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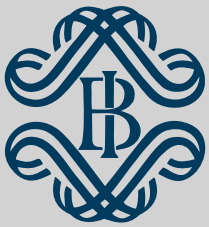
by Lorenzo Bini Smaghi



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WAITING FOR EMU: LIVING WITH MONETARY POLICY ASYMMETRIES IN THE EMS

by

Lorenzo Bini Smaghi(*)

Abstract

In an exchange rate system such as the EMS, with full capital mobility and highly credible parities, the ability to use monetary policy to achieve price stability in all countries is diminished in the presence of differentiated domestic inflationary pressures. A country can achieve domestic monetary policy objectives only if it acts as leader of the system and brings the others to accept its policy stance even if it is not optimal for them. Several factors influence the ability of a country to perform the role of leader, such as its size and the credibility of its policies. A further important factor is the position of the currency in the fluctuation band. The design of the EMS makes it easier for countries whose currencies have a strong position within the band to act as leaders. As a consequence, the leadership of the system is likely to be exercised by the countries that have to conduct the most restrictive monetary policies, due for instance to their domestic inflationary pressures or their unbalanced budgetary positions. As a result, the monetary policy of the system will tend to be excessively restrictive.

Contents

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Introduction and main conclusions[1]

In a fixed exchange rate system with full mobility of capital there can be only one monetary policy for the whole area. This policy can be determined either by the single authority of the monetary union or by the country playing the role of leader, with the others acting as followers and fixing their exchange rates with the former. In this second case, every single country has an incentive to be the leader of the system since the followers have to bear the burden of adjustment in the face of asymmetric shocks. For the system as a whole, the burden of adjustment is lower if the country subject to the shock acts as follower rather than the leader. This suggests that the monetary policy stance of the area should be determined by the country which is most stable, the others acting as followers and fixing their exchange rates with the former.

If exchange rates are not irrevocably fixed, and agents perceive that they might be modified, the above results are not as clear-cut. In particular, the welfare loss suffered by a country experiencing an asymmetric shock that acts as follower rises. This welfare loss would be reduced if the country realigned its exchange rate. If agents expect that the country will eventually realign, a policy of maintaining the exchange rate fixed increases the burden of adjustment even further. Therefore, a country experiencing a shock has an even greater incentive to be the leader of the system than under fully fixed exchange rates. For the system as a whole there is no longer a clear advantage in attributing the role of leader to the most stable country. The determination of the role of leader is therefore likely

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1. I wish to thank D. Porciani for research assistance. I benefited from useful discussion with L. Guiso and M. Canzoneri. I naturally remain responsible for any errors and for the opinions expressed.

to be a rather controversial, occasionally conflictual, issue.

In the EMS, where the current parity grid is still not perfectly credible, the problem of which country acts as the leader of the system has recently re-emerged. While capital controls were maintained in most countries and Germany had the lowest rate of inflation, it acted and was recognized as the leader of the system, while the others followed an exchange rate target. With the liberalization of capital movements and in the presence of occasionally differentiated inflationary pressures in the member states the leadership role is likely to shift from the lowest inflation country to one with stronger inflationary pressures. The experience of the last two years confirms that countries with stronger inflationary pressures registered an appreciation of their exchange rates within the fluctuation band which has reduced the room for manoeuvre of the countries with lower inflation, sometimes even leading the latter to have to adopt a more restrictive monetary policy stance than would have been required on the basis of their domestic conditions alone.

The structure of the EMS tends to give a greater leadership role to countries which adopt a more restrictive monetary policy stance and whose exchange rate tends to appreciate within the band over those whose currency depreciates since it is easier to sterilize capital inflows than capital outflows. Therefore the system's monetary policy tends to be influenced more by the countries that conduct a more restrictive policy because of their higher inflationary pressures while countries with the lowest inflation have to bear the burden of adjustment. This "perverse" asymmetry determines on average a more restrictive monetary policy than under full monetary union.

This paper is organized in four sections. The next one examines recent developments in the monetary policy and exchange rate structure of the EMS. The second section

describes a simple two-country model that is examined in the third section to compare the adjustment to asymmetric shocks under different exchange rate regimes. The last section examines the policy dilemma in the EMS.

1. Monetary policy and exchange rate stability before EMU

Until the start of the third phase of EMU, responsibility for the conduct of monetary policy will remain with the national authorities; however, these policies cannot substantially differ between each other, given the objective of exchange rate stability in the EMS.[2] The main issue to be solved in the first and second phases of EMU is thus how monetary policy should be conducted in the member states to preserve exchange rate stability and achieve convergence of inflation towards the best performance.

During most of the ERM period the monetary policy stance of the system was determined by Germany's central bank.[3] This was due to three main factors. Firstly, Germany had the lowest rate of inflation, so that it was implicitly recognized that giving the Deutsche mark the anchor role ensured the convergence of inflation towards the best inflation performance. Secondly, the credibility of Germany's anti-inflation policy, deriving from the country's good record and the independence of the Bundesbank, helped other countries' authorities to acquire credibility by pegging their currency to the DM.[4] Finally, the relative stability of Germany's financial and money markets favored the conduct of a monetary policy based on quantitative targets defined in

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2. See Padoa-Schioppa (1985, 1988).

3. See Giavazzi and Giovannini (1989), Mastropasqua, Micossi and Rinaldi (1988), Guerrieri and Padoan (1988), Padoa-Schioppa (1991).

4. See Giavazzi and Pagano (1988).

terms of domestic objectives.[5]

Empirical evidence on the asymmetric functioning of the EMS does not lead to clear-cut results.[6] However, it is widely recognized that, compared with Germany, the other ERM countries gave greater weight in setting monetary policy to the position of their currency within the band or its exchange rate against the DM. The former very seldom undertook intra-marginal interventions to influence the exchange rate of the DM within the band. Furthermore, restrictions on capital movements eased the adjustment of domestic policies in countries with higher inflation rates.

Starting in 1986-87 the basic premises underlying the asymmetric monetary policy coordination mechanism in the ERM began to change. First, inflation rates converged, especially among the countries that had adhered to the narrow band from the start of the system. In 1991, Germany's inflation rate was among the highest within that group. Second, capital controls were removed, thereby increasing the interdependence of national monetary policies.[7] It became increasingly hard for German monetary policy to be isolated from monetary developments in the other countries, through sterilization of other countries' interventions, and therefore to perform the role of anchor for the system.[8]

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5. Bini Smaghi and Vori (1991) show that in a two-country symmetric system it is optimal for the country with the least financial disturbances to play the role of leader.

6. For a discussion of the issue, see Wyplosz (1989), Fratianni and Von Hagen (1990), Bini Smaghi and Micossi (1990), Weber (1990).

7. Weber (1990) shows that the test of causality between German and French interest rates suggests a reduction of the significance of the causality from Germany's rates to French rates since 1987 and a rise of the significance of the causality from French rates to German rates.

8. The characteristics of this "new EMS" are examined in Giavazzi and Spaventa (1990) and Bini Smaghi and Micossi (1990). See also Miller and Sutherland (1990).

Finally, the economic and monetary unification of Germany resulted in the definition of quantitative targets for the money supply being affected by the uncertainties regarding monetary behavior in the former East Germany.

All in all, in the early 1990s the ERM has been characterized by a group of countries that have reached a high degree of inflation convergence and whose monetary and financial markets are highly integrated. The question of how monetary policy is to be determined has become more controversial. Even if monetary policy aims in all countries at price stability with the same determination, exchange rate stability is not ensured. Keeping the "house in order" is not sufficient for the EMS to function smoothly. This is because countries may be subject to asymmetric shocks, which require temporarily differentiated monetary policy reactions to ensure price stability: for instance, the more intense the demand shock experienced in any country, the more restrictive monetary policy will have to be. This, however, is inconsistent with exchange rate stability and therefore tensions are likely to emerge in the ERM. A well known recent example is the differential between the growth of domestic demand in Germany and that of the other countries during 1990-91, which led monetary policy in Germany to become more restrictive, thereby creating strains in the ERM, in particular in countries where inflation was lower than in Germany. The crucial question is thus: how should monetary policy be conducted in the system to reconcile exchange rate and price stability?

The next two sections examine this issue analytically. The basic working assumption throughout the paper is that all the monetary authorities in the area share the objective of pursuing price stability.[9] The paper

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9. This is a different assumption from that of Currie, Levine and Pearlman (1990) and Laskar (1990), where countries have different preferences in terms of inflation and growth.

concentrates on the performance of different monetary regimes in which all countries are tough inflation fighters, as the European central bank is expected to be in full EMU.

2. The model

Consider a simple two-country discrete time model, with five basic equations per country:

$$(1) \qquad m_t^d - p_t = y_t - 1/\lambda\, i_t$$

$$(2) \qquad y_t^d = -\sigma(i_t - ({}_tp_{t+1} - p_t)) - \gamma(p_t - s_t - p_t^*) + g_t$$

$$(3) \qquad y_t^s = \delta(p_t - {}_{t-1}p_t)$$

$$(4) \qquad y_t^d = y_t^s$$

$$(5) \qquad m_t^d = m_t^s$$

The first equation represents the demand for money, m_t, as a function of the price level, p_t, income, y_t, and the rate of interest, i_t; the second equation describes aggregate demand, which is a negative function of the real interest rate $i_t - ({}_tp_{t+1} - p_t)$, the real exchange rate $p_t - s_t - p_t^*$ and a demand disturbance g_t with zero expected value; the third equation is a standard Lucas-type supply function, in which income depends on the difference between the price level and the value expected in the previous period. The fifth equation represents the money market equilibrium condition, the money supply being equal to demand. All the variables are expressed in logarithmic terms except the interest rate. The economy of the second country (called country F, the first being country H) can be described with a similar set of equations in which the variables are asterisked; it is assumed that the two countries are equal in size and with respect to the value of

the parameters.[10]

The two economies are linked through the standard open market parity conditions:

$$(6) \qquad i_t = i_t^* + {}_t s_{t+1} - s_t$$

The above model can be solved by normalizing to zero the time t-1 level of prices in the two countries ($p_{t-1}-p^*_{t-1} = 0$). The general solution of the model is provided in the Appendix for the two periods equilibrium (short and long term). The price levels in the two countries are determined by the demand shock and the money supply. Only asymmetric shocks, i.e. $g_t \neq g_t^*$, will affect the exchange rate. Deviations from the purchasing power parity may temporarily occur to satisfy the open interest parity condition which reflects perfect capital mobility (and no risk premium). A country affected by an inflationary shock g will experience, with unchanged money supply, a temporary appreciation of its exchange rate.

It is assumed that the authorities of the two countries have a welfare function similar to that assumed in Barro and Gordon (1983):

$$(7) \qquad W_t = -|p_t - p_{t-1}| + (1/\delta)(y_t - \bar{y})$$

The first term refers to the absolute value of the rate of inflation: any change, positive or negative, in the price level, decreases welfare. The second term refers to the deviation of income from its long-term value; an increase in income above its long-term level raises welfare. Substituting

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10. This simplification is of course crucial. The results would clearly be different, although less interesting, if a country was smaller; there would be little scope for discussing a regime in which the small country played the role of leader.

in (7) for equation (3) and (4) we obtain:

$$(8) \qquad W_t = -|p_t - p_{t-1}| + (p_t - {}_{t-1}p_t)$$

The above welfare function indicates that, ex-ante, there is no incentive to inflate for either country since any increase in prices with respect to the level prevailing in the previous period, anticipated or not, decreases welfare or, at most, leaves it unchanged.

3. Adjustment under fixed exchange rates

The model developed in the previous section suggests that, in the absence of asymmetric shocks, there are no incentives for the two countries to deviate from the fixed exchange rate. It is interesting to examine how the two countries' economies adjust under fixed exchange rates in the face of asymmetric shocks, for example $g_t>0$ and $g_t^*=0$. It is assumed...for simplicity that the authorities can modify the money supply instantaneously at each point in time to attain the desired target, whether this is expressed in terms of the exchange rate, the interest rate or the price level; m_t can therefore be expressed as a reaction function in terms of the contemporaneous values of the objectives. This presumes that the authorities have information about the exogenous shocks just before these affect the economy.[11]

We consider first the benchmark case in which the fixed exchange rate regime is fully credible and enforceable

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11. See Barro (1976). A rationalization of this assumption is that in a market-clearing system such as the one assumed in the model the monetary authority can attain its target, expressed either in terms of the interest rate, the exchange rate or the price level by providing at the moment of the clearing the amount of money necessary to attain the desired target.

and then examine the situation of a not credibly fixed exchange rate.

3.1. Irrevocably fixed exchange rates

In a fixed exchange rate system the mechanism determining the supply of money must be specified. Three different assumptions can be made: a) an asymmetric system with leadership of country H; b) an asymmetric system with leadership of country F; c) a symmetric system (Monetary Union). The leadership of a country implies that it is able to determine monetary conditions in a way that maximizes its own welfare function, while the other fixes its exchange rate with the former, its money supply being endogenous. The solutions of the model, in terms of price, income and welfare, following a shock $g_t>0$ ($g_t^*=0$), under the three regimes is shown in Table 1.

Under an asymmetric system the country that assumes the leadership is able to insulate itself from the inflationary shock affecting either country. If country H is the leader (case a), it will stabilize prices at time t on the level prevailing at time t-1; country H's interest rate rises while the money supply falls, in order to counteract the excess aggregate demand. Country F will bear the burden of the adjustment since, to keep the exchange rate stable, it must also increase its interest rate, which in turn produces a temporary fall in the price level and income. Its welfare will consequently decrease. If, on the contrary, country F is the leader (case b), the burden of adjustment will fall on country H. The latter cannot raise its interest rate sufficiently to counteract the inflationary pressure; it therefore records a temporary increase in its price level and income. The negative effect on welfare produced by the increase in the price level is compensated by the unexpected increase in income. Country H's welfare nevertheless

decreases at time t+1, when prices and income fall back to the long-run equilibrium level. Finally, if the system is symmetric, the burden of the adjustment will be spread over the two countries in terms of price and income adjustment.

The welfare results clearly show that each country maximizes its welfare when it acts as the leader of the system, since it is able to transfer the burden of the adjustment on the follower. Considering the system as a whole, by adding the welfare of the two countries, the regime in which country F, which is not subject to the inflationary shock, performs the role of leader (case b) produces the best result in terms of overall welfare. This suggests that the system is better off if the monetary stance of the system is determined by the country which is not subject to shocks. Countries should therefore bear the burden of adjustment for the shocks affecting them. The worst solution occurs when the country subject to the inflationary shock performs the role of leader (case a), imposing on the follower its more restrictive monetary policy. The symmetric system is an intermediate case since the cost of the adjustment is shared between the two countries, the larger part being borne, however, by the country not subject to the shock.

3.2. Pegged but adjustable exchange rates

The welfare of the country bearing the burden of adjustment to an asymmetric shock can be improved if it is allowed to modify the exchange rate. In particular, when the follower is affected by the shock (case b), it would be better off if at time t it temporarily appreciated the exchange rate. This would enable it to maintain the price level unchanged and therefore to eliminate the welfare loss. If, instead, the shock affects the leader (case a), the follower would be better off if it temporarily depreciated its currency to avoid the reduction of its price level and

income. This is in line with the traditional result that a fixed exchange rate rule is sub-optimal in the presence of asymmetric shocks, and countries have an incentive to deviate from such rule.

Another interesting result of this model is that even if countries stick to the fixed exchange rate rule at the time the shock occurs, they still have an incentive to deviate in the following period, until the long-run equilibrium level of prices and income is fully restored. This is particularly important in the case in which the follower is affected by an inflationary shock (case b). Country H, even if it maintained the exchange rate fixed at time t, would be better off, in terms of welfare, if it devalued at time t+1. If the authorities decided to behave accordingly, while agents expected them to stick to the fixed exchange rate rule, so that ${}_{t}s_{t+1}=0$, welfare would be improved, by $2/z\ g_t$ ($z=2\gamma+\sigma+\delta$; Table 3). Welfare would be increased by only half that amount if agents had expected the devaluation.

In the case in which the leader is subject to the inflationary shock (case a), the follower, if it does not devalue at time t, would be better off by revaluing at time t+1. Welfare would be unchanged if agents did not anticipate a revaluation; it would improve if agents anticipated a revaluation. A similar analysis can be undertaken for a symmetric system.

In short, even if the authorities maintain exchange rates unchanged after an asymmetric shock, they still have an incentive to modify the exchange rate in the following period. Solving for the welfare function specified in equation (8), it can be seen that welfare is maximized when prices are set at time t+1 at the same level as that of time t, i.e. if the exchange rate is adjusted to render permanent the temporary change in the relative price level. Table 3 shows the values of welfare when the authorities maximize welfare on the assumption that agents expect them to stick to

the exchange rate rule. If agents anticipate that the authorities will modify the exchange rate to maximize their welfare, part of the gain obtained from the exchange rate adjustment vanishes.

If the authorities decide to stick to the fixed exchange rate rule while agents instead formulate their expectations on the assumption that the authorities will maximize their welfare function, welfare may decrease. In particular in the case in which the follower country is affected by the inflationary shock (case b), and agents anticipate that the authorities will aim at maximizing welfare by devaluing, country H's interest rate will be higher than country F's, by the amount of the expected devaluation. If country H sticks instead to the fixed exchange rate rule, prices at time t+1 will be lower than anticipated at time t; the level of income will also be lower. The discrepancy between the actual and the expected price level will persist as long as prices remain above their long-run level, since the authorities will still have an incentive to devalue. In the case in which country H is the leader (case a), country F's welfare might increase if the country sticks to the fixed exchange rate rule while agents expect a revaluation, since this would determine an unexpected increase in income which would compensate for the welfare loss produced by the increase in the price level.

In summary, if agents form their expectations according to the one-period ahead welfare maximization of the authorities but the latter instead stick to the fixed exchange rate rule, the welfare loss to be borne by the follower will be the same independently of which country is affected by the shock.[12] The advantage of being the leader of the system is larger than under a system in which exchange rates are irrevocably fixed. For the system as a whole there

12. For simplicity the welfare values in the different time periods are not discounted.

is no longer a clear advantage in having the more stable country act as the leader.

The model of course does not explain why the two countries continue to maintain fixed exchange rates in the face of asymmetric shocks. This is not the purpose of the paper. Maintaining a fixed exchange rate regime has to be justified on other grounds, such as the greater size and frequency of symmetric shocks compared with asymmetric shocks and the fact that the latter on average do not penalize any member country.[13] However, when asymmetric shocks occur, countries have an incentive to deviate from the fixed exchange rate rule; this incentive remains as long as the effects of the shocks persist. The expectation of such incentive by economic agents makes exchange rate fixity more painful to maintain, in particular for the follower which has to bear the burden of adjustment.

4. Policy dilemmas prior to EMU

4.1. "Perverse" asymmetry in the EMS

The model developed in the previous two sections shows that a country has an advantage in being the leader of an asymmetric exchange rate regime since it can give priority to price stability while the follower has to adjust its domestic monetary conditions to ensure exchange rate stability. This advantage increases if exchange rates are not irrevocably fixed and agents anticipate that in certain circumstances the authorities have an incentive to deviate from the fixed exchange rate rule.

This shows the basic conflict inherent in the EMS in the face of asymmetric shocks. Until exchange rates are credibly fixed, the country experiencing an inflationary

13. See Cohen and Wyplosz (1989) and Weber (1990).

shock runs a risk if it does not counter it immediately; if it lets its price level increase temporarily, agents know that in the next period it will have an incentive to devalue. The anticipation by agents of the exchange rate adjustment leads to a higher level of the interest rate and a slower adjustment to the long-run equilibrium level, with negative effects on income. The other country, which is not affected by the inflationary shock, will try to avoid having to raise its interest rate, following the increase in the other country, since this would cause a reduction in its price and income level that would decrease its welfare. In contrast with the full credibility case, the two regimes bring about a similar welfare deterioration for the system as a whole. There is therefore no clear-cut assignment of the leadership role on the basis of overall welfare. Countries will try to assume the leadership role, so as to maximize their own welfare.

In a fixed exchange rate system with no institutionalized anchor role there is no systematic way to resolve this type of conflict, especially if all countries are subject to shocks. However, in the ERM, countries whose currencies are in the top part of the fluctuation band tend to have an advantage in maintaining monetary policy oriented towards domestic objectives since it is in principle easier for them to sterilize capital inflows than for countries in the opposite situation to defend their currencies through sales of reserves, since the latter are finite. The country at the bottom of the band is therefore likely to have to raise its interest rate to prevent its currency from reaching the lower margin. In short, in the EMS it is the currency in the higher part of the band which is more likely to perform the role of leader.

In the past the currencies in the top part of the band were those of low-inflation countries. At present, however, the situation has partly changed. With complete capital mobility and national monetary policies aimed at

price stability, the currencies of the countries subject to the greatest domestic inflationary pressures, and with the most restrictive monetary policies tend to appreciate, rising to the top part of the fluctuation band. These countries are in a more favorable position to perform the role of leader.

Until monetary union is completed, through the creation of a single central bank whose objective is the price stability of the area as a whole, national authorities concentrate on fighting their own country's inflation. Since inflationary pressures may differ across countries, monetary policies may tend to diverge in the short run, jeopardizing exchange rate stability. The latter is maintained only if one country adjusts to the other's policy. Given the way the EMS works, the country where there are less inflationary pressures tends to bear the burden of adjustment suffering temporary recessionary pressures. On average, in a system such as the EMS the monetary policy of the area will tend to be determined by the highest inflation country and therefore will be more severe than it would be under full EMU.

4.2. A broad look at the data

This section aims at examining how some of the recent exchange and interest rate developments in the EMS might be interpreted in the light of the theoretical model analyzed above. Two particular issues are worth focusing on. The first is the relationship between interest rates and exchange rates among the currencies in the narrow band. The second is the extent to which the leadership in the system is affected by one currency's position in the fluctuation band. The analysis is based mostly on graphical analysis. More formal econometric analysis needs to be done on this issue.

In the analytical framework developed in section 2 above, in which monetary authorities pursue the objective of price stability, a country that experiences an inflationary

shock tends to adopt a more restrictive monetary policy which implies an increase in its interest rate and a short-term appreciation of the exchange rate within the fluctuation band. The model therefore implies a positive correlation between interest rate differentials and the position of a currency in the fluctuation band.

An alternative model considered in the literature is based on purchasing power parity, according to which an increase in inflation in one country leads to an expected depreciation of its currency. In such a model interest rate differentials are negatively correlated with the position in the band.[14]

The EMS has long been considered a crawling peg system, with less than full accommodation of inflation differentials. This interpretation is consistent with the second model. However, the recent developments tend to suggest that the first model, adopted in this paper has become more relevant. Figures 1, 2 and 3 show that in the last two years countries with higher or increasing inflation experienced an appreciation of their nominal exchange rate. This is due to the fact that these countries adopted more restrictive monetary policies, which led to interest rate rises, to counteract their inflationary pressures. This is particularly evident in the case of Germany as the DM appreciated within the fluctuation band towards the end of 1990 and 1991, while German interest rates rose as a response to increasing inflation. Conversely, the French franc dropped to the lower part of the band as the differential between French interest rates and those in the other ERM countries decreased while inflation was falling in France. This tends to confirm the positive relationship between interest rate differentials and the position in the

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14. Papell (1984) explains how the two models can be reconciled by specifying the monetary authorities' reaction function.

band.

It is interesting to notice that this is a rather recent development in the system. Running a simple regression between the position of a currency in the fluctuation band and the interest rate differential, the coefficient is significantly positive only in the 1990-91 period for France and Italy. Tables 4 and 5 report these results. In Table 5 the lagged value of the interest rate differential is used as the independent variable to avoid the possible simultaneity bias. In the earlier years (1983-89) the coefficients are not significantly different from zero, except for Germany. These results should be interpreted with care; the high degree of autocorrelation of the errors in some cases might signal some misspecification. More thorough empirical analysis should therefore be undertaken. However, the assumption of a positive correlation between interest rates and exchange rates underlying the model developed in section 2 does not seem to be rejected.

The second issue concerning the asymmetric nature of the EMS has been widely addressed in the literature, as mentioned in section 1. Results have differed widely and no convincing evidence has yet settled the debate. Recent research tends to suggest that the degree of asymmetry, if any, has been reduced in recent years. The model developed in section 2 suggests that this may have been due not to the fact that monetary policy coordination has evolved towards a more symmetric system but to the fact that more than one country has had the opportunity to play the role of leader. Symmetry is therefore not a deliberate choice but may be due to the role of leader shifting from one country to another, depending on which is positioned at the top of the band and adopts the most stringent monetary policy. Greater symmetry therefore does not result in a more balanced monetary policy but on a more restrictive one.

If assessing the degree of asymmetry in the EMS has proven to be a difficult task, examining its restrictiveness

is even harder. Looking at graphical evidence may, however, provide some interesting clues for further analysis. Figures 1, 2 and 4 suggest that France, whose currency is in the lowest part of the fluctuation band in the course of 1991, and whose inflation rate has been falling, experienced the highest real interest rate in the system. The real interest rate differential with Germany widened by over two percentage points in the course of 1991. This tends to suggest that France's monetary policy has been maintained more restrictive than would have been justified on the basis of its domestic conditions, in order to maintain the exchange rate of the franc in the fluctuation band. Also in Germany, in the first half of 1990, nominal interest rates increased slightly in spite of the fall in inflation, as the DM was depreciating in the fluctuation band. As a result, German real interest rates rose in the first half of 1990.

On the other hand, the appreciation of the exchange rate of the DM towards the top of the band does not seem to have limited the scope for interest rate increases in Germany. German interest rates rose steadily in the course of 1991, although initially not as quickly as inflation. In the case of Italy, instead, the position of the lira close to the top of the fluctuation band favored an easing of interest rates in the first part of 1990 and in mid-1991.

These first indications suggest that countries whose currencies are in the highest part of the fluctuation band are in a better position to achieve their domestic monetary policy objectives, in particular to maintain a restrictive stance to counteract inflationary pressures. Countries that are in the lowest part of the band and that experience lower inflation seem instead to be severely constrained by the need to maintain their currency within the band and might have to adopt a more restrictive monetary policy than would be required by domestic conditions.

In summary, the predictions of the model seem to be

in line with the short-term correlations recently observed in the ERM between inflation, interest rates and exchange rates. With stable exchange rate expectations, the currency of the country with the greatest inflationary pressure tends to appreciate. The consistency between price and exchange rate stability has been preserved in different ways. Germany played a leadership role whenever it recorded greater domestic inflationary pressures, since it unambiguously privileged price stability. On these occasions the other countries followed the German stance. When, on the other hand, inflationary pressures were stronger in other countries, notably in Italy, a more symmetric approach was followed, with exchange rate stability being privileged. Interest rates were kept high in Germany, and sometimes also in France, in spite of their lower, even falling inflation, while they fell in Italy, in spite of its rising inflation.

Table 1

Adjustment to a shock $g_t > 0$ under a fully-believed fixed exchange rate rule (*)

Country	p_t	p_{t+1}	y_t	y_{t+1}	w_t	w_{t+1}	w_t+w_{t+1}
1. H country leader							
H	0	0	0	0	0	0	0
F	-1/z	0	-δ/z	0	-2/z	-1/z	-3/z
2. F country leader							
H	1/z	0	δ/z	0	0	-1/z	-1/z
F	0	0	0	0	0	0	0
3. Symmetric system							
H	1/2z	0	δ/2z	0	0	-1/2z	-1/2z
F	-1/2z	0	-δ/2z	0	-1/z	-1/2z	-3/2z

(*) Agents expect fixed exchange rates and the authorities implement fixed exchange rates; $z=2\gamma+\sigma+\delta$; all values multiplied by g_t.

Adjustment to a shock $g_t>0$ under a not-believed fixed exchange rate rule (*)

Country	p_t	p_{t+j}	y_t	y_{t+j}	w_t	w_{t+j}	Σw_{t+j}
1. H country leader							
H	0	0	0	0	0	0	0
F	$-1/z$	$-\delta^j/z^{j+1}$	$-\delta/z$	$\sigma\delta^j/z^{j+1}$	$-2/z$	0	$-2/z$
2. F country leader							
H	$1/z$	δ^j/z^{j+1}	δ/z	$-\sigma\delta^j/z^{j+1}$	0	$-2\sigma\delta^{j-1}/z^j$	$-2/z$
F	0	0	0	0	0	0	0
3. Symmetric system							
H	$1/2z$	$\delta^j/2z^{j+1}$	$\delta/2z$	$-\sigma\delta^j/2z^{j+1}$	0	$-\sigma\delta^{j-1}/z^j$	$-1/z$
F	$-1/2z$	$-\delta^j/2z^{j+1}$	$-\delta/2z$	$\sigma\delta^j/2z^{j+1}$	$-1/z$	0	$-1/z$

(*) Authorities fix the exchange rates while agents expect them to maximize their welfare; $z=2\gamma+\sigma+\delta$; all values multiplied by g_t.

Table 3

Welfare under alternative exchange rate regimes and expectations after a shock $g_t > 0$ (*)

Country	Agents expect FER Authorities FER	Agents expect FER Authorities Max W	Agents expect Max W Authorities Max W	Agents expect Max W Authorities FER
1. H country leader				
W_H	0	0	0	0
W_F	-3	-3	-2	-2
2. F country leader				
W_H	-1	1	0	-2
W_F	0	0	0	0
3. Symmetric system				
W_H	-1/2	1/2	0	-1
W_F	-3/2	-3/2	-1	-1

(*) FER: fixed exchange rate; Max W: maximization of utility; all values multiplied by $g_t/(2\gamma+\delta+\sigma)$.

Table 4

Results of regression

$$ds_t = c + \alpha ds_{t-1} + \beta di_t + u_t$$

	c	ds_{t-1}	di_t	R^2	H	SE
1. Italy						
1983-86	-.04 (-.05)	.86* (11.90)	.03 (.26)	.78	1.13	.80
1987-89	-1.93 (-1.95)	.89* (9.57)	.34 (1.70)	.73	1.56	.63
1990-91	-.82* (-3.23)	1.00* (8.62)	.27* (3.53)	.77	1.40	.22
2. France						
1983-86	.00 (.06)	.92* (11.10)	.02 (.54)	.74	2.60	.24
1987-89	-.13 (-1.45)	.66* (4.88)	.03 (.25)	.40	1.34	.38
1990-91	-.14 (-1.44)	.69* (5.85)	.27* (3.40)	.71	1.53	.19
3. Germany						
1983-86	.89* (2.05)	.71* (7.07)	.13* (1.99)	.54	3.33	.53
1987-89	.63* (2.14)	.74* (7.09)	.10 (1.83)	.81	-2.16	.21
1990-91	.53 (1.93)	.73* (5.04)	.26 (1.79)	.73	.53	.33

ds_{t-1} = lagged value of dependent variable (position of the country's currency in the fluctuation band); di_t = interest rate differential with the other ERM countries; (*) significant at 1 per cent level.

Table 5

Results of regression

$$ds_t = c + \alpha ds_{t-1} + \beta\, di_{t-1} + u_t$$

	c	ds_{t-1}	di_{t-1}	R^2	H	SE
1. Italy						
1983-86	.06 (.08)	.87* (11.70)	.01 (.12)	.78	1.11	.81
1987-89	-1.07 (-.98)	.85* (9.17)	.16 (.74)	.71	1.74	.65
1990-91	-.58* (-2.64)	.82* (7.00)	.22* (3.02)	.74	.98	.23
2. France						
1983-86	.00 (.06)	.92* (11.00)	.02 (.58)	.74	2.60	.24
1987-89	-.19* (-2.16)	.68* (5.22)	.15 (1.36)	.44	1.06	.37
1990-91	-.22* (-1.97)	.62* (4.20)	.20* (2.04)	.62	2.45	.22
3. Germany						
1983-86	1.19* (2.79)	.68* (6.97)	.17* (2.73)	.58	3.27	.52
1987-89	.71* (2.30)	.72* (6.54)	.12* (2.01)	.81	-2.43	.21
1990-91	.74* (3.28)	.64* (4.99)	.35* (3.14)	.79	.37	.29

ds_{t-1} = lagged value of dependent variable (position of the country's currency in the fluctuation band); di_{t-1} = lagged value of interest rate differential with the other ERM countries; (*) significant at 1 per cent level.

Fig. 1

Position in the ERM fluctuation band
(bilateral divergence; percentage points)

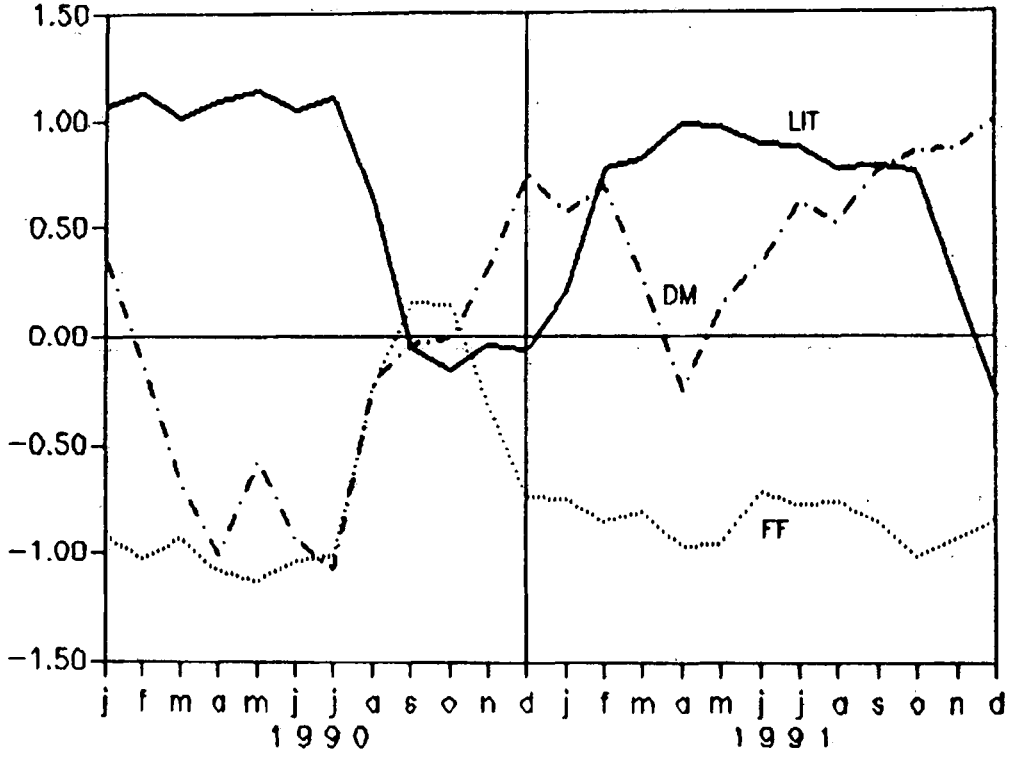
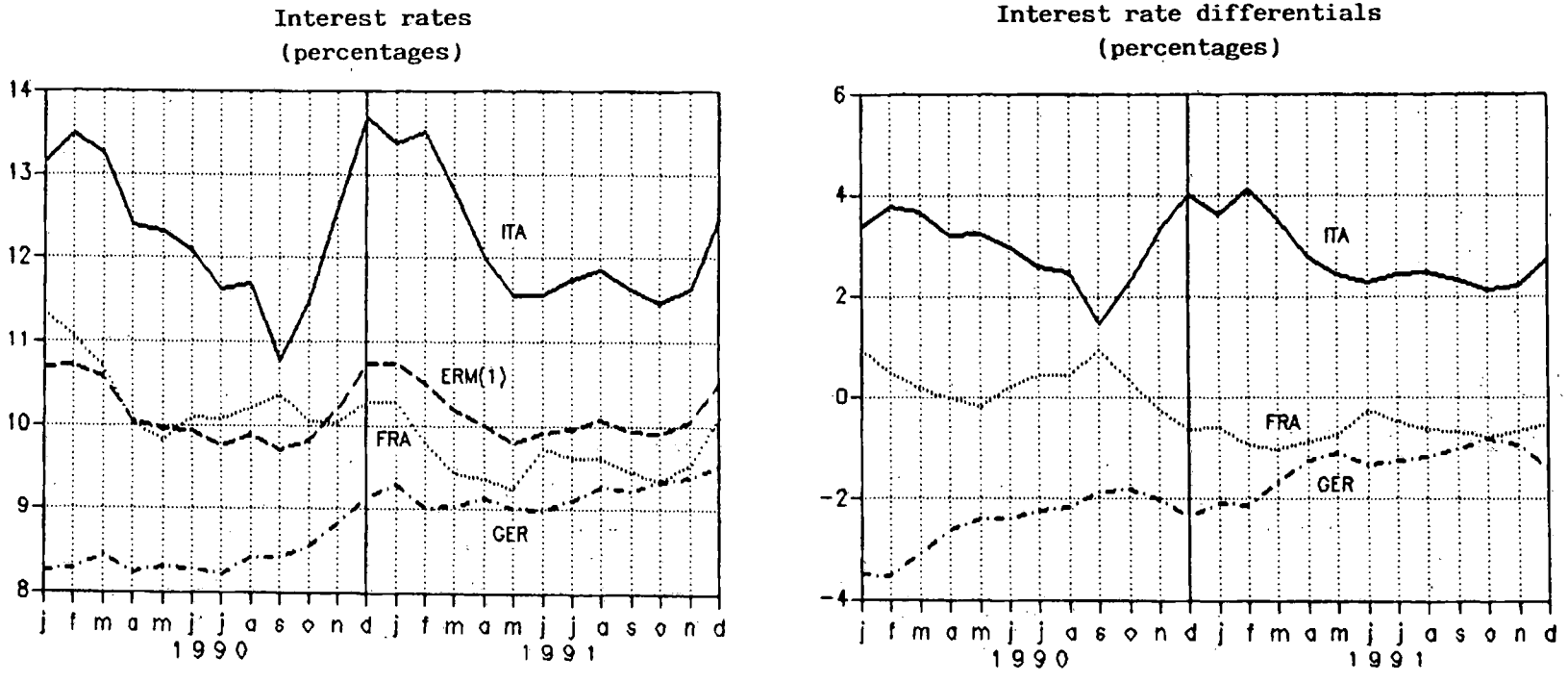


