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Fiscal Consolidations under Fixed Exchange Rates

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FISCAL CONSOLIDATIONS UNDER FIXED EXCHANGE RATES

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Abstract

We present the "fixed exchange rate" version of the Obstfeld and Rogoff model and analyze the international transmission of fiscal policy shocks. It is shown that the welfare effects of an unanticipated contraction in government expenditure in the home country crucially depend on the way in which world money stock is set. If home authorities alone are responsible for pegging the exchange rate, a fiscal adjustment induces a decrease in the real interest rate, stimulates private consumption and limits the contraction in world output, compared with a situation in which a cooperative scheme is implemented. The model is then used to propose a new interpretation of recent events in the EU countries that have enacted restrictive fiscal policies while pegging their currencies to the DM.

Contents

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1. Introduction[1]

Although many researchers have sought since the early eighties to develop dynamic open economy models with explicit microfoundations,[2] the Mundell-Fleming model has remained the most widely used framework for analyzing the international transmission of monetary and fiscal policy. This is because until very recently microfounded international models were unable, by assuming fully flexible prices, to predict certain standard features of the short-run dynamics of output, exchange rates and the current account induced by changes in policy variables.

The model proposed by Obstfeld and Rogoff (1995a, 1996) introduces short-run nominal price rigidities in a setup based on the intertemporal approach to the current account with monopolistic competition on the supply side. This resolves the previous shortcomings but to date has been used essentially to study the responses to money supply shocks in a context of flexible exchange rates.[3]

In this paper we solve the Obstfeld-Rogoff model (O-R) under fixed exchange rates and analyze the international transmission of fiscal policy shocks, with particular reference to the experience of the EU countries over the past two decades. There are at least three good reasons for this analytical exercise. First, since the O-R model is certain to be increasingly used, even outside the academic world, it seems natural to provide a "fixed exchange rate" version, whose properties can then be compared with those of the Mundell-Fleming model. The second reason is more specific. So far, the literature on fiscal consolidation in Europe has not satisfactorily addressed the issue of international transmission under fixed exchange rates. Giavazzi and Pagano (1990, 1996) focused essentially on the effects on private consumption,

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1 A draft of this paper was written while I was visiting Princeton University. I wish to thank Filippo Altissimo, Riccardo De Bonis, Annalisa Ferrando, Roberto Rinaldi, Alan Sutherland and participants at the Royal Economic Society Conference, University of Warwick, Coventry, 1-4 April 1998, for very useful comments. My special thanks go to Tonino Covelli for editorial assistance. I am indebted to Ken Rogoff to whom I owe a great deal for encouragement and intellectual stimulation. All errors and omissions are of course mine. The views expressed are my own and do not necessarily reflect those of the Banca d'Italia.

2 This literature is usually referred to as the intertemporal approach to the current account and to the international real business cycle. For surveys of these works, see Obstfeld and Rogoff (1995b) and Backus, Kehoe and Kydland (1993).

3 See, for example, Betts and Devereux (1996) and Kollmann (1997). Chari, Kehoe and McGrattan (1997) have developed an international real business cycle model with sticky prices and price discrimination across markets to study the effects on nominal and real exchange rates of a shock to money growth.

referring to the closed economy version of the overlapping-generations model proposed by Blanchard (1985),[4] while the open economy model proposed by Alesina and Perotti (1997), though correctly emphasizing the role of redistributive budgetary policies and of distortionary taxation in Europe, is highly unsatisfactory on a number of grounds, mainly because, as a static model, it simply ignores the implications of intertemporal government and consumer constraints. Third, by deriving economic agents' behavior from utility maximization, the O-R model offers a radically new perspective to evaluate the welfare effects of the choice of alternative exchange rate and monetary policy regimes. The consequences are quite surprising and suggest a profound reconsideration of fiscal consolidation in the EU countries. The paper shows, in fact, that if one country (say France) enacts an unanticipated permanent reduction in government consumption, a bilateral exchange rate peg would not be welfare-improving with respect to a situation in which the foreign country (say Germany) pursues an independent monetary policy, while France unilaterally pegs its exchange rate to the Deutsche Mark.

The paper is organized as follows. Section 2 gives a brief non-technical description of the O-R model with fixed exchange rates (the formal model is described in detail in Appendix I) and draws the main implications regarding both permanent and temporary fiscal shocks. Section 3 provides some broad empirical evidence on the timing of fiscal actions in EU countries in the last two decades and their macroeconomic impact and presents the results of an empirical test focused on the responses of private consumption to changes in public consumption. Section 4 concludes.

2. The Obstfeld-Rogoff model with fixed exchange rates

The model postulates two countries inhabited by infinitively lived consumer-producers with perfect foresight who share the same preferences and technology and maximize their utility over consumption, real money balances and leisure. Each producer has some monopolistic power over his single differentiated good, which is sold in both countries at the same price, expressed in a common currency.

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[4] The open economy version of this model is not particularly useful for studying the international transmission of fiscal policy since it assumes fully flexible prices, exogenous output and an exogenous real interest rate. The same criticism applies to Bertola and Drazen (1993) and to Sutherland (1995).

Home country (H) and foreign country (F) are identical except for size and the goods they produce. Though the relative price of the consumption bundle is always equal to one because of identical tastes and no barriers to trade, the relative price of H's goods with respect to F (the terms of trade) can vary in response to exogenous shocks. The demand for any good depends on its price relative to that of the consumption bundle and on total world demand (private and public consumption[5]). The supply function states that the marginal utility of the additional revenue obtained from an extra unit of a given good must equal the marginal disutility of the leisure foregone.[6]

The only asset traded in the perfectly integrated world capital market is a riskless bond earning interest expressed in terms of the consumption bundle. Real money balances can be held only by domestic residents; demand for them depends on private consumption and on the nominal interest rate, which is the same in the two countries and is equal to the real interest rate plus expected inflation.

It is assumed that government consumption is purely dissipative and does not affect productivity or private utility and that it is financed by non-distortionary taxes and seignorage. Since Ricardian equivalence holds in the model there is no role for public debt.[7] Given these circumstances and perfectly flexible prices, an unanticipated permanent fiscal contraction in H would cause the system to display typical classical properties and instantaneously jump to the new steady-state equilibrium, with no effects on the current account or real interest rate. In particular, steady-state consumption in H would increase by less than the amount of the fiscal cut, because residents discount a higher level of permanent income and work less; therefore H's output would decline. The opposite would hold for F.

In the O-R model, however, prices are set one period in advance, so that they cannot adjust immediately to an unanticipated shock; thus in the short run (period 1) output is entirely

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[5] It is assumed that there is no national bias in government demand.

[6] Though the level of output is endogenous, it is worth stressing that there is no capital or investment, so that the model is best applied to short-medium term dynamics.

[7] An obvious extension would be to develop an overlapping generations version of the model and analyze how different government expenditure financing schemes affect the main international transmission channels. Here, however, our main interest is to focus on the welfare implications of alternative monetary policy regimes in a context of fixed exchange rates.

demand-determined; prices adjust only in the long run (period 2).[8] In this context a permanent cut in public consumption in H tilts the time profile of output available for private consumption, leading to a current account imbalance. Another significant difference in comparison with fully flexible-price models is that the real interest rate has to change in the short run to maintain money market equilibrium, thus inducing private consumption to deviate from its new steady-state level.

Suppose now that H represents any of the EU countries except Germany and F represents Germany. With flexible exchange rates this distinction is irrelevant, but it can be crucial under fixed exchange rates, depending on the monetary rules. Since the focus here is on the transmission of fiscal shocks in the short and medium run, it is assumed that the exchange rate parities are perflectly credible so that no problems from speculative attacks can arise.

We consider two monetary policy regimes. In one, H alone is responsible for pegging the exchange rate while F pursues an independent monetary policy aimed at long-run price stability. This regime represents, admittedly in rather crude fashion, the situation actually faced by most of the EU countries that have enacted fiscal adjustment in the last fifteen years while Germany was pursuing price stability.[9] In the other regime, H and F cooperate to maintain the pegged exchange rate while keeping the world money stock constant.[10]

The *long run* effects of an *unanticipated permanent* cut in H's government expenditure[11] on world real variables (consumption, $\widetilde{C}^W$, output, $\widetilde{Y}^W$, and real money balances, $\widetilde{M}^W - \widetilde{P}$)[12] are computed equating aggregate world demand and supply of goods and supply and demand

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[8] Kollmann (1997) uses the small-country version of the O-R model to explore its dynamic implications when prices are set two or four periods in advance and are changed according to a "Calvo-type" mechanism.

[9] In the period under consideration, Germany severely cut its public consumption only once, in 1989 (see Table 3 in Section 3).

[10] The assumption of constant money stock, rather than a constant rate of growth, is made because the O-R model is linearized around a steady-state with constant exogenous variables (see Appendix I). Moreover, this facilitates comparison with the flexible exchange rate results.

[11] In Appendix I the model is solved for the general case in which both H and F change their level of public consumption.

