation of the ECU against other currencies. This is the acceptable concomitant of an expansion in Italy (and indeed it has a smaller contractionary effect on that country than it would outside the Union). However, the rest of the ECU block will also suffer a real appreciation, and it is not so clear that this is just a pecuniary externality

Fiscal Policy Analysis on large Models

Fiscal solvency has also to be taken into account in the use of large scale macro models in policy analysis. Forward looking models should not necessarily solve in response to permanent fiscal expansions. They will do so only if Ricardian equivalence is built in to the model, or if the nominal (real) interest rate is less than the nominal (real) rate of growth, or if fiscal closure is imposed. If government spending rises as a percent of GDP and if taxes rise in line with nominal GDP then we would have a constant increase in the primary deficit and the debt stock can be expected to rise permanently. If the nominal interest rate on the debt stock is less than the rate of growth of nominal income then the net and gross debt stocks will asymptote onto a new, higher level. However, if the nominal interest rate exceeds the growth rate then an increase in the primary deficit may cause the debt stock (as a proportion of GDP) to explode. We demonstrated in Anderton, Barrell and In't Veld (1992a) that debt explosions would be possible in Germany, France, Italy and the UK, where real interest rates exceeded real growth rates for much of the 1980s.

Debt explosions should prevent our models solving for two reasons. First they, violate the "no-Ponzi game" condition, and hence a model that has the possibility of a debt explosion cannot contain the saddlepath that is necessary for sensible forward solutions to exist. We extend the Buiter Miller analysis in Appendix 3 and demonstrate the conditions for a saddlepath to exist.[8] Second, we cannot usually solve large models over infinite horizons, and therefore it is usually necessary to impose terminal conditions for each forward looking variable. The most difficult variables in forward models are those with (close to) unit roots in their forward looking behaviour. The exchange rate is a particularly good example. It is not held down by the inertia in the price system in the first period of a simulation, and hence it needs an end value boundary condition. It has been common to use the ratio of net overseas assets to nominal GDP in a terminal condition, and to require it to return parallel to base.[9] This should not be possible in the face of government debt stock explosions. If the private sector has, as it should, a net wealth equilibrium then it will not, net, hold the extra government debt. The only other possibility is for the overseas sector to hold the debt, and if the government debt stock explodes, so does the stock of overseas assets. That is why Currie and Levine (1991) associate fiscal solvency with national solvency. Weale (1989) et al discuss these issues at length, and demonstrate the superiority of targetting wealth over other strategies.

In Barrell and In't Veld (1992) we discussed the introduction of solvency constraints and fiscal closure into our model, NIGEM. There are many ways to impose closure. We experimented with the use of government expenditure as an instrument in the work reported in Whitley (1992) but decided that using a tax rate gave results that were easier to interprete. An adapted form of the income tax rate rule for the major economies is:

8 Blanchard and Fisher (1989) demonstrate the point for a closed economy using an overlapping generations model and a model of perpetual youth. Even in a world where expectations are rational we would still expect consumers to partially discount the future tax liabilities associated with an increase in debt. This is clearest in the model of perpetual youth where the discount factor depends on the decay rate of the population.

9 We have experimented with relative net assets both as a terminal condition and as a risk premium.

$$tr_{jt} = tr_{jt-1} - b\,(deficit_{jt-1} - target_{jt-1}) \qquad (1)$$

so that the tax rate tr in country j at time t changes in proportion to the deviation of the deficit from its target value (b is a scaling factor). This is similar to the rule that is used on Multimod (see Masson et.al. (1990)), but the combination of less nominal inertia in that model along with the assumption of forward looking consumers means that solvency effects the path of the economy more rapidly than on NIGEM.[10] Charts 1 to 4 illustrate how the above feedback rule on the direct tax rate helps to prevent a debt explosion for the four European economies. For this purpose, we have undertaken a permanent fiscal shock of 1 per cent of GDP and operated the model in forward looking mode, but with fixed exchange rates. Chart 1 shows the effects of the tax rate rule for Germany. In the absence of the rule, the deficit to GDP ratio is $3\frac{1}{2}$ percentage points above base after 30 years and the debt to GDP ratio has exploded to 40 percentage points above base. In contrast, when fiscal solvency is imposed, the tax rate rule ensures that the deficit is returned to base within approximately 6 years of the introduction of the constraint.

Charts 2 to 4 show similar results for France, Italy and the UK. The charts show clearly that the initial stimulus of the fiscal expansion is quite similar under both variants. Fiscal multipliers are typically between 0.5 and 1 in the first year, and return gradually back to base. Only after 3 to 5 years is there a significant difference between fiscal multipliers. When fiscal solvency is not imposed, output returns only slowly back to base. But with the feedback rule on the income tax rate, the rise in the tax rate ensures output returns back to base within 5 to 10 years. It is clear from these simulations that the lack of a fiscal policy constraint would vitiate all optimal policies conclusions drawn

10 The Multimod rule targets the level <u>and</u> rate of change in the bond stock as a percent of GDP. As Weale et al (1989) show the deficit and debt targets are essentially equivalent because the debt stock enters the deficit. The equivalence only disappears if the nominal multiplier and the ratio of high powered money to income are both very high.

