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ABSTRACT

Joining the Euro - the Macro Effects on the UK Economy*

Stochastic simulations are used on the Liverpool Model of the UK to assess the effect of macroeconomic stability of the UK adopting the Euro. Instability increases substantially, particularly for inflation and real interest rates. A key factor is the extent of the Euro's instability against the dollar; by adopting a regional currency the UK imports this source of shocks, as well as losing its control of interest rates. The results are not highly sensitive to changes in assumptions about the degree of labour market flexibility, the use of fiscal policy, and increased convergence of monetary transmission.

JEL Classification: E42 and E53
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JOINING THE EURO-THE MACROECONOMIC EFFECTS ON THE UK ECONOMY

by Patrick Minford, David Meenagh and Bruce Webb
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The central issue embodied in the first and second tests set by the British Chancellor of the Exchequer in 1997 is how far the UK will suffer, in the form of increased volatility – in popular parlance 'boom and bust' - and given any alternative flexibility it can deploy, from losing its power to set its own independent interest rate through having its own currency and exchange rate. One can use indirect evidence on this from a variety of sources - such as the extent to which the euro-zone and the UK business cycles have been similar and the degree of asymmetry of the two region's shocks. Such evidence has been assembled for a number of countries, including the UK, within the 'optimal currency area' literature; the general verdict of this literature is that a country such as the UK is exposed to substantially 'asymmetrical' shocks and that this is likely to impose a cost on it if it gives up monetary autonomy. However this evidence is only indirect in the sense that it does not give us a quantitative estimate of what would happen if we joined EMU as compared with continuing outside. It indicates likely direction of effect but cannot tell us its likely size and therefore its likely painfulness. To find this out we would ideally like to try it out. Unfortunately we cannot of course as EMU is effectively irreversible; the nearest thing to a try-out was our experience of the European Exchange Rate Mechanism, which was not entirely encouraging, but it was not EMU, since our exchange rate was fixed but adjustable whereas under EMU it is fixed and never again adjustable. However, there is a technique we can use, analogous to that used by pilots learning to fly; they use a simulator. We can use a model of the UK economy of the sort used regularly to give answers about the effects of other policies and to make forecasts; and we can simulate its behaviour in response to typical shocks under our present arrangements and then by contrast under EMU. This ('stochastic simulation analysis') gives us a reading on the difference in the volatility of the UK economy under the two monetary regimes.

This question is not to be confused with the question of the likely short-term outlook for the economy if it joins or stays out. That is of interest too (and would depend on what exchange rate we joined at, whether our interest rates had 'converged' or not, and other elements in the initial situation when we joined); but this is of little importance for a long-lasting, even permanent, decision to join EMU because these short-term differences in the forecast would give way, in the absence of further shocks, to a similar outlook. Our inflation target is basically the same as the ECB's; and our growth rate over the long-term will not be affected by a different monetary regime with a similar inflation target. So the serious issue is how the economy behaves in response to shocks once embedded in a different monetary regime. That behaviour could be very different and the difference long-lasting because the regimes are so different; under one we can react to shocks by changing our interest rates, under the other we cannot.

To examine this issue of relative volatility we use a well-known forecasting model that has been quite successful in forecasting the economy in both the 1980s and the 1990s - the Liverpool Model of the UK; it has also been influential in developing the

* **We are grateful for comments to Ray Barrell.**

counter-inflation and anti-unemployment policies of the UK - that is, both ‘demand-side’ and ‘supply-side’ policies. We first say a few words about the model and describe the methods we are using on it, before turning to previous results of such exercises and then the results we get in this one.

