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ABSTRACT

The Price of EMU Revisited*

Using the recent EC Commission report 'One Market, One Money' as a point of reference, we consider the merits of a single currency in Europe. The main benefit is the reduction in transaction costs, which the report estimates at 0.4% of European Community (EC) GDP (but much less in countries with sophisticated financial systems). A weak case is made for other benefits. The principal potential cost, and the main concern of this paper, arises from macroeconomic instability, the stochastic equivalent of the problems stressed in the traditionally Keynesian literature on 'optimal currency areas'. Since the EC has a low level of labour mobility, a negligible fiscal offset to national shocks, and a fair degree of short-run nominal rigidity in wages and prices, one would expect that under European Monetary Union (EMU) the loss of the exchange rate as a stabilizing mechanism would be damaging. This duly emerges from our stochastic simulations of both the world and the UK Liverpool models. Our multilateral world simulations reveal that, under both fixed money supply rules and strategically responsive monetary policy, floating is superior to EMU for all countries, and that even if the rest of the Community proceeds with EMU, the UK is better off outside it. This latter conclusion is reinforced in the exercise on the more refined UK quarterly model. We examine critically the EC's stochastic simulation exercise using the IMF Multimod world model. The simulations yield a positive result for EMU by inserting shocks in risk premia into the Uncovered Interest Parity relationships and removing these between EC currencies under EMU. This approach is, we argue, internally inconsistent and econometrically flawed. Additionally, the EC simulations are based on asymmetric assumptions about monetary policy under floating and EMU. As a result, the comparison between floating and EMU is seriously biased.

JEL classification: F31, F33, F42
Keywords: EMU, floating, optimal currency area, instability, monetary regimes, cooperation, UK

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NON-TECHNICAL SUMMARY

We consider the merits of a single currency in Europe, using the recent EC Commission report 'One Market, One Money' as a point of reference. The main benefit claimed for EMU in this report is the reduction in transactions costs, which it estimates at 0.4% of EC GDP (but much less in countries with sophisticated financial systems). A weak case is made for other benefits. The main benefit is greater price stability (including greater policy credibility) under EMU. Price stability is attainable without EMU, however, as is policy credibility. Indeed, the contrary is also possible – an absence of both price stability and policy credibility under EMU, whose institutions have yet to be created and survive.

The principal potential cost from monetary union, and the main concern of this paper, arises from macro instability, the stochastic equivalent of the problems stressed in the traditionally Keynesian 'optimal currency area' literature. In that literature it is assumed that wages and prices are rigid and hence exchange rate flexibility will help countries adjust to shocks which disturb a country's prices relative to those of its competitors; in addition the flexibility of national interest rates under floating will act as a further shock absorber. It is not necessary to assume anything more than some short-run nominal and real rigidity to motivate the analogous analysis for an environment of repeated shocks, however. While relative wages and prices would eventually adjust to each shock, there may well be a cost if this adjustment process is slow relative to one where the exchange rate can move (instantaneously). The interest rate argument also remains relevant.

The optimal currency area literature notes the relevance of labour mobility and fiscal transfers in mitigating the need for the exchange rate and interest rate stabilizers. In the United States there is high labour mobility and large transfers via the federal budget, which support the argument that the United States is an optimal currency area. The Community has low labour mobility, however, and a negligible fiscal offset to national shocks. It also exhibits a fair degree of short-run nominal and real rigidity in wages and prices. The loss of the exchange rate and interest rate stabilizers under EMU can therefore be expected to be damaging. The presence and extent of this damage, if any, is the focus of this paper.

We use stochastic simulations, in which the model is subjected to large numbers of shocks typical of the past and the resulting variability under EMU and floating compared. In each regime we assume that the authorities' monetary policy is set optimally subject to institutional constraints, about which we make various assumptions of 'regime'. Our main monetary regimes are: a Friedmanite money supply rule, various cooperative coalitions within the EC, and world cooperation. We argue that like should be compared with like. For example, EC-wide monetary cooperation under EMU and under floating. If monetary cooperation is desirable,

then the question remains – the relevant one here – whether cooperation should be carried out under floating exchange rates which provide the cooperating parties with extra degrees of freedom, or whether exchange rate fixity is better.

To evaluate variability we use a weighted average of the variances of principal macroeconomic variables: prices, output, real interest rates, real exchange rates and money supply growth itself. We find, as the optimal currency area analysis suggests, that macroeconomic variability approximately doubles under EMU (at the EC level). This emerges from stochastic simulations on both the world and the UK Liverpool models. Our multilateral world exercise finds that, under both fixed money supply rules and with strategically responsive monetary policy, floating is superior to EMU for all countries, and that even if the rest of the EC should proceed with EMU, the UK benefits more from remaining outside. This latter conclusion is reinforced in the exercise on the more refined UK quarterly model.

The EC Commission also carried out a stochastic simulation exercise on the IMF Multimod world model, which generally exhibits greater wage and price rigidity than the Liverpool models. Yet surprisingly the simulations yield a positive result for EMU. We discuss possible reasons for these results. One is that the simulations introduced shocks in risk premia into the Uncovered Interest Parity relationships and then removed these between EC currencies under EMU. The approach is internally inconsistent, however, and econometrically flawed; the rational expectations assumption implies constant risk premia, given that the model's errors have constant variance. A further reason for the surprising simulation results may lie in the asymmetric assumptions about monetary policy under floating and EMU. This would bias the resulting comparison. Until it has been possible to establish the Commission's procedures in detail, their study should be treated with caution.

We conclude that the 'optimality' of the proposed EC currency area remains far from proven and that the present timetable for EMU may well be over-ambitious.

The price of EMU Revisited

by Patrick Minford, Anupam Rastogi and
Andrew Hughes Hallett*

(University of Liverpool)

Every schoolboy knows the advantages in principle of a common currency, even if he has never travelled abroad. Furthermore, the EC Commission (1990) has made a heroic attempt to measure them. Their efforts run to 351 pages and they suggest that the efficiency gain from removing currency uncertainty and exchange costs may be worth as much as 10% of EC GNP. Virtually all of this comes from the effect of a supposed reduction in the risk premium on the cost of capital. Various other gains are adduced from the common currency, including those of increased price stability (including through enhanced credibility), more disciplined public finance and greater macroeconomic stability.

However, price stability is attainable with or without EMU, as is credibility. Whether EMU makes them more easily attainable is a matter of political economy, which is not tackled by the EC's report: what will the Euro-

Fed's powers and incentives be, as opposed to those of existing monetary authorities? These questions raise wide considerations and are not easily settled. We will not pursue them in this paper, but merely note that there are strong arguments to suggest that agreement between 12 democratic governments on a Euro-Bank devoted solely to tight money and unaccountable to the participating democracies is unattainable. These arguments are not addressed in the EC report but merely assumed away.

By discipline on public finance seems to be meant the inability of a regional government to raise taxation through seigniorage. Here a virtue is made of what in the literature is regarded as a problem, making optimal taxation more difficult. Again we will not pursue this matter in this paper. Merely consider for example in passing the parlous financial state of the Italian government since the withdrawal of its powers to levy a sizeable inflation tax on the otherwise tax-free zone of the shadow economy, especially in the South. Whatever else the new tight ERM has done for Italy it has made the prospect of reaching budget balance much more distant, if it has not disappeared altogether: Ponzi-like the Italian government goes on borrowing at an overvalued exchange rate sustained by exchange rate support which guarantees returns for large capital inflows. The EC report offers no mechanisms, only pious hopes, for achieving movement to fiscal balance under EMU. No seigniorage and no alternative fiscal mechanism: it hardly seems to constitute a fiscal improvement.

The last of the EC report's claims, on macro stability, will be looked at under the heading of stabilisation gains and constitutes our main agenda in this paper.

Analytically, the efficiency gain claimed by the EC report comes from removing the transaction costs of currency exchange and the hedging costs of guarding against currency uncertainty. Whether the estimate is reasonable or not, we do not know. There are three qualitative arguments which suggest it may be on the high side:

(1) currency risk is diversifiable in a world of many currencies and investment vehicles whose risks are correlated with currency risk. Hence the cost of hedging should tend to the premium on specific risk, viz zero.