Chart 1 German Fiscal Expansions

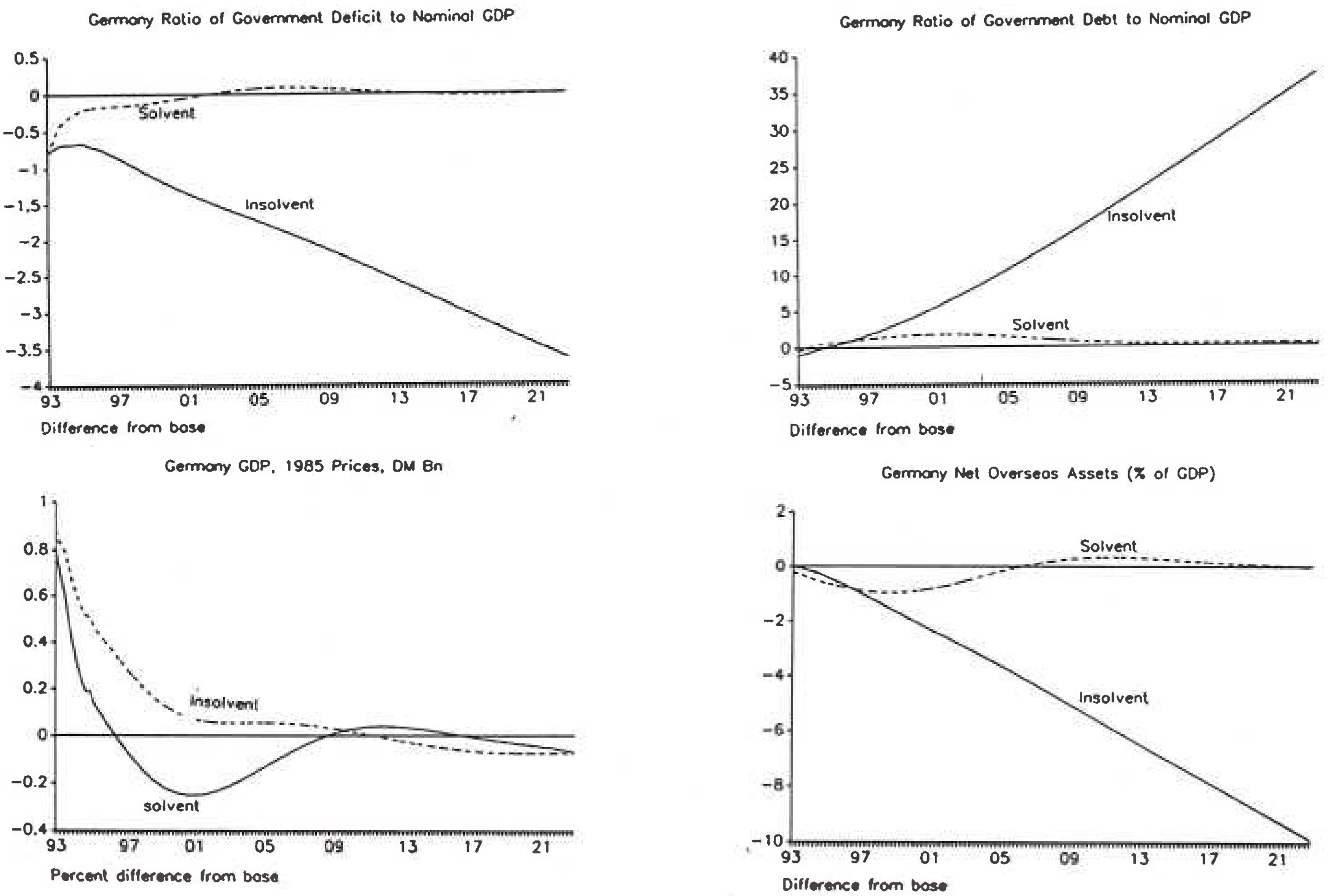


Chart 2 French Fiscal Expansions

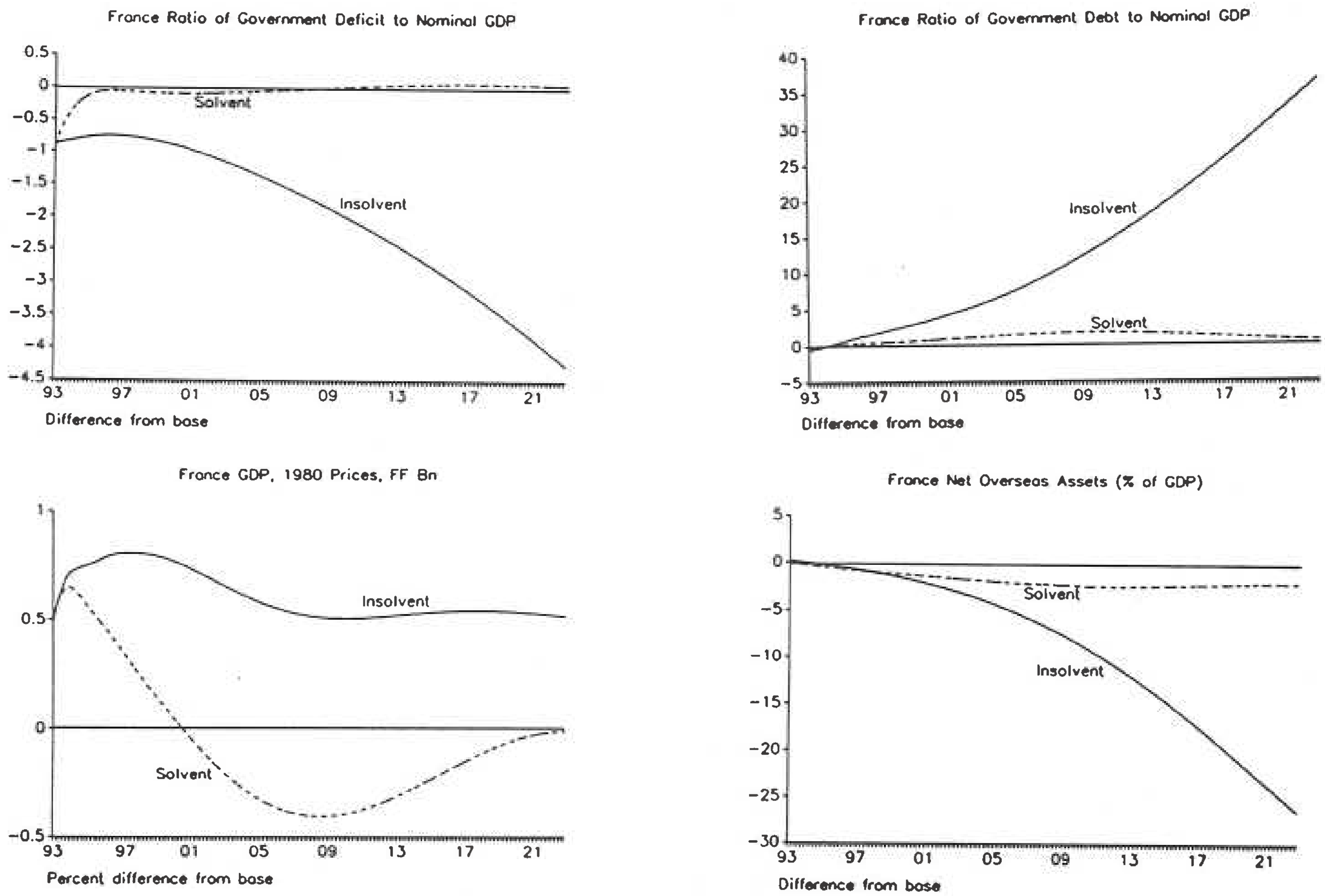


Chart 3 Italian Fiscal Expansions

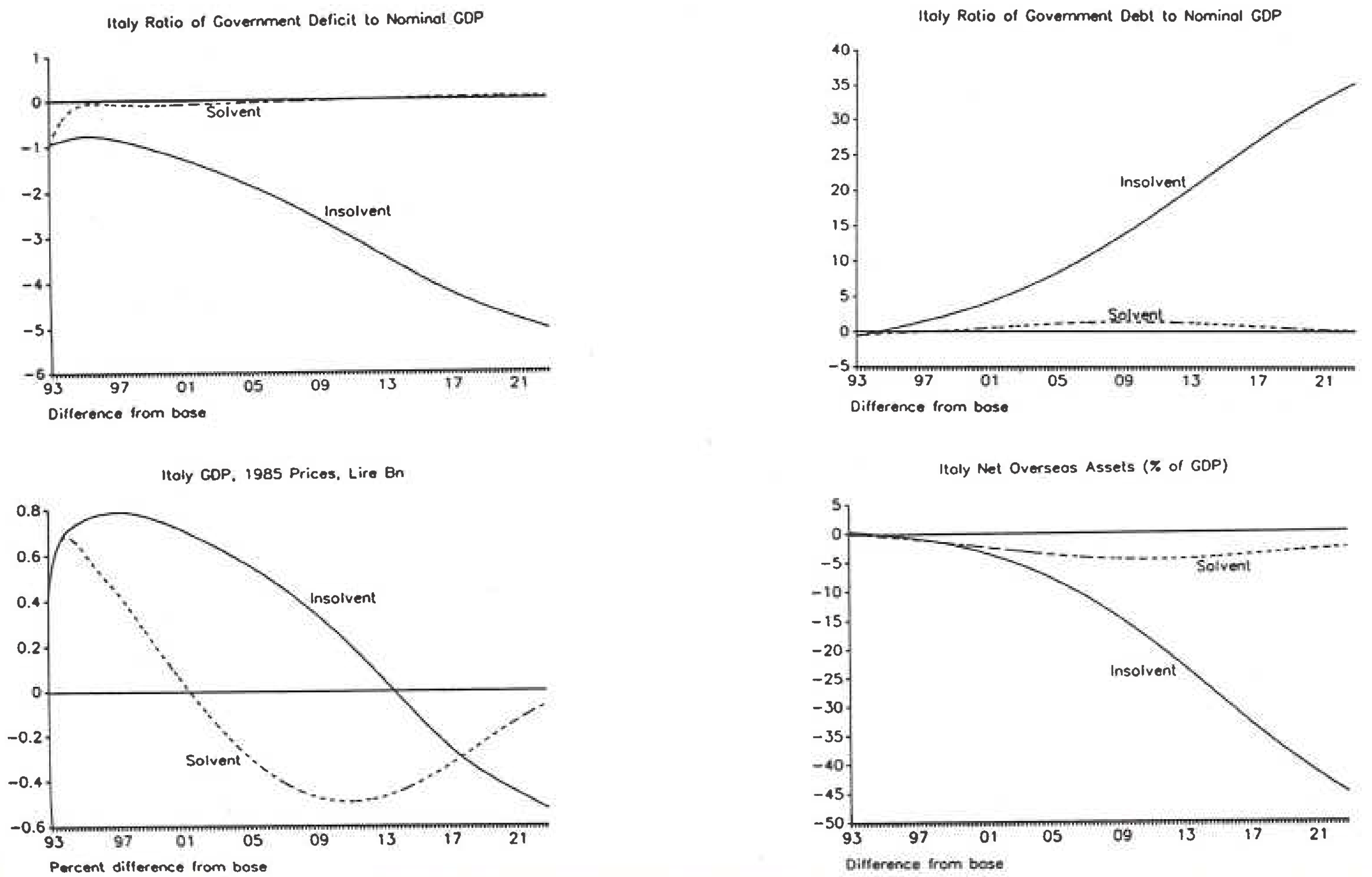
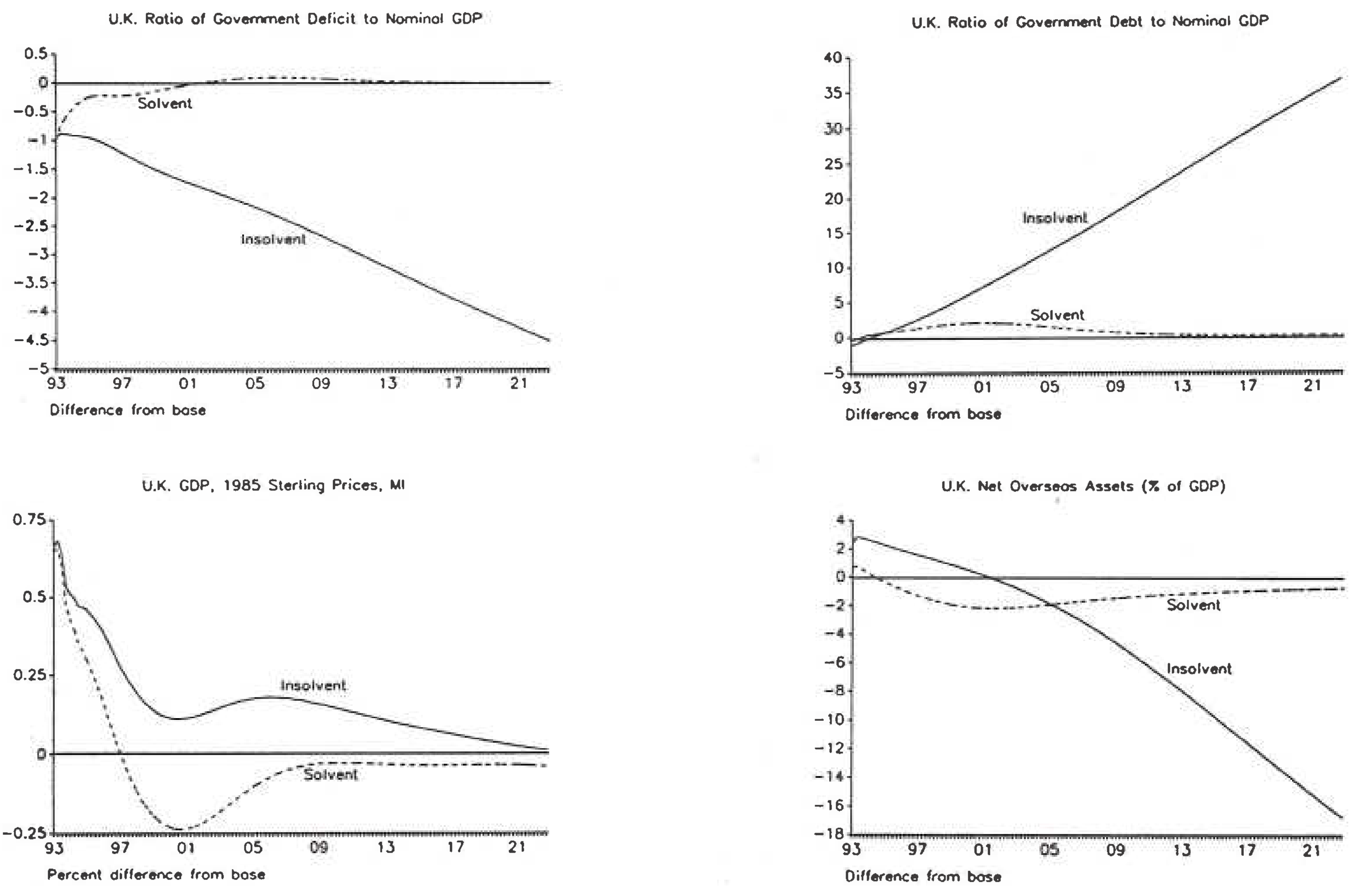


Chart 4 U.K. Fiscal Expansions



using a forward looking model.

A debt explosion would eventually lead to monetisation of the debt, and hence rational actors would not be willing to hold new debt. However, it is possible for the authorities to monetise the debt stock along the path, but this will involve an active <u>monetary</u> as well as fiscal policy, except in limited cases. Assume the deficit (D) is financed either by issuing high powered money (M) or bonds (B), and is spent on the primary deficit (A-T) and on debt service (rB), where A is absorption, T is net taxes and r is the interest rate.

$$D_t = \Delta M_t + \Delta B_t \quad (2)$$

$$D_t = A_t - T_t + rB_{t-1} \quad (3)$$

on dividing by nominal GDP and rearranging

$$\Delta b_t = - ps_t - m_{t-1}\,\Delta m_t + \frac{(r_t - g_c)}{1+g_t}\, b_{t-1} \quad (4)$$

where ps_t is the primary surplus (t_t - a_t) at time t, g is the growth rate of nominal GDP and m is the ratio of high powered money to GDP and Δm_t is the change in the stock of high powered money divided by last periods stock. The bond stock will settle onto a constant path if

$$(r_t - g_t)/(1-g_t)\; b_{t-1} = m_{t-1}\,\Delta m_t + ps_t \quad (5)$$

If $r < g_t$ and people hold some money then it is possible for a government to run a primary deficit and still have the bond stock stabilise at a finite level. If r>g then a primary surplus may eventually be required if the debt stock is to stabilise and solvency is to hold. However, if r is close to g and people hold a lot of money (or rather increase their holdings of money a lot) then it may be possible to run a small primary deficit. This deficit can be financed by part of the money issue whilst the rest of the money issue can be used to pay the interest (net of stock shrinkage $[-g/(1+g)]b_{t-1}$) on the existing debt stock. However, it is clear that in most circumstances this is

unlikely to happen.

In this paper we are interested in the effects of a permanent increase in government spending. We analyse them in a number of ways in order to investigate the importance of fiscal solvency in policy analyses using large models, and also to investigate the prospects for the major European economies. These issues are addressed in Appendix II. It is clear from our algebra that the effects of a shock will depend upon the growth rate and the bond stock on the base. It will also depend on the deficit financing rule and the monetary policy environment. The looser the monetary stance the less likely we are to observe a debt explosion. The least restrictive monetary stance normally considered involves fixed nominal interest rates. If a primary fiscal expansion takes place and the authorities operate with fixed nominal interest rates then the financing of the deficit is dictated, because increases in money demand are accommodated and hence $\Delta M/M=\beta g$ where β is the income elasticity of demand for money and g is the increase in nominal income associated with the shock. The rest of the deficit is financed by issuing bonds. Appendix II sets out the rather restrictive conditions under which a primary fiscal expansion accompanied by a policy of fixing interest rates can be associated with a stable debt stock.

It is possible that a permanent primary fiscal expansion can be associated with a stable debt stock. The fiscal expansion will raise nominal GDP, and this will shrink the existing debt stock and hence the interest payments as a proportion of GDP. If the debt stock and the change in nominal income are both large then the shrinkage in interest payments could be large enough to accommodate the change in the primary surplus. However, amongst the main European economies only the Italians have a net debt stock that is large enough for this to be a possibility. Table 3 sets out the net debt stocks and ratios of high powered money to GDP, for the four major European economies. We have undertaken some runs to allow us to gauge the effects of a one percent of GDP permanent primary fiscal expansion. We have assumed that interest rates and exchange rates are fixed, and that overseas holders of government debt are myopic, and hence hold the exploding debt stock. In these counterfactuals nominal GDP is $2\frac{1}{2}$ to 4 percent above base.[11]

Table 3: The Stability of Debt

	b(net)[a]	b(gross)[a]	m[b]	Nominal GDP Difference from base in the long run %	Net Debt Shrinkage
Germany	24.4	43.2	7.34	3.4	0.83
France	30.1	51.6	1.59	3.8	1.14
Italy	105.3	108.1	8.11	2.8	2.94
UK	35.8	41.0	1.93	2.6	0.93

a OECD Economic Outlook: debt as a percent of GDP
b IFS Country tables = (Reserve Money - International Reserves) as a percent of GDP

The rise in the price level associated with the increase in nominal GDP causes the real exchange rate to appreciate, reducing real net imports. As we could expect the required change in the real exchange rate depends upon the competitiveness elasticities in the trade equations and the model and they differ between countries. The rise in the real exchange rate has to be just sufficient to crowd out the increase in government spending. Appendix II also shows that the effects of the shock on the debt stock depend upon the rate of growth on the base as well as the interest rate on the base. The higher the interest rate the more room provided by a given level of debt shrinkage. Again, only in Italy is it possible that interest rates are sufficiently high to allow this possibility.

Although it is possible that permanent primary shocks do not lead to debt explosions, it is very unlikely that they will not do so in Europe. This leads us to two conclusions. The first is that the European Commission is probably correct to be concerned about issues of fiscal solvency. Our set of charts also plots the ratio of overseas assets as a percent of nominal GDP. The stock of overseas assets declines without bound, as we would expect if the stock of government debt expands without bound. Portfolio composition effects clearly matter, but they are second order. If the private sector has a wealth equilibrium, is forward looking and has a higher discount rate than the government faces then the shock should move it to a new equilibrium. If the private sector is backward looking the process of adjustment will take longer. However, in both cases we expect a new equilibrium will be achieved. Hence if the debt stock increases significantly the majority of the new debt issued is likely to be held abroad. To the extent it is not the wealth equilibrium will necessitate that the private sector disposes of other assets.[12] Our second conclusion is that the total asset stock could not be used in a sensible terminal condition in this model if fiscal solvency is not imposed. Any attempt to undertake policy analysis is in these circumstances is flawed, and even if solutions are presented, they cannot be economically sensible.