[12] All variables are expressed in per capita terms.

of real money balances (details in Appendix I). Solving for $\widetilde{C}^W$, $\widetilde{Y}^W$ and $\widetilde{M}^W - \widetilde{P}$ gives:

$$\widetilde{C}^W = -\frac{n\widetilde{G}}{2} > 0 \tag{1}$$

$$\widetilde{Y}^W = \frac{n\widetilde{G}}{2} < 0 \tag{2}$$

$$\widetilde{M}^W - \widetilde{P} = \frac{\widetilde{C}^W}{\varepsilon} > 0 \tag{3}$$

where all the variables are expressed as percentage deviations from the initial steady-state values, n is H's share of world population,[13] ε is the inverse of money demand elasticity, and H's public consumption, $\widetilde{G}$, is negative. Long run world consumption and real money balances increase after a permanent fiscal contraction in H while world output decreases. Under the first monetary scheme ($\widetilde{P} = 0$), the world money stock has to accomodate the higher money demand induced by the increase in consumption; for the same reason, under the second scheme ($\widetilde{M}^W = 0$) prices must fall (all the results are summarized in Table 1).

As regards individual country variables, while private consumption in H rises (residents are wealthier, thanks to the cut in future taxes[14]), F's consumption declines because foreign producers suffer a downward shift in the aggregate demand for their goods. Thanks to higher permanent income, H-country residents will work less, so output will fall; the contrary is true for F-country residents. Thus, in the new steady state, the relative supply of H's goods is lower, producing an improvement in its terms of trade.

The main result is that long-run effects are entirely determined by the real economy and are thus totally independent of the monetary scheme used to peg the exchange rate .

In the *short run*, because prices are sticky, the transmission mechanism is radically different. Since relative prices do not change, the cut in H's public consumption has the same impact on aggregate demand and output in both countries.[15] H's relative consumption

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[13] When H is very small ($n \longrightarrow 0$) world variables are obviously unaffected by the shock.

[14] H-country residents' consumption will increase by less than the fall in public consumption because they will enjoy more leisure. As we will see below, H residents are better off also because in the short run they accumulate foreign assets and in the long run will earn interest on them.

[15] This result depends crucially on the assumption that there is no national bias in government expenditure.

increases, but by less than the change in public consumption,[16] so that H runs a current account surplus (see equation 43A in Appendix I).[17]

The impacts on world consumption, $\widehat{C}^W$, and output, $\widehat{Y}^W$, are given by[18]:

$$(4) \qquad \widehat{C}^W = \widetilde{C}^W - (1-\beta)\widehat{r} = -\frac{n\widetilde{G}}{2} - (1-\beta)\widehat{r}$$

$$(5) \qquad \widehat{Y}^W = \widehat{C}^W + \widetilde{G}^W = \frac{n\widetilde{G}}{2} - (1-\beta)\widehat{r}$$

where $\widehat{r}$ represents the short-run deviation of the the real interest rate from its steady-state value. This represents the difference between the two monetary schemes. In the first case, F aims at stabilizing the long-run price level,[19] so that in the short run the money stock is held constant ($\widehat{M}^* = 0$); therefore r must decrease to compensate for the fall in consumption. At the same time the rise in consumption in H drives the demand for money up; with prices fixed, money supply has to rise to prevent an appreciation of the currency.

This result contrasts with that obtained under flexible exchange rates. In that case, if world money stock is held constant, the increase in world consumption implies a higher real interest rate. Here, instead, world money stock has to rise, so the real interest rate falls.[20] Thus world private consumption is pushed above its new steady-state level and residents in both H and F enjoy greater consumption; at the same time the fall in output is less than in the long run (Figure 1).[21]

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[16] The change in relative consumption is the same in the short and in the long run (equation 41A).

[17] This result contrasts with that obtained under flexible exchange rates where a permanent fiscal contraction in H induces a current account deficit (Obstfeld and Rogoff, 1995a). There the contractionary effects on H's relative output are larger since the exchange rate rises and residents need to borrow abroad to smooth their consumption.

[18] Since the fiscal shock is permanent $\widehat{G} = \widetilde{G}$.

[19] Because PPP holds in the model, F acts as a price stabilizer for the whole area.

[20] This result does not depend on the assumption of long run price stability and would also hold if monetary policy in F remained passive even in the long run.

[21] Figures 1 and 2 have been drawn with the following parametrization: $\widetilde{G} = \widehat{G} = -0.01$; $\overline{r} = 0.04, n = 1/2, \theta = 10, \varepsilon = 1$, where $\overline{r}$ is the steady state value of the real interest rate.

Let us now consider the second scheme, in which the countries cooperate to peg the exchange rate and to keep world money stock constant.[22] In this case the real interest rate is set on the world money market and, since world consumption increases, r must rise; the change is actually the same as with flexible exchange rates (see Appendix II and Obstfeld and Rogoff, 1995a).

It is clear from (4) and (5) that in the short run both world consumption and output will be lower than in the new steady state; correspondingly, residents in both H and F enjoy less consumption and hold lower real money balances, but work less than with a non-cooperative scheme. Since the negative impact on consumption outweighs that on leisure, welfare is greater in both countries under the first than under the second monetary regime (see Appendix II).

A similar analysis can be drawn with respect to a *temporary* cut in public consumption in H. The main difference is that long-run real variables for the world do not change; however, the shock does have lasting effects on the single country variables. In particular, in the long run, there will be a redistribution of consumption and leisure from F to H, H's terms of trade will still improve and its residents will accumulate foreign assets (see Table 2; all the technical details are in Appendix I).

Again, the short run effects depend on which monetary rule is applied. Under the first, the real interest rate still declines, pushing consumption in H and F above its long run level (Figure 2), and output falls in both countries; under the second, which is again similar to the flexible exchange rate case, no change in the real interest rate is required since long-run world consumption is unaffected by the temporary shock, and consumption in both countries will immediately jump to the new long-run equilibrium level.[23] At the same time, output in both H and F declines more than in the previous case and by the same percentage as H's government expenditure. The effects on consumption outweigh those on output, so the first monetary scheme results in a higher level of welfare for both countries (Appendix II).

Thus, in the O-R model with fixed exchange rates the international transmission of fiscal schocks is qualitatively the same in the case of permanent or transitory policy changes. However, from Figures 1 and 2 it is clear that the effects differ greatly in absolute size. In

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[22] Again, the results would not change qualitatively if the two countries cooperate to maintain long-run price stability.

[23] The temporary fall in world aggregate demand is fully offset by a decrease in output.

particular, in the case of a permanent shock the choice of the monetary scheme matters a lot, since the upward or downward adjustment in the real interest rate is significant. If the fiscal shock is temporary, however, the short-run depressive effects on output are large and greater than the expansionary effect on private consumption.[24]

3. Fiscal contractions and expansions in the European Union

In the last two decades severe efforts have been made in most European countries to curb the rise in the public debt, whose ratio to GDP had considerably increased during the seventies, after the first oil shock. Moreover, in the last few years the issue of fiscal consolidation has become particularly "hot", as several EU countries have had to enact significant budget cuts to reach the Maastricht target ratio of 3 per cent of GDP by 1997.

Table 3 reports the episodes of "severe" fiscal expansion or contraction in the period 1979-1997 in the EU countries that joined the Exchange Rate Mechanism of the EMS at its launch in 1979[25] and in those that pegged their currencies to the DM (Austria[26]) or to the ECU (Finland and Sweden[27]). The episodes have been selected on the basis of changes in the share of public consumption in GDP (at constant 1990 prices), using a methodology similar to that proposed by Alesina and Perotti (1995, 1996).[28] A total of 28 severe fiscal actions were identified, 8 expansions and 20 contractions; 5 of the expansions were enacted in connection

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[24] This last result is consistent with the predictions of the models proposed by Bertola and Drazen (1993) and Sutherland (1995).

[25] The United Kingdom, Spain, Portugal and Greece are therefore excluded. Luxembourg is also excluded for lack of data.

[26] Austria joined the EU and the ERM only in January 1995; since 1974, however, its exchange rate has been closely pegged to the DM.

[27] Finland and Sweden formally adhered to the EU only in 1995. From 1977 to 1991 the Finnish markka was actually pegged to a trade-weighted currency index and from 1991 to 1992 to the ECU. From the beginning of the eighties the Swedish krona was also pegged to a weighted currency basket and from 1991 to the ECU.

[28] A *severe* expansion or contraction is defined when an absolute change in the ratio of public consumption to GDP, adjusted by the share of public consumption in total primary cyclically adjusted expenditure, is: a) greater than 1.5 percentage points in a year; b) greater than 0.5 percentage points, in each of three consecutive years. Similar methodologies are also used also by McDermott and Wescott (1996) and by Caselli and Rinaldi (1998). Changes in public consumption rather than in the cyclically adjusted primary deficit are considered here to be consistent with the O-R model. European Commission data have been used (European Commission, 1997, 1998).

with the second oil shock at the beginning of the eighties; 7 of the contractions were undertaken in the period 1994-97.