(2) a transaction involving currency exchange should not, on the face of it (given the negligible cost of keying in electronic orders), cost any extra in credit transactions than an ordinary transaction in home currency, other than the cost of hedging net balances in any one currency between clearings.

(1) and (2) suggest that the only saving comes in the exchange of notes and coin. But this is extremely

limited: notes and coin is generally a small percentage (with one or two exceptions such as Italy), and that part of it which is exchanged for foreign notes and coin is a small percent of that again.

The EC Commission's estimate of the transactions cost saving on its own is 0.4% of GDP; this is based on a survey of financial firms' commission charges, and these are applied to estimates of the volume of business attracting these charges. While this is a more believable estimate than the huge aggregate figure, it may still be on the high side. Indeed the report suggests that it is heavily concentrated among the smaller countries with less sophisticated banking systems (and for a country with a sophisticated system may be as low as 0.1%).

(3) If the gain were as large as the EC estimate, then other pairs of nations enjoying a similar degree of inter-trade would have surely actively considered a common currency. Yet the countries of EFTA, of North America, of Eastern Europe, to name but a few candidates, have never seemed to put this idea seriously on the treaty agenda.

This last point suggests that whatever the truth in the EC Commission's estimate the key point in inducing nations to have a common currency must lie elsewhere, in the balance of other gains and losses. Indeed, it is that assumption that lies behind the extensive literature on the 'optimal common currency area'; that literature invokes a variety of criteria - for example, the degree of labour and capital mobility, and the extent of fiscal transfers- but the extent of foreign exchange transactions does not figure importantly among them, though there must be a presumption that there will be some gain from reduced currency transactions costs.

Our purpose here is to examine this balance of other gains and losses, and specifically those coming from the loss of a flexible exchange rate and so individual monetary policy in reacting to stochastic shocks- which we shall loosely call the 'stabilisation' aspect.

Stabilisation gains and losses

In evaluating the stabilisation aspect for any given common currency proposal, one must make assumptions about the institutional framework. It makes a lot of difference, whether there is a high degree of labour mobility and what the fiscal transfer arrangements are.

In the case of the EC, it has been noted by Eichengreen (1990) that the fiscal offset to any national or regional decline in GDP is less than 1% (as against 30% in the US for instance); nor are there any plans to raise this offset coefficient to any number remotely comparable with the US one. The Delors Committee (Delors, 1989) called for a doubling but even that may well not be agreed by the nations that have to double their fiscal contribution to Brussels.

Labour mobility is also limited, for the vast bulk of nationals in the richer countries of the EC. The key reason appears to be language and cultural differences, which make for instance a Frenchman pause before resettling in Frankfurt. What significant migration there is is from the poorer countries to the richer, as immigration controls that normally stop this are invalidated. But even this is not great because capital mobility within the free EC market enables workers in poor countries such as Spain, parts of the UK and of Italy, on the 'periphery' of the EC, to attract investment and enjoy improved wages without the cost of moving; capital mobility and free trade act therefore as a substitute for labour mobility, as stressed in the Heckscher-Ohlin theory.

We assume that trade is free for our purposes here even if 1992 has not yet fully come through and may not do so until the next century. We also assume that capital is perfectly mobile within the EC and that there are no exchange controls.

It is obvious, as the optimum currency area stresses, that whatever stabilisation task is performed by flexible exchange rates and divergent monetary policy, it can partially be substituted for by either labour mobility or fiscal transfers. To that extent, the EC is handicapped in its bid to be an optimum currency area. Our calculations below reflect this handicap. (If EMU goes ahead regardless, that might well lead to demands for further progress on fiscal policy and labour mobility, but that is another matter.)

Our methodology-stochastic simulation of Liverpool models

Before proceeding, we should note a point frequently made by those in favour of EMU: that monetary arrangements as such should not alter the equilibrium state of the real economy, merely national price levels. Real business cycle theorists would go further and argue that even the short run behaviour of real variables should be immune to monetary arrangements, provided that they do not constitute a change in transactions technology.

Our approach here is straightforward. We agree, and the Liverpool models explicitly assume, that real equilibria are immune to monetary arrangements. But our model features a variety of ways in which short run behaviour differs under different monetary arrangements: so our position is not that of the real business cycle approach. In our opinion, that approach has not yet come up with a representation of European economies which can rival that produced by our more conventional rational expectations model with its stress on nominal contracts and monetary surprises.

We still have to answer the question of whether we can properly capture behavioural differences across such different regimes as flexible rates and the totally fixed rates of a common currency. This problem of the Lucas critique (Lucas, 1976) is inherent in most pieces of applied work that address issues of policy interest, which usually involve whether there should be a different policy regime. Ultimately, there is no satisfactory answer: either one comes up with some representative agent model, in which the structure is 'deep' but has a poor fit and is short of institutional relevance, or one produces a model of the orthodox aggregate supply-demand variety, as ours here, in which the estimates fit reasonably but though expectations react rationally, the parameters themselves may shift as agents reoptimise.

The Liverpool models have been estimated over both fixed and floating periods, and appear to have reasonable stability across this particular regime change (for example, Minford, Ioannidis and Marwaha, 1983). To this extent they should be useable for our study here, which can be thought of as comparing stage 3 of the Delors proposals (Delors, 1989), where currencies are pegged finally with floating. They cannot be used with as much confidence to evaluate a Europe in which there is the common currency itself- but they may be the nearest we can get with our present econometric technology. One should remember nevertheless that even after a common currency is entered, it is in principle possible for any sovereign country to withdraw from it later- it requires the cessation of national sovereignty, and political union therefore, to guarantee totally against this; so perhaps EMU and stage 3 are not so distinct as might seem at first.

Evaluating the cost of fixing exchange rates

When exchange rates are irrevocably fixed, then in the conditions of perfect capital mobility assumed in our models national monetary policy is entirely impotent also and some rule must be invoked for the single monetary authority in charge within the currency area. Formally, therefore, we can treat this as equivalent de facto to a common currency area (with the caveat mentioned above that because the latter is or ought to be 'more irrevocable' than merely pegged rates, behavioural parameters could change).

How either floating or EMU behaves in the face of shocks depends on how monetary policy behaves. We distinguish two main possibilities: money supply targets pursued without response to shocks ('fixed money'), and continuous money supply optimisation in response to events (including those produced by other countries' responses, the non-cooperative Nash strategy assumption)- 'strategic money'. Under EMU clearly the latter monetary response is the result of some sort of cooperation between EC countries; to model this we assume that each country's preferences are given an equal weight in this cooperative decision-making. In practice, as we only model four of the EC countries explicitly- Germany, France, Italy and the UK-, this equality is limited to them.

In an earlier paper (Hughes Hallett et al, 1990) we examined the Exchange Rate Mechanism from a stabilisation viewpoint, using the technique of stochastic simulation. We found that loose ERM arrangements, of the fixed-but-adjustable rate variety, produced considerable instability, both under fixed and strategic money; the instability was far worse under strategic than under fixed money, as the interaction of monetary strategies within the ERM produced extreme fluctuations in both exchange rates and money supplies. Floating offered greater stability, whether under fixed or strategic money. However, if ERM countries acted cooperatively among themselves (an EMS coalition optimising jointly vis-a-vis other countries), then ERM instability was greatly reduced, though still greater than the equivalent arrangements under floating.

Thus, we concluded, a priority within the ERM must be either to let countries float, as effectively occurs under wide margins with occasional parity change where the new parity range can overlap the existing rate. Or else to arrange close cooperation in monetary policy, with very limited parity changes in consequence. The ERM, we 'predicted' from this analysis, would evolve either into a 'tight ERM' (coalition) or back towards de facto floating; or finally towards a combination of both, a two-tier system, with some countries adopting a tight ERM and others opting for floating. Such a prediction is of course gratifyingly close to what has actually evolved in the past decade and a bit since the EMS started in 1979.