These diagnostic simulations were all undertaken on a 30 year base (1993q1 to 2022q4), and it is quite clear that long bases are essential to our analysis. The potential deficit explosion is not obvious in the first five years of our simulation without solvency, and fiscal multipliers with solvency have not disappeared for up to 20 years. This is in part because our solvency rule will take the debt stock to GDP ratio back to base, and it is associated with some overshooting of GDP and the deficit. If our fiscal multipliers were larger the debt explosion would take longer to emerge because of the effect on tax revenues at constant tax rates. The effects of the expansion in spending upon the debt stock depends in part upon the deficit financing rule and the associated monetary policy stance, and it is to these issues that we turn next.

11 This is of a similar order of magnitude as on the Institute domestic model NIDEM, and hence a permanent primary deficit shock will cause the net debt to explode.

12 We split our asset stock into equities, bonds and short term assets, and we have a simple portfolio equilibrium system that allocates the receipts of interest on the new debt. All else equal if debt in one country increases then world debt increases. Hence in a closed world everybody has to hold more debt.

Interest Rates and Exchange Rates

The effects of any fiscal policy change, even with a fiscal solvency requirement, will depend upon its effects on interest rates and exchange rates, and these in turn will depend upon the financing of the government deficit and upon the monetary rules in operation. Our financing rule is always the same, but we wish to be able to analyse the effects of three different targetting rules for the money supply, along with three different policy regimes for the exchange rate. The results will also depend upon the exchange rate equation we have in operation.

Solvency and forward looking exchange rates are obviously in some sense linked. If the overseas private sector is sufficiently forward looking to recognise an insolvent expansion then we would also expect its behaviour with respect to the exchange rate to be forward looking. Although it would be possible for us to analyse solvency with a backward looking exchange rate, we do not think it helpful. In this paper we have therefore assumed forward looking behaviour with respect to the exchange rates.

In the 1980's the countries of the European Community moved from a relatively flexible version of the Exchange Rate Mechanism, where realignments were permitted, to a system of virtually fixed rates. During this period the UK and Spain joined the system and the Scandinavian countries became associated with it. The virtual fixed rate system lasted from 1987 (or 1990) until the Autumn of 1992 when the pressures on the expanded system became difficult to sustain. The core ERM can be described as an asymmetric EMU, in that exchange rates are fixed, but monetary policy is essentially dictated by one country, Germany[13]. We can also analysis policy in Europe in the context of a core EMU consisting of France and Germany with the UK and Italy floating outside. Both are then free to determine their own monetary policies.[14]

13 In a world where all players are large, dominance is not possible, but a game with leadership is always possible. Currie (1992) clarifies the distinction between different types of EMU.

14 In a monetary union a European Central Bank (ECB) will dictate

We cannot be sure what monetary rules will be implemented by a Central Bank, and indeed they may change them in response to a change in the policy environment. NIGEM can be operated under three sets of monetary assumptions, and they are set out in appendix I. Different monetary policy rules will produce different exchange rate reactions in response to a common shock. If we implement money base targetting then a fiscal expansion should raise the demand for money and as a consequence the interest rate will rise. This should produce an upwards jump in the exchange rate, and the effects of the real appreciation will mitigate the expansionary effects of the fiscal impulse.[15] We can also implement inflation and GDP targetting as advocated by Masson and Symansky (1990). This allows a shock to be absorbed in part by a change in the price level, and hence the monetary stance is a little more lax than we would have with money base targetting. As a result the interest rate increase will be more moderate, and hence the exchange rate jump will be smaller. We also allow users to target the real interest rate, and a positive fiscal shock could be associated with a depreciation of the exchange rate because monetary policy is more accommodating.

Rational expectations for the exchange rate were first introduced into NIGEM in Gurney (1990) and Barrell and Gurney (1991) but had been widely applied to macromodels following on from the work of Minford (1982). In all our analyses reported below we assume that we have model consistent expectations, and hence we can write the expected exchange rate as

monetary policy and take into account developments in Europe as a whole. If we were to look at EMU as well then there are three exchange rate policy regimes to consider ; floating exchange rates, an asymmetric EMU with German leadership, and a symmetric EMU with a responsible Central Bank in place.

15 Conversely, a fiscal contraction should cause the interest rate to fall, and hence the exchange rate to depreciate. Giavazzi and Pagano (1990) argue that it is possible that we could observe an expansionary fiscal contraction, and that the exchange rate effect could overwhelm the interest rate effect. It is not clear that such a phenomenon has ever been observed (see Bradley and Whelan (1992)),and it seems extraordinarily implausible for any of the large economies considered here.

$$ {}_{t}e_{t+1} = {}_{t}e_{t}\left[(1+r_{t}) \,/\, (1+r_{at})\right]*rp_{t} \qquad (6) $$

where ${}_{t}e_{t}$ is the exchange rate expected for t+1 at time t, r_t is the (properly scaled) short term interest rate at home and r_{at} is that in the US. The term rp represents a risk premium between assets. We have assumed in this paper that it is not affected by solvent fiscal expansions. We argued in Barrell and In't Veld (1992) that the equilibrium condition in our stock flow model is that the rate of change in net overseas assets (as a proportion of nominal GDP) should be constant. If the net asset stock is constant then the flow onto the stock should also be constant, and hence an asset stock equilibrium condition is equivalent to a current balance terminal condition where the current balance as a percent of GDP has to be parallel to base. This condition can have two interpretations. First, following Minford et al (1980) it can be seen as a condition required by theory, and if it is not met, then the model has not achieved equilibrium by the terminal date. A more appealing interpretation is that we require the risk premia to be heading toward a constant at the terminal date.[16,17] It is

[16] If the rate of growth of nominal GDP is constant then a constant net asset to GDP ratio implies a constant current balance to GDP ratio. If a shock changes the equilibrium net assets to GDP ratio, for instance by changing the equilibrium stock of government debt as a percent of GDP, then the equilibrium current account will also change. More formally if py is nominal gdp, na are net overseas assets, if and nar = na/py, then dnar/dt = 0 requires $(\delta na/\delta t)/py-(na/py)(\delta py/\delta t)/py)=0$. If revaluations are neutral and nominal growth constant at a rate a then dna/dt = cbv and hence cbr=nar*a, where cbv is the current balance and cbr and nar are the current balance to gdp ratio and the net assets to gdp ratio.

[17] Any condition we have imposed can be written as

$$ XR_T - XR_T(\text{base}) = XR_{T-4} - XR_{T-4}\ (\text{Base}) $$

or

$$ XR_T - XR_{T-4} = XR_T(\text{base}) - XR_{T-4}\ (\text{base}) $$

where T is the terminal date, XR the relevant terminal ratio , and (base) indicates the value on the base. We have taken the fourth difference in order to avoid problems of seasonality in the condition (see Wallis et al (1986)) and we have used a version of forward shooting (see Barrell and Gurney (1991)).

clear from charts 1 to 4 that even with a solvent fiscal expansion the net asset ratio has not stabilised in the first 15 to 20 years, although it does eventually do so. If we impose our terminal condition too early it can do considerable damage to the solution, and it could even induce us to make the exchange rate jump in the wrong direction. In order that stock flow equilibrium is achievable we need to undertake our analyses over considerable time horizons.[18]

However, it is clear that our conditions imply other variables must stabilise along with the net asset ratio. If the asset stock is to stabilise in these conditions then the equivalent of the primary surplus or deficit must also stabilise. The total balance on trade in goods and non-factor services is the obvious equivalent in the current account of the primary deficit in the government accounts. If the asset stock is to stabilise then the trade balance has to be constant. If the reaction to a shock requires that in the long run the trade balance has to be parallel to its original path then the real exchange rate has also to be parallel to its original path.

It is useful to make a distinction between the behaviour of the private and public sectors. If there is a solvent fiscal shock that expands the stock of debt then, as long as portfolio composition does not change much the majority of the new debt must be held abroad. If the stock of public sector assets held is increasing, then so will the flow of public sector IPD debits. If we have fiscal solvency and a wealth equilibrium in the private sector then a terminal condition (or stabilising feed back rule) for the debt stock also suffices to stabilise the stock of public sector debt held overseas. Under the same circumstances the stock of private sector overseas assets should also stabilise. If the shock involves an eventual change in taxes, as it should, then personal disposable income will be lower. As a result we would expect the private sector to hold less wealth as a percent of GDP, and hence the private sector current balance will be smaller. However, much of the adjustment of the private sector current balance comes through the IPD

[18] These issues are discussed further in Blake and Westaway (1992) and in McKibben and Sachs (1991).

balance. The private sector trade balance equilibrium will also change, but these effects can be seen as second order.

We can draw several conclusions from this analysis. The first concerns the choice of terminal conditions. If the asset stock ratio is to stabilise then the current balance ratio must stabilise at the same time. The trade balance must stabilise at the same time in order that the change in the interest income balance can cumulate to the level required by the new equilibrium for the net asset ratio. In order that the trade balance stabilises the real exchange rate must stabilise. Our work suggests that this can take up to 15 years on NIGEM and that after 20 years the trade balance is much closer to base than is the net asset stock. It would appear that any of the private sector net asset ratio, the current balance, real exchange rate or the trade balance can be used as terminal conditions in large models. The real exchange rate is a key price variable in the model, and forcing it to stabilise too early would distort the whole pattern of results. Hence we advocate using the trade balance as the terminal condition variable because this allows us the side check that the real exchange rate has actually stabilised, rather than has been forced to do so.

The choice of a flow variable as the bearer of the terminal condition has its advantages. The flow variable will be much closer to base well before the stock condition on to which it is cumulating, and hence we can operate on much shorter bases. If the flow condition approximately holds, and it is clear that it is not an excessive constraint on the model, then it is clear that the stock condition will eventually be met, even if it has not been achieved by the end of our counterfactual run. One might say that all one needs to know is that the rocket is on a trajectory that will eventually land it on the moon, not that it has actually got there. As Blake and Westaway (1992) show, the use of asset stock terminal conditions in finite horizon models can do considerable damage. Flow conditions will still do damage in finite horizon models, but properly chosen they will be less damaging. We are advocating that we use terminal conditions that can be approximately achieved over a finite horizon and that ensure the that the asset stock condition is eventually reached, although we might expect that it asymptotes to its

eventual equilibrium and never achieve it in a finite time.[19]

The effect of a fiscal shock on the exchange rate, and our choice of terminal condition variable, will depend upon the exchange rate regime that is in place. The prospects for European Monetary Union, are of course uncertain, but it is useful to assess the differences that may be observed under a wide EMS and a narrow one excluding the UK and Italy. In the former case we assume that the exchange rate commitments are fully credible and hence that the markets take into account the net position of the potential union. In this case the ERM-wide trade balance is the relevant terminal condition. If any of the members undertook an insolvent fiscal expansion this would no longer be the case. We would then have to move to a narrower condition. We also analyse a narrow ERM using a terminal condition that excludes the UK and Italy.

The Impact of Fiscal Policy in NIGEM[20]

Fiscal multipliers under fixed exchange rates were reported above. Fiscal shocks with fixed exchange rates can only be seen as diagnostic exercises, unless we set up the policy environment carefully. We have to specify a rule for the generation of the world money supply as well

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19 This discussion should also make clear one other implication of our analysis. A given real exchange rate can be associated with a range of possible stocks of overseas assets generated by a range of different, but solvent, paths for the fiscal deficit. Hence if one wishes to calculate whether the exchange rate is overvalued one should look at the sustainability of the private sector trade balance, not the overall current balance. This result has relevance both for the common, but probably misguided, analysis of FEERs and for the analysis of the prospects for the current balance in the UK over the next few years. The fiscal deficit has been considerably worse than had been anticipated, and hence the stock of debt will be higher and the equilibrium level of overseas assets will be lower. However, the fact that we have revised downward our forecasts for the current balance in the last year should not lead us to radically change our views on the equilibrium level of the real exchange rate. This should depend only on our analysis of the sustainable trade balance.

20 The model used is described in the May 1993 model manual.

as its distribution between countries. We do not do that here as our objectives are more limited. We have undertaken 1% of GDP fiscal shocks with fiscal solvency constraints in place under monetary targetting with forward looking exchange rates. Fiscal multipliers in large scale models are often small, and those in NIGEM are no exception. There are a number of reasons for crowding out. First, we are dealing with open economies, and they have been becoming more open over time, and this will reduce the size of multiplier effects. Second, wealth effects and forward looking behaviour will reduce the effects of fiscal expansions on current consumption. A rise in short rates in the future will be reflected in long rates now, and this will cause equity prices, bond prices and financial wealth to fall.[21] Forward looking wages may well increase fiscal multipliers in the short term as nominal wages rise in anticipation of future price increases. However, the degree of nominal inertia in the economy, and as embedded in this model (see Anderton, Barrell, In't Veld and Pittis (1992)), probably means that this countervailing effect is quite moderate.

Table 4 gives fiscal multipliers for NIGEM, and MULTIMOD. In each case multipliers are small, and the combination of fiscal solvency constraints and money base targetting can actually make them negative in the medium run.

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21 Long rates in the model are the geometric average of expected future short rates, and our terminal condition is that $r_T = r_{T+1}$ for all J, where T is the terminal date.