The Liverpool Model of the UK and the stochastic simulation method used

The model (an account can be found in Minford, 1980) has been used in forecasting continuously since 1979, and is now one of only two in that category. The other is the NIESR model, which however has been frequently changed in that 20-year period: the only changes in the Liverpool Model were the introduction in the early 1980s of supply-side equations (to estimate underlying or equilibrium values of unemployment, output and the exchange rate) and the shift from annual data to a quarterly version in the mid-1980s. In an exhaustive comparative test of forecasting ability over the 1980s, Andrews et al (1996) showed that out of three models extant in that decade - Liverpool, NIESR, and LBS - the forecasting performance of none of them could ‘reject’ that of the others in non-nested tests, suggesting that the Liverpool Model during this period was, though a newcomer, at least no worse than the major models of that time. For 1990s forecasts no formal test is available, but the LBS model stopped forecasts and in annual forecasting post-mortem contests the NIESR came top in two years, Liverpool in three. In terms of major UK episodes, Liverpool model forecasts successfully predicted the sharp drop in inflation and the good growth recovery of the early 1980s. From the mid-1980s they rightly predicted that the underlying rate of unemployment was coming down because of supply-side reforms and that unemployment would in time fall steadily in consequence. Then they identified the weakness of UK membership of the ERM and its likely departure because of the clash between the needs of the UK economy and those of Germany leading the ERM at the time of German Reunification. After leaving the ERM they forecast that inflation would stay low and that unemployment would fall steadily from its ERM-recession peak back into line with the low underlying rate - as indeed was the case. Thus we would suggest that the Liverpool Model has a good, indeed unmatched, forecasting record.

A model should not only be capable of producing good forecasts; it should also give credible answers to questions about the effects of policy changes. In this respect, the Liverpool Model has been extensively used in policy analysis bearing on the ‘monetarist’ and ‘supply-side’ reforms of the Conservative governments of Margaret Thatcher. It is now generally conceded that these reforms have been broadly successful; the Liverpool Model acted to some degree as intellectual underpinning for them at a time of general academic hostility from UK macroeconomists.

We therefore suggest that the Liverpool Model can be regarded as a suitable vehicle for evaluating the impact of a major policy shift - that of joining EMU - on the economy’s behaviour in response to shocks. Comparative work on other models would also be of interest, though in the past few years resources devoted to such models has been drastically reduced as a result of the ESRC’s cut-off of funds for their support. There is the NIESR model of the UK and also NIGEM the NIESR’s linked model of the UK and other major world economies; we discuss below a comparable study to ours using NIGEM carried out by Barrell and Dury (2000). There are also models in the public sector - those of the Treasury and the Bank of England - though their theoretical basis and their forecasting record are both rather unclear, as is their fitness at this stage for stochastic simulation - an exercise which is highly demanding of the model's structure. It is a major undertaking to carry out stochastic simulation on any model. It requires that the model have a reliable economic structure so that its behaviour in response to a wide range of shocks is reasonable, something that comes from regular use in analysis and forecasting over a long period. It also requires a great deal of detailed work on the inputs and a considerable familiarity with the model's workings so that assumptions are made that do not conflict with the model's logic. In practice this can only be done by a team working regularly on the model. For our work on the Liverpool Model we obviously have access to and have used our own forecasting team in Cardiff Business School - but plainly we do not have similar resources for dealing with other models and our understanding is that the same may be true of the teams themselves dealing with these models. Fortunately, as we have seen the Liverpool Model has strong claims to give relatively authoritative assessments.

The method of stochastic simulations involves

1. Identifying the typical shocks hitting the economy and estimating their variability on relevant data, usually over the past two decades; this variability is assumed to match the chosen sample period.

2. Generating a large number of sets of random drawings from each shock distribution. Each set is a series of shocks over a set number of years, here 16.5 years or 66 quarters. The shocks are applied to the model in sequence, generating a 'scenario' for the economy over that period. We ran a large number of randomly generated sequences of drawings, filtering out those generating extreme instability as unrealistic. We retained 183 sets, that is 183 different scenarios for a given 'monetary regime', either floating as now or EMU.

3. From our 183 scenarios over 66 quarters we obtain 12078 observations on the state of the economy, i.e. on each of prices, interest rates short and long, on GDP and other 'variables'. We compute the variability of these variables from this large sample of observations for the given monetary regime. We can then compare and contrast across regimes.

A great many assumptions go into such an analysis and it is only reasonable to question them in detail. The fact is we are attempting to see how the future might unfold and the future may fail to resemble the past in particular ways. The virtue of the stochastic simulation method is that we can investigate such concerns quantitatively by simply redoing the analysis under interesting differences of assumption. This can generate a range of possible differences in variability between our two regimes.