What we do here is to take the same analysis further, to evaluate the relative stability of EMU. For the countries deciding whether to go ahead with it (viz. here Germany, France, Italy and the UK) we ask two sets of questions:

(1) How does EMU compare with floating?

(2) Given that EMU goes ahead,

(a) will any country wish not to participate?

(b) What will the rest of the world do in reaction to it?

Before embarking on this comparison, it is worth asking what one might expect to find. Holding money supplies of relevant countries constant (as in the rule suggested by Friedman, 1968), one would observe the relative capacity of the two exchange rate regimes to stabilise shocks- 'model stability'. If one thinks of the Liverpool model as an up-to-date Mundell-Fleming model (Mundell, 1963;

Fleming, 1962; the updating consists in rational expectations and wage-price transmission but with some short-term nominal rigidity remaining), then it is a well-known feature of such a model that only under domestic monetary shocks will totally fixed exchange rates stabilise output more than floating exchange rates. In this case holding interest rates constant, with the money supply endogenous, as under fixed rates, perfectly stabilises output. However, with shocks to aggregate demand or to foreign monetary conditions the variation in interest rates and the exchange rate under floating stabilises output more, as the IS curve has to move along the LM curve -see Figure 1.

If one considers supply shocks- Figure 2-, it remains true that floating will stabilise output more than fixed rates, since the aggregate demand curve will be shifted under floating by the movements of interest rates and exchange rates, whereas under fixed rates the aggregate demand curve will not shift.

The effects on prices, real interest rates and real exchange rates are complex and ambiguous, with no clear presumptions; the balance from the output effects therefore points to greater stability under floating, unless (as has not been the case in the past) the predominant source of shocks is disturbances to money demand.

FIGURE 1 Framework for monetary and demand shocks (under Floating, LM operates, under Fixed BB operates)

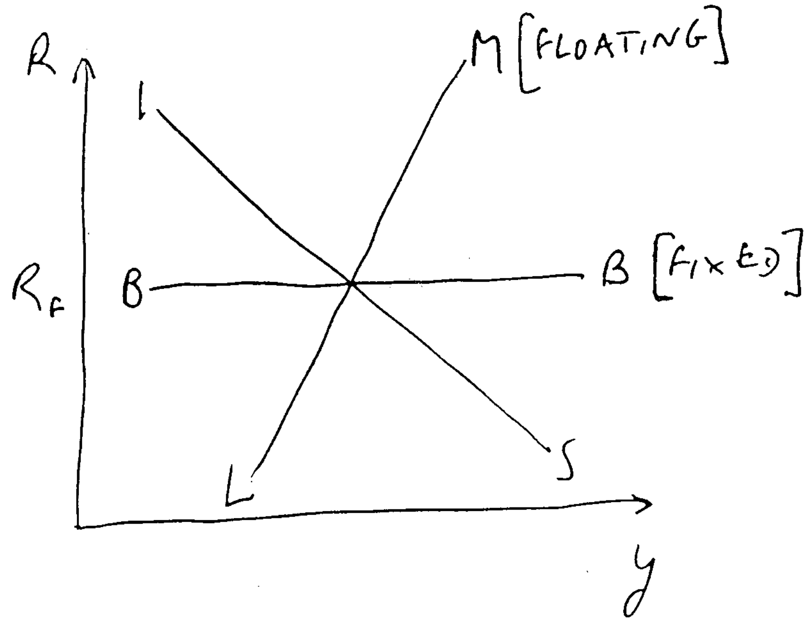

FIGURE 2 Negative supply shock illustrated: under Fixed AD curve does not shift, under Floating it shifts to A'D' as interest and exchange rates fall.

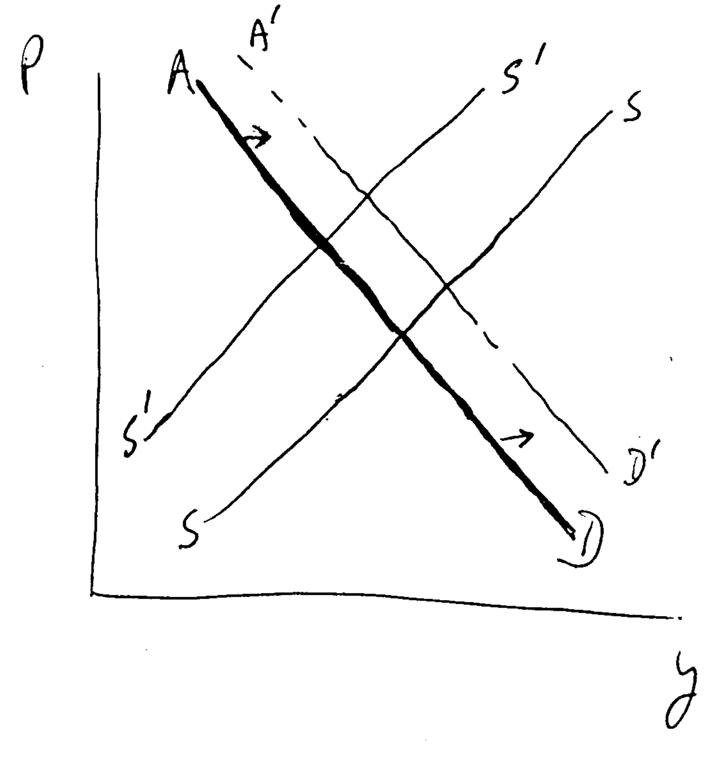

Table 1: Costs of EMU v. Floating (Nash)

	EMU	Floating	Prefers
EC:			
GE	0.2	1.8	EMU
FR	0.4	0.9	EMU
IT	0.5	41.6	EMU
UK	0.6	0.2	FL
ROW:			
US	1.6	1.0	FL
CA	20.3	47.4	EMU
JA	3.6	6.8	EMU

Table 2: Joint EC costs of feasible EC regimes

	Fixed Money	Nash Indep.	Nash coalitions in EC ALL	ex-UK	ex-FR	ex-IT	World Coop.
Floating	3.0	44.5	1.1	13.2	209.2	5.6	2.2
EMU	4.8	-	1.8	2.2	4.4	3.2	5.0

Table 3: Costs of EC monetary coalition v. Worldwide cooperation under floating

	EC coalitn.	worldwide coop.
US	0.3	0.5
CA	8.6	3.4
JA	0.9	0.4
ROW	9.8	4.3
GE	0.3	1.3
FR	0.1	0.6
IT	0.7	0.2
UK	0.02	0.1
EC	1.12	2.2
WORLD	10.92	6.5

Table 4: Costs of EMU v. being outside EMU

	EMU	Floating/EMU for others	Prefers
FR	0.4	2.8	Stay in
IT	0.5	1.4	..
UK	0.6	0.2	Not join

Table 5: Costs of EMU ex-UK v. Floating (Nash)

	EMU ex-UK	Floating	Prefers
GE	0.4	1.8	Stay in EMU
FR	0.9	0.9	Indifferent
IT	0.7	41.6	Stay in EMU

Table 6: Costs of EMU ex-UK v. worldwide monetary cooperation with EMU bloc

	EMU ex-UK	Worldwide coop with EMU ex-UK
US	1.7	1.6
CA	24.3	20.7
JA	4.0	2.2
ROW	30.0	24.5
GE	0.4	0.8
FR	0.9	2.3
IT	0.7	1.9
UK	0.2	0.2
EC	2.2	5.2
WORLD	32.2	29.7

EMU for all EC: how does it compare with floating?

When one turns to the possibilities for active monetary responses to shocks- something that few would wish to rule out, especially when shocks are large and identifiable-, there may appear to be a trade-off between the number of independent monetary instruments for dealing with differential national shocks (maximised under floating) and the extent of monetary coordination (which must be total under fully fixed rates). Nevertheless, coordination under fixed rates will not imply the same set of monetary policies as coordination under floating rates; and it must in principle be the case that cooperation using the full scope of independence granted by floating will be optimal. Again, therefore, we would expect floating to have the advantage in this aspect of the competition.