Table 4: Fiscal Multipliers, 1% of GNP Fiscal Impulse

Country	Year	1	2	3	4	5	6
US	Multimod	.74	.32	-.10	-.44	-.66	-.70
	NIGEM	.85	.50	.28	.15	.07	-.01
Japan	Multimod	.64	.28	-.06	-.32	-.46	-.48
	NIGEM	.78	.30	.07	-.04	-.13	-.17
Germany	Multimod	.44	.18	-.02	-.16	-.22	-.24
	NIGEM	.65	.32	.15	.06	-.02	-.08
France	Multimod	.68	.64	.44	.14	-.20	-.52
	NIGEM	.58	.64	.56	.47	.37	.27
UK	Multimod	.54	.28	.04	-.20	-.36	-.46
	NIGEM	.62	.47	.38	.25	.10	-.03
Italy	NIGEM	.57	.67	.58	.48	.40	.30

The monetary policy regime has some impact on the profile of the multiplier. We analyse a number of different regimes in this section. The first is an ERM with German monetary targetting, and our results are given in table 4 economies for the full length of the simulation under this assumption. Fiscal multipliers are initially positive, but in the long run fiscal policy does not have an impact on the level of output. In all cases the exchange rate rises initially before falling along the open arbitrage path. Table 5 gives the initial exchange rate and interest rate changes.

Table 5: Initial interest rate and exchange rate response after fiscal expansion under German money base targetting

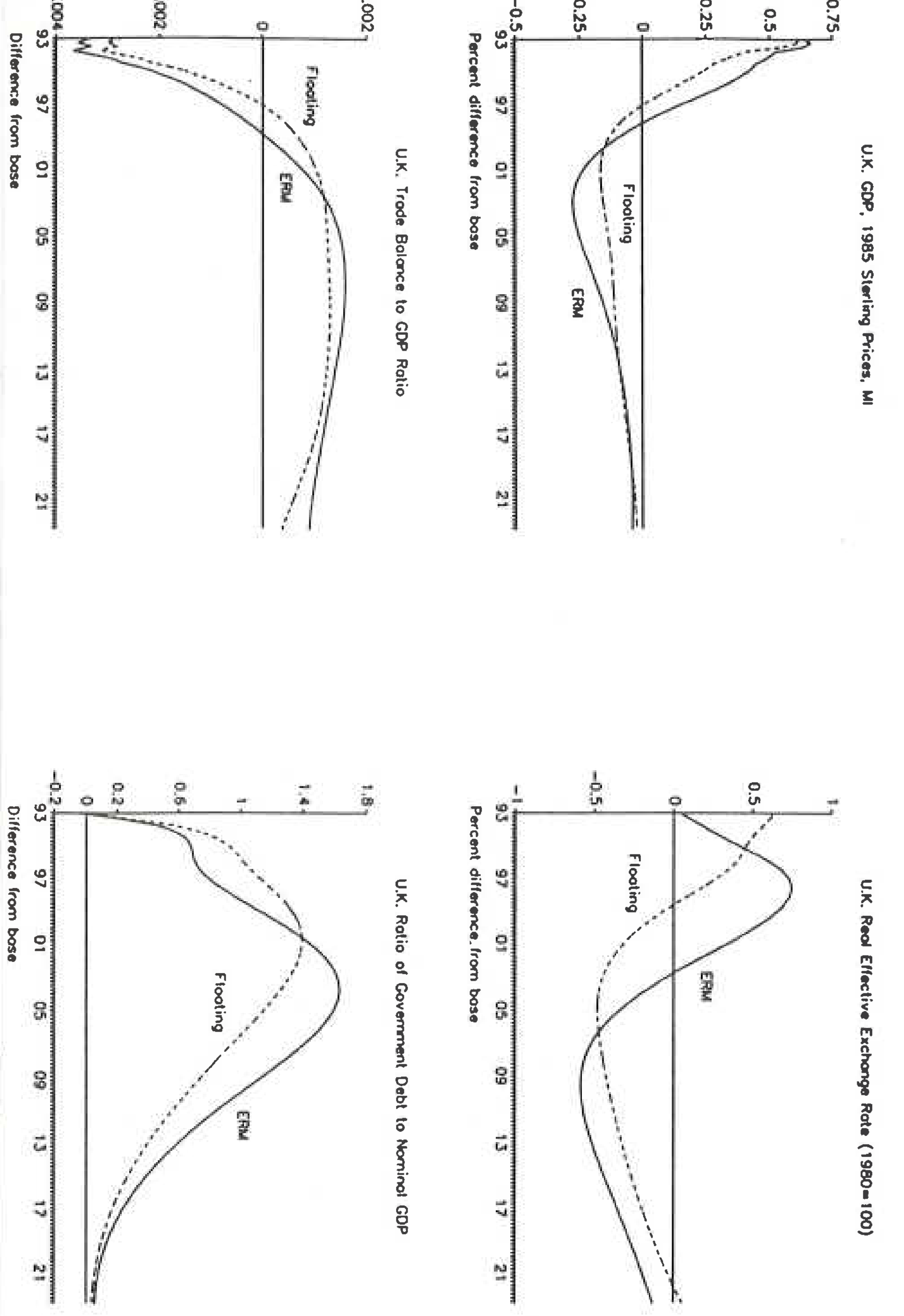
Country	Interest rate	Effective exchange rate	Dollar e.r.
Germany	0.21	0.20	-0.37
France	0.03	0.05	-0.13
Italy	0.02	0.05	-0.13
UK	0.01	0.03	-0.08

As we have stressed above, the degree of crowding induced by the shock depends upon the monetary policy rule used in the experiment. This is in part because the change in the short interest rate is different, but it also follows from the forward looking nature of the model. An EMS with German monetary targetting ensures that German output is exactly back on base in the long run. The interest rate response for fiscal expansions in the other European economies is much smaller, as the spill-over effects on the German economy take much longer to materialise. Long term interest rates are the forward convolution of expected short rates, and the jump in the long rate is much larger under a fiscal expansion in Germany itself. Both equity prices and bond prices depend upon the current long rate, and hence financial wealth falls in response to the fiscal shock. Some of this effect is felt abroad because some of the bond and equity stocks are owned by overseas residents.

Monetary union in Europe may well change the scale of fiscal multipliers, but the differences may depend upon the monetary targetting regime that is in place. Whitley (1992) and Anderton, Barrell and In't Veld (1992b) show that the difference between soft and hard EMU can be insignificant in terms of the effects of fiscal policy. In most cases the fiscal multipliers are larger than in the individual country cases because the effects on the target variables is less. The only exception is when a fiscal expansion takes place in Germany under the ERM, when only German variables are targetted.

The simulations for the UK are of particular relevance. Chart 5 plots GDP multipliers for a simulation where the UK is outside the ERM and compares them to the same path when the UK is inside an ERM with German monetary targetting. Even with independent monetary policy a solvent fiscal expansion produces an initial increase in the effective exchange rate of only 0.6 percent. The exchange rate then follows the open arbitrage path, and because interest rates are higher than on the base, the effective exchange rate depreciates. The scale of the jump in the exchange rate is not out of line with that produced on widely used, theoretically based, forward looking models such as Multimod, with Masson et al (1990) reporting an initial jump of 0.94 per cent in response to a one percent of GDP solvent fiscal expansion

Chart 5 The U.K. Inside and Outside the ERM



Although our fiscal multipliers are small, they are not zero, and a fiscal expansion causes a temporary increase in output. A fiscal contraction will give the reverse effect, albeit a temporary one. We would argue that the short run profile of the multiplier is little affected by our fiscal rule, but we have to acknowledge that this is a (arbitrary) design feature, and we could use rules that produce what is in effect a balanced budget multiplier or one that was so loose as to produce virtually the same results as an insolvent expansion. We would argue that the first is uninformative whilst the second should produce solution problems for any well specified model. The next section goes on to suggest an alternative, less arbitrary, rule and then applies it to the fiscal policy debate surrounding the Maastricht Treaty.

Sustainable Fiscal Policy and the Maastricht Criteria

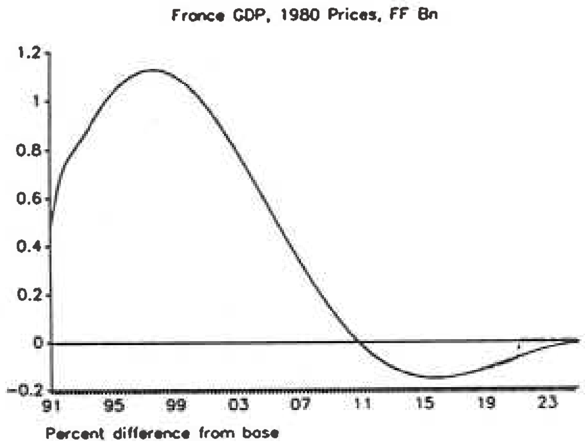
Section one above detailed the scale of the changes in fiscal stance that would be required in order to achieve the Maastricht criteria for government deficits. They would require fiscal contractions in the majority of European countries. In order to analyse the effects of such contractions we have repeated the fiscal policy simulations and relaxed the fiscal deficit targets in the tax rule (1) by 1 per cent of GDP. In these simulations, a smaller increase in the direct tax rate is provoked by tax rule (1) and the fiscal deficits now stabilise around 1 per cent of GDP below their base value. This implies that the debt stock will eventually stabilise at a higher level relative to GDP. These simulations can illustrate what the effects of abandoning the Maastricht conditions could have. If the Maastricht criteria would be abandoned then in the short run nominal demand would be strong throughout Europe. The contractionary effects of achieving monetary union would depend upon the effects on exchange rates and on the degree of demand spillovers between countries. Demand spillovers are generally small (see Whitley 1992) but they do exist. The effect on exchange rates will depend upon the size of the increase in interest rates and on the long run effect on portfolio balance. We also believe that standard policy analysis using large macro-models would be better done if we based our standard simulations of fiscal policy on shocks of this nature. They allow forward looking models to solve whilst removing most of the

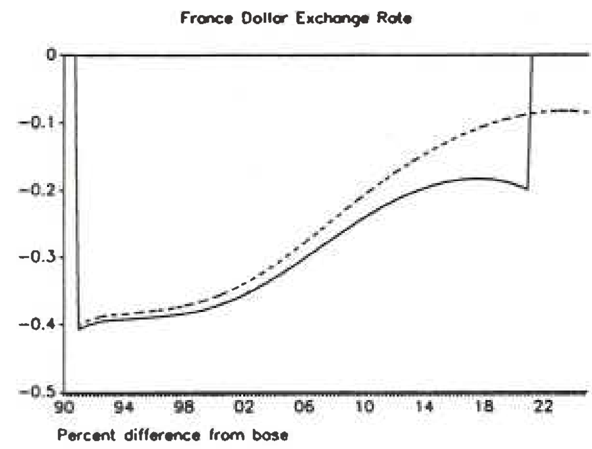
arbitrariness of the fiscal solvency rule that is necessary for them to do so.

Table 6 gives the effects on output of such fiscal relaxations taken one country at a time. We have assumed that the German Bundesbank continues to target the money base. It is obvious when these are compared to those in Table 4 that the effects on output are much bigger. Eventually output returns to base, but the effects are now more prolonged, with fiscal effects from this permanent shock being felt for 10 to 15 years. Multipliers are initially larger than in the solvent expansion because long rates rise by more in the first period. The greater crowding out effect is not fully offset by the longer fall in the exchange rate. The debt to GDP ratio stabilises at a higher level, and net overseas assets fall. In each case the exchange rate initially appreciates because of the increase in interest rates. Table 7 contains the first period exchange rates and interest rates for each of the EMS fiscal shocks. If the concerted fiscal contraction necessary for monetary union were not to take place and we were in a soft or asymmetric EMU (or ERM) then the interest rate response would depend upon developments in Germany. If the fixity of exchange rates were fully credible then DM, Franc, Lira and Sterling assets would all be perfect substitutes and the exchange rate effects would depend upon the effects on the net assets of the Community as a whole. There might, however, be country specific effects on risk premia and interest rate because deficit risk might be higher.