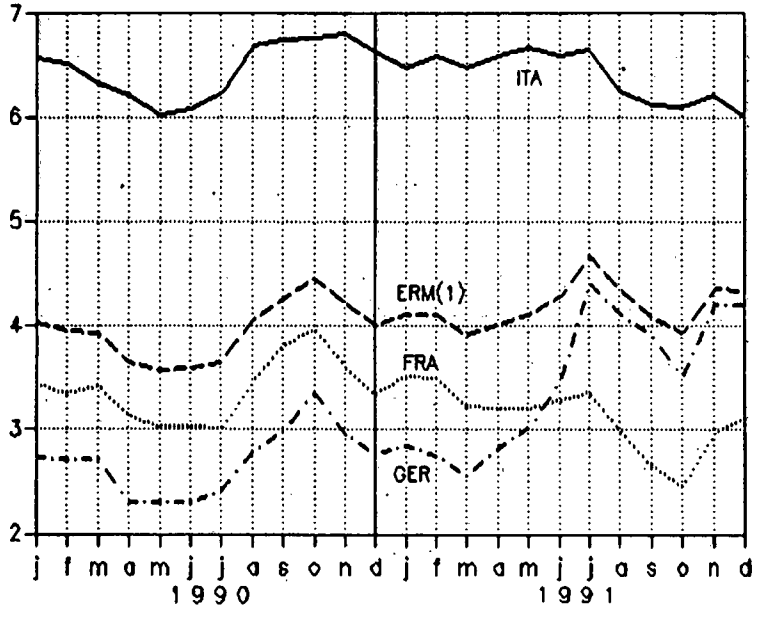
Fig. 2



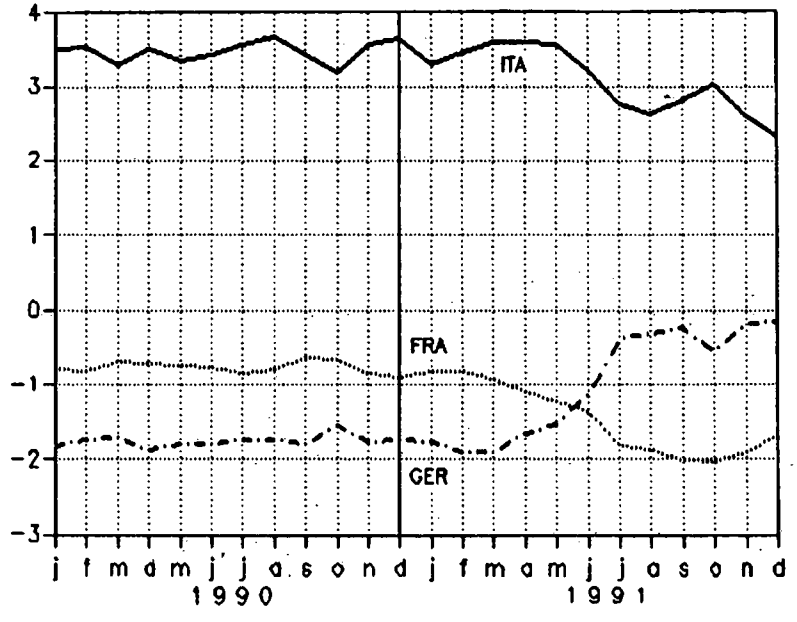
Three-month interbank rates. For the construction of the ERM interest rate, and of the differentials, see Appendix 2.

Fig. 3

Consumer price inflation
(percentages)



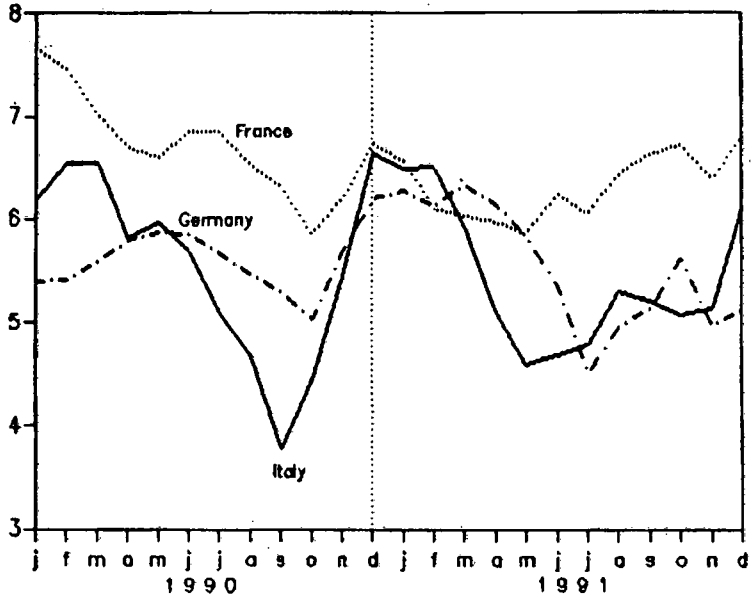
Consumer price inflation differentials
(percentages)



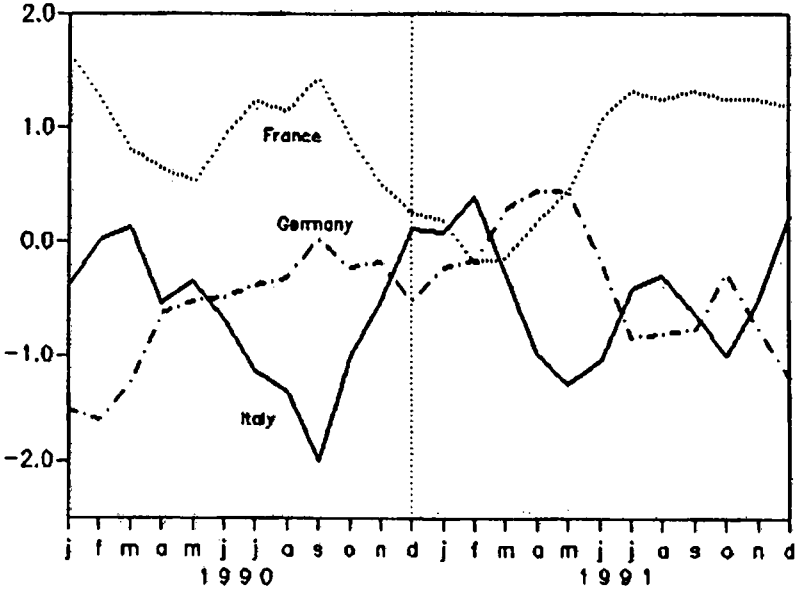
For the construction of the ERM inflation rate, and of the differentials, see Appendix 2.

Fig. 4

Real interest rates
(percentages)



Real interest rate differentials
(percentages)



Three-month interbank rates, deflated by consumer price inflation.
For the construction of the ERM rate and of the differentials, see Appendix 2.

APPENDIX 1

Solution of the model

1. General solution

The system of equations (1) to (6) in the text can be expressed as the following system of equations in terms of the two countries' price level and of the exchange rate:

$$(A.1) \qquad \begin{bmatrix} A & -\gamma & -\gamma \\ -\gamma & A & \gamma \\ \gamma(1+\delta) & -\gamma(1+\delta) & -A(1+2\gamma(1+\delta)) \end{bmatrix} \begin{bmatrix} p_t \\ p_t^* \\ s_t \end{bmatrix} =$$

$$\begin{bmatrix} \delta\,(1+\sigma\lambda)_{t-1}p_t + \sigma\lambda m_t + \sigma_t p_{t+1} + g_t \\ \delta\,(1+\sigma\lambda)_{t-1}p_t^* + \sigma\lambda m_t^* + \sigma_t p_{t+1}^* + g_t^* \\ \lambda\delta\,(1-\sigma-\gamma)({}_{t-1}p_t - {}_{t-1}p_t^*) - \lambda(\gamma+\delta-\sigma)(m_t - m_t^*) + \\ \qquad +\lambda\sigma(1+\delta)({}_t p_{t+1} - {}_t p_{t+1}^*) + \lambda(1+\delta)(g_t - g_t^*) - \lambda A_t s_{t+1} \end{bmatrix}$$

where $A = [\delta(1+\sigma\lambda) - \sigma(1+\lambda) + \gamma]$.