Table 1 shows the costs of these two regimes under the assumption that countries not within the ERM or EMU choose independent money supply growth rates to minimise their welfare costs subject to the choices of others: a Nash non-cooperative equilibrium results. Under floating the EC countries each also behave in this way. Under EMU, Germany is assumed to set its money supply, minimising EC joint welfare costs- a coalition differing from ERM through the absence of any margins of intra-EC currency fluctuation at all. (We assume that ERM is not under discussion here: it is regarded as a poor substitute for EMU, as indeed we found it to be in our previous paper, Hughes-Hallett et al, 1990).

It can be seen that if this is the relevant choice set, then there is not full agreement between EC countries on which is best. Germany, France and Italy prefer EMU, the UK floating. In case other countries' preferences have any influence, they too can be seen to differ, with the US urging floating on the EC and Japan and Canada urging EMU.

Beside this money supply regime, it would be possible to imagine completely fixed money supplies (following a Friedman rule) or money supplies coordinated worldwide to minimise joint world welfare costs. Of course the first is not generally practised while the second would require international agreement currently absent.

However unlikely, all these regimes are shown in Table 2 with the joint welfare costs of EC countries that result from them. A rational way for the EC to choose a regime would be to settle on that exchange rate/monetary regime combination which minimised their joint welfare costs; then side-payments (or equivalent compensation) could be made to those who lose out.

Table 2 reveals that the optimum is a coalition of all EC countries for the management of their money supplies but under floating rates. The next best is EMU, followed by worldwide cooperation under floating; this last would also be the first choice of the world community, which could presumably make it worth the EC's while, as Table 3 makes clear.

It would seem therefore that the global optimum for the EC is to float but to coordinate monetary policies. Furthermore, the rest of the world has an interest in coordinating with them too, offering the EC countries the necessary inducements.

If EMU goes ahead, who will participate?

Tables 4 and 5 address this issue; we assume that EMU goes ahead for independent (perhaps political) reasons. Let us assume that Germany is committed to being part of EMU, since it has the central bank around which the ERM has been organised.

Table 4 shows the costs to the three other countries of being outside EMU and floating. Both France and Italy prefer to stay in. The UK however prefers to stay out. So far no surprises.

Table 5 then asks whether the remaining three still find EMU preferable to a return to floating, given that the UK refuses to participate. The answer is that they are not tempted back to floating without a coalition, though it remains preferable to float with a coalition including the UK.

How would the rest of the world react to an EMU (excluding the UK)?

In Table 6 we show the gains achievable by world cooperation in monetary policy, given that the EC pursued an EMU excluding the UK. As in the case above where the EC countries coordinate their monetary policies under floating and it pays the rest of the world to coordinate with them, so here.

Conclusions from the multilateral analysis:

We have found that the best regime for the EC would be floating, with monetary policies either (best of all) coordinated worldwide or (if this is impossible) coordinated within an EC-wide coalition in a world of independent Nash behaviour. However if for other reasons EMU goes ahead then it would pay the UK (alone) to stay out and float. The rest of the world, UK included, would still profit from coordinating with the EC's EMU, as would they, but it may not be practicable.

This analysis has used a welfare cost measure with five components- output, price, real interest rate and real exchange rate variances. Appendix B shows that when only the first two are included in conventional manner, then the EC preference for floating would be greatly strengthened, as one might reasonably expect when exchange rate stability is not an objective. There would be a strong opposition on all sides to EMU, making further analysis of its precise form of little interest. Hence our central conclusion is substantially strengthened, implying that our actual choice of welfare weights is necessary to give the analysis any point at all. If exchange rate stability is not an objective, then EMU will not be a starter.

A complementary approach- the Liverpool Quarterly model of the UK alone:

The above calculations are done in a multilateral context, using our multilateral Liverpool world model. This allows us to study both the fixed money and the strategic money cases.

But inevitably an annual model, as we have found from our work on the UK, is not as empirically reliable, because estimated with fewer degrees of freedom, as a quarterly model. Accordingly, we set out to test the annual results on our Liverpool Quarterly model of the UK (Minford, Matthews and Rastogi, 1990). We can only do this for fixed money at the present time, but this at least gives us a limited comparison of results with the more elaborate annual exercise.

In the work on the UK model we are unable to replicate the strategic analysis of the multilateral model, for the obvious reason that it is a single country. We could allow the UK to optimise its monetary response to shocks under floating, clearly something it cannot do under EMU. However, we have not been able to implement this as yet: therefore our calculations do not include the element of instrument use that is present in the multilateral calculations, and must favour floating.

What we have done is to compare EMU and floating for the UK, assuming that money supply is fixed, both at home and abroad. Hence we take German inflation as given (but allow for shocks to the German real exchange rate). What this exercise does is to check how important the automatic stabiliser effect of floating exchange rates is for the UK. Details of our methods are given in Appendix A.

We can divide our analysis into two parts: the effects of shocks to UK behavioural equations (consumption, wages etc.) and those to exogenous variables, domestic and

Table 7: Standard errors of key variables, over 8 years (shocks applied in first 4): Floating and EMU in the UK, under Fixed Money worldwide

SHOCKS:	Behavral		POLICY		WORld		ALL	
	Float	EMU	Float	EMU	Float	EMU	Float	EMU
GDP(% of 1990)	18.3	20.1	5.1	7.6	0.4	15.1	18.4	24.6
GDP growth (%)	27.3	26.9	4.4	5.3	0.5	4.0	27.1	26.6
Price level (% of 1990)	17.1	6.6	12.8	19.9	1.5	36.0	20.3	49.1
Inflation(%)	5.6	6.6	5.2	13.2	0.6	7.9	7.4	17.7
Interest rate (short term,%)	5.6	0.8	8.5	1.5	1.1	2.1	9.9	2.4
Real exchange rate(%)	11.5	9.7	30.6	28.6	2.9	50.2	32.1	63.2
Unemployment (%)	16.7	18.0	1.6	1.3	0.2	1.0	10.3	11.0
Misery index (Inflation + Unemployment)	22.3	24.6	6.8	14.5	0.8	8.9	17.7	28.7

foreign. The former can be thought of as the uncertainty arising if government policy and the world environment is totally stable. One might expect floating to have a superiority with respect to the latter, because under EMU there is a greater propensity to import foreign shocks.

With regard to the former, it could go either way. For example, with prices it would depend on how behavioural shocks impact on the real exchange rate and so prices under EMU, or on the demand for money and so prices under floating. In fact it turns out that price uncertainty is important in determining overall instability in this model, so that this also will decide stability for other variables.

It can be seen from the first two columns of Table 7 that there is not a great deal of difference in the response of floating and EMU to UK behavioural shocks. The capacity to stabilise is roughly the same. EMU actually stabilises the price level somewhat better while floating has a slight superiority in stabilising inflation, output and unemployment. But as these things go there is really nothing in it.

Once one includes policy and world shocks the picture changes markedly. The price level's volatility under EMU depends on the volatility of the real exchange rate of Germany as well as of the UK. We have assumed that German monetary policy succeeds in totally stabilising the

German price level through its monetary policy rule. But of course EMU cannot stabilise Germany's real exchange rate against the world as a whole; we have assumed volatility in this of the order of the past two decades.

UK domestic policy shocks impacting on the real exchange rate will also matter, especially supply side shocks.

Both these sorts of shocks are stabilised by a floating rate in their effects on prices, because monetary conditions determine prices. There is therefore some reason to suppose that floating will give more stability in the face of policy and external shocks than EMU.

This indeed turns out to be the case. Though growth under EMU is of similar stability, and nominal interest rates of course are much more stable under EMU, the output level and all other nominal variables are destabilised by EMU. The results indicate that shocks produce larger and more persistent deviations of both price level and output under EMU than under floating. (The greater persistence is confirmed by the ratio of the standard error in the second four years to that in the first four when the shocks come in: see table 8). The additional instability under EMU comes largely from its greater vulnerability to world shocks, especially of course the DM's real volatility, but policy (supply side) shocks contribute importantly too. To world shocks floating gives almost complete protection, so that EMU's performance is proportionally very much worse; but the deterioration of the misery index under supply side shocks is over 100%.

Across all shocks, therefore, this poor performance on policy and world shocks means that floating gives substantially less instability than EMU. There is a 60% deterioration in the overall misery index in EMU relative to floating.

Table 8: Ratio of standard error in second 4 years to that in first 4 years

	Floating	EMU
GDP	0.31	0.97
Growth	0.12	0.25
Price level	1.36	2.14
Inflation	0.47	0.54
Interest rate	0.13	0.73
Real exchange rate	0.65	2.11
Unemployment	0.04	0.08

Comparing the EC Report on stabilisation

In the EC report, a study is presented using the Multimod model (Masson, Symansky and Meredith, 1990) of the IMF which evaluates the ERM and EMU by the method of stochastic simulations used here. Their table of results is reproduced here. It finds that while output instability may increase under EMU and ERM for some countries compared with floating, inflation instability reduces progressively for all four EMS countries as one moves from floating to EMS, and EMS to EMU.

Table 9: EC report's results (using Multimod) for given interest rate response functions- standard errors from stochastic simulations

	Float	EMS	EMU(asymmetric) incl UK
GDP:			
EC4	4.5	4.9	4.2
UK	6.7	6.6	5.4
US	2.7	2.7	2.7
Japan	4.1	4.1	4.1
Inflation			
EC4	3.6	3.5	2.9
UK	5.3	4.6	4.0
US	2.3	2.4	2.4
Japan	4.0	4.0	4.0

A systematic comparison with our results is difficult because the EC study takes interest rate reaction functions as given, whereas we assume money supplies as given under `fixed money' and strategically set under Nash. Furthermore, other countries' policies are held fixed, again with constant interest rate functions. Probably, the closest comparison is with our fixed money assumption.

On this basis, our multilateral results go in the opposite direction to those of the EC study. We find under fixed money that for the four EMS countries we too study (viz. Germany, France, Italy, and the UK) there is a worsening of performance between floating and EMS; there is an improvement of EMU compared with EMS, as in the EC study, but it is not close to the level of floating. (Our EMS results are to be found in Hughes Hallett et al, 1990).

As for the rest of the world, this most markedly prefers floating under our multilateral study, particularly relative to EMS but also relative to EMU. However, in the EC study neither the US nor Japan appear to be affected by the change in EC regime.

What our results (both multilateral and UK quarterly models) also bring out strongly is the UK's preference for floating, even when the rest of the EC has EMU. This is something not specifically looked at by the EC study, but it seems likely from the result they show that they would have found the UK to be worse off outside EMU.
For the ERM the EC study makes the assumption that the parity is changed by 4% when the real exchange rate has

deviated by 8% or more. Our default assumption was that the parity is changed freely after a year so as to achieve exchange market clearing within the margins. But we found that instability was increased by ERM under assumptions close to the Multimod one, viz that parity change be limited to 5% after a one year delay.

The EC methodology-a critique

The EC authors take the Uncovered Interest Parity relationships of their model and treat them as stochastic, currency by currency. They estimate variances and covariances for these errors, which they refer to as `exchange rate shocks' under floating and then under EMU suppress the errors between the EC currencies. Though Annex E of the EC report, which gives details of the Multimod exercise, gives no breakdown of the costs associated with different groups of shocks, it is evident from the explanation in Box E.3 on p.324 that the main result comes from this group of shocks. The Box entitled `Exchange rate shocks and macroeconomic stability' begins as follows:
`A very simple analytical example may illustrate why the disappearance of intr-Community exchange rate shocks will reduce the variability of macroeconomic variables such as inflation and output.'

This inclusion of errors from the UIP equations as exchange rate shocks seems entirely reasonable at first sight. However, there is an important difference between the errors in these equations and those in the other behavioural equations. The UIP relation comes from (a) covered interest parity which is found to hold virtually exactly for currency deposits such as Euro-deposits where no exchange controls operate and (b) the equality of the forward rate with the expected future exchange rate.

(a) gives R(i)=R(j) - F(ij) + S(ij), where F is the forward rate, and S the spot rate and i,j are the two currencies paired.

(b) gives F(ij)= ES(ij)(t+1), hence

UIP: R(i)=R(j) -ES(ij)(t+1) + S(ij)

In innumerable tests of UIP under rational expectations, using

S(ij)(t+1)= ES(ij)(t+1) + e(t+1)

the error

R(i) - R(j) + S(ij)(t+1) - S(ij) which should equal e(t+1) is checked for the requisite lack of correlation with respect to past errors and other relevant information available at t. Much evidence has been found of a degree of correlation however. This could be associated either with a failure of rational expectations (or of the model used to generate them) or with a variable risk-premium.

The latter could be explained by asset pricing theory. The return on an uncovered deposit with exchange risk will exceed that on a safe covered deposit by a risk-premium reflecting the systematic risk endured, ie the correlation of the risky element with general market risks. This correlation is the product of the variance-covariance matrix of all asset returns, this matrix in turn resulting from the whole variance-covariance matrix of primary shocks to the economy and the economic model within which they interact. These matrices are generally treated as fixed when models are estimated, because if they vary there is heteroscedasticity and in principle model parameter instability. Yet in the UIP literature the evidence so far suggests this may constitute a problem if the rational expectations hypothesis is accepted.

The EC study takes this view. Hence these UIP errors. But notice that they are not random shocks from a (normal) distribution with fixed variances and covariances, as in the rest of the model. They are varying risk-premia, that is variations in the product of a market share vector and a variance-covariance matrix.

These variations are strictly at odds with the assumed constancy of the primary error var-covar matrix and model parameters. For consistent application of these ideas in Multimod it would be necessary to assume heteroscedastic errors in other parts of the model, and allow for the necessary parameter variation also (because optimising behaviour depends on the var-covar matrix of endogenous variables). This is of course not done.

More practically, even if one neglects this inconsistency, there is a severe estimation problem for the variance-covariance of the risk-premia. Annex E discusses at length four ways of identifying them:

1. letting S(ij)(+1)=ES(ij)(+1)
2. assuming the random walk, that S(ij)(+1)=S(ij)
3. letting Multimod generate ES(ij)(+1)
4. assuming a partial equilibrium three equation model of real exchange rates and real interest rates, which is at best loosely related to the full Multimod model.

3. would have got closest, but even that would implicitly assume that, the Multimod model and var-covar matrix of primary shocks being given, there should not be varying risk-premia: thus the estimate would necessarily have been biased. To implement it even so would require simultaneous estimation of the equations and the model expectations; IV estimates would contaminate the error variance with expectations error. But in any case they dismiss it as infeasible.

1. and 2. are obviously no good: 1. is wrong, and 2. is inconsistent with Multimod.

That left 4. which they used. But the model used is not consistent with Multimod, and it sets the expected and the actual future real exchange rates equal, as in 1. with nominal exchange rates- clearly wrong, and bound to introduce a spurious error.

The figures which result strain credulity. The (annual) standard deviation of these risk-premia lies between 5 and 11% (of the spot rate), as against a typical standard deviation of 2% for the primary shocks elsewhere. Yet in asset markets generally risk-premia are thought to be, even if variable, reasonably stable and possessing persistence; hence the widespread use of the ARCH model of changing variance. The idea that the variance of a var-covar matrix (premultiplied by a constant vector) can massively exceed the variance of primary shocks is a hard one to credit.

It might be retorted that if say prices have a variance of 2% then it is perfectly plausible to assume exchange rates have one of 10%, because of the well-known `overshooting' of the exchange rate `jump' variable. But this overshooting comes from the model's reaction to a primary shock not from variation in the exchange risk-premium. The model itself should replicate this overshooting property; if it is generated by a secondary shock to the risk-premium, then the modeller must have a properly articulated link between primary shocks and the shock to the premium. But no such link is presented here nor is it appropriately estimated.