The terminal condition requires that the trade balance for the ECU block returns to base. In each case the terminal condition is satisfied without causing violence. The most sustained fiscal multiplier in table 6 is that for France and hence the effects of a fiscal shock in France under the assumption of German targetting are the most revealing about the effect of imposing the terminal condition. Chart 6 shows the European wide trade balance, French GDP and the Franc/Dollar exchange rate for two different length runs with a shock to spending and to the deficit target. It is clear the path for GDP is unaffected by the length of run, and the jump in the exchange rate is little affected by extending the run by three years. The difference between the jumps is 1/10th of the absolute convergence criteria in NIMODEL, and hence it

Chart 6 A French Fiscal Expansion in the ERM





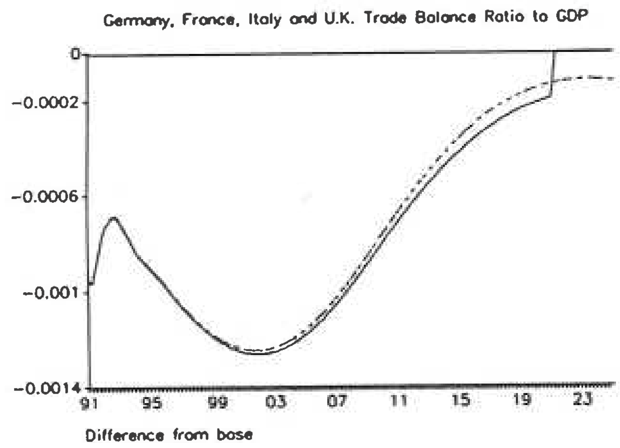
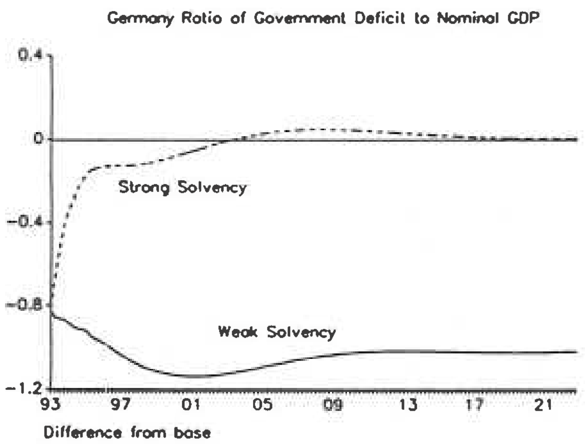
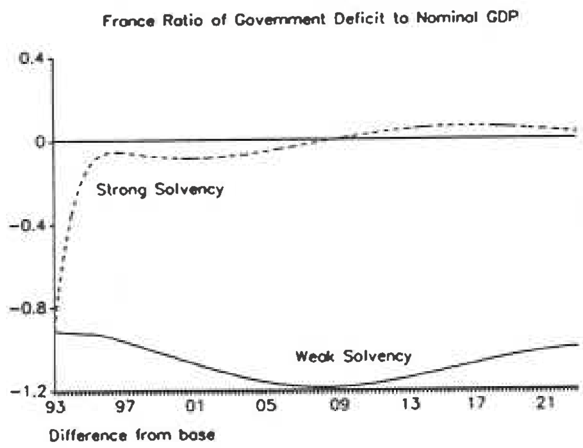
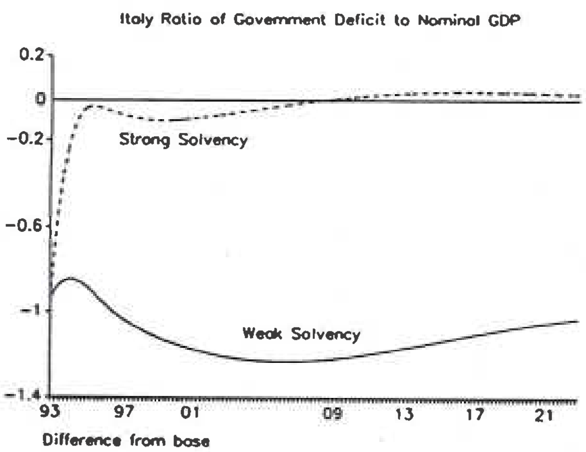
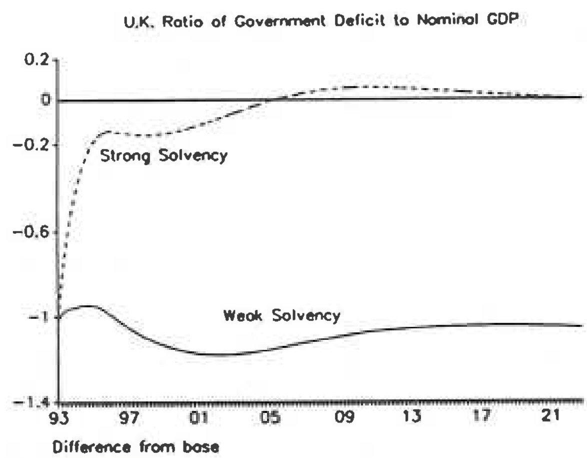


Chart 7 Weak and Strong Solvent Expansions









cannot contain significant information.[22] The terminal condition variable is also little affected by the length of run, staying on the same path when we add on extra 3 years.

Table 6: Fiscal multipliers when fiscal deficit target is relaxed

Year	1	2	3	4	5	10	15
Country							
Germany	.59	.51	.51	.50	.46	.23	.23
France	.59	.78	.88	.98	1.05	1.02	.50
Italy	.56	.72	.78	.82	.84	.59	.04
UK	.66	.66	.72	.71	.64	.11	-.16

Table 7: Initial interest rate and exchange rate response after fiscal expansion when fiscal deficit target is relaxed.

Country	Interest rate	Long rate	Effective exchange rate	Dollar e.r.
Germany	0.17	0.17	0.89	-1.97
France	0.02	0.02	0.17	-0.40
Italy	0.02	0.02	0.11	-0.29
UK	0.01	0.02	0.13	-0.27

Chart 7 plots the ratio of the government deficit to gdp in each of the large European economies. A fiscal expansion of this nature would obviously be inconsistent with the Maastricht Treaty targets that we have on our base.The abandonment of the Maastricht criteria might well be associated with the collapse of the Exchange Rate Mechanism. This we believe might well involve more than just a realignment for as Britton (1992) and Minford (1992) argue the ERM needs to move to monetary union or to collapse. If the criteria were abandoned and exchange rates were allowed to float then the effects would differ significantly between countries, and they would also depend upon the monetary targets used.

22 We would need to experiment with a number of difference length runs to see if invariance held.

Table 8

Fiscal multipliers for the UK when fiscal deficit target is relaxed

Year	1	2	3	4	5	10	15
Inside EMS	.66	.66	.72	.71	.64	.11	-.16
Outside EMS	.52	.39	.37	.34	.30	.10	-.04

Table 9

Initial interest rate and exchange rate response for the UK when fiscal deficit target is relaxed

	Interest rate	Long rate	Effective exchange rate	Dollar rate
Inside EMS	.01	.02	0.13	-.27
Outside EMS	.10	.16	1.51	-1.56

If the Maastricht Treaty is abandoned and exchange rates are allowed to float the the outcomes will be different. We again find it useful to concentrate on the UK. Table 8 gives the fiscal multipliers for the UK in response a shock to spending and to the deficit target when it is inside the ERM and when it is outside. The fiscal multipliers are generally larger inside the ERM because the burden of exchange rate adjustment is shared with the rest of the Community, and interest rates are set by the Bundesbank, and the expansion is in the UK. Table 9 gives the initial effects on interest rates and exchange rates in the two situations. The jump in the exchange rate with a shock to debt is six times larger when the UK is outside the ERM than when in it. The change to the terminal condition is much less when the effects of the expansion are shared by all ERM members. However, the shock to the debt stock causes the exchange rate jump to be more than three times the size of that observed when the UK is in the ERM but the debt stock has to return to base. When the UK is outside the ERM a shock to the debt stock produces a jump $2\frac{1}{2}$ times that observed when the shock is associated with a constant debt stock. The effects of the debt stock driven expansion are much more sustained, and hence interest rate effects from money base targetting are greater in this case.

Conclusions

Our paper demonstrates that, although fiscal multipliers in Europe are small, the application of the Maastricht criteria will in general be contractionary. In the long run the level of activity is unaffected by the government debt stock and hence by the government deficit. However, in the short to medium term fiscal policy will have an impact, and the contraction required under the Maastricht treaty will reduce output and raise unemployment. The effects, and their timing, depend upon the monetary rule followed by the authorities, but the overall picture is dominated by a real contraction.

Appendix I: Interest Rate Rules on NIGEM

We cannot be sure what rules of operation any Central Bank may choose for monetary policy, and indeed they may choose to vary them in response to the policy problem facing them. In policy analysis on our model we consider three alternative monetary rules, and each may have their advantages in a particular situation. The three rules that are used are money base targetting, GDP and inflation targetting and real interest rate targetting. We could also analyse the effects of P* targetting, but we would argue that this would introduce an unnecessary complication at this stage, and in any case this rule has considerable similarities to our inflation and GDP targetting rule. Different monetary policy rules will produce different exchange rate reactions. For instance, if we undertook a solvent fiscal expansion with a fixed nominal interest rate the we would expect an initial depreciation of the exchange rate. This is because a fiscal expansion with fixed interest rates would require an increase in the monetary base, and hence an increase in the price level. Hence the exchange rate has to depreciate to return the economy to its real equilibrium.

Most textbook treatments of fiscal policy assume that any solvent expansion is accompanied by a fixed money base rule. The expansion in demand subsequent upon the increase in government spending should increase the demand for money, and with a fixed money rule the interest rate will rise in order to ration the available supply. This should induce an increase in the exchange rate, at least compared to where it would otherwise have been, and the effects of the appreciation should mitigate the expansionary effects of the solvent expansion. Money base targetting is frequently advocated, but it can be rather difficult to implement. Most estimated money demand functions for the European economies contain lags in both the interest rate and in the dependent variable. A general money demand function can be written as

$$m/p = \gamma\ (L)Y + \beta(L)\ r + \delta(L)\ m/p$$

where m is the targetted money stock, p is the price level, Y is the scale variable (for instance income) and $\gamma(L)$, $\beta(L)$, $\delta(L)$ are polynomials in the lag operator. If we invert this function to solve for the interest rate then the authorities would have to hit their money base target period by period:

$$r = B(1)^{-1}(\bar{m}/p) - B(1)^{-1}\gamma(L)Y - B(1)^{-1}B(L^{*})\,r - B(1)^{-1}\delta(L)(\bar{m}/p)$$

where $\bar{m}$ indicates the target and L^{*} indicates a lag distribution that has its first element $\beta(1)$, removed. Such a function is liable to display considerable instrument variability if m has to be hit period by period.

We have chosen to overcome the problem of instrument instability by finding the long run solution:

$$m/p = a + bY + cr$$

and inverting it to solve for r:

$$r = \frac{1}{c}\,\frac{m(\text{target})}{p} - \frac{b}{c}Y - \frac{a}{c}$$

where (target) denotes a targetted variable. In the long run the interest rate will be set to achieve the target, but short term target overshoots are permitted.

Although money base targetting is often advocated, it is not always an appropriate rule to operate. If there is a terms of trade shock, then the appropriate response may be to allow the price level to change.[23] If there is a shock that expands equilibrium output (an unexpected increase in the labour force is a good example) then a rigid money base targetting rule could be unnecessarily deflationary. It is possible to avoid some of these problems either by shifting the target or by deriving a new rule. We have implemented the Masson/Symansky (1990) GDP

23 This is the reason for constructing p* or price level targets.

and inflation targetting rule which will accommodate step changes in the price level, but not step changes in the inflation rate.[24] A solvent fiscal expansion would cause the interest rate to rise, but the increase is unlikely to be as large as under money base targetting, and hence any appreciation of the exchange rate should be more moderate with this monetary rule in place. The targetting rule is

$$r_t = \delta(\beta(\dot{p}_t - \dot{p}_t(\text{base})) + \alpha(Y_t - Y_t(\text{base}))) + (1-\delta)r_{t-1}$$

where (base) indicates the trajectory on the base, $\dot{p}$ is the inflation rate, and the parameter δ is the instrument damping factor, and β and α are the weights given to deviations from base in inflation and output. We have followed the Commission and taken β=2.0 and α=0.4, giving five times the weight on inflation as on output in our rule. Our experimentation for the comparison exercise in Barrell and Whitley (1992) suggested to us that the instrument damping factor should be set equal to 0.5.

Our third monetary rule targets the real interest rate (rr). This has been used for diagnostic purposes by HM Treasury in, for instance, Bredenkamp (1987). This rule is more expansionary in its implications for the price level, and hence the exchange rate effects will be different. The real exchange rate will be constant throughout any counterfactual with this rule (apart from any changes in the risk premia that may be induced by the shock being considered), and hence we would expect a solvent fiscal expansion to be associated with a depreciation of the nominal exchange rate. Barrell and Gurney (1991) analyse the implications of this rule at length. The rule can be written as

$$rr_t = r_t - \dot{pe}_t$$

where $\dot{pe}$ is the expected rate of inflation over the period ahead. The

24 This rule was used by the Commission in "One market, one money" and in the simulations reported in J. Whitley (1992). See Barrell and In't Veld for details.

use of this rule requires that we have a proxy for the price expectations of the authorities, and we use model consistent expectations.[25] This rule would of course, be inadequate if the shock changed the equilibrium real interest rate, and we might expect to observe solution problems with our counterfactuals and instabilities in the real world if it were used in these situations.

The European Central Bank will adopt one of our monetary targetting rules, and that it will be concerned with the aggregate price level in Europe PE_t.

$$PE_t = \sum_{j=1}^{12} a_{jt} P_{jt}$$

where P_{jt} is the price level in country j at time t and a_{jt} is the GDP weight for that country and time. The money demand equation we use for Europe as a whole is taken from Gurney and In't Veld (1991), and money demand depends upon European output, prices and interest rates. Our GDP/inflation targetting rule also uses European aggregate variables. Interest rates are the same everywhere in Europe under both symmetric and asymmetric EMU, but we assume that asymmetric EMU (or rather the ERM) is associated with German leadership, and hence our monetary rules depend upon German variables only. Under floating exchange rates the interest rates can obviously differ between countries and we assume independent targetting in such cases, but such differences have to be reflected in the trajectory for exchange rates.

25 We could use other expectation proxies such as those based on learning (see Barrell, Caporale, Hall and Garrett (1992)) but we feel it would be an unnecessary complication in this paper. We use a standard rate of growth terminal condition for the price level at the terminal date T

ie $\log CED_{T+1} - \log CED_T = \log CED_T - \log CED_{T-1}$

Appendix II: Base Dependency and fiscal shocks

Government financing plans have to be on a solvent path. The primary deficit (P_t) and payments on debt servicing ($r_t B_{t-1}$) must be financed by borrowing, either in the form of interest bearing assets (B_t) or high powered money M_t. The deficit identity can be written therefore

$$\Delta B_t + \Delta M_t = P_t + r_t B_{t-1} \qquad II(i)$$

or equivalently

$$B_t = (1+r_t)\, B_{t-1} + P_t - \Delta M_t \qquad II(ii)$$

If we use lower case to denote ratios to GDP(Y_t) and assume (as an approximation) that the ratio of high powered money to income $\left(m = \frac{M_t}{Y_t}\right)$ is constant then this identity can be restated as

$$b_t = p_t - \frac{g_t}{1+g_t} m + \left[\frac{1+r_t}{1+g_t}\right] b_{t-1} \qquad II(iii)$$

The debt accumulation process will be called stable if and only if the debt stock remains bounded after a permanent fiscal expansion. It is immediately apparent that if the economy is dynamically inefficient, ie $g_t > r_t$, $\forall t$ then the debt process is stable.

The more interesting case is when the economy is dynamically efficient, ie $g < r$. The debt process however could still be stable. In this instance the fiscal expansion is financed indirectly from the increased growth of the economy which enables greater monetisation of the debt and increases the debt shrinkage. In order to derive some necessary conditions for this case assume the economy is initially in equilibrium, that is

$$p_t = \frac{g_t}{1+g_t} m - \frac{(r_t - g_t)}{(1+g_t)} b_{t-1} \qquad II(iv)$$

and after a permanent change in the final stance the economy comes to rest at the new equilibrium.

$$p_t^{\dagger} = \frac{g_t^{\dagger}}{(1+g_t^{\dagger})} m - \frac{(r^{\dagger} - g^{\dagger})}{(1 + g^{\dagger})} b^{\dagger}$$

We are particularly interested in the case where interest rates are held constant, and hence the constancy of the ratio of high powered money to income is a more reasonable assumption. If $r^{\dagger} = r$ then our problem of analysing the effects of a shock are considerably simplified.

Subtract the two expressions, and take first order approximation then:-

$$\Delta p = \left(\frac{\Delta g}{1+g}\right)\left(\frac{m}{1+g}\right) + \frac{\Delta g}{(1+g)}\left(\frac{1+r}{1+g}\right) b - \frac{(r-g)}{(1+g)} \Delta b \qquad \text{II(vi)}$$

where Δ signifies the long run changes. Therefore if the fiscal expansion is to be solvent then it has to be partly financed by an increased issue of high powered money (first term) and the increased debt shrinkage, (2nd term), but the rest must be financed by reduced interest payments (3rd term). In order therefore for a dynamically efficient economy to finance a permanent fiscal expansion, either a great deal of high powered money has to be issued and/or the debt stock must be reduced along the expansionary path. This requires, at a minimum, in the short run ($\Delta b = 0$), that

$$\partial p - \frac{\partial g}{(1+g)}\left[\frac{m}{(1+g)} + \frac{(1+r)\ b}{(1+g)}\right] < 0 \qquad \text{II(vii)}$$

or equivalently

$$\frac{\partial g}{\partial p} > \frac{1}{m/(1+g)^2 + (1+r)\ b\ /\ (1+g)^2} = \frac{1}{(m + b)}$$

Debt shrinkage will, as an approximation, only be sufficient to stabilise the debt stock if the increase in the nominal growth rate always stays above the inverse of the sum of the debt stock and high powered money as a percent of GDP.

Equation II(vi) displays the base dependency that debt stocks induce into simulation analysis in our models. The existence or otherwise of a saddlepath when there is no fiscal feedback rule will depend, interalia, on the nominal interest rate on the base, the nominal growth rate on the base and the debt stock on the base. If fiscal closure is imposed then the long run effects of the shock will depend upon these same three variables.

Appendix III: The existence of a saddlepath

In this appendix, we extend the basic Buiter-Miller model of the exchange rate to include a risk premium and hence analyse the effects of debt explosions. These changes only slightly alter the conclusions of their model, but these changes are desirable enough to be of interest here.

The model is as follows

$$m_t - p_t = ky_t - \lambda (r_t - r_d) \text{ (LM Curve)} \quad (1)$$

$$y_t = -\gamma (r_t - \dot{p}) + \delta(e_t - p_t) + \varepsilon z + g \text{ (IS Curve)} \quad (2)$$

$$\dot{p} = \varnothing y + \Pi \text{ (augmented Phillips curve)} \quad (3)$$

$$\dot{e} = (r_t - r_t^W) + \mu z_t \text{ (UIP with Risk)} \quad (4)$$

$$\dot{z} = -\alpha y + \beta(e-p) \text{ (Net Foreign wealth)} \quad (5)$$

$$\dot{m} = \Pi \text{ (constant target inflation)} \quad (6)$$

m_t money base target
p_t domestic price level
y_t demand for output
r_t domestic nominal interest rate on non-money assets
r_d (exogenous) domestic nominal interest rate on money assets
e_t domestic currency price of foreign currency
r_t w exogenous world nominal interest rate
z_t domestic real net foreign wealth
Π (exogenous) target core inflation
g government expenditure
$l_t = m_t - p_t$ real balance
$c_t = e_t - p_t$ competitiveness

(All quality and price variables are in logs)

The only modification to the standard model is the additional net foreign wealth equation. The rate of change of Net foreign wealth is negatively related to domestic absorption. Domestic absorbtion increases with domestic demand, y, but decreases with competitiveness.

This is the relation summarised by equation (5).

At this point we have assumed that there is a solvent government, or we have full Ricardian equivalence. Hence real private sector financial wealth follows net foreign wealth and so net foreign wealth also feeds into the demand for output (IS curve).

The risk premium is assumed to be inversely related to the net foreign wealth position. This reflects the increased exposure of the overseas sector to the effects of country specific default risks.

After minor manipulations it is possible to rewrite the equations with l_t, c_t, z_t as the states

$$\dot{l} = -\varnothing y$$

$$\dot{c} = (r_t - r_t^W) + \mu z_t - \varnothing y - \Pi$$

$$\dot{z} = -\alpha y + \beta c_t$$

and the IS and LM curves as

$$l_t = ky_t - \lambda(r_t - r_a)$$

$$(1-\gamma\varnothing)y_t = -\gamma r_t + \gamma\Pi + \delta c_t + \varepsilon z_r + g$$

or expressed in matrix form, where D is the differential operator,

$$\begin{vmatrix} D & 0 & 0 & \varnothing & 0 \\ 0 & D & -\mu & \varnothing & -1 \\ 0 & -\beta & D & -\alpha & 0 \\ 1 & 0 & 0 & -k & \gamma \\ 0 & -\delta & -\varepsilon & 1-\gamma\varnothing & \gamma \end{vmatrix} \begin{vmatrix} l \\ c \\ z \\ y \\ r \end{vmatrix} = \begin{vmatrix} 0 \\ -r^W \quad -\Pi \\ 0 \\ \lambda r_d \\ \gamma\Pi + g \end{vmatrix}$$

Now y,r can be expressed as factors of l, c, z.

$$\begin{pmatrix} y \\ r \end{pmatrix} = \begin{pmatrix} \frac{1}{\Delta} \end{pmatrix} \begin{pmatrix} -\gamma & -\lambda\partial & -\lambda\varepsilon \\ [1-\gamma\varnothing] & -k\partial & -k\varepsilon \end{pmatrix} \begin{pmatrix} l \\ c \\ z \end{pmatrix} + \frac{1}{\Delta} \begin{pmatrix} \gamma\ \lambda\ [rd-\Pi]-\lambda g \\ \Delta\Pi - \lambda\ (1-\gamma\varnothing)(rd-\Pi)-kg \end{pmatrix}$$

where the determinant $\Delta = \gamma\ (\lambda\varnothing - k) - \lambda$

Substitute these expressions for y,r back to give the state-space equations for the process.

$$\begin{pmatrix} \dot{l} \\ \dot{c} \\ \dot{z} \end{pmatrix} \begin{pmatrix} \varnothing\gamma & \varnothing\lambda\delta & \varnothing\lambda\varepsilon \\ 1 & \partial(\varnothing\lambda-k) & \Delta\mu + \varepsilon(\varnothing\lambda-k) \\ -\alpha\gamma & \Delta\beta + \delta\alpha\lambda & \alpha\lambda\varepsilon \end{pmatrix} \begin{pmatrix} l \\ c \\ z \end{pmatrix} + \frac{1}{\Delta} \begin{pmatrix} -\varnothing\lambda\gamma(\Pi-r_d)+\varnothing\lambda g \\ -\lambda(r_d - \Pi)-\Delta r^w(\varnothing\lambda-k)g \\ \alpha y\lambda(r_d - \Pi)+\alpha\lambda g \end{pmatrix}$$

or $\dot{x} = Ax + B$

The long run or equilibrium conditions for this system $\dot{l} = \dot{c} = \dot{z} = 0$ are therefore

$$\begin{pmatrix} l \\ c \\ z \\ y \\ r \end{pmatrix} = \begin{vmatrix} \lambda\ (r_d - \Pi) - \lambda r^w\ /\ (\ 1 + \gamma\mu/\varepsilon)\ -\lambda g/\delta \\ 0 \\ \gamma/\varepsilon[1/(1+\gamma\mu/\varepsilon)]\ r^w - 1/\varepsilon\ (1/(1+\gamma\mu/\varepsilon))g \\ 0 \\ \Pi + 1/(1+\gamma\mu/\varepsilon)r^w + \mu/\varepsilon\ (1/(1+\gamma\mu/\varepsilon))g \end{vmatrix}$$

In the discussion here, we only highlight the major differences from Buiter-Miller model. In this extension, competitiveness or the real effective exchange returns to base whatever the world interest rate. The mechanism now is that unexpected world interest rate shock causes the currency to depreciate, this improves the net wealth position and hence reduces the risk premium and therefore begins to appreciate the currency back to base. In this model it is therefore not possible to sustain a competitive advantage due to the additional wealth effects.

The sensitivity of the risk premium to a shock is proportioned to $\gamma\mu/\varepsilon$ and therefore increases with less propensity to consume from wealth and increases the steeper the IS curve.

These wealth effects do not alter significantly the conditions for the existence of a saddle-path. To prove this it is necessary to derive the characteristic equation of the state-space process. The characteristic frequencies, s, are the roots of the equation.

$$s^3 \frac{(-\alpha\lambda\varepsilon - \varnothing y - \delta\phi + \delta k)}{\Delta} s^2 + \frac{(\varnothing\delta + \mu\lambda(\beta-\alpha\delta)-\beta(\gamma\mu+\varepsilon)(\phi\lambda-k))s}{\Delta}$$

$$+ \frac{\beta\varnothing\ (\gamma\mu + \varepsilon)}{\Delta} = 0$$

The Routh Hurwitz stability criterion give necessary and sufficient conditions for the existence of single unstable root to this equation. A necessary condition is that the $\det(A) = 0$ or equivalently $\Delta < 0$ and a sufficient condition is trace $(A) = \alpha + \varepsilon + \delta\varnothing y + \delta\varnothing - \delta k > 0$.

It is relatively easy to draw conclusions from this model concerning our insolvent government. If some expenditure is absorbed by the government, and is is financed by borrowing then overseas assets will fall relative to private sector wealth. The new government debt is not fully offset by the behaviour of the private sector, hence most of the new debt has to be held, net, by the overseas sector and hence the risk premium will rise. If the shock involves an insolvent fiscal expansion then the overseas debt stock falls without bound, and therefore the risk premium rises without bound. Hence a saddlepath cannot exist.

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Chart 1 German Fiscal Expansions

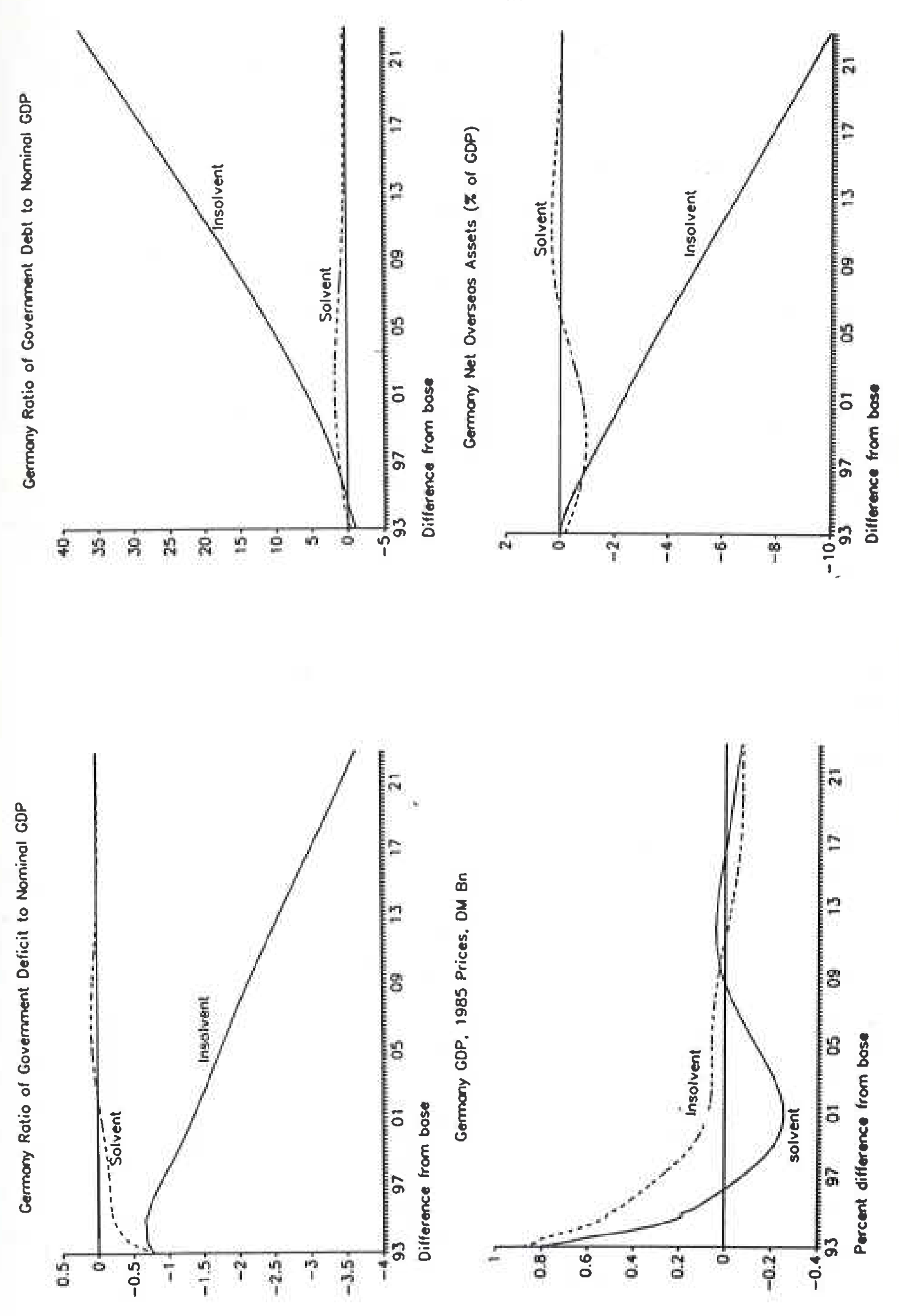


Chart 2 French Fiscal Expansions

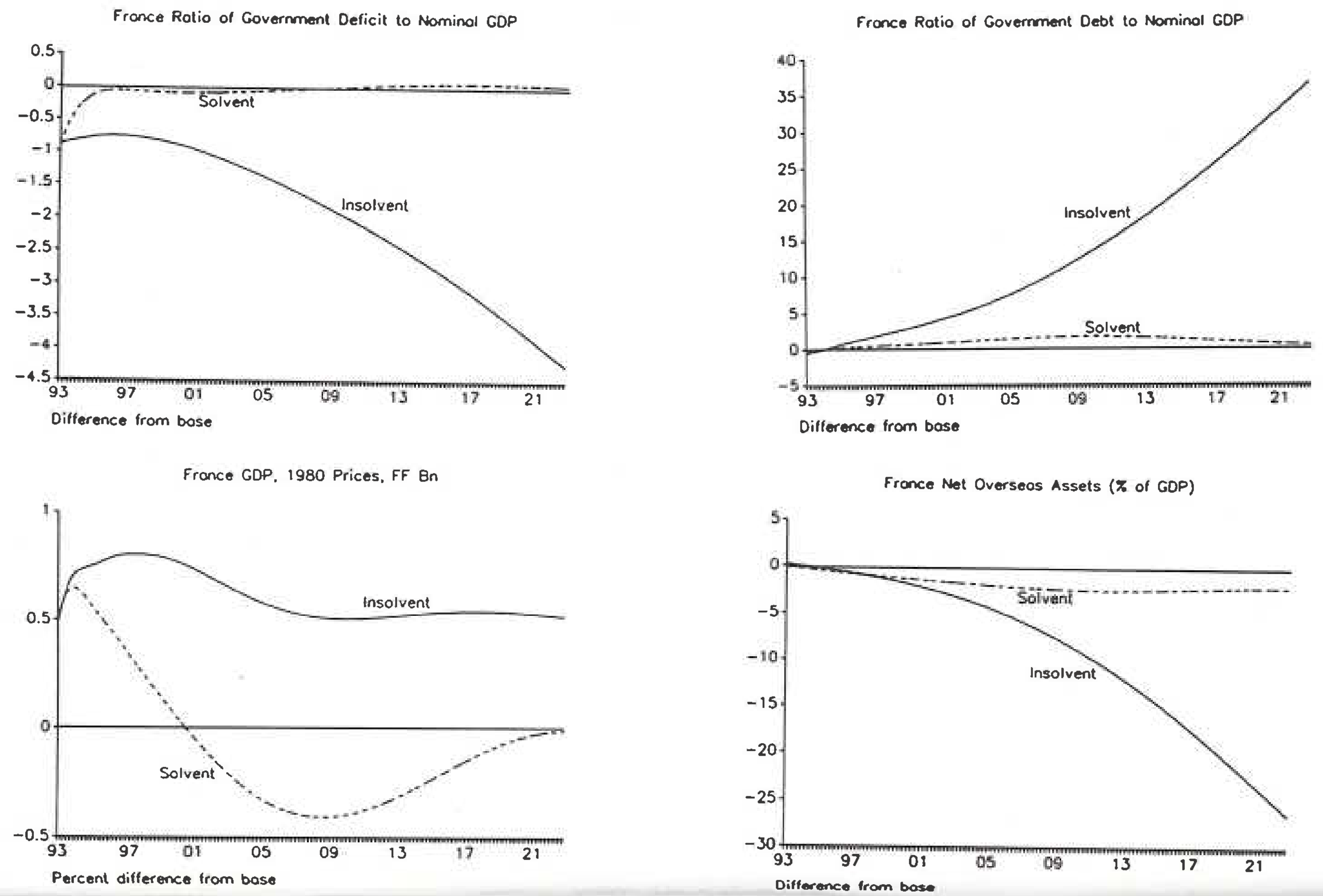


Chart 3 Italian Fiscal Expansions

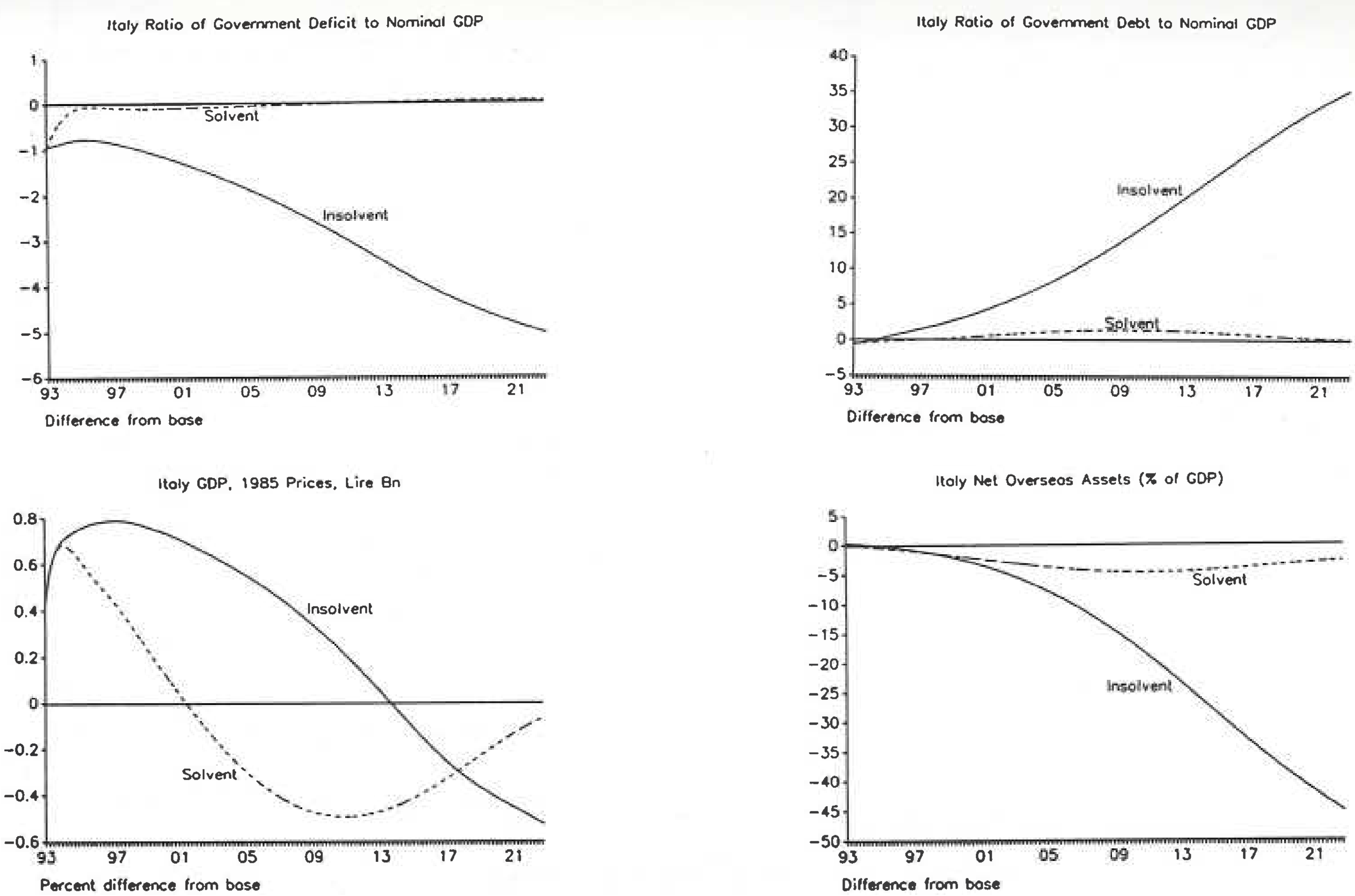


Chart 4 U.K. Fiscal Expansions

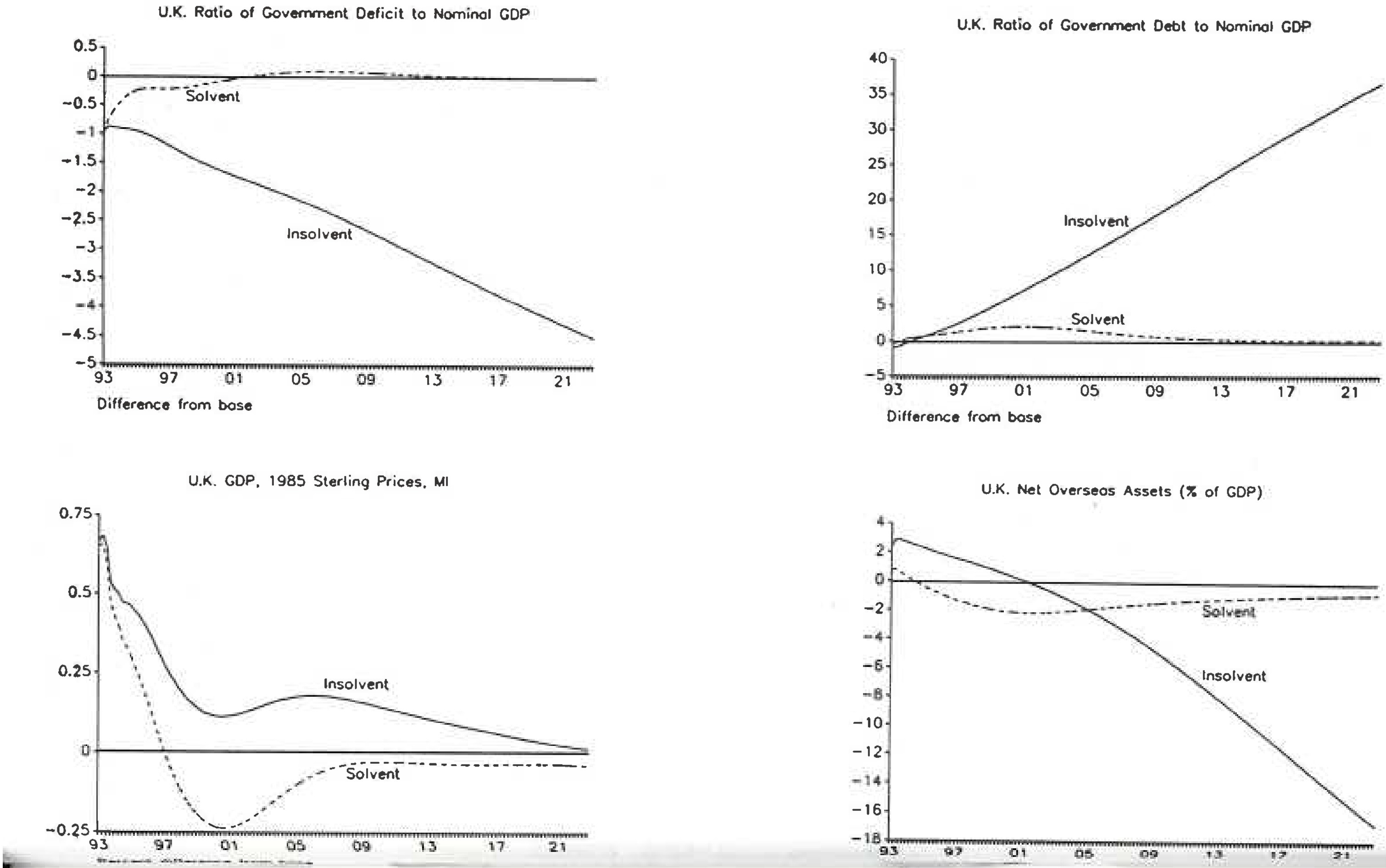


Chart 5 The U.K. Inside and Outside the ERM

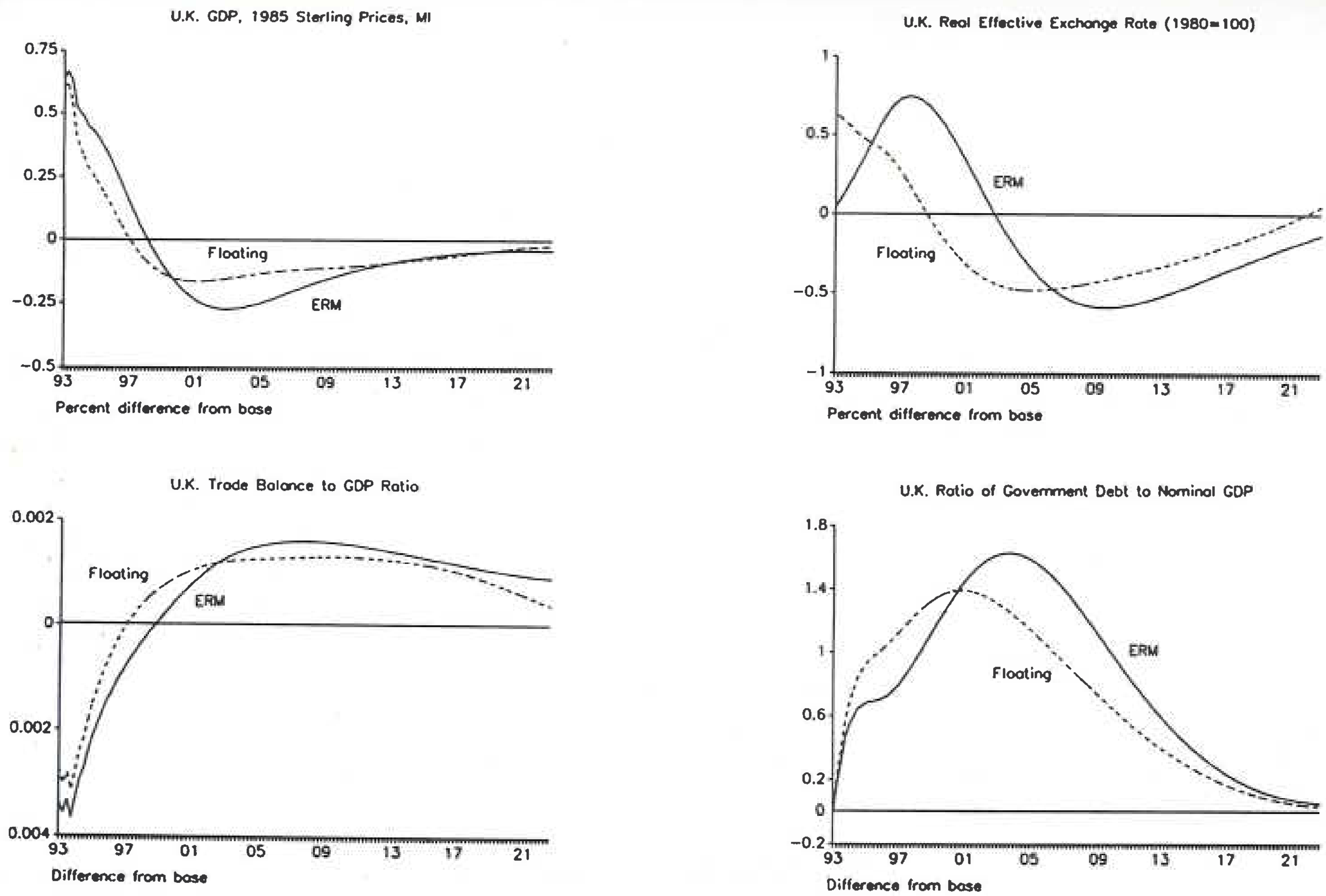


Chart 6 A French Fiscal Expansion in the ERM

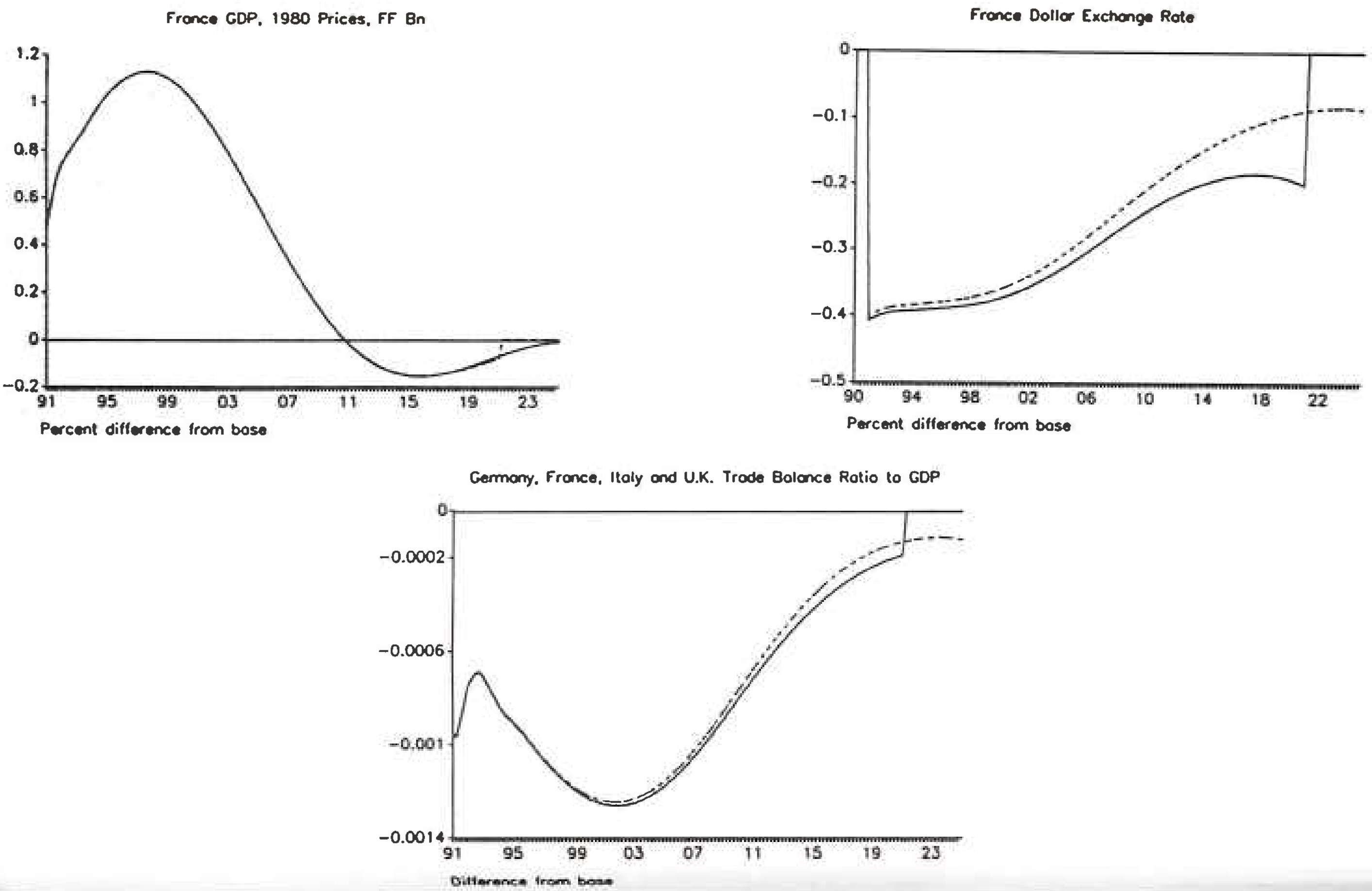
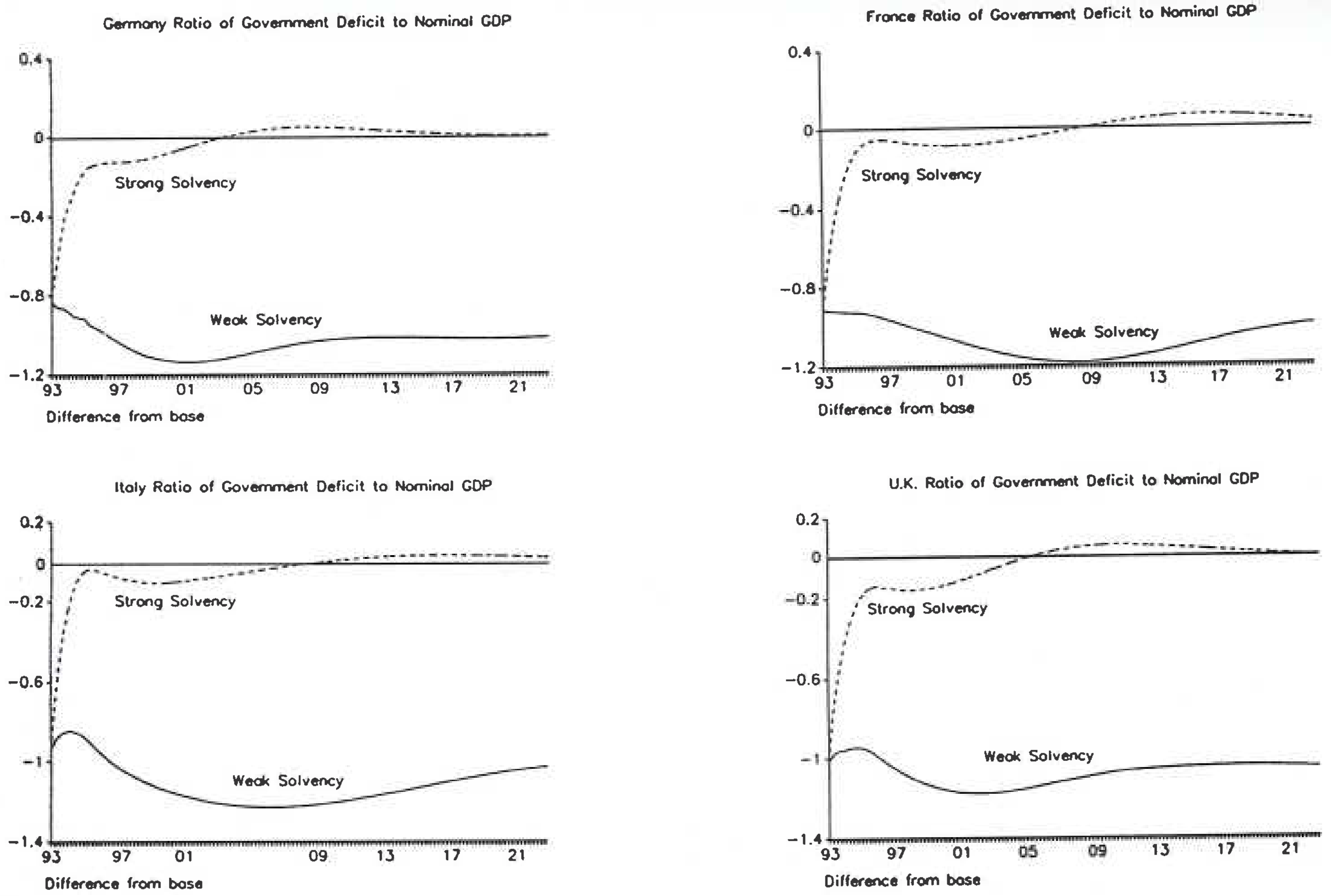


Chart 7 Weak and Strong Solvent Expansions



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