Results of previous stochastic simulation exercises on the UK and EMU

There has been a variety of previous work on the effects of joining EMU, both for European countries generally and for the UK alone. The general conclusion of this work has been that there would be a substantial increase in variability under EMU; the variances of output and inflation are the principal focus of these studies. The earliest independent study was in 1992 by Minford, Rastogi and Hughes Hallett (1993) building on their earlier work in the late 1980s using the Liverpool Multi-country Model and also the UK model; later Masson and Symansky (1992) used the IMF's Multi-Mod, a multi-country model. The range of findings by these authors for European countries generally was quite wide; Masson and Symansky found rises of inflation variance up to 40% and of output variance up to 30%, Minford et al found very much larger rises, probably because they permitted monetary policy to be optimised in respect of these variances. The EU Commission (1990, Annex E) also published a study of this type which purported to find that EMU actually reduced macro variability; their methods were strongly criticised by these other authors on the grounds that they had unrealistically over-estimated the variances of the risk-premia on national EU currencies which of course disappear on entry into EMU. Hence their comparison is biased heavily in favour of EMU. We discuss the far more recent study by Barrell and Dury (2000) below.

For the UK the only previous study was by Minford et al. where they found very large rises, of 80% for the output variance and nearly six times for the inflation variance. That study was similar in method to the one here. The main difference in this one is that the data we are using are more recent, for the late 1980s and 1990s instead of for the 1970s and 1980s; we have also taken the opportunity to use the method of bootstrapping the actual data instead of using estimated variances and covariances within a normal distribution. Finally we have carefully overhauled all aspects of the operation and made a number of detailed improvements. Nevertheless it is likely that the main difference is from the newer data.

The results of this exercise

The basic result of our exercise is displayed in figure 1 which shows the variances for four key variables - output around its potential or 'trend', inflation, unemployment and real short-term interest rates. There are two diamond-shaped graphs; one shows the combination of these variances under floating, the other under EMU. The graph shows the logarithms (to base 10) of the variances; this means that an equal distance along two axes measures an equal proportional rise in the two variances and as one moves along an axis each equal length is the same proportional rise (from the starting point of the length). For ease of comparison the floating ones are set equal to 0.1 so that the EMU diamond shows the EMU variances as a proportion of the corresponding floating ones (the scale being logarithmic we can accommodate the wildly differing proportions involved on the same scale). What we see is that all the implied variances are considerably higher under EMU than under floating. The variance (the square of the standard deviation) is used, as is standard, in our measures of welfare cost. That of output around its trend is nearly a third higher; that of unemployment nearly a fifth higher; real interest rates a multiple of over 4 times; and that of inflation under EMU is approximately tenfold that under floating. The EMU environment is one in which ECB nominal interest rates are moving a fair amount for euro-zone-wide reasons and yet because they are poorly addressed to UK shocks the UK economy experiences considerably worse output, employment and above all inflation swings.

How can such a big difference arise? First, let us be clear about the floating monetary rule we have used. It is one in which interest rates react in a rather standard way to the deviations of current output, inflation and also M0 from their targets (the precise equation can be found in Appendix 2, the Model Listing, but in short the change in short-term nominal interest rates reacts to all three, in terms of deviations from their long-run target, with a coefficient of 1.33). This gives a standard deviation of real interest rates of 2.6% (p.a.), of inflation of 2.1% (p.a.), and of output of 2.5% around its trend; these values seem to match reasonably with what we would expect from the current environment under the MPC. Different monetary rules could be used to change this combination of variabilities; in effect we find that there are trade-offs; one can reduce inflation variability sharply for example by tough inflation targeting but at the cost of greater real interest variability (more 'activism') and probably also more output variability. Equally, we could find outcomes with less output variability were we to be willing to see more variability in the other two. One of the areas of major interest in our research is investigating improved rules for monetary policy when this can be independently carried out (i.e. under floating); the results we report for floating here could undoubtedly be improved on were we to undertake a full search for better rules (as one might assume were implicitly being implemented by the major efforts of the Monetary Policy Committee)- however in the time available we have stuck to a basic simple rule which produced tolerable results.

Second, consider the factors driving inflation under EMU. UK prices of traded goods and services would be set in world markets at euro prices. They would be impacted upon therefore by three forces: the movements in the euro exchange rate (principally against the dollar), competing euro-zone prices and in UK costs. UK non-traