Symmetry versus Asymmetry in a Fixed Exchange Rate System

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I. Introduction

There are widely recognized benefits of maintaining stable exchange rates area among a group of countries with high mobility of goods, services, and factors of production (*Mundell* 1961). The agreement reached at the Maastricht summit in December 1991 to establish European Monetary Union (EMU), however, came only as the outcome of prolonged negotiation among the member countries, and the agreement left some countries the right to opt out of certain aspects of the arrangements. In interpreting the differences in countries' preferences of exchange rate regime that these negotiations imply, it is important to compare EMU with the relevant alternatives – not only with floating rates, the alternative generally considered in the literature on optimal currency areas, but also the Exchange Rate Mechanism (ERM) of the European Monetary System (EMS) that precedes it.[2]

The EMS, like EMU, is intended to create a "zone of monetary stability" in Europe. An important difference is that it implies an asymmetry among its members – with Germany controlling its money supply, while the other countries use their monetary policies to stabilize their exchange rates with Germany (e.g. *Giavazzi* and *Giovannini,* 1989). The focus in the literature has been mainly on whether this asymmetric system could help enable other central banks to stabilize inflation by borrowing credibility from the Bundesbank (e.g. *Giavazzi* and *Pagano,* 1986, *Giavazzi* and *Giovannini,* 1987, *Melitz,* 1988, *Lane* and *Rojas-*

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[2] Surveys of the EMS can be found in Gros and Thygesen, 1988, or in *Ungerer* et al., 1986.

Suarez, 1992). The present paper has a different emphasis: to examine the implications of symmetric and asymmetric systems for different countries, in the terms that are typically emphasized in the literature on optimal currency areas – viz – the stability of real income.[3]

In addressing this issue, it is important to note that "it takes two to tango": even if, for instance, an asymmetric currency area is in the interest of the group of countries as a whole, its maintenance requires that both "center" and "peripheral" countries take actions consistent with this asymmetry. This is also true of a symmetric currency area. Consider, for example, a simplified setting, in which two countries (which, for ease of exposition, will be referred to as Germany and France) each have to choose whether to incorporate exchange rate feedback in their determination of the money supply. This is implicitly a very simple game theoretic setting, in which the monetary arrangement that emerges is a Nash equilibrium that emerges from a combination of choices made by the two countries.

Table 1

Germany

		Exchange Rate Feedback	No Feedback
France	Exchange Rate Feedback	BCA	GDA
	No Feedback	GFA	FF

Thus, if both countries incorporate exchange rate feedback, the result is bilaterally maintained currency area (BCA), which in many respects is similar to EMU.[4] If France stabilize the exchange rate but Germany does not, adhering instead to money supply targets, the result is a Greater

[3] Other literature (e.g. *Marston,* 1985) has focused on whether a small country can stabilize its real income more effectively by joining a currency union. See also *Melitz,* 1985, *Roubini,* 1989, and various contributions in *Bhandari,* 1985.

[4] In this paper, we are treating the BCA as a limiting case of regimes in which both central banks intervene to some extent, that is $\kappa, \kappa* \to \infty$, rather than evaluated at the limit itself. At the limit – perhaps typified by European Monetary Union (EMU) – a bilateral arrangement would also require agreement on the target exchange rate and on the overall stance of monetary policy, either through direct agreement or through the formation of a European central bank; this would be incompatible with non-cooperative equilibrium.

Deutschmark Area (GDA); a Greater Franc Area (GFA) is the mirror image. If neither country intervenes, a Free Float (FF) results.

Strategic interaction among sovereign countries can be modeled most simply as a Nash equilibrium.[5] In this example, asymmetry may emerge as a Nash equilibrium, even though it is neither country's favorite regime. For instance, the emergence of a GDA from the independent choices of sovereign nations requires that Germany prefer a GDA to BCA, but requires that France prefer a GDA to a FF. These are the only relevant alternatives, provided that France cannot *compel* Germany to incorporate exchange rate feedback into its monetary policy and Germany cannot *prevent* France from taking the exchange rate into account. It is not necessary, in order for the asymmetric arrangement to persist, for either partner to prefer GDA to either of the other two options that are not available to it: Germany need not prefer GDA to GFA or FF, and France need not prefer GDA to BCA and GFA.

In order to see whether the interests of different members of the EMS might diverge on the desirability of moving to a symmetric system, it is necessary to analyze and compare how various shocks are transmitted to prices and output in each country under the three different regimes. In this paper, we shall do this, using a simple variant of the *Mundell-Fleming* model with rational expectations to make each country's preferences over policy regimes more concrete. The model assumes perfect capital mobility as now seems appropriate given the elimination of capital controls by all ERM members as of end 1992.

The rest of the paper proceeds as follows. Section II contains a brief presentation of the model, a derivation of output and the exchange rate, and some discussion of how the effects of monetary policies interact within the model. In Section III, we use the model to derive the implications of alternative, symmetric or asymmetric, exchange rate arrangements for the variability of prices and incomes in each country. In Section IV, we compare the transmission of shocks under these alternative regimes, and use this comparison to specify under what circumstances an asymmetrical arrangement like the EMS would emerge from the voluntary choices of its sovereign members. In Section V, the possibility of interest rate feedback in a currency union is considered. Section VI concludes the paper.

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[5] Nash equilibrium is attractive in this context because it does not *assume* any strategic asymmetry but permits asymmetric behavior to emerge as an equilibrium.

II. The model

The model is a modified two-country version of the standard ad hoc rational expectations model (e.g., *Barro,* 1976). The model is simplified by assuming stochastic purchasing-power parity. There are also random shocks to aggregate supply and to money demand in each country, as well as to worldwide demand. Rational expectations are assumed.[6]

For expositional convenience, we shall again refer to one country as "Germany" and the other "France".