To get a broad idea of the macroeconomic impact, averages of all the variables relevant to the O-R model were computed for the period of the fiscal actions and for the two years before and after each. The data in Tables 4a and 4b are averages of all the episodes reported in Table 3;[29] they must be interpreted with some caution, as their variance is fairly high.

During fiscal contractions (Table 4a), private consumption growth was higher than in the EU as a whole[30] and the current account with the rest of the world and the EU, which started from near balance, turned into a significant surplus; these features persisted in the following two years and are in line with the model. Also, GDP growth was higher than in the EU (both during and after fiscal contractions), in contrast with the model's predictions of a zero differential in the short run and a negative differential in the long run.[31] As regards the terms of trade, the real exchange rate was used as a proxy; this seems more appropriate here since the terms of trade for EU countries were heavily affected by fluctuations in the prices of raw materials and the dollar. Two different measures were considered based, respectively, on unit labor costs and producer prices of manufactures. Although the latter is more consistent with the model setup, it could be influenced by cyclical variations in profit margins and by pricing-to-market policies. With fixed exchange rates, the real exchange rate should remain constant in the short run and appreciate in the long run. The data show that, on average, fiscal contractions induced a decline in the real exchange rate, in both the short and long run, which was more pronounced for unit labour costs.

As pointed out in Section 2, the behavior of the real interest rate depends on monetary rules. In this respect it is reasonable to assume that Germany always followed an independent monetary policy while all the other EU countries pegged their exchange rates to the DM. A

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[29] In computing the averages we excluded the last fiscal contractions in Italy and in Sweden as well as the Finnish contraction in 1993-95, since they took place, at least partially, with flexible exchange rates. The Finnish contraction of 1997 has been included since the Finnish markka joined the ERM in October 1996. The averages thus refer to 17 rather than 20 episodes.

[30] Since the EU includes the country taking the fiscal measure, the figures underestimate the true differential. A better measure in this context would be the differential with respect to a weighted average of all the EU countries not taking any fiscal action.

[31] These results are also in contrast with the standard Mundell-Fleming predictions, which imply that with fixed exchange rates in the short run the improvement in the current account comes from a relative decline in domestic output and consumption.

decrease (increase) in the real EU interest rate is therefore to be expected as a consequence of fiscal contractions (expansions) in all countries except Germany; the opposite would stem from fiscal action by Germany. In the model the real interest rate is unique; since this was not the case in Europe in the period under consideration, the German interest rate is probably the best proxy for the whole area. Indeed, Table 4a shows that during fiscal contractions the German short-term rate decreased at first and then remained fairly constant, while the long term rates remained fairly constant during and declined after the action.

Fiscal expansions were associated with more or less opposite results (Table 4b). Consumption growth proved much lower than the EU average, both during and after the expansion; the current account, though continuously improving, remained in deficit; the differential in GDP growth was significantly negative during the action, but turned positive afterwards; the German short-term rate rose considerably during and declined slightly after, while the long-term rate increased steadily. The only striking difference with respect to contractions is the behavior of the real exchange rate: here, as predicted by the model, both measures indicate a substantial real depreciation. Thus this picture of the path followed by the main macroeconomic variables seems to be broadly in line with the predictions of the O-R model. The only significant exceptions are GDP growth, which was positively rather than negatively correlated with private consumption, and the real exchange rates, for which the empirical evidence is more puzzling and no clear correlation with fiscal actions is discernible.[32]

One of the most interesting results concerns private consumption and confirms the findings of Giavazzi and Pagano that in some EU countries consumers reacted to fiscal policy changes much more in line with "classical" than "Keynesian" predictions.[33] As is shown in Section 2 consumption plays a crucial role in the international transmission of fiscal impulses; to cast more light on this issue, the following equation was estimated on a panel of annual data

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[32] Froot and Rogoff (1991) provide evidence of a positive correlation between the real exchange rate and domestic government consumption for the EU countries in 1979-1989. However, testing a small country neo-classical model with traded and nontraded goods, they used real exchange rates based on consumer rather than producer prices.

[33] The countries are Ireland and Denmark (Giavazzi and Pagano, 1990) and Sweden (Giavazzi and Pagano, 1996). In Giavazzi and Pagano (1996) cross-country evidence for all the OECD countries is also provided showing that private consumption did respond to fiscal policy changes according to the classical predictions when the changes were strong and permanent.

for the 10 EU countries considered in Table 3 and for the period 1979-1997:[34]

(6) $$\dot{C}_t - \dot{C}_t^* = a0 + b0\dot{G}_t + b1\dot{G}_t^* + c0 * diffr_t + \mu_t$$

where $\dot{C}_t$ and $\dot{C}_t^*$ are the domestic and foreign rates of change in private consumption, and $\dot{G}_t$ and $\dot{G}_t^*$ are the corresponding changes in public consumption (as a percentage of GDP, at constant prices), $diffr_t$ is the differential between the domestic and foreign short-term real interest rates, which were different from zero for most EU countries in the period considered and therefore cannot be ignored in the empirical analysis as possible determinants of the differentials in consumption growth, and μ_t is an uncorrelated error term. (6) is derived from equation 41A in Appendix I; according to the predictions of the O-R model the differential in the rate of growth of private consumption between H and F is negatively affected by an increase in domestic government expenditure (classical effect), but is positively affected by a fiscal expansion abroad (Keynesian effect), that is $-1 < b0 < 0$ and $b1 = -b0$. The real interest rate differential has been included to control for the fact that, during the period, short term real interest rates differred substantially across EU countries; the expected sign of $c0$ is obviously negative.

One advantage of estimating (6) is that it holds in both the short and long run, so that data frequency is not relevant and annual data can be used. Another advantage is that the signs, though not the absolute dimension, of $b0$ and $b1$ are independent of whether the fiscal shock is permanent or temporary (compare equations 41A and 54A in Appendix I). Since only tradable goods are considered in the O-R model and it is assumed that there is no national bias in government expenditure, the effects of domestic and foreign fiscal actions are equal in absolute size, but as public demand is likely to fall on non-traded goods as well, we should expect $|b1| \leq |b0|$.[35] To check for the robustness of our results, we considered both the EU and Germany as the "foreign country".

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[34] For Italy, Sweden and Finland the sample period is 1979-1992 because, after that year these three countries adopted a flexible exchange rate regime until October 1996 (Finland) and November 1996 (Italy).

[35] Obstfeld and Rogoff (1995a, 1996) also develop a small-country model with traded and nontraded goods. Following a permanent fiscal expansion in H, the response of consumption is qualitatively the same as set forth here, but there are differences in the behavior of the current account, which is not affected by the policy change, and of the real exchange rate, which appreciates in the long run.

Let us first consider the case in which the foreign country is EU [36] (Table 5a). We could not reject the hypothesis that the two coefficients for domestic and foreign public consumption have the same absolute value. Moreover, the signs are negative and positive, less than one, as predicted by the model, and they are highly significant. This confirms that private consumption reacted to domestic fiscal actions in a classical way also in a sample limited to the EU countries and for a period shorter than that analyzed by Giavazzi and Pagano (1996). Quite surprisingly, spill-over effects were also relevant; indeed, the a-priori presumption of national biais in public consumption expenditure is not supported by the data. The coefficient of the short-term real interest rate differential is negative, as expected, but is hardly significant. These results are fairly robust since they do not depend on the estimating procedure. In particular, the fixed effects model with autocorrelated disturbances indicates that an increase of 1 percentage points in the rate of growth of domestic public consumption (relative to GDP) induces a fall of 0.4 percentage points in the rate of growth of domestic private consumption relative to the EU average.

The same regression was also run considering Germany as the foreign country; Table 5b shows the results. There are two main differences compared with those presented above. First, the hypothesis that the absolute value of foreign public consumption is equal to that of domestic public consumption could not be accepted; indeed, it turns out that, while the size of the former is about the same as estimated before, as it should be, the size of the latter is significantly smaller. Second, the short term real interest rate differential turns out to be negative and significant in this case; this is not surprising since, until very recently, German short term interest rates were lower than those prevailing in the other EU countries.

4. Conclusions

In the paper we present the “fixed-exchange rate” version of the O-R model and show how it can lead to a theoretical interpretation of fiscal adjustments undertaken in the EU countries in the last twenty years that differs in several respects from the standard Mundell-Fleming approach.

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[36] Here EU is given by a weighted average of the 10 countries listed in Table 3.

First, it is shown that, following an unanticipated cut in public consumption, the real exchange rate of the country involved tends to appreciate rather than depreciate in the short run. In contrast to the common wisdom, it follows that the fall in output is less pronounced under fixed than flexible exchange rates. A fixed exchange rate regime would thus not appear to be such a bad thing if a number of countries all have to make significant budget cuts at once; in fact, the short-run depressive effect would be less than with flexible exchange rates. This result is diametrically opposed to that predicted by the Mundell-Fleming model.

Even more interestingly, monetary policy should become more expansionary, not restrictive in the country undertaking a fiscal consolidation. How can this be brought about? If the responsibility for pegging the exchange rate is shared equally by the two countries, the world money stock is simply redistributed from the foreign to the home country, so that short-run money market equilibrium implies a higher real interest rate and a lower level of consumption in both countries than those prevailing in the new steady state. On the contrary, if the home country has the entire responsibility for pegging its exchange rate while the foreign country pursues an independent monetary policy, the world money stock rises in the short run, thus lowering the real interest rate and residents of both countries will enjoy more consumption.

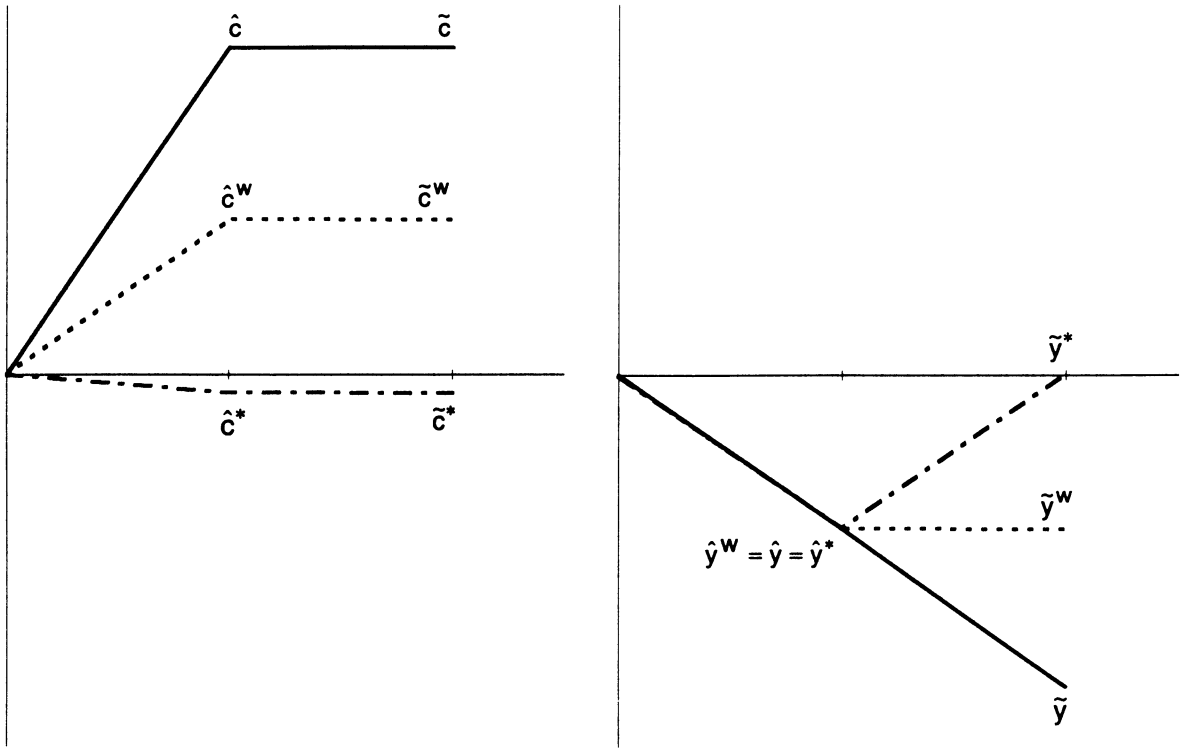
There are two rather appealing features in the model. First, all the results are general, in the sense that they do not depend either on the relative size of the two countries involved, or on the particular values of any parameter; only the absolute size of the effects obviously does. Second, the main predictions of the model are the same whether the fiscal shock is permanent or temporary. However, the comparative welfare gains from a monetary scheme of unilateral pegging are much larger if the fiscal consolidation in the home country is permanent.

A rigorous empirical test of the O-R model is beyond the scope of this paper and is left to future research. Nevertheless, we show that the behavior of the main macroeconomic variables following the major fiscal shocks in the EU countries is broadly in line with the main implications of the model. In particular, the results of panel regressions for 10 EU countries in the period 1979-97 show that private consumption reacted to changes in public consumption at home and abroad according to the predictions of the theoretical model. These finding are indeed consistent with previous results pointing to the relevance of classical effects of fiscal shock on private consumption behavior.

Figure 1

EFFECTS ON CONSUMPTION AND OUTPUT OF A *PERMANENT* CUT IN PUBLIC CONSUMPTION IN H

Unilateral pegging of the exchange rate



Bilateral pegging of the exchange rate

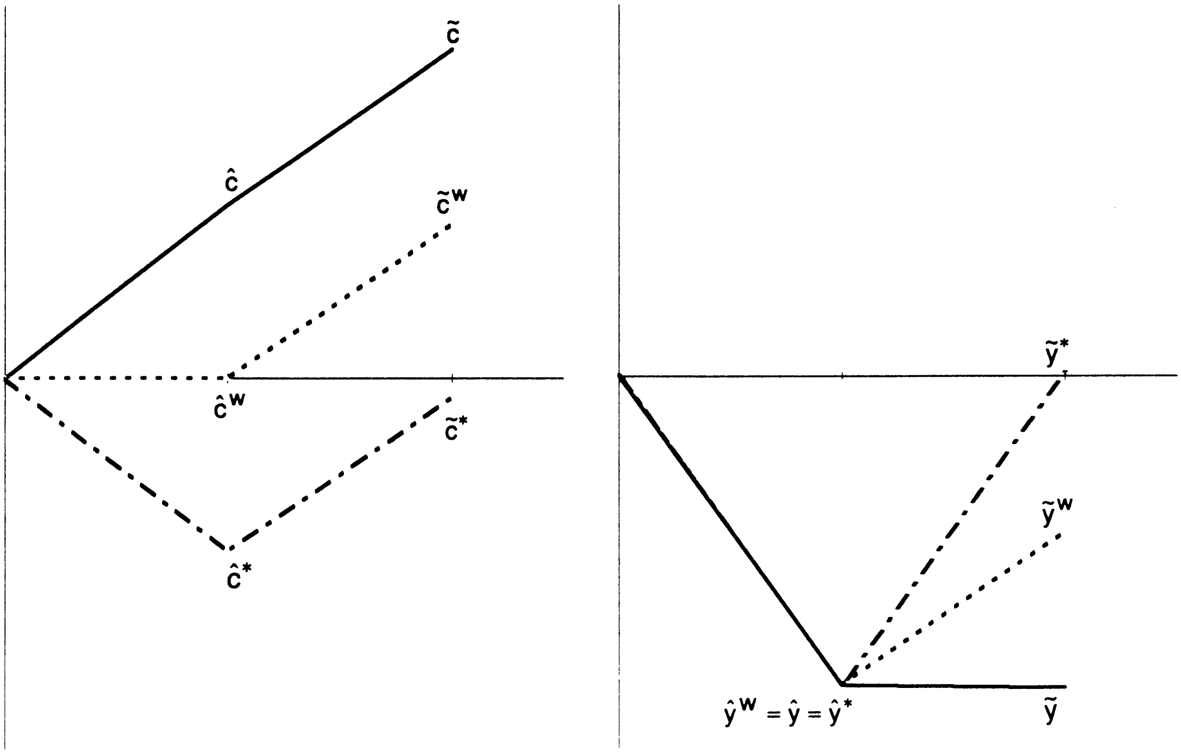
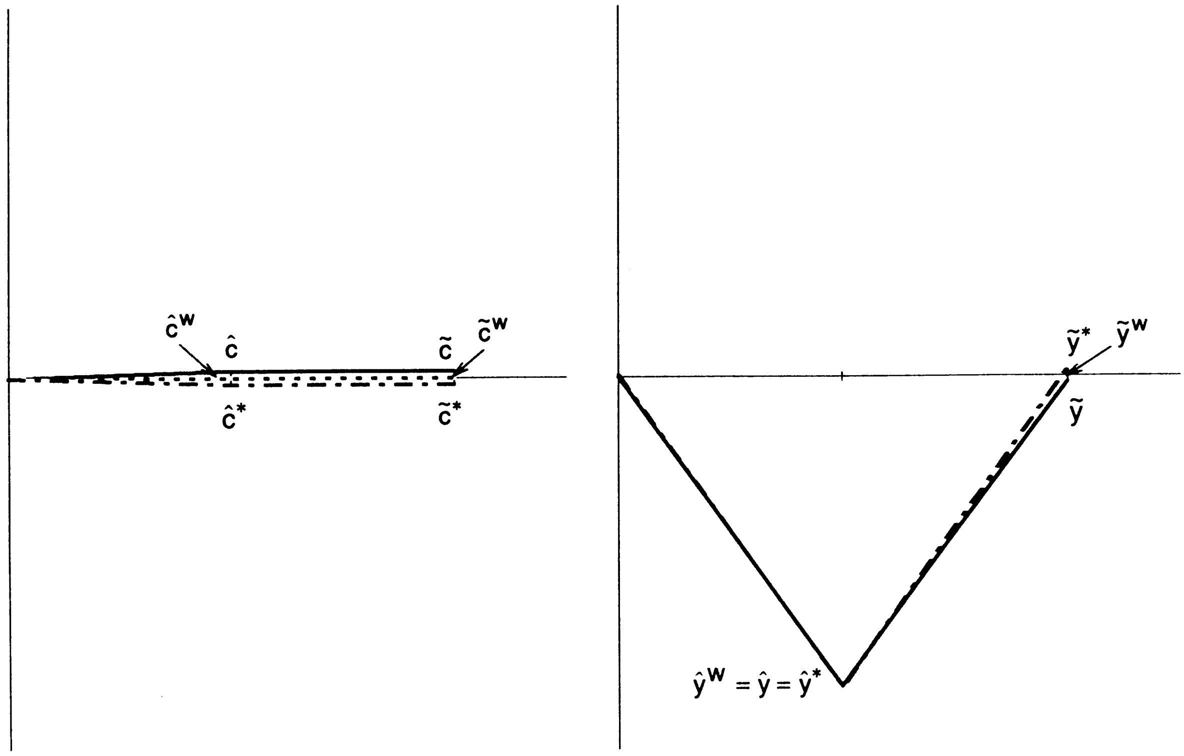


Figure 2

EFFECTS ON CONSUMPTION AND OUTPUT OF A *TEMPORARY* CUT IN PUBLIC CONSUMPTION IN H

Unilateral pegging of the exchange rate



Bilateral pegging of the exchange rate

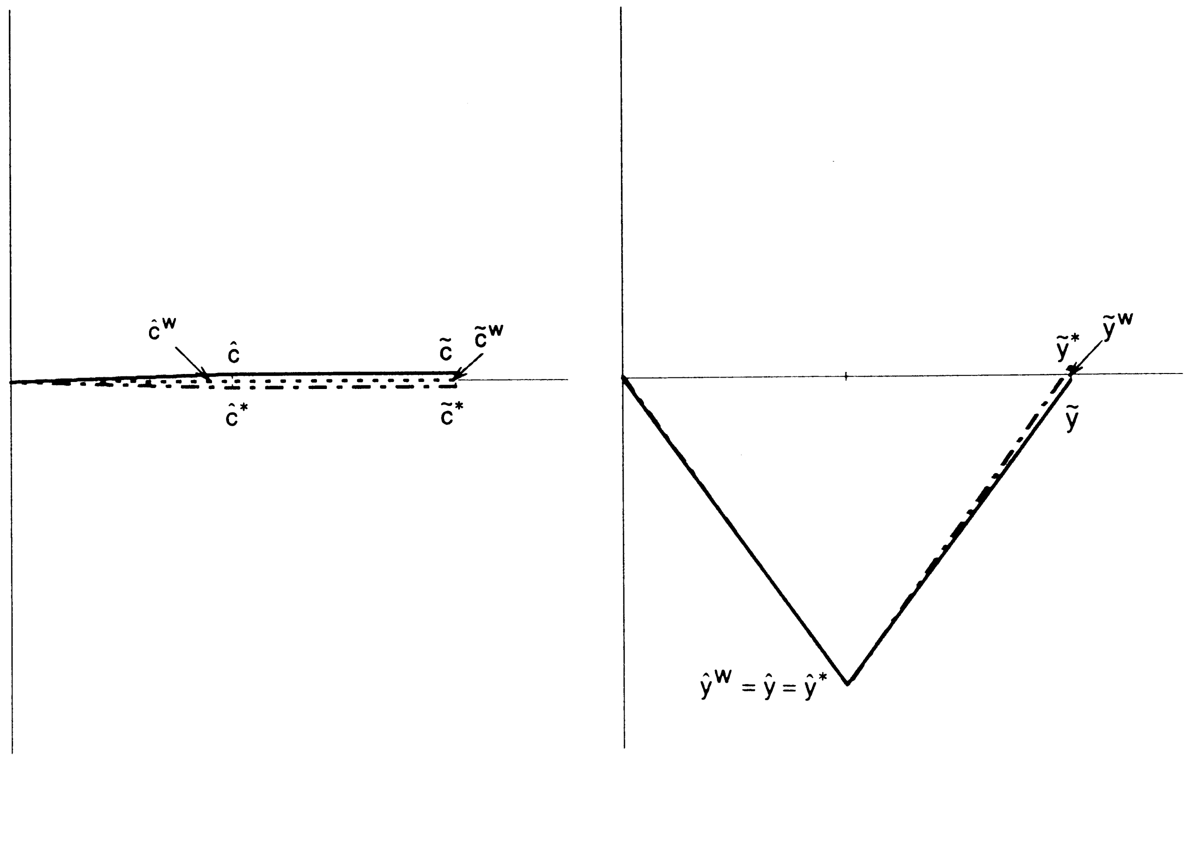


Table 1

Long and Short Run Effects of a Permanent Cut in Public Consumption in H

	World		Country H		Country F	
Long Run	Unilateral pegging	Bilateral pegging	Unilateral pegging	Bilateral pegging	Unilateral pegging	Bilateral pegging
Private Consumption	**+**		**+**		**–**	
Output	**–**		**–**		**+**	
Real Money Balances	**+**		**+**		**–**	
Money	**+**	••	**+**	**+**	**–**	**–**
Prices	••	**–**	••	**–**	••	**–**
Terms of Trade	**n.a.**		**+**		**–**	
Short Run	**World**		**Country H**		**Country F**	
Private Consumption	**+**	**+**	**+**	**+**	**–**	**–**
Output	**–**	**–**	**–**	**–**	**–**	**–**
Real Money Balances	**+**	••	**+**	**+**	••	**–**
Real Interest Rate	**–**	**+**	**–**	**+**	**–**	**+**
Current Account	**n.a.**	**n.a.**	**Surplus**	**Surplus**	**Deficit**	**Deficit**

Legenda: + increase with respect to the initial steady-state equilibrium;
– decrease; •• no change; n.a. not applicable.

Table 2

Long and Short Run Effects of a Temporary Cut in Public Consumption in H

	World		Country H		Country F	
Long Run	Unilateral pegging	Bilateral pegging	Unilateral pegging	Bilateral pegging	Unilateral pegging	Bilateral pegging
Private Consumption	••		+		–	
Output	••		–		+	
Real Money Balances	••		+		–	
Money	••	••	+	+	–	–
Terms of Trade	**n.a.**		+		–	
Short Run	**World**		**Country H**		**Country F**	
Private Consumption	+	••	+	+	–	–
Output	–	–	–	–	–	–
Real Money Balances	+	••	+	+	–	–
Real Interest Rate	–	••	–	••	–	••
Current Account	**n.a.**		**Surplus**	**Surplus**	**Deficit**	**Deficit**

Legenda: + increase with respect to the initial steady-state equilibrium;
– decrease; •• no change; n.a. not applicable.

Table 3

Episodes of severe expansion and contraction in public consumption by the general government in EU countries
(period 1979-97)

	Expansions	Contractions
Belgium		1987-90
Denmark	1979-81	1983-86; 1989-91; 1994-95
Germany	1981-83; 1991-93	1989
France		1988-91;1994
Ireland	1980	1984; 1987-90;1993-97
Italy	1981-83	(1994-95)
Netherlands	1982	1984; 1988-90; 1994-97
Austria		1987-90; 1995-97
Finland	1990-92	(1993-95); 1997
Sweden	1990-93	1986-88; (1994-97)

Source: Based on Commission's data.
The episodes in brackets took place under a regime of flexible exchange rates. For the definition of severe expansion (contraction) see note 27 in the text.

Table 4a

European Union : Macroeconomic effects of fiscal contractions

(average rate of change)

Macroeconomic variable	Previous two years	During	Subsequent two years
GDP - EU (1) (per capita)	-0.1	0.8	0.2
Consumption - EU (1) (per capita)	-0.5	0.4	0.1
Current Account (2)	-0.1	1.1	1.3
Current Account (2) vis-à-vis EU	0.3	1.2	1.1
Real exchange rate vis-à-vis EU (ULC) (3)	102.6	99.3	98.9
Real exchange rate vis-à-vis EU (producer prices) (3)	103.3	102.0	101.2
Real interest rate (short term)	5.0	4.4	4.7
Real interest rate (long term)	5.7	5.7	5.2
German short term real interest rate	3.7	3.2	3.3
German long term real interest rate	4.4	4.6	4.1

Sources: Based on Commission's data and forecasts (May 1998).
(1) Weighted average of the 10 EU countries listed in Table 3.
(2) As a percentage of GDP.
(3) Levels. Index 1991=100. An increase indicates a real appreciation (an improvement in the terms of trade).

Table 4b

European Union : Macroeconomic effects of fiscal expansions

(average rate of change)

Macroeconomic variable	Previous two years	During	Subsequent two years
GDP - EU (1) (per capita)	-0.3	-1.3	0.7
Consumption - EU (1) (per capita)	-0.4	-1.8	-0.6
Current Account (2)	-2.3	-2.6	-1.1
Current Account (2) vis-à-vis EU	-0.5	-0.8	-0.4
Real exchange rate vis-à-vis EU (ULC) (3)	99.8	99.5	94.8
Real exchange rate vis-à-vis EU (producer prices) (3)	102.6	100.2	99.2
Real interest rate (short term)	2.5	4.0	3.7
Real interest rate (long term)	3.0	4.3	5.3
German short term real interest rate	3.4	4.1	3.2
German long term real interest rate	3.6	3.7	4.4

Sources: Based on Commission's data and forecasts (May 1998).
(1) For the definition of EU see note (1) to Table 4a.
(2) As a percentage of GDP.
(3) Levels. Index 1991=100. An increase indicates a real appreciation (an improvement in the terms of trade).

Table 5a

Panel Regression Results of Equation:

$$\dot{C} - \dot{C}^* = a0 + b0\dot{G} + b1\dot{G}^* + c0\,\mathrm{diffr}$$

F country is : **European Union**

	OLS	FE	FE
$\dot{G}$	-0.46 (7.76)	-0.50 (7.79)	-0.42 (6.13)
$\dot{G}^*$	0.46 (7.76)	0.50 (7.79)	0.42 (6.18)
diffr	-0.11 (1.61)	-0.10 (1.39)	-0.17 (1.95)
constant	-0.05 (0.36)		
$\hat{r}$			0.23
nobs	175	175	165
Adj R^2	0.26	0.29	0.20
Log L	-343.2	-334.9	-311.9
F test	32.08	7.56	4.65
F test for the restriction $b0 + b1 = 0$	2.06	2.61	1.85

Table 5b

Panel Regression Results of Equation:

$$\dot{C} - \dot{C}^* = a0 + b0\dot{G} + b1\dot{G}^* + c0\ \text{diffr}$$

F country is : **Germany**

	OLS	FE	FE
$\dot{G}$	-0.51 (7.86)	-0.55 (7.88)	-0.53 (6.98)
$\dot{G}^*$	0.26 (3.73)	0.27 (3.90)	0.24 (3.38)
diffr	-0.16 (2.37)	-0.15 (2.14)	-0.19 (2.42)
constant	0.14 (0.74)		
$\hat{r}$			0.10
nobs	156	156	147
Adj R^2	0.31	0.33	0.28
Log L	-328.0	-321.8	-304.6
F test	24.47	7.95	6.13
F test for the restriction $b0 + b1 = 0$	8.25	9.87	9.20

Appendix I

The Obstfeld-Rogoff model with fixed exchange rates

The setup of the model is the same as in Obstfeld and Rogoff (1995a). The world is inhabited by a continuum of consumer-producers, indexed by $z \in [0,1]$, each producing a single differentiated good. The home country (H) consists of individuals in the interval $[0,n]$, while the foreign country (F) consists of the remaining $(n,1]$.

Individuals' preferences[37] are defined over a consumption index, C, domestic real money balances M/P and effort l spent in production, with disutility ϕ. Output and effort are linked by the following simple relationship, $y = Al^{1/2}$, and the utility function for the representative resident j of H is:

$$\text{(1A)} \qquad U_t^j = \sum_{s=t}^{\infty} \beta^{s-t} \left[\log C_s^j + \frac{\chi}{1-\varepsilon} \left(\frac{M_s^j}{P_s} \right)^{1-\varepsilon} - \frac{\kappa}{2} y_s(j)^2 \right] \qquad \forall j \in [0,n]$$

where $0 < \beta < 1$ and $\varepsilon, \chi > 0$ and $\kappa = 2\phi/A^2 > 0$. The consumption index, C^j, is given by:

$$\text{(2A)} \qquad C^j = \left[\int_0^1 c^j(z)^{(\theta-1)/\theta} dz \right]^{\theta/(\theta-1)} \qquad \forall j \in [0,n]$$

where $\theta > 1$ is the intratemporal elasticity of substitution. Since there are no impediments or costs to trade, the law of one price holds for every good:

$$\text{(3A)} \qquad p(z) = Ep^*(z) \qquad \forall z \in [0,1]$$

where E is the nominal exchange rate (units of domestic currency for one unit of foreign currency) and $p(z)$ and $p^*(z)$ are the domestic and foreign currency prices of good z. The price index associated with C is:

$$\text{(4A)} \qquad P = \left\{ \int_0^n p(z)^{1-\theta} dz + \int_n^1 \left[Ep^*(z) \right]^{1-\theta} dz \right\}^{1/(1-\theta)}$$

[37] Since all individuals in the world share the same preferences, the maximization problem is presented here with reference to the representative resident of H.

Since home and foreign residents have the same preferences, (3A) and (4A) imply:

(5A) $$P = EP^{*}$$

so PPP holds also with respect to the composite consumption index. For the representative resident of H the budget constraint is:

(6A) $$P_t F_t^j + M_t^j = P_t(1 + r_{t-1})F_{t-1}^j + M_{t-1}^j + p_t(j)y_t(j) - P_t C_t^j - P_t \tau_t$$

where F_t^j and M_t^j are, respectively, the stock of international real riskless bonds and of domestic money held at the end of period t; r_t is the real interest rate, expressed in terms of the consumption index, earned between t and $t+1$; τ_t are per capita lump-sum real taxes.

Given the consumption index C^j, the H-country individual's demand for good z is given by:

(7A) $$c^j(z) = \left[\frac{p(z)}{P}\right]^{-\theta} C^j \qquad \forall j \in [0, n]\,, \quad \forall z \in [0, 1]\,.$$

It is assumed that per capita government consumption, G, does not affect private utility. Since Ricardian equivalence holds in the model, the government budget constraint can be written as:

(8A) $$G_t = \tau_t + \frac{M_t - M_{t-1}}{P_t}$$

in other words, all government expenditure is financed by taxes and seignorage. Let $G = \left[\int_0^1 g(z)^{(\theta-1)/\theta} dz\right]^{\theta/(\theta-1)}$ be a composite of goods as C and assume that governments are price takers; then integrating demand for good z across all H and F individuals and H and F governments gives the following world demand curve:

(9A) $$y_t^d(z) = \left[\frac{p_t(z)}{P_t}\right]^{-\theta} (C_t^W + G_t^W) \qquad \forall z \in [0, 1]$$

where: $C_t^W \equiv nC_t + (1-n)C_t^*$ and $G_t^W \equiv nG_t + (1-n)G_t^*$ are, respectively, the world per capita private and public consumption.

The representative individual in H maximizes (1A) subject to (6A), taking C^W and G^W as given. The first-order conditions with respect to F_t^j, M_t^j and $y_t(j)$ are:

$$C_{t+1}^j = \beta(1+r_t)C_t^j \tag{10A}$$

$$\frac{M_t^j}{P_t} = \left[\chi C_t^j\left(\frac{1+i_t}{i_t}\right)\right]^{1/\varepsilon} \tag{11A}$$

$$y_t(j)^{(\theta+1)/\theta} = \left(\frac{\theta-1}{\theta\kappa}\right)\frac{\left(C_t^W+G_t^W\right)^{1/\theta}}{C_t^j} \tag{12A}$$

where $1+i_t = \frac{P_{t+1}}{P_t}(1+r_t)$ and i is the nominal interest rate. Equilibrium for the world economy requires that: a) domestic nominal money supply must be equal to demand in each country; b) net foreign assets must be zero[38]; c) world total consumption (private and public) must be equal to world output (since there are no investments), i.e.:

$$C_t^W + G_t^W = n\frac{p_t(h)}{P_t}y_t(h) + (1-n)\frac{p_t^*}{P_t^*}y_t^*(f) \equiv Y^W. \tag{13A}$$

In order to analyze the effects of exogenous changes in G and G^* a linearized version has to be computed around a well-defined initial equilibrium. First, define a steady-state equilibrium as one in which all exogenous variables are constant. Since consumption is also constant, from (10A) the world real interest rate is given by:

$$\overline{r} = (1-\beta)/\beta \tag{14A}$$

where overbars indicate steady-state values. Steady-state consumption must equal steady-state income in both countries[39]:

$$\overline{C} = \overline{r}\overline{F} + \frac{\overline{p}(h)\overline{y}}{\overline{P}} - \overline{G} \tag{15A}$$

$$\overline{C}^* = -\left(\frac{n}{1-n}\right)\overline{r}\overline{F} + \frac{\overline{p^*}(f)\overline{y}^*}{\overline{P}^*} - \overline{G}^*. \tag{16A}$$

A closed form solution exists for the fully symmetric steady state where $\overline{F_0}^* = \overline{F_0} = 0$ and $\overline{G}_0 = \overline{G}_0^* = 0$. Since prices are pre-set one period in advance, the model is

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[38] $nF_t + (1-n)F_t^* = 0 \qquad \forall t.$

[39] The superscript j has been omitted to simplify notation.

characterized by different short- and long-run equilibrium conditions, which have to be solved simultaneously (let short-run be period 1 and long-run be period 2). The conditions that hold in period 2 can be found by linearizing, around the initial symmetric steady state, the definitions of C^W and G^W, (4A) and (5A), together with equations (9A), (11A), (12A) and (13A) and their foreign counterparts. With fixed exchange rates, E is exogenous and constant at $\overline{E}$, while world per capita money stock, $M^W \equiv nM + (1-n)M^*$, becomes endogenous. Thus we end up with the following system of 12 equations:

$$\widetilde{C}^W = n\widetilde{C} + (1-n)\widetilde{C}^* \tag{17A}$$

$$\widetilde{G}^W = n\widetilde{G} + (1-n)\widetilde{G}^* \tag{18A}$$

$$\widetilde{P} = n\widetilde{p}(h) + (1-n)\widetilde{p}^*(f) \tag{19A}$$

$$\widetilde{P} = \widetilde{P}^* \tag{20A}$$

$$\widetilde{y} = -\theta(1-n)(\widetilde{p}(h) - \widetilde{p}^*(f)) + \widetilde{C}^W + \widetilde{G}^W \tag{21A}$$

$$\widetilde{y}^* = \theta n(\widetilde{p}(h) - \widetilde{p}^*(f)) + \widetilde{C}^W + \widetilde{G}^W \tag{22A}$$

$$(1+\theta)\widetilde{y} = -\theta\widetilde{C} + \widetilde{C}^W + \widetilde{G}^W \tag{23A}$$

$$(1+\theta)\widetilde{y}^* = -\theta\widetilde{C}^* + \widetilde{C}^W + \widetilde{G}^W \tag{24A}$$

$$\widetilde{C} = \overline{r}\widetilde{F} + \widetilde{y} + (1-n)(\widetilde{p}(h) - \widetilde{p}^*(f)) - \widetilde{G} \tag{25A}$$

$$\widetilde{C}^* = (-\frac{n}{1-n})\overline{r}\widetilde{F} + \widetilde{y}^* - n(\widetilde{p}(h) - \widetilde{p}^*(f)) - \widetilde{G}^* \tag{26A}$$

$$\widetilde{M} - \widetilde{P} = \widetilde{C}/\varepsilon \tag{27A}$$

$$\widetilde{M}^* - \widetilde{P}^* = \widetilde{C}^*/\varepsilon \tag{28A}$$

where $\widetilde{X} \equiv dX/\overline{X_0}$ denote the percentage change in period 2 from the initial value, $\overline{X}_0$, for any variable, except for $\widetilde{G} \equiv dG/\overline{C}_0^W$, $\widetilde{G}^* \equiv dG^*/\overline{C}_0^W$ and $\widetilde{F} \equiv dF/\overline{C}_0^W$. In period 1, H and F prices do not change, H and F output are demand-determined and the two current account identities are:

$$F_1 = \frac{p_1(h)y_1}{P_1} - C_1 - G_1 \tag{29A}$$

$$F_1^* = \frac{p_1^*(f)y_1^*}{P_1^*} - C_1^* - G_1^*. \tag{30A}$$

By linearizing around the initial equilibrium (10A), (11A) and (12A), together with their foreign counterparts, and with (29A) and (30A) and the definitions of C^W and G^W, we get the following system of 10 equations that fully characterize the short-run equilibrium of the system:

$$\widehat{C}^W = n\widehat{C} + (1-n)\widehat{C}^* \tag{31A}$$

$$\widehat{G}^W = n\widehat{G} + (1-n)\widehat{G}^* \tag{32A}$$

$$\widehat{C} = \widetilde{C} - (1-\beta)\widehat{r} \tag{33A}$$

$$\widehat{C}^* = \widetilde{C}^* - (1-\beta)\widehat{r} \tag{34A}$$

$$\widehat{y} = \widehat{C}^W + \widehat{G}^W \tag{35A}$$

$$\widehat{y}^* = \widehat{C}^W + \widehat{G}^W \tag{36A}$$

$$\widetilde{F} = \widehat{y} - \widehat{C} - \widehat{G} \tag{37A}$$

$$-\frac{n}{1-n}\widetilde{F} = \widehat{y}^* - \widehat{C}^* - \widehat{G}^* \tag{38A}$$

$$\widehat{M} = \frac{\widehat{C}}{\varepsilon} - \frac{\beta}{\varepsilon}\left(\widehat{r} + \frac{\widetilde{P}}{1-\beta}\right) \tag{39A}$$

$$\widehat{M}^* = \frac{\widehat{C}^*}{\varepsilon} - \frac{\beta}{\varepsilon}\left(\widehat{r} + \frac{\widetilde{P}^*}{1-\beta}\right) \tag{40A}$$

where $\widehat{X} \equiv dX/\overline{X_0}$ denotes the percentage change in period 1 from the initial value, $\overline{X_0}$, for any variable, except $\widehat{G} \equiv dG/\overline{C}_0^W$, $\widehat{G}^* \equiv dG^*/\overline{C}_0^W$. $\widehat{F} = \widetilde{F}$ since in period 2 the current account must be balanced.

Effects of a permanent worldwide fiscal shock

First, we will consider the effects of a permanent world-wide fiscal shock such that: $\widehat{G} = \widetilde{G} > 0$, $\widehat{G}^* = \widetilde{G}^* > 0$ and $\widetilde{G} - \widetilde{G}^* > 0$. To solve the model, find first $\widetilde{F}$ from (31A) - (38A) and then use it in (17A) - (28A) to compute the long-run solutions for all variables; long-run solutions can then be plugged back in (31A) - (40A) to find short-run solutions. The simplest approach is to solve for relative variables:

$$\text{(41A)} \qquad \widetilde{C} - \widetilde{C}^{*} = \frac{-(1+\theta)(1+\overline{r})}{\Psi}\left(\widetilde{G} - \widetilde{G}^{*}\right) < 0^{40}$$

$$\text{(42A)} \qquad \widetilde{y} - \widetilde{y}^{*} = \frac{\theta(1+\overline{r})}{\Psi}\left(\widetilde{G} - \widetilde{G}^{*}\right) > 0$$

$$\text{(43A)} \qquad \widetilde{p}(h) - \widetilde{p}^{*}(f) = \frac{-(1+\overline{r})}{\Psi}\left(\widetilde{G} - \widetilde{G}^{*}\right) < 0$$

$$\text{(44A)} \qquad \widetilde{F} = \frac{-(1-n)(1+\theta)}{\Psi}\left(\widetilde{G} - \widetilde{G}^{*}\right) < 0.$$

In the long run a *permanent* relative fiscal expansion in H reduces that country's relative private consumption but increases relative output; H's terms of trade worsen and H runs a current account deficit. To solve for the levels of individual variables, first compute the effects on long-run world variables $\widetilde{C}^{W}$and $\widetilde{Y}^{W}$.Taking a weighted average of (21A) and (22A) and of (23A) and (24A) and solving for $\widetilde{Y}^{W}$ and $\widetilde{C}^{W}$gives $\widetilde{Y}^{W} = \frac{\widetilde{G}^{W}}{2}$ and $\widetilde{C}^{W} = -\frac{\widetilde{G}^{W}}{2}$[41]. A permanent increase in world public consumption raises the long-run level of world output, but lowers private consumption by the same amount. The solutions for individual variables are then given by:

$$\text{(45A)} \qquad \widetilde{C} = -\frac{\widetilde{G}^{W}}{2} - (1-n)\frac{(1+\theta)(1+\overline{r})}{\Psi}\left(\widetilde{G} - \widetilde{G}^{*}\right) < 0$$

$$\text{(46A)} \qquad \widetilde{C}^{*} = -\frac{\widetilde{G}^{W}}{2} + n\frac{(1+\theta)(1+\overline{r})}{\Psi}\left(\widetilde{G} - \widetilde{G}^{*}\right)$$

$$\text{(47A)} \qquad \widetilde{y} = \frac{\widetilde{G}^{W}}{2} + (1-n)\frac{\theta(1+\overline{r})}{\Psi}\left(\widetilde{G} - \widetilde{G}^{*}\right) > 0$$

$$\text{(48A)} \qquad \widetilde{y}^{*} = \frac{\widetilde{G}^{W}}{2} - n\frac{\theta(1+\overline{r})}{\Psi}\left(\widetilde{G} - \widetilde{G}^{*}\right).$$

(45A) is always negative and (47A) always positive; but the sign of (46A) and (48A) depends on the relative size of the fiscal shock in F; for $\widetilde{G}^{*}$sufficiently small $(i.e : \widetilde{G}^{*} \to 0)$ (46A) and (48A) are respectively positive and negative. From (27A) and (28A) it is also possible to solve for the changes in real money balances, which depend only on the changes in private consumption in H and F. Note that the long-run solutions for all real variables do not depend on the way in which $M^{W}$is endogenized. However, to find the change in the absolute

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[40] In fact, $\Psi = 2\theta + \overline{r}(1+\theta) > 0$.