The system can be solved to analyze the effect of an asymmetric shock ($g_t > 0$; $g_t^* = 0$) by making the following normalizing assumption:

$$p_{t-1} = p_{t-1}^* = s_{t-1} = m_{t-1} = m_{t-1}^* = 0$$

To maximize the welfare function defined in equation (7) in the text, the authorities use their instrument m_t to stabilize prices at the level prevailing in the previous period, i.e. $p_t=p_{t-1}=0$. Solving (A.1) accordingly yields the following values for the money supply and the exchange rate:

$$(A.2) \qquad \begin{cases} m_t = \left(-\frac{1}{\sigma\lambda} \right) \left(1 - \frac{z}{x} \right) g_t \\ m_t^* = -\left(\frac{1}{\sigma\lambda} \right) \left(\frac{\gamma z}{x} \right) g_t \\ s_t = -\left(\frac{z}{x} \right) g_t \end{cases}$$

where $z = (\gamma+\sigma+\delta) + \lambda\sigma(1+\delta)$

$$x = \sigma A(1+2\gamma(1+\delta))+2\gamma(\gamma+\delta+\sigma).$$

It is readily seen that if both countries maximize their welfare by keeping the price level unchanged they must restrict at time t their money supply to counter the inflationary shock produced by g_t; the monetary restriction is obviously greater in country H where the shock occurs. The exchange rate of country H's currency appreciates. At time t+1 all values move back to their long-term equilibrium value, since g_t is a temporary shock.

2. Solution under fixed exchange rates

Solving the model in (A.1) under fixed exchange rates implies setting $s_t = s_{t-1} = {}_t s_{t+1} = 0$. Under this condition the two countries cannot maximize welfare jointly. Three different cases are therefore considered.

2.1. Case a: country H leader ($W_t = 0$, $W_{t+1} = 0$)

This implies that $p_t = {}_{t-1}p_t = {}_tp_{t+1} = 0$. Therefore $y_t=0$ and $i_t=(1/\sigma)(g_t + \gamma p_t^*)$.

Substituting in (A.1), gives:

(A.3) $\quad p_t^* = -(1/z)\ g_t;\quad y_t^* = -(\delta/z)\ g_t$

where $z = 2\gamma+\sigma+\delta$.

2.2. Case b: Country F leader ($W_t^*=0$; $W_{t+1}^*=0$)

This implies that $p_t^*=0$, $y_t^*=0$ and therefore $i_t^* = (\gamma/\sigma)p_t$. Solving for (A.1), one obtains:

(A.4) $\quad p_t=(1/z)\ g_t;\quad y_t=(\delta/z)\ g_t$

2.3. Case c: Symmetric system

The authorities maximize the following Welfare function $W' = -|P_t - P_{t-1}|+\delta/2(Y_t-\bar{Y})$ where $P_t = (1/2)(p_t+p_t^*)$. This implies that $p_t+p_t^*=0$. This gives:

(A.5) $\quad p_t = -p_t^* = (1/2z)\ g_t;\quad y_t = -y_t^* = (\delta/2z)\ g_t$

3. Fixed exchange rates with agents expecting authorities to maximize welfare in the next period

The following considers the situation in which agents expect authorities to maximize welfare in the next period in their own country, even if this eventually entails

a departure from the fixed exchange rate regime.

3.1. Case a: Country H leader ($W_t = 0$; $W_{t+j} = 0$)

If agents also expect the authorities in country F to maximize welfare, from equation (7) it follows that the expectation concerning the one period ahead exchange rate is formulated as follows:

$$_{t+j}s_{t+j+1} = -_{t+j}p^*_{t+j+1} = -p^*_{t+j} \text{ so that } _{t+j}W^*_{t+j+1} = 0.$$

If instead the authorities stick to the fixed exchange rate rule ($s_{t+j+1}=0$), substituting in (A.1) gives:

$$p^*_{t+j} = -\delta^j/z^{j+1}\, g_t$$
$$y^*_{t+j} = \delta^j\sigma/z^{j+1}\, g_t. \qquad \text{(A.6)}$$

Substituting in the welfare function for country F yields the results of Table 2.

3.2. Case b: Country F leader ($W^*_t=0$; $W^*_{t+j}=0$).

If agents expect the authorities of country H to maximize welfare, it follows from equation (7) that the expectation concerning the one period ahead exchange rate is formulated as follows:

$$_{t+j}s_{t+j+1} = {}_{t+j}p_{t+j+1} = p_{t+j}, \text{ so that } {}_{t+j}W_{t+j+1} = 0.$$

If instead the exchange rate remains unchanged ($s_{t+j+1}=0$), substituting in (A.1) gives:

$$p_{t+j} = \delta^j / z^{j+1} \, g_t$$

(A.7)

$$y_{t+j} = -\sigma\delta^j / z^{j+1} \, g_t$$

APPENDIX 2

Construction of ERM aggregate

This appendix explains the methodology used in the construction of the aggregate ERM consumer price inflation and interest rates shown in Figures 1 and 2.

The ERM consumer price index is constructed using the following formula:

$$CP_{ERM} = \prod_k CP_k^{\alpha_k} \qquad \sum_k \alpha_k = 1$$

where k = 1,8 ERM countries
CP_k = the consumer price index of country k
α_k = weights of country k

The weights α_k have been calculated on the basis of countries' private consumption at current prices in the years 1986-88, expressed in national currency and then converted to a common currency on the basis of the purchasing power parities published by the OECD.[15] The weights are shown in Table A.1.

The aggregate ERM interest rate is constructed using the following formula:

$$I_{ERM} = \left(\prod_k (1+I_k/100)^{\beta_k} - 1\right) * 100$$

where k = 1,8 ERM countries
I_k = the interest rates of country k
β_k = weight of country k

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15. See, "Parités de pouvoir d'achat et dépenses réelles", OECD, 1987.

The methodology used for the calculation of the weight β is similar to that for α above, except that national product is used instead of private consumption. The weights are shown in Table A.1. Interest rates refer to three-month domestic money market rates, except for Denmark and Ireland, for which Eurorates were used.

Table A.1

Weights of ERM countries

	Private consumption	National product
Germany	29.12	31.16
France	28.08	27.35
Italy	27.41	26.34
Netherlands	6.97	6.85
Belgium-Luxemburg	5.03	4.67
Denmark	2.38	2.60
Ireland	1.02	1.03

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