The equations are as follows:

$$y_t = \gamma(p_t - E_{t-1}p_t) + w_t^s \tag{1}$$

$$y_t^* = \gamma^*(p_t^* - E_{t-1}p_t^*) + w_t^{s*} \tag{2}$$

$$p_t = p_t^* + s_t + u_t^p \tag{3}$$

$$m_t - p_t = y_t - \delta i_t + v_t \tag{4}$$

$$m_t^* - p_t^* = y_t^* - \delta^* i_t^* + v_t^* \tag{5}$$

$$i_t = i_t^* + E_t s_{t+1} - s_t \tag{6}$$

$$y_t + y_t^* = -\psi^{-1}(i_t + E_t p_{t+1} - p_t) + \alpha u_t^p + u_t^d - \rho/\psi \tag{7}$$

Here y_t, y_t^* are the logs of real national income in Germany and France, respectively, expressed as deviations from their trend levels; p_t, p_t^* are the logs of the two countries' price levels; s_t is the log of the nominal exchange rate, that is the price of francs in terms of deutsche marks; m_t and m_t^* are the logs of the money supplies in the two countries; i_t and i_t^* are the nominal interest rates in the two countries; $\delta, \delta^*, \gamma, \gamma^*, \rho$ and ψ are parameters. α is a parameter reflecting France's weight in world expenditure. The supply shocks w_t^s and w_t^{s*}, money demand shocks v_t and v_t^*, purchasing power parity (PPP) shock u_t^p and world demand shock u_t^d are all assumed to be independently distributed with zero mean and variances $\sigma_s^2, \sigma_{s^*}^2, \sigma_v^2, \sigma_{v^*}^2, \sigma_p^2$, and σ_d^2, respectively.[7]

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[6] This model is very similar to the three-country framework presented in *Lane* 1990, and the two-country model in *Lane* 1989.

[7] *Stockman* (1988) has provided some empirical evidence on the relative magnitudes of various sources of disturbances in Europe.

Equations (1) and (2) are expectational aggregate supply equations. Equations (3) and (4) are semilog money demand equations with unitary income elasticity. Equation (5) is a stochastic PPP relationship, while equation (6) requires uncovered interest parity. The absence of any shock to this relationship reflects the liberalization of capital movements Project 1992, which should remove any significant barriers to interest arbitrage. Equation (7) is a world demand equation, indicating that world demand depends on real interest rates; the reason that the PPP shock u_t^p appears in this equation is that it is associated with a temporary divergence between real interest rates in the two countries.

We shall be assuming for simplicity (as in *Barro* (1976)) that the authorities wish to stabilize real income[8] around its natural or full information level – thus also minimizing the variance of unanticipated price movements.[9] We shall assume that the authorities can observe exchange rates, but cannot immediately observe the current levels of income and prices. The authorities may choose to deviate from their money supply targets in response to movements of the exchange rate, as these incorporate information about this period's shocks; the resulting monetary feedback rules can be represented as follows:

$$m_t = m_t^T - \kappa (s_t - s_t^T) \tag{8}$$

$$m_t^* = m_t^{T^*} + \kappa^* (s_t - s_t^{T^*}) \tag{9}$$

Various simple rules can be represented as special cases, depending on the policy parameters in equation (8) and (9): with flexible exchange rates, $\kappa = \kappa^* = 0$, while fixed exchange rates imply that κ and/or $\kappa^* \to \infty$, depending on which central bank maintains the peg. Bilateral foreign exchange market intervention implies that $\kappa, \kappa^* \neq 0$.

Incorporating these feedback rules, income in Germany is:

$$y_t - w_t^s = (\gamma/\Delta) \{\pi_{11} w_t^s + \pi_{12} w_t^{s^*} + \pi_{13} u_t^p + \pi_{14} v_t + \pi_{15} v_t^* + \pi_{16} u_t^d\} \tag{10}$$

where

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[8] The authorities' concern about the expected rate of inflation is reflected in the target money supply, $m_t{}^T$ and $m_t{}^{T^*}$, respectively.

[9] The assumption that the full-information level of income is optimal rules out the time-consistency problem which is central to the "credibility" view of the EMS, e.g., *Giavazzi* and *Pagano* (1986), *Giavazzi* and *Giovannini* (1987).

$$\Delta = -\{(1+\gamma)(1+\gamma^*)(1+\delta)(1+\delta^*) - \gamma\gamma^*\delta\delta^* + (1+\gamma)\kappa^* + (1+\gamma^*)\kappa + (1+\gamma+\gamma^*)(\delta^*\kappa + \delta\kappa^*) + (\psi - 1) \cdot [(1+\gamma)\gamma^* + \delta^* + \gamma^*\delta\delta^* + \gamma^*(\delta^*\kappa + \delta\kappa^*)]\}$$

$$\pi_{11} = (1+\gamma^*)(1+\psi\delta+\delta^*) + \psi(\delta^*\kappa + \delta\kappa^*) + \psi\delta\delta^* + \kappa^* + (\psi - 1)\gamma^*\delta^*$$

$$\pi_{12} = (1+\psi\delta^*)\kappa + \psi\delta(1+\delta^*+\kappa^*)$$

$$\pi_{13} = -[(\alpha+\gamma^*)\psi(\delta\delta^* + \delta^*\kappa + \delta\kappa^*) + \alpha\psi(1+\gamma^*)\delta + (1+\gamma^*)\kappa]$$

$$\pi_{14} = (1+\gamma^*)(1+\delta^*) + \kappa^* + (\psi - 1)\gamma^*\delta^*$$

$$\pi_{15} = \kappa - \psi\gamma^*\delta$$

$$\pi_{16} = -\psi[\delta\delta^* + \delta^*\kappa + \delta\kappa^* + (1+\gamma^*)\delta]$$

A similar expression may be derived for income in France, *mutatis mutandis*. As is clear from equation (10), income in each country is affected by shocks occurring in both countries, as well as by PPP and global demand shocks. The impact of the various shocks is influenced by the exchange market intervention policies pursued by both countries' authorities, as reflected by the parameters κ and κ^*.

We can also find a solution for the exchange rate:

$$(11) \qquad s_t = (1/\Delta)\{\pi_{31}, w_t^s + \pi_{32} w_t^{s^*} + \pi_{33} u_t^p + \pi_{34} v_t + \pi_{35} v_t^* + \pi_{36} u_t^d\}$$

where

$$\pi_{31} = (1+\gamma^*)(1+\psi\delta) + \psi\gamma^*\delta^* + (1-\psi)\delta^*$$

$$\pi_{32} = -[(1+\gamma)(1+\psi\delta^*) + \psi\gamma\delta + (1-\psi)\delta]$$

$$\pi_{33} = \alpha\psi(1+\gamma)\delta^* + (1-\alpha\psi)(1+\gamma^*)\delta + \psi\gamma(1+\gamma^*)\delta + \psi\gamma^*(1+\gamma)\delta^* + \alpha\psi(1+\gamma)(1+\gamma^*)$$

$$\pi_{34} = (1+\psi\gamma)\delta^* + (1+\gamma^*) + \psi\gamma^*\delta^*$$

$$\pi_{35} = -[(1+\psi\gamma)\delta + (1+\gamma) + \psi\gamma^*\delta]$$

$$\pi_{36} = \psi[(1+\gamma)\delta^* - (1+\gamma^*)\delta]$$

Thus, the exchange rate also depends on all the shocks that impinge on the two countries, and the effect on these shocks is conditioned by the

policies pursued in the two countries (as these appear in the determinant of the system, Δ). Supply and demand shocks in the two countries have parallel and opposite effects on the exchange rate. World demand shocks affect the exchange rate only to the extent that the two countries differ in their structure. The exchange rate is also affected by PPP shocks.

This model provides a setting in which the two countries' choices among alternative policy rules, and the ways in which these choices interact, can be examined. We proceed with this analysis in the following section.

III. Some Simple Policy Rules

In this section, we shall consider some alternative simple rules for monetary policy, and examine these rules' implications for the transmission of shocks within and between the two economies. We find that, depending on the variances of different kinds of shocks, the regimes have different implication for the variance of national income in the two countries.

We shall compare four simple alternative regimes, as discussed in the introduction: a free float (FF), a greater deutschmark area (GDA), a greater franc area (GFA), and a bilaterally maintained currency area (BCA).[10]

In our analysis, we shall proceed as follows. First, we shall discuss the four alternative regimes, concentrating on a special case in which the interest elasticity of money demand is $\delta = \delta^* = 0$, the interest elasticity of aggregate demand is $\psi = 1$, the slope of the aggregate supply curve is the same in both countries $\gamma = \gamma^*$, and both countries have the same weight in aggregate demand, $\alpha = 1/2$. We also consider a somewhat more general case: we present the equations for this more general case in the Appendix I, and use a table to summarize the effects of various types of shock in this case. This enables us to consider how the relative magnitude of different types of shocks affects each country's preference for each monetary regime.

1. Free Float (FF)

We assume that under a FF each country adheres to a constant growth rate monetary rule, while maintaining a flexible exchange rate vis-à-vis

[10] We deal with intermediate cases, with $o < \kappa < \infty$ and $o < \kappa < \infty$ in another paper, *Gros* and *Lane* (1992).

the rest of the world. In this case, since each central bank fixes its money supply irrespective of observations of the exchange rate, $\kappa = \kappa^* = 0$. This implies that (in the simplified special case) German income is

$$y_t - w_t^s = -[\gamma/(1+\gamma)](w_t^s + v_t) \tag{12}$$

A similar expression can be derived for French income. As we see, if the interest elasticity of money demand in both countries is zero, flexible exchange rates and money supply rules insulate each country's income from shocks occurring in the other country, as well as from shocks to the PPP relationship. Income in each country is affected only by supply and demand shocks occurring in that country.

The reason that flexible exchange rates insulate each country's income from external shocks in this case is that the exchange rate absorbs all the effect of the PPP shock, as well as the difference between French and German shocks:

$$s_t = [1/(1+\gamma)]\{w_t^s - w_t^{s^*} + \gamma u_t^p + v_t - v_t^*\} \tag{13}$$

As we see, all the shocks except the worldwide demand shock affect the exchange rate, with the effects of shocks in Germany being the opposite of those of shocks in France.

The insulation provided by exchange rate flexibility is not complete if the interest elasticity of money demand is not zero. The reason for this is that the exchange rate, in turn, is linked with interest rates via the interest arbitrage condition (6). This implies that any shock affecting the exchange rate must affect interest rates, and therefore, if money demand is interest sensitive, will also affect prices and incomes. For example, a positive transitory supply shock in France temporarily raises the value of the franc; since a temporary appreciation is associated with the expectation of a subsequent depreciation, this leads interest rates to increase in France and decrease in Germany, thereby affecting demand for money and the price level in opposite directions in the two countries. In the more general case, domestic, foreign and PPP shocks all influence both countries' price levels and national incomes, although domestic shocks still have a greater impact on domestic income than foreign shocks under this regime. The results for this more general case are presented in the Appendix I.

2. *A Greater Deutschmark Area (GDA)*

In a GDA, the Bundesbank adheres strictly to a money supply target, while the Banque de France stabilizes the franc-DM exchange rate; thus $\kappa = 0$ while $\kappa^* \to \infty$. Again, in our zero-interest elastic case, German income is

$$y_t - w_t^s = -[\gamma/(1+\gamma)]\{w_t^s + v_t\} \tag{14}$$

Thus, in an asymmetric currency area, national income and prices in the anchor country would be insulated from the effects of foreign supply and demand shocks, PPP shocks, and world demand shocks, if the interest elasticity of demand for money were zero. At the same time, in the peripheral country,

$$y_t^* - w_t^{s*} = -[\gamma/(1+\gamma)]\{w_t^s + v_t + (1+\gamma)u_t^p\} \tag{15}$$

Thus, with interest inelastic money demand, French prices and income is also insulated from the effects of French money demand shocks, as well as from world demand shocks, while it is affected inversely by German supply and portfolio shocks; PPP shocks lead to a proportional change in prices and an associated change in income. French supply shocks affect French income but not prices, and thus do not occasion a deviation of income from its full information level.

If the interest elasticity of money demand is not zero (see Appendix I), both countries' price levels and income are still insulated from French money demand shocks, which are absorbed by the French money supply as a result of the French policy of allowing the money supply to vary in order to stabilize the exchange rate; in this case, however, all other shocks would have some effect on each country's income, although French supply shocks have a smaller impact on both countries' incomes than have similar shocks in Germany. Supply shocks in either country lead to negative price surprises, leading income to fall short of its natural level; PPP shocks and French supply shocks are transmitted to German income via prices and interest rates. A positive shock to German money demand leads to a decrease in German income. A rise in world demand also tends to increase income in Germany. French income is likewise affected by all of the shocks except French portfolio shocks. French income falls below its full information level in case of positive supply shocks or German money demand shocks, or in the case of negative world demand shocks; it is also affected by PPP shocks.

3. A Greater Franc Area (GFA)

The circumstances under which a GFA might emerge in Europe are also worth considering. The transmission of shocks under a GFA is the mirror image of that under a GDA.

4. A Bilateral Currency Area (BCA)

A fourth regime is a BCA, which is similar to plans for EMU. Here, both central banks adjust their money supplies in order to stabilize their bilateral exchange rate. Here, $\kappa, \kappa^* \to \infty$ so German income is given by

$$y_t - w_t^s = \frac{-\gamma}{2(1+\gamma)}\{w_t^s + w_t^{s^*} - (1+\gamma)u_t^p + v_t + v_t^*\} \tag{16}$$

while French income is determined symmetrically. Thus, under this regime, a supply or money demand shock in France leads German income to deviate from its full information level to the same degree as an equal shock in Germany (and vice versa). The use of monetary policy in both countries to stabilize the exchange rate transmits shocks within the currency area; symmetry in the exchange rate arrangements implies symmetry in the transmission of shocks.[11]

IV. Comparing Regimes

Having discussed the way in which shocks are transmitted under alternative exchange rate arrangements, we are now ready to compare the alternative regimes, and thus to consider the circumstances under which they might emerge as a Nash equilibrium from the choices of two sovereign countries. Here, we shall use the results for the more general case treated in Appendix I, in which the interest elasticity of money demand is not assumed to be zero. By comparing corresponding coefficients in equations (A1), (A3), (A4), and (A5), we can rank the impact of shocks under alternative exchange rate arrangements. Here, a ranking of 4 denotes the largest impact in absolute value, while a ranking of 1 denotes the smallest impact. GDA-G and GFA-F denotes the GDA from Germany's standpoint or the GFA from France's, i.e. the asymmetrical currency arrangement seen from the standpoint of the party that does

[11] This symmetry is also borne out in the case in which the interest elasticity of money demand is non-zero (see Appendix I).

not intervene to stabilize the exchange rate; GDA-F and GFA-G denote the impact of shocks on the intervening parties in one of the asymmetrical arrangements.

Table 2

Regime

Shocks	FF	GDA-G GFA-F	GDA-F GFA-G	BCA
Home supply[12]	4	3	1	2
Foreign supply	1	2	4	3
Home money demand	4	3	1	2
Foreign money demand	2	1	4	3
Purchasing power parity	1	2	4	3
World demand ($\delta > \delta^*$)	4	3	1	2
World demand ($\delta < \delta^*$)	1	2	4	3

We can draw a number of conclusions from these results. One is that, if foreign supply shocks or PPP shocks are relatively large, a country that wishes to stabilize its real income around its natural or full information level would prefer to maintain a flexible exchange rate regime, or to be the nonintervening party in an asymmetrical currency area (Germany in a GDA or France in a GFA). If foreign money shocks are large, being the nonintervening party is first choice and flexible exchange rates second. If home supply or money demand shocks are large, one would prefer to be the intervening party in an asymmetrical currency area (France in a GDA or Germany in a GFA). The ranking of the impact of world demand shocks can go either way, depending on whether the interest elasticity of money demand is greater at home or abroad.

In the light of these considerations, how can one account for the emergence of an asymmetric system as a Nash equilibrium from the choices of the two countries? In order for a GDA to persist, two conditions must be met:

(i) $$\mathrm{Var}\,(y_t - w_t^s \mid \mathrm{GDA}) \leq \mathrm{Var}\,(y_t - w_t^s \mid \mathrm{BCA})$$

[12] A sufficient condition for the ranking of the effects of a home supply shocks is $\delta, \gamma \leq 1$.

(ii) $$\text{Var}(y_t^* - w_t^{s^*} \mid \text{GDA}) \leq \text{Var}(y_t^* - w_{;t}^{s^*} \mid \text{FF})$$

That is, an asymmetric regime would break down either if the leader were reluctant to lead or if the follower were reluctant to follow. If condition (i) is violated, Germany could achieve more economic stability by also intervening in the foreign exchange market, rather than leaving the intervention to France. If condition (ii) is violated, France could better stabilize its economy by ignoring the exchange rate and controlling its money supply. If, therefore, either of these conditions should fail to hold, the EMS in its present form would not arise as a Nash equilibrium from the interaction of the voluntary choices of sovereign nations.[13]

As Table 2 indicates, Condition (i), required for Germany to refrain from foreign exchange market intervention, is satisfied if the variances of French supply shocks, French money demand shocks and PPP shocks are large relative to supply and money demand shocks occurring in Germany. The role of world demand shocks depends on the structure of the two economies: if $\delta < \delta^*$, a high variance of world demand shocks favors Germany's choosing to abstain from foreign exchange market intervention, while if $\delta > \delta^*$, the converse is true.

Condition (ii), the condition needed for it to be in France's interest to stabilize the exchange rate even if Germany does not, is more likely to be satisfied if French money demand and aggregate supply shocks tend to be large, relative to PPP shocks and to shocks occurring in Germany. World demand shocks tend to discourage French intervention if $\delta < \delta^*$ and encourage it if $\delta > \delta^*$.

Thus, combining these two conditions, an asymmetrical exchange rate system like the present day EMS is most likely to arise if the variance of money demand and aggregate supply shocks is larger in the peripheral countries than in the anchor country.

The role of world demand shocks, impinging in a symmetrical way on both countries, is particularly important. The rankings given in the table implies that, in the presence of world demand shocks, unless the two countries are identical in structure ($\delta = \delta^*$), both countries may prefer an asymmetric regime over the relevant alternative. For example, if the interest elasticity of demand for money is lower in Germany than in

[13] It is, of course, nevertheless possible that countries could be persuaded to participate in an asymmetrical EMS though some form of *quid pro quo,* even though regime is not itself in their interest. This argument is made, for instance, by *Giavazzi* and *Giovannini* (1989).

France ($\delta < \delta^*$), the Nash equilibrium is a GDA: as the table indicates, Germany prefers this to BCA, while France prefers it to a FF. This implies that, even with symmetric shocks, it is possible for asymmetric exchange rate arrangements to emerge if the two countries differ in economic structure.

The conditions under which an asymmetrical EMS is likely to arise are different from those under which it is the most-preferred arrangement for both parties. For example, if French supply shocks are very large, Germany might prefer a GDA to a symmetric system, but might prefer flexible exchange rates to both. However, it is not always true that the "follower" would gain from moving to a symmetric system: in particular, as can be seen in Table 1, the asymmetric EMS is the *most* effective of the four regimes in insulating the follower from supply and money demand shocks occurring at home, so the follower would actually prefer an asymmetric EMS if either of these shocks has a sufficiently large variance.

The analysis so far has been based on Nash equilibrium. Is it possible that some other equilibrium could be established by bargaining between the two countries, based on one country's threats to pursue monetary polices detrimental to the other? Appendix II shows that this possibility is ruled out in the model presented in this paper.

Empirical evidence on the relative magnitude of various shocks has thus far been mixed, and as the foregoing analysis has shown, is difficult to interpret. Some empirical investigation has focused on assessing the relative importance of aggregate shocks and country specific shocks, using the Aoki factorization into "+ and - systems", distinguishing shocks that impinge in the same way on two countries ($y + y^*$) from those that impinge in opposite ways on different countries ($y - y^*$). Following this approach, *Cohen* and *Wyplosz* (1989) found that shocks were predominantly symmetric, but *Weber* found that symmetric shocks also appeared to be important. Some earlier results presented by *Stockman* (1988) are also somewhat supportive of the role of asymmetric shocks, although these results are limited to supply shocks. This is not necessarily the relevant distinction in the context of this framework, however, as asymmetry of shocks is neither necessary nor sufficient for asymmetry of the currency area to be desirable: in this model, if independent aggregate supply or demand shocks affect both countries, but their variances are similar, a common currency area maintained by bilateral exchange market intervention may be preferred by both countries and emerge as a Nash equilibrium. On the other hand, even if all shocks were world

demand shocks whose impact on both countries' output has the same sign, a difference in the structure of the two countries' economies ($\delta \neq \delta^*$) could lead an asymmetric currency area to emerge as a Nash equilibrium. Thus, empirical evidence pertaining to the model remains inconclusive.

The model implies that countries' preferred exchange rate arrangements might alter as Europe moves toward a single market. The elimination of barriers to movement of goods, capital and people within the European community might be expected to reduce the extent of deviations from the law of one price, represented here as PPP shocks. A lower variance of PPP shocks would increase France's interest in a common currency area. More significant is the fact that it would increase the relative attractiveness, from Germany's standpoint, of a bilateral currency area, instead of a greater Deutschmark area. The liberalization of goods and factor markets might therefore in itself tip the balance in favor of a symmetric rather than an asymmetric currency area.[14]

Another set of events that may tip the balance in favor of a BCA is German unification. This may well be expected to increase the variability shocks to national income in Germany; demand shocks would be associated with uncertainty about aggregate demand conditions in East Germany in the light of currency unification, given the possibility of a liquidity overhang, while supply shocks would be associated with uncertainty about East German labor productivity, the viability of reorganization of East German industry and the eventual extent of labor migration. Our analysis suggests that Germany might now consider it more desirable to spread the effects of its internal shocks abroad, while other EMS member countries consider the benefits of insulating themselves from these same shocks. This suggests a further reason that member countries agreed to move towards a symmetric EMU. It may also suggest a reason for the widening of the ERM banks in mid-1993.

V. Interest Rate Feedback and European Monetary Union

In a bilateral currency area, where, both countries dedicate their monetary policies to fixing the exchange rate, the remaining degree of

[14] It might be argued that the creation of a single market might augment the variance of stochastic shifts in relative output demand among the member countries, as residents of each country become less severely constrained in their choice between domestic and foreign goods; however, relative output demand becomes increasingly irrelevant as barriers to movements of goods are eliminated, and, by definition, when a single market is established, the law of one price holds.

freedom, i.e. the overall monetary policy stance for the currency area, $m + m^* = m^T + m^{T^*}$ is independent of the exchange rate and is not used for stabilization purposes; this is a simple result of rules (8) and (9) for the limiting case in which $\kappa, \kappa^* \to \infty$. This is not a necessary consequence of a common currency area. The possibility that some degree of stabilization policy could be preserved within a common currency area – as long as the national central banks continue to exist – can be explored by considering the possibility of interest rate feedback in montary policy.

It is conceptually a straightforward matter to add interest rate feedback in the general case of monetary policy (as in *Gros* and *Lane* (1989), although the results become somewhat unwieldy when generalized to include interest rate as well as exchange rate feedback. The monetary-policy feedback rule is modified to

$$m_t = m^T - \kappa(s_t - s_t{}^T) + \lambda(i_t - i_t{}^T) \tag{17}$$

for Germany, and

$$m_{t^*} = m^{T^*} - \kappa^*(s_t - s_t{}^T) + \lambda^*(i_t{}^* - i_t{}^{T^*}) \tag{18}$$

for France.

In the limiting case in which exchange rates are fixed, a single interest rate must prevail throughout the currency area, and from the point of view of stabilizing community income it would be optimal to use the information it provides to determine the overall monetary stance; either country would prefer an appropriately chosen interest rate feedback policy to the monetarist monetary rule characterized in sections III and IV above. If the aggregate supply relationship is the same in both countries ($\gamma = \gamma^*$), and if both are equal in size ($\alpha = 1/2$), then the optimal feedback response for Germany is

$$\begin{aligned}\lambda = {} & \{2\gamma(\sigma_s^2 + \sigma_{s^*}^2) + (1 + 2\gamma)(\sigma_v^2 + \sigma_{v^*}^2) + (\gamma + 2)(\gamma + 1/2)(\gamma + 1)\sigma_p^2\} \\ & /\{2\gamma(\sigma_s^2 + \sigma_{s^*}^2) + (\gamma + 2)(\gamma + 1/2)^2\sigma_p^2 - \gamma\sigma_d^2\} - \lambda^*\end{aligned} \tag{19}$$

while France's optimal feedback parameter is

$$\begin{aligned}\lambda^* = {} & \{2\gamma(\sigma_s^2 + \sigma_{s^*}^2) + (1 + 2\gamma)(\sigma_v^2 + \sigma_{v^*}^2) + (\gamma + 2)(\gamma + 1/2)(\gamma + 1)\sigma_p^2\} \\ & /\{2\gamma(\sigma_s^2 + \sigma_{s^*}^2) + (\gamma + 2)(\gamma + 1/2)^2\sigma_p^2 - \gamma\sigma_d^2\} - \lambda\end{aligned} \tag{20}$$

Inspection of equation (19) and (20) uncovers the following result: even if the variances of supply and demand shocks differ across the two countries, both countries agree on the optimal total degree of feedback to the interest rate, $\lambda + \lambda^*$. This is essentially because, as the EMS converges to a common currency area, and if capital is mobile as has been assumed throughout the analysis, shocks in each country are transmitted to prices in both countries in an identical manner, even though, because of stochastic shocks to aggregate supply and PPP relationships, the countries' actual levels of output and prices may still fluctuate relative to one another. Perfect capital mobility and the convergence to unified exchange rates also imply that it does not matter in which country the money supply is altered in response to interest rate movements. Therefore, a combination of intervention policies that minimizes the variance of one country's income also minimizes that of the other country's income. All that would have to be coordinated between the two sets of authorities is how responsibility for the agreed overall degree of interest rate feedback is to be assigned to the central banks of the two countries; this is a trivial coordination problem, which has no distributional consequences. Regardless of whether interest rate feedback were chosen by the individual national central banks or by a European central bank, there would be no need to weigh different countries' interests in choosing the optimal degree of interest rate feedback to incorporate into monetary policy.[15]

Differences between the structure of the two economies would imply that the degree of interest rate feedback that is optimal from each country's standpoint may differ. If the interest rate were set by a European central bank, it would be natural to assume that the interest rate feedback parameter is chosen to minimize the variance of the weighted average of the national incomes of the two countries. This would, however, raise the possibility of conflict of interest between countries: both countries would prefer that overall monetary policy reacts *somewhat* to the interest rate, but one country may prefer a "monetarist" EMU to an activist one that takes a European point of view in determining the degree of interest rate feedback.

VI. Conclusion

In this paper, we have sought to present a model to explain how either symmetric or asymmetric monetary arrangements could emerge from the

[15] A somewhat similar result has recently been presented by *Begg* (1990).

choices of sovereign countries. In our discussion, we have stressed the fact that "it takes two to tango": to explain an asymmetrical relationship, one must explain why the leader leads, as well as explaining why the follower follows. In doing so, care must be taken to specify what alternatives can be chosen by each party. In this framework, we find that an asymmetrical system like the EMS is likely to arise from the voluntary choices of both anchor and peripheral countries if the variance of supply and portfolio shocks is relatively large in the peripheral countries. In this case, it is actually the peripheral countries that gain from an asymmetrical EMS, in the sense that they would prefer the EMS to either flexible exchange rates or a symmetrical currency area; if there are large shocks in the peripheral countries, the anchor country would prefer the EMS to a symmetric currency area, but would prefer flexible exchange rates to either of the other alternatives.

Another important case in which an asymmetrical currency area may be a Nash equilibrium is the case in which world demand shocks are important, but the different countries differ in their economic structure; in the paper, the case considered is one in which there may be differences in the interest elasticity of demand for money in the two countries. It is shown that, given such a difference in structure, even if this common demand shock is the only one affecting output in the two countries, an asymmetric exchange rate arrangement may emerge from the voluntary choices of the two countries.

Our analysis helps explain why the move towards a European single market has been accompanied by a reconciliation of divergent preferences toward exchange rate areas. As barriers to trade and factor movements are reduced or eliminated, departures from the law of one price might be expected to diminish. German unification, by increasing the variability of shocks in that country, also reduces the advantages – both to Germany and to other countries – of using Germany as an anchor country. Our model suggests that member countries may now have less to gain by maintaining asymmetric monetary arrangements in Europe.

Appendix I

In this Appendix, we consider the transmission of various shocks to the exchange rate and to income in the two countries, using a more general case than is developed in the main body of the paper. In particular, we relax the assumption, made in presenting equations (12) through (16), that $\delta = \delta^* = 0$.

In this more general case, under a free float, income in Germany is

$$y_t - w_t^s = \left(\gamma/\Delta^{FF}\right) \cdot \left\{\pi_{11}^{FF} w_t^s + \pi_{12}^{FF} w_t^{s^*} + \pi_{13}^{FF} u_t^p + \pi_{14}^{FF} v_t + \pi_{15}^{FF} v_t^* + \pi_{16}^{FF} u_t^d\right\} \tag{A1}$$

where

$$\Delta^{FF} = -\left[(1+\gamma)^2(1+\delta+\delta^*) + (1+2\gamma)\delta\delta^*\right]$$

$$\pi_{11}^{FF} = (1+\gamma)(1+\delta+\delta^*) + \delta\delta^* \qquad \pi_{12}^{FF} = \delta(1+\delta^*)$$

$$\pi_{13}^{FF} = -\left[\left(\gamma + \frac{1}{2}\right)\delta\delta^* + \frac{1}{2}(1+\gamma)\delta\right] \qquad \pi_{14}^{FF} = (1+\gamma)(1+\delta^*)$$

$$\pi_{15}^{FF} = -\gamma\delta \qquad \pi_{16}^{FF} = -\left[(1+\gamma)\delta + \delta\delta^*\right)$$

Similar results hold, *mutatis mutandis,* for French income. Thus, in the general case, the FF regime does not insulate either country's income from shocks occurring in the other country, or from PPP or world demand shocks. A positive supply shock in either country leads both countries' incomes to rise by less than the amount of the shock. A positive money demand shock will lower income at home and raise it abroad. A PPP shock also raises income in one country and lowers it in the other, while a positive world demand shock raises both countries' incomes. All of these, as well as domestic supply and portfolio shocks, lead national income to deviate from its natural level. Domestic shocks do, however, have a greater impact on domestic income than foreign shocks under this regime.

The reason that exchange rate flexibility does not insulate an economy against external shocks in this more general case, in contrast to the special case presented in the text, is the following: the exchange rate reflects various shocks, both internal and external. The reduced form for the exchange rate is:

$$s_t = \left(1/\Delta^{FF}\right) \cdot \left\{\pi_{31}^{FF} w_t^s + \pi_{32}^{FF} w_t^{s^*} + \pi_{33}^{FF} u_t^p + \pi_{34}^{FF} v_t + \pi_{55}^{FF} v_t^* + \pi_{36}^{FF} u_t^d\right\} \tag{A2}$$

where

$$\pi_{31}^{FF} = (1+\gamma)(1+\delta) + \gamma\delta^* \qquad \pi_{32}^{FF} = -(1+\gamma)(1+\delta^*) - \gamma\delta$$

$$\pi_{33}^{FF} = \gamma(1+\gamma)(1+\delta+\delta^*) + \frac{1}{2}(1+\gamma)(\delta^*-\delta)$$

$$\pi_{34}^{FF} = 1 + \gamma + (1+2\gamma)\delta^*$$

$$\pi_{35}^{FF} = -[(1+\gamma) + (1+2\gamma)\delta] \qquad \pi_{36}^{FF} = (1+\gamma)(\delta^*-\delta)$$

As we see, all the shocks except the worldwide demand shock affect the exchange rate, with the effects of shocks in Germany being the opposite of those of shocks in France. The exchange rate, in turn, is linked with interest rates via the interest arbitrage condition (6). For example, a positive transitory supply shock in France temporarily raises the value of the franc; since a temporary appreciation is associated with the expectation of a subsequent depreciation, this leads interest rates to increase in France and decrease in Germany, thereby affecting demand for money, and therefore the price level and income in both countries.

Next, let us consider a GDA, in which the Bundesbank adheres strictly to a money supply target, while the Banque de France stabilizes the franc-DM exchange rate. Here, German income is

(A3)

$$y_t - w_t^s = \left(\gamma/\Delta^{GDA}\right) \cdot \left\{\pi_{11}^{GDA} w_t^s + \pi_{12}^{GDA} w_t^{s^*} + \pi_{13}^{GDA} u_t^p + \pi_{14}^{GDA} v_t + \pi_{15}^{GDA} v_t^* + \pi_{16}^{GDA} u_t^d\right\}$$

where

$$\Delta^{GDA} = -[(1+\gamma) + (1+2\gamma)\delta]$$

$$\pi_{11}^{GDA} = 1 + \delta \qquad \pi_{12}^{GDA} = \delta$$

$$\pi_{13}^{GDA} = -\left(\gamma + \frac{1}{2}\right)\delta \qquad \pi_{14}^{GDA} = 1$$

$$\pi_{15}^{GDA} = 0 \qquad \pi_{16}^{GDA} = -\delta$$

Thus, German income is insulated from French portfolio shocks, which are absorbed by the French demand for money; all other shocks have

some effect on German income (although French supply shocks have a smaller impact than similar shocks in Germany). Supply shocks in either country lead to negative price surprises, leading income to fall short of its natural level (although, in general, by less than the amount of the shock). A positive shock to German money demand leads to a decrease in German income. A rise in world demand increases income in Germany. French supply shocks and PPP shocks are transmitted to German income via prices and interest rates.

French income is determined as follows:

(A4)

$$y_t^* - w_t^{s^*} = \left(\gamma/\Delta^{\mathrm{GDA}}\right) \cdot \left\{\pi_{21}^{\mathrm{GDA}} w_t^s + \pi_{22}^{\mathrm{GDA}} w_t^{s^*} + \pi_{23}^{\mathrm{GDA}} u_t^p + \pi_{24}^{\mathrm{GDA}} v_t + \pi_{25}^{\mathrm{GDA}} v_t^* + \pi_{26}^{\mathrm{GDA}} u_t^p\right\}$$

where

$$\pi_{21}^{\mathrm{GDA}} = 1 + \delta \qquad \pi_{22}^{\mathrm{GDA}} = \delta$$

$$\pi_{23}^{\mathrm{GDA}} = \left[(1 + \gamma) + \left(\gamma + \frac{1}{2}\right)\delta\right] \qquad \pi_{24}^{\mathrm{GDA}} = 1$$

$$\pi_{25}^{\mathrm{GDA}} = 0 \qquad \pi_{26}^{\mathrm{GDA}} = -\delta$$

Thus, in a GDA, French income is affected by all of the shocks except French portfolio shocks, which are absorbed by the French money supply in the course of stabilizing the exchange rate. French income falls below its full information level in case of positive supply shocks or German money demand shocks, or in the case of negative world demand shocks; it is also affected by PPP shocks.

The case of a GFA, in which France maintains a money supply target while Germany stabilizes the bilateral mark-franc exchange rate, is similar.

Finally, let us consider the case of a bilaterally maintained currency area, or BCA. In this regime, both central banks adjust their money supplies in order to stabilize their bilateral exchange rate, so that $\kappa, \kappa^* \to \infty$. Accordingly, German income is

(A5)

$$y_t - w_t^s = \left(\gamma/\Delta^{BCA}\right) \cdot \left\{\pi_{11}^{BCA} w_t^s + \pi_{12}^{BCA} w_t^{s*} + \pi_{13}^{BCA} u_t^p + \pi_{14}^{BCA} v_t + \pi_{15}^{BCA} v_t^* + \pi_{16}^{BCA} u_t^d\right\}$$

where

$$\Delta^{BCA} = -[2(1+\gamma) + (1+2\gamma)(\delta+\delta^*)]$$

$$\pi_{11}^{BCA} = \pi_{12}^{BCA} = 1 + \delta + \delta^*$$

$$\pi_{13}^{BCA} = -\left[\left(\gamma + \frac{1}{2}\right)(\delta+\delta^*) + (1+\gamma)\right]$$

$$\pi_{14}^{BCA} = \pi_{15}^{BCA} = 1 \qquad \pi_{16}^{BCA} = -(\delta+\delta^*)$$

while French income is determined symmetrically. Thus, under this regime, a supply or money demand shock in France affects German income to the same degree as an equal shock in Germany. It is also noteworthy that, under this regime, a positive French money demand shock lowers German income, while under the FF regime, it raises it.

The results for the more general base, as presented in this Appendix are the basis of the ranking of the impact of various shocks under alternative regimes, presented in Table 1 in Section IV of the paper.

Appendix II

The analysis in the main body of the paper is based on non-cooperative (Nash) equilibrium. Another possible way of establishing exchange rate arrangements would be through bargaining between the two countries: a different equilibrium might be achieved through bargaining if one country preferred a configuration of policies B, different from the Nash equilibrium A, and could get the other country to agree to configuration B by threatening to carry out actions leading to a configuration of policies C which the other country considered even worse than B (even though the other country preferred A to B). To investigate this possibility, let us consider the example in which supply shocks in France are large. In this case, the Nash equilibrium is a GDA, since Germany prefers this to BCA while France prefers it to a FF. Germany, however,

is dissatisfied, preferring a FF to a GDA: could Germany achieve a FF through bargaining? In this setup, Germany could try to persuade France to refrain from foreign exchange market intervention by threatening to intervene in the foreign exchange market itself, resulting in a BGA; this, however, would not be an effective threat, since although France prefers a GDA to a BCA, it also prefers a BCA to a FF, and thus would never accept a FF to avoid the threatened move to a BCA. As for France, the GDA is its most preferred alternative, so it has no incentive to try to achieve any alternative equilibrium through bargaining. Similar arguments can be made to rule out the possibility of achieving an alternative equilibrium through bargaining given other alternative assumptions about the shocks. The non-cooperative equilibrium is therefore the relevant one for analysis in this framework.

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Zusammenfassung

Symmetry vs. Asymmetry in einem festen Wechselkurssystem

Mit dem Übergang vom Europäischen Währungssystem (EWS) zur Europäischen Währungsunion (EWU) wird ein asymmetrisches System (das EWS) durch ein symmetrisches (die EWU) ersetzt. Im Rahmen eines analytischen Zweiländermodells untersucht der vorliegende Beitrag daher die Auswirkungen von Schocks auf die beteiligten Länder in symmetrischen und asymmetrischen Währungssystemen. Diese Analyse zeigt, daß der Wegfall der noch bestehenden Handelshemmnisse durch das Binnenmarktprogramm, sowie der durch die Wiedervereinigung ausgelöste Schock, den Übergang zu einem symmetrischen System (also der EWU) attraktiver macht.

Summary

Symmetry versus Asymmetry in a Fixed Exchange Rate System

Moving from the European Monetary System (EMS) to a European Monetary Union (EMU) implies a move from an asymmetric to a symmetric currency system. This paper uses a simple two-country model to compare the impact of various shocks on each country's economy under alternative monetary arrangements, providing a basis for comparing symmetric and asymmetric systems and permitting an interpretation of the member countries' divergent interests and the resulting Nash equilibrium. The analysis implies that the removal of trade barriers through the European Single Market plan and the additional shocks associated with German unification may partly explain the recent move toward a symmetrical system.

Résumé

Symétrie vs asymétrie dans un système de taux de change fixes

Avec le passage du Système Monétaire Eurpoéen (SME) à l'Union Monétaire Européenne (UME). Un système asymétrique (le SME) est remplacé par un système symétrique (l'UME). Dans le cadre d'un modele analytique de deux pays, cet article examine les conséquences de chocs sur les pays membres dans des systèmes monétaires symétriques et asymétriques. Cette analyse montre que la suppression des barrières commerciales encore existantes par le programme du marché intérieur, de même que le choc provoqué par la réunification rendent plus attirant le passage vers un système symétrique (donc l'UME).