[41] It is straightforward to show that $\widetilde{M}^{W} - \widetilde{P} = -\frac{\widetilde{G}^{W}}{2\varepsilon}$.

price level $\widetilde{P} = \widetilde{P}^{*}$, we need to make specific assumptions about the way in which M^{W} is set. If F pursues an independent monetary policy aiming at long-run price stability $\left(\widetilde{P} = \widetilde{P}^{*} = 0\right)$ and H adjusts its money supply to keep the exchange rate constant we get:

$$\widetilde{M}^{W} = \frac{\widetilde{C}^{W}}{\varepsilon} = -\frac{\widetilde{G}^{W}}{2\varepsilon} < 0 \tag{49A}$$

$$\widetilde{M} = \frac{\widetilde{C}}{\varepsilon} < 0 \tag{50A}$$

$$\widetilde{M}^{*} = \frac{\widetilde{C}^{*}}{\varepsilon}. \tag{51A}$$

Thus, a permanent world wide fiscal expansion, by decreasing long-run private consumption, implies lower world money stock. The money stock of H decreases, while the effect on F's money supply is ambiguous depending on the size of $\widetilde{G}^{*}$.

To find the short run solutions it is first necessary to solve for the change in the real interest rate $\widehat{r}$. Since prices are fixed, F's monetary policy is passive, that is $\widehat{M}^{*} = 0$, while H sets its money stock to keep the exchange rate constant. In this case, the real interest rate is determined entirely in F's money market:

$$\widehat{r} = \widetilde{C}^{*} \tag{52A}$$

$\widehat{r} > 0$ if $\widetilde{G}^{*}$is small compared with $\widetilde{G}$ so that a relative fiscal expansion in H leads to an increase in the real interest rate. Given $\widehat{r}$, it is straightforward to solve for the short-run changes of H's and F's consumption, $\widehat{C}$ and $\widehat{C}^{*}$, of $\widehat{C}^{W}$ and, from (35A) and (36A) of their output, $\widehat{y}$ and $\widehat{y}^{*}$. In the short run F's real money balances are obviously constant, while the endogenous change in those of H is:

$$\widehat{M} = \frac{-(1+\theta)(1+\overline{r})}{\Psi\varepsilon}\left(\widetilde{G} - \widetilde{G}^{*}\right) < 0. \tag{53A}$$

Effects of a temporary worldwide fiscal shock

In the case of a temporary fiscal shock there are no effects on the long-run level of world real variables (i.e.: $\widetilde{G}^{W} = \widetilde{Y}^{W} = \widetilde{C}^{W} = 0$) and $\widetilde{G} = \widetilde{G}^{*} = \widetilde{G}^{W} = 0$; then solving for $\widetilde{C} - \widetilde{C}^{*}$,

$\widetilde{y}-\widetilde{y}^{*}$, $\widetilde{p}(h)-\widetilde{p}^{*}(f)$ and $\widetilde{F}$ gives:

$$\text{(54A)} \qquad \widetilde{C}-\widetilde{C}^{*} = \frac{-(1+\theta)\overline{r}}{\Psi}\left(\widehat{G}-\widehat{G}^{*}\right)<0$$

$$\text{(55A)} \qquad \widetilde{y}-\widetilde{y}^{*} = \frac{\theta\overline{r}}{\Psi}\left(\widehat{G}-\widehat{G}^{*}\right)>0$$

$$\text{(56A)} \qquad \widetilde{p}(h)-\widetilde{p}^{*}(f) = \frac{-\overline{r}}{\Psi}\left(\widehat{G}-\widehat{G}^{*}\right)<0$$

$$\text{(57A)} \qquad \widetilde{F} = \frac{-2\theta(1-n)}{\Psi}\left(\widehat{G}-\widehat{G}^{*}\right)<0.$$

The effects on relative long-run real variables are qualitatively the same as those induced by a permanent fiscal action. If $\widehat{G}-\widehat{G}^{*}>0$, H's relative consumption will decline and H will still run a deficit. The effects on individual variables are:

$$\text{(58A)} \qquad \widetilde{C} = \frac{-(1+\theta)(1-n)\overline{r}}{\Psi}\left(\widehat{G}-\widehat{G}^{*}\right)<0$$

$$\text{(59A)} \qquad \widetilde{C}^{*} = \frac{(1+\theta)n\overline{r}}{\Psi}\left(\widehat{G}-\widehat{G}^{*}\right)>0$$

$$\text{(60A)} \qquad \widetilde{y} = \frac{\theta\overline{r}(1-n)}{\Psi}\left(\widehat{G}-\widehat{G}^{*}\right)>0$$

$$\text{(61A)} \qquad \widetilde{y}^{*} = \frac{-n\theta\overline{r}}{\Psi}\left(\widehat{G}-\widehat{G}^{*}\right)<0$$

Since a temporary shock has purely redistributive consequences, the effects in H and F have opposite signs; real money balances will change in line with private consumption (equations 50A and 51A still hold). As before, in the short run the change in the real interest rate is entirely determined in F's money market (equation 52A still holds) and from (59A) will always be positive for a relative fiscal expansion by H.

Appendix II

Welfare implications of alternative monetary policies

Following any shock at time 1, the change in utility for the representative H-country resident, can be computed by totally differentiating (1A) around the initial equilibrium[42]:

(1B)
$$dU = \left[\widehat{C} + \chi^{'}\widehat{M} - \frac{(\theta-1)}{\theta}\widehat{y}\right] + \frac{\beta}{1-\beta}\left[\widetilde{C} + \chi^{'}\left(\widetilde{M} - \widetilde{P}\right) - \frac{(\theta-1)}{\theta}\widetilde{y}\right]$$

where $\chi^{'} = \chi\left(\frac{\overline{M}_0}{\overline{P}_0}\right)^{1-\varepsilon} = \chi\left(\frac{\overline{M}_0^*}{\overline{P}_0^*}\right)^{1-\varepsilon}$. An analogous expression can be obtained for the representative resident of F. Following an *unanticipated permanent cut in H's public consumption* ($\widetilde{G} < 0$, $\widetilde{G}^* = 0$ and $\widetilde{G}^W = n\widetilde{G}$), (1B) can now be evaluated under regime one, in which H unilaterally pegs the exchange rate and F pursues an independent monetary policy, and under regime two in which H and F cooperate to peg the exchange rate. Since the long-run changes are independent of the monetary regimes, we need only to evaluate the short-term changes. Thus under regime one we get:

(2B)
$$dU_{one} = \frac{\widetilde{C}^W}{\theta} - \frac{(1-\beta)\widehat{r}_{one}}{\theta} + (1-n)\left(\widetilde{C} - \widetilde{C}^*\right) - \frac{(\theta-1)}{\theta}n\widetilde{G} + \chi^{'}\left(\frac{\widetilde{C} - \widetilde{C}^*}{\varepsilon}\right) + \Omega$$

where Ω represents long-run changes, and under regime two:

(3B)
$$dU_{two} = \frac{\widetilde{C}^W}{\theta} - \frac{(1-\beta)\widehat{r}_{two}}{\theta} + (1-n)\left(\widetilde{C} - \widetilde{C}^*\right) - \frac{(\theta-1)}{\theta}n\widetilde{G} + \chi^{'}(1-n)\left(\frac{\widetilde{C} - \widetilde{C}^*}{\varepsilon}\right) + \Omega$$

---

[42] Note that at the initial equilibrium $\overline{y}_0 = \left(\frac{\theta-1}{\theta\kappa}\right)^{1/2}$.

The corresponding expressions for the representative F resident are:

$$dU^*_{one} = \frac{\widetilde{C}^W}{\theta} - \frac{(1-\beta)\widehat{r}_{one}}{\theta} - n\left(\widetilde{C} - \widetilde{C}^*\right) - \frac{(\theta-1)}{\theta} n\widetilde{G} + \Omega^* \tag{4B}$$

$$dU^*_{two} = \frac{\widetilde{C}^W}{\theta} - \frac{(1-\beta)\widehat{r}_{two}}{\theta} - n\left(\widetilde{C} - \widetilde{C}^*\right) - \frac{(\theta-1)}{\theta} n\widetilde{G} - \chi' n\left(\frac{\widetilde{C} - \widetilde{C}^*}{\varepsilon}\right) + \Omega^*. \tag{5B}$$

Subtracting (3B) from (2B) and (5B) from (4B) gives:

$$dU_{one} - dU_{two} = dU^*_{one} - dU^*_{two} = -\frac{(1-\beta)(\widehat{r}_{one} - \widehat{r}_{two})}{\theta} + \chi' n\left(\frac{\widetilde{C} - \widetilde{C}^*}{\varepsilon}\right) \tag{6B}$$

which is always positive since $\widehat{r}_{one} < 0$ (equation 52A) , $\widehat{r}_{two} > 0$ and $\widetilde{C} - \widetilde{C}^* > 0$ for a *permanent fiscal contraction by H*. Thus the improvement in welfare is the same for H and F-country residents, if the first rather than the second monetary scheme is adopted.

It is straightforward to show that (6B) also holds for a *temporary fiscal contraction by H*. Since $\widehat{r}_{one} < 0$ (equation 52A), $\widehat{r}_{two} = 0$ [43] and $\frac{\widetilde{C}-\widetilde{C}^*}{\varepsilon} > 0$, it follows that (6B) is still positive.

[43] To see this, take a weighted average of (39A) and (40A) and solve for $\widehat{r}$, given $\widehat{M}^W = 0$ and no changes in long-run values. Note that the real interest rate does not change for a temporary fiscal shock with flexible exchange rates either (Obstfeld and Rogoff 1995a).

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