In the absence of a model which consistently allows for heteroscedasticity throughout its error and parameter structure, it seemed to us best to adhere to the homoscedastic assumptions of the rational expectations model, including that of constant risk-premia. This does not imply that there are no exchange rate shocks- far from it. Rather, the exchange rate is shocked by primary shocks within a fixed model structure like all other endogenous variables. Whether this can adequately account for the actual variation in exchange rates is a matter of empirical test over the whole model; neither we nor Multimod have carried out such tests but at least we have used our model empirically in forecasting with reasonably successful results.

Clearly, across a regime change like that from floating to EMU risk-premia will change, and in particular the intra-EC exchange risk-premium will disappear. This changes an intercept, however, and does not affect stochastic simulation results.

In addition to the risk-premium, the authors claim that the UIP relationship contains a further error, the difference between the actual expectation and the model's prediction of it. This is indeed so but a moment's reflection indicates that this should not be included in a stochastic simulation.

This error is the result of model (parameter) error. Yet the object of a stochastic simulation is to discover how, according to a model, the world would behave before and after a change in the policy environment. So one simulates the shocks to the world within the model's representation of it, holding the model constant. This precludes any model variation (ie model errors).

If one writes down the UIP equation in the Multimod model, and assumes for this purpose a zero risk-premium, it reads:

R(i)= R(j) - ES(ij)(t+1) + S(ij)

The rational expectations assumption in the model then implies that ES(ij)(t+1) can be computed from the model's solution. Notice that the equation has no error term (absent the risk-premium), because UIP is by derivation from asset pricing an exact relationship, like an identity. The model to be used in stochastic simulation therefore stipulates a zero error in this equation.

When the model's computation of ES(ij)(t+1) is substituted into the UIP relation, using actual R(i), R(j), and S(ij), there will indeed be a residual, representing model error.

But that is irrelevant to the model residuals, which are the estimated behavioural errors. In computing these over the past, the UIP equation should be forced to have a zero residual, because that is an assumption of the model. This is how a full information systems estimator would compute the residuals; it would in effect throw any inexactness in the UIP equation into the other equations where $R(\dot{i})$ entered.

When the model is simulated, therefore, there is no stochastic component in this relationship, by definition of the model.

One may certainly go to a higher order of investigation and ask how does the assessment vary if the model changes. Thus one may take repeated drawings for the model's parameters and for each drawing, holding the implied model constant across the two policy regimes, redo the stochastic simulations for both. But that still does not involve putting an error into the UIP relationship, as done here by these authors; it puts the variation into the parameters governing the expectation in the UIP relationship. This would be a form of welcome sensitivity testing but it would not give the results found in the EC study which rely on the change in the UIP error term between floating and EMU.

So the EC method is seriously misleading on this aspect also.

If we are right that this treatment of the UIP equation is a major reason for the differences between our Liverpool multilateral results and those of EC/Multimod, then we feel confident in rejecting the EC methodology and results. To sum up, their exercise misleadingly includes model error, and, on the inclusion of variable risk-premia, their methodology is internally inconsistent, the estimation is biased in principle, quite deficient in practice, and the practical results are highly implausible.

However, it would seem that the difference does not end there. In addition,the EC simulations appear to have been run on different assumptions about monetary policy across floating and EMS/EMU. Under floating interest rate functions of each EMS country other than Germany allow the money supply to be relatively responsive to inflation shocks. Under EMS/EMU, the exchange rate is tied to a German interest rate policy that allows virtually no such responsiveness. In our simulations by contrast each country fixes and achieves money supply targets under floating, while under EMS/EMU it is linked via the exchange rate regime to Germany which also achieves money supply targets; this allows exchange rate regimes to be compared for a given monetary regime, as well as monetary regimes to be compared for a given exchange rate regime. The EC exercise on Multimod compares a combination of floating and one monetary regime with a combination of EMS/EMU and a different monetary regime. It is therefore quite unclear whether the benefits they find come from a superior monetary regime or the adoption of the EMU exchange rate regime per se. This confusion could well further explain why the EC results contrast with ours.

Conclusion

This paper began with a review of the costs and benefits of EMU other than those of macroeconomic stability and concluded that they are unlikely to be large enough to dominate the stability issue. We then considered this issue through stochastic simulation analysis. We first used the full Liverpool world model in conjunction with the strategic analysis of Brandsma and Hughes Hallett, permitting examination of all countries' strategic interactions. Secondly, we considered the narrower issue of UK costs and benefits, given rest of world policies, using the Liverpool quarterly model of the UK alone.

In our multilateral analysis we found that, while floating was preferred to EMU by France and the UK, Germany and Italy both preferred EMU. Nevertheless if floating can be combined with an EC-wide coalition to coordinate monetary policy, then this is the globally preferred monetary-cum-exchange-rate regime for the EC as a whole. In this case the rest of the world has an incentive to enter into general monetary cooperation, also under floating; the EC would join in this if suitable side-payments (or weightings on policy choice) were found.

If in spite of this EMU in some form goes ahead, then we find that the UK, alone of the EC countries, would not wish to participate. Given in turn this exclusion of the UK, the other three countries would find it in their interests to go ahead with EMU rather than revert to floating, assuming this is the breakdown alternative. (It remains the case that if floating with coordinated monetary policy were available as the breakdown alternative, it would be preferred.)

These results are strengthened in favour of floating, if a more conventional welfare cost including only output and price volatility were used. In other words, if exchange rate stability is of no consequence, then EMU is unattractive. Such gains as EMU contributes in macroeceonomic stability overwhelmingly consist in greater exchange rate stability.

However, of all the models being considered here, the one with the greatest empirical claim is the UK quarterly model. Even if one considered the claims of the EC exercise using Multimod to cast doubt on our multilateral exercise, in spite of the strong reasons we have given to doubt those claims, nevertheless one is left with the result of the Liverpool quarterly model. This suggests that for the UK at least tying the currency to a foreign vehicle exposes the economy to greater instability from world and supply side shocks that floating largely protects against. For shocks to behavioural equations there is not much to choose between EMU and floating. But the importance of world and supply side shocks for the UK economy is undeniable. When the average behaviour of these over the last two decades is integrated into the exercise it tips the balance sharply against EMU.

Another study underway in Glasgow University (Hughes Hallett and Vines, 1990) though limited so far to deterministic simulations reinforces our negative assessment of EMU, finding as we do that there are likely to be serious costs of this sort.

This result is surely no more than commonsense would suggest. One does not have to be a Keynesian to believe that there is enough short run nominal rigidity in wages and prices to cause adjustment costs in the face of global shocks which a floating rate can ease through its total flexibility. Exchange markets react instantly, with forward-looking expectations, to shocks, while wages and prices react slowly, slowed by contract and information lags.

A previous conventional wisdom (eg Macdougall, 1977) had it that a common currency in Europe would require large scale fiscal transfers to compensate regions and nations for these costs. The new EC Commission wisdom has it that there are no such costs to set against the massive benefits they claim from higher efficiency in exchange. Implicitly, they are adopting a position that is not New Classical- for the Liverpool model is that- so much as Real Business Cycle. They have used a multilateral model- Multimod- which is New Keynesian to support their position, but we have found serious deficiencies in the way in which the EC Commission has used this model to evaluate these changes in exchange rate regime.

To New Classical economists it must be gratifying that the powerful bureaucrats of Brussels have so far been converted to classical economics as to have jumped clean over to a frictionless classical world! All these years apparently we have been foolishly believing there was some gain to having an independent currency and exchange rate; in the light of the new EC logic, surely the whole world should become a single currency area!

The EC report is breathtaking therefore in its claims, both explicit and implicit. We are not convinced and for the UK at least must warn that the consequences of EMU would be severe.

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Appendix A

Stochastic Simulation of the Liverpool Quarterly Model of the UK

Like any other large macro model the Liverpool Quarterly model of the UK is stochastic in nature i.e. its predicted values are subject to random variations. Howrey and Kelejian (1971) have shown that the deterministic solution of a non-linear model is generally a biased estimate of its conditional expectations, the reason being that the expectation of a non-linear function of a random variable is not generally equal to the same function of the expectation of that variable. This problem is more acute in a rational expectations model due to expectational errors. The numerical technique of stochastic simulation has been used in the past to investigate the non-linearities of large macro models [Nagar (1969)], but in the past modellers were restrained in using this technique due to the constraint of computer resources. At present, however, this constraint is not as acute as it was in the past; hence this technique is being used more widely, eg Fisher and Salmon(1986), Ireland and Westaway (1990), Minford and Rastogi (1990). In this study we have used this technique to quantify likely variations in the major macro-variables as a result of change in regime.

Drawing the stochastic errors

The quarterly model is estimated using FIML estimation method, hence we could generate pseudo-random numbers not only based on the distribution of the historical residuals but also take into account information on any possible contemporaneous cross-equation correlation of shocks (see table -1 for mean of historical residuals and their covariance matrix). The method used to draw a vector of shocks ui from a multivariate distribution with the given covariance matrix C is explained in Nagar (1969). The matrix C is decomposed to give a matrix A such that C = A'A. The vector ui is obtained by multiplying the matrix A by a vector ei of shocks of each element drawn from an independent normal distribution. In practice, this decomposition and multiplication is done by the NAG library subroutine G05EZF.

The random error vector of the exogenous variables, however, is based on the historical distribution of the errors obtained from time-series models of the variables (see Table 2 for the models, means and sample period). We have assumed that these errors are normal and independently distributed.

Stochastic simulations

60 sets of drawings of 16 random shocks were made from the error distribution shown in Table-1 and Table-2. The shocks were applied to one period at a time, with lagged dependent variables from the first period's shock simulation used for the second periods shock and so on; they were applied to the first 16 quarters of the base run. All shocks were unanticipated on occurrence; and the model is solved forward to the terminal date 16 quarters beyond the sixteenth quarter. Thus each set of shocks gives one complete alternative run of the model over sixteen quarters.

Table -1

	Mean
log(m0)	0.00657
log(goods)	0.00002
log(con.)	-0.00006
xvol/.32y*	-0.00146
log(nm0)	0.01060
xval/y	-0.00171
rxr	-0.00635
log(rw)	0.00130
log(u)	-0.00598

Covariance Matrix

	log(m0)	log(goods)	log(con.)	xvol/.32y*	log(nm0)	xval/.32y*	rxr	log(rw)	log(u)
log(m0)	0.00045								
log(goods)	1.01D-06	2.09D-06							
log(con.)	9.11D-06	4.45D-06	0.00015						
xvol/.32y*	-6.07D-06	-0.00002	0.00008	0.00593					
log(nm0)	0.00050	-1.11D-06	5.81D-06	0.00064	0.00089				
xval/.32y*	-0.00008	-3.93D-06	0.00005	0.00116	0.00002	0.00218			
rxr	-0.00058	-0.00001	0.00005	-0.00030	-0.00052	0.00051	0.00353		

log(rw) 0.00013 -1.55D-06 -5.55D-06 0.00026

0.00013 0.00005 -0.00054 0.00027

log(u) -0.00052 0.00001 -0.00007 0.00035 -

0.00041 0.00136 0.00093 -0.00018 0.00328

Table -2

Exogenous variable processes

Sample 1966:1 to 1982:4

RSUS = .0011 + .9252 RSUS-1

SE (.003) (.088) Mean=0.00466 S.D.=

0.0102

DLogWT = .0626 -.01066 LogWT-1

SE (.025) (.006) Mean=0.00148 S.D.=

0.0279

DTL = .00811 -.03103 TL-1

SE (.003) (.018) Mean=0.00018 S.D.=

0.0080

DTF = .00602 -.0519 TF-1

SE (.002) (.028) Mean=0.00024 S.D.=

0.0102

DLogB = -.0995 -.06765 LogB-1

SE (.044) (.028) Mean=0.00244 S.D.=

0.0412

DTI = .00974 - .07283 TI-1

SE (.013) (.031) Mean=-.00726 S.D.=

0.0939

DTAX = .03018 -.10638 TAX-1

SE (.018) (.042) Mean=-.02746 S.D.=

0.0022

DUNR = -.00144 - .005879 UNR-1

SE (.018) (.042) Mean=0.00 S.D.=

0.0067

Sample 1966:1 to 1982:4

DLogGXR= 0.1881 -.0399 LogGXR-1

SE (.24) (.051) Mean=0.00 S.D.=

0.0212

APPENDIX B

The decomposition of welfare costs in the world model analysis- how sensitive is the measure?

The key judgements in our multilateral analysis (see Appendix C for more detail, and for full details, Hughes Hallett et al, 1990) rested on the comparisons of welfare for EC countries in different regimes, monetary and exchange rate. Our quadratic welfare cost measure weights the variance (around base simulation values) of output, prices, real interest rates, the real exchange rate and the money supply. The weights are set to penalise equally the following deviations from base (assumed to be the desired trajectory) in each period:

1% on the level of output and prices

1% p.a./ 1 percentage point on the real (1-year) interest rate/the real exchange rate respectively

3% p.a. on the rate of growth of the money supply.

In Table B.7 we list all the components of the welfare cost measure for two cases- floating (Nash) and EMU (Nash). It can be seen that they go in different directions to each other and it follows that there will be sensitivity to the weights in the cost measure.

In particular the real exchange rate plays an important part, often moving sharply as relative money supplies move. Its variance can be regarded as an associated cost of using the monetary instrument. But if given no weight our results would change.

To obtain an idea of how much they would change we have redone text Tables 1-6 in terms of a welfare cost in which only output and prices have a weight. To achieve complete comparability we assume that governments also minimise this welfare cost. We now compare the results in Tables B.1- B.6 (which are the equivalent, table by table of text tables 1-6)

Table B.1: EMU v. floating (Nash)- output/price weights only (y,p only)

EC:	EMU	FLOAT	Prefers
GE	6396	97	Float
FR	1304	102	Float
IT	424	91	Float
UK	891	51	Float
ROW:			
US	364	391	EMU4
CA	4126	49928	EMU
JA	505	163	Float

Table B.2: Joint EC welfare costs of all regimes (y,p only)

	Fixed money	Nash Indep.	Nash ALL	coalitions (EC) ex-UK	ex-FR	ex-IT	World Coop
Floating	644	342	4695	2138	992	4253	478
EMU	2743	-	9015	10532	11818	33358	-

Table B.3: Costs of EC Coalition v. worldwide coop. under floating (y,p only)

	EC coalition	World coop
US	292	532
CA	1633	2038
JA	472	180
ROW	2397	2750
GE	1297	190
FR	3097	151
IT	85	89
UK	216	48
EC	4695	478
world	7092	3228

Table B.4: EMU v. floating outside EMU (y,p only)

	EMU	Outside EMU	Prefers
FR	1304	506	Stay out
IT	424	1070	Stay in
UK	891	161	Stay out

Table B.5: EMU excluding UK v. Floating (Nash) -y,p only

	EMU ex-UK	Floating	Prefers
GE	4902	97	Float
FR	4035	102	Float
IT	1434	91	Float

Table B.6: Costs of EMU ex-UK v. worldwide coop. with EMU (y,p only)

	EMU ex-UK	World coop.
US	556	2733
CA	5539	8900
JA	685	1568
ROW	6780	13201
GE	4902	665
FR	4035	1441
IT	1434	1208
UK	161	378
EC	10532	3692
WORLD	17312	16893

Table B.1 shows that when the exchange rate ceases to be a target all the countries that previously preferred EMU to floating now prefer floating, with the exception of Canada which alone continues to prefer EMU and the US which now marginally prefers EMU. This difference is readily intelligible: since the main aim of EMU is to stabilise exchange rates, when that is no longer valued, floating must be relatively enhanced.

Table B.2 shows that the preferred EC regime now is plain Nash floating without any coalitions. It turns out that the EC coalition provokes a much sharper monetary response from the ROW than occurs under independent Nash; the reason is that when exchange rate movement, a side-effect of using money, does not matter the money supply is varied more while the ROW naturally responds more to EMU than to independent EC policies.

Table B.3 confirms that worldwide cooperation under floating remains preferable to a mere EC coalition. This should be true whatever the targets. A suitable set of side-payments (or policies) would ensure that all were better off- but we have not experimented with such policy variations here.

Table B.4 shows that when the exchange rate target is not an objective, France joins the UK in wanting to remain outside EMU if it is formed. Of course, if EC preferences truly did not include exchange rate stability then there would be no EMU, because of the overwhelming preference for floating, as shown by B.1.

This preference is again shown in Table B.5, where EMU ex-UK is far worse for the other three than a return to independent floating. In our text table 5 all three either preferred to stay in EMU or were indifferent.

Finally, Table B.6 finds that there are some modest worldwide gains from augmenting EMU ex-UK with worldwide cooperation. Like those in text Table 6 these gains are limited, presumably because of the constraint on policy placed by the EMU.

In summary, suppressing exchange rate (and interest rate and monetary) stability as an objective sharply increases the general preference for floating, as one might reasonably expect. Our main welfare measure therefore favours EMU, and our text results which emphasise the superiority of floating would only be strengthened by an alternative.

APPENDIX C: METHODS FOR STOCHASTIC SIMULATION OF LIVERPOOL MULTILATERAL WORLD MODEL

We set out here briefly the key elements in our methods for the comparison of floating and EMU under different monetary regimes, within our full multilateral model and allowing for strategic interaction.

Notes on assumptions and methodology

The outturn is evaluated over a policy planning horizon of six years, inclusive of the year of the shock. Each country is assumed to have one instrument of response, namely money supply growth. It is allowed to plan the use of this instrument at the time of a shock occurring - ie no lag is assumed in policy response or shock perception. The instrument can be altered for two years at a time.. Whenever it is altered, it is a surprise to the private sector. So for example suppose the private sector had expected (in the `base run' excluding the shock) 2% money growth throughout. Then in response to the shock say the government plans 3% for two years, 5% the next two, and 7% the last two. The surprise is 1% in years 1 and 2, 3% in years 3 and 4, and 5% in years 5 and 6. Thus in effect the private sector assumes that the government's policy changes are temporary.

This assumption probably understates the private sector's capacity to forecast future policy changes- indeed a public with knowledge of the government's preferences and the model could rationally predict the government's intentions. On the other hand, the alternative assumption of fully credible and revealed policy intentions for six years ahead - the full rational expectations policy scenario- is empirically hard to sustain, presumably because our assumed government preference maximisation is not a good model of government behaviour, convenient as it may be for this exercise. This aspect is worth pursuing in future work. Meanwhile, the results should not be unduly sensitive since the parity changes which are the key to our findings occur in the year after the shock. These are influenced mainly by the shock and the change in money supply in the first two years.

The detailed assumptions about the EMS system in our default model are: margins +/- 3% around a Dm. parity, parity changes permitted in multiples of +/- 5%., and a gap of at least a year between them. In practice this means that the parity can change in the year after an initial shock and then once a year thereafter.

Nash strategies are determined at the time of the shock, with governments using the model and their knowledge of each other's welfare function to compute the equilibrium. (This assumes that they have an information advantage over the private sector, as just discussed.)

Both Nash and cooperative strategies are assessed using the algorithm of Brandsma and Hughes Hallett (1989). This takes the multipliers from the Liverpool model for policy and shock effects, computes the first order conditions, and solves for the simultaneous strategy choices. To keep down the amount of computation the model simulations and multipliers are for three periods: the averages respectively of years 1-2, 3-4 and 5-6.

Notes on the stochastic simulations

38 sets of drawings of 6 random shocks were made from error distributions shown in Table C.1. Being single equation estimates there is no covariance estimated or assumed. The shocks were applied one year at a time, with lagged dependent variables from the first year's shock simulation used for the second year's shock and so on; they were applied to the first 6 years of the base run. The shocks are unanticipated on occurrence; and the model is solved forward to the terminal date ten years beyond year 6. Each set of shocks gives one complete alternative run of the model over six years. The shocks are reduced in size (divided by 100) in order to speed model convergence and reduce the already enormous amounts of computer time required. The averages of years 1-2,3-4,and 5-6 from the resulting model run are then input into the Brandsma and Hughes-Hallett programme described above to compute the Nash outturn. At the end the results are scaled up to correspond to the size of the original

shocks. This scaling procedure is likely to bias the results for the EMS towards greater stability because larger shocks will create greater strains within the fixed margins around parity. However we get so much separation between regimes on instability anyway that the ranking which is of key importance to us should not be seriously affected.

Table C.1 -- Single equation errors - Liverpool world model

(sample period 1957-81 for U.S.A., Canada, France and Italy and U.K., 1956-85 for Japan, 1961-83 for Germany)

U.S.A.	Standard error	
log M1	.057	
log g	.003	
log ndc	.003	
log (RXR)	.079	
xvol/y**	.009	(73-81)
Canada		
log M1	.066	
log g	.002	
log ndc	.002	
log (RXR)	.026	
xvol/y**	.016	(73-81)
France		
log M1	.029	
log g	.002	
log ndc	.006	
log (RXR)	.132	
xvol/y**	.006	(73-81)
Italy		
log M1	.005	
log g	.003	
log ndc	.002	
log RXR	.187	
xvol/y**	.027	(73-81)

Japan (source: Rastogi, 1989)

log ndc	.0166
log g	.0139
log M1	.0618
log (RXR)	.0604
log Export	.0420
log Import	.0615
xvol/y**	.009

Germany (Source, Davis, 1987)

log ndc	.012
log g	.006
log M1	.019
log (RXR)	.038
xvol/y**	.037

U.K. (Source, Minford et al, 1984)

log M	.041
log g	.005
log (RXR)	.001
log ndc	.024
log RW	.006
log U	.005
xvol/y**	.0175

Notation -

ndc = private sector non-durable consumption
g = private sector stock of physical assets
M1 = demand for real balances M1
RW = real earnings
RXR = real exchange rate
U = unemployment in '000.
xvol = trade balance excluding terms of trade effects
Y** = equilibrium value of Y

Appendix D; The Liverpool World Model's Forecasting performance

Table D.1 reports the model's forecast errors since 1984 up to two years ahead. As a benchmark IMF errors over 1971-86 are shown from Artis (1988). Errors for a strictly comparable period are not available and the period since 1984 has of course been relatively stable. Nevertheless, the Liverpool forecast errors appear to be of tolerable size.

Table D.1 - Liverpool World Model forecasts (published in Quarterly Economic Bulletins)

Forecast Errors (RMSE)

Zero-Ahead Forecast Errors

	Growth		Inflation	
	LPL	IMF	LPL	IMF
USA	1.061	1.063	0.454	0.724
Canada	1.404	1.338	0.906	1.567
Japan	1.259	1.716	0.594	2.418
Germany	1.125	1.412	0.463	0.862
France	0.669	1.208	0.214	1.291
Italy	1.290	1.470	0.566	1.971

One Year Ahead Forecast Errors

	Growth		Inflation	
	LPL	IMF	LPL	IMF
USA	1.284	2.047	1.494	1.725
Canada	0.887	2.238	1.613	2.731
Japan	1.476	3.217	0.955	4.200
Germany	1.488	2.207	1.378	0.686
France	0.933	1.085	1.671	1.200
Italy	1.053	2.482	1.771	3.574

Two Year Ahead Forecast Errors

	Growth	Inflation
	LPL	LPL
USA	1.022	2.197
Canada	1.185	1.971
Japan	1.131	1.486
Germany	0.764	1.761
France	0.535	2.978
Italy	0.795	2.665

1. LPL Forecasts 1984 - 1989
2. IMF Forecasts 1971 - 1986
3. IMF Forecast errors taken from M.J. Artis 'How Accurate is the World Economic Outlook? A Post-Mortem on Short-Term Forecasting at the IMF' IMF Staff Studies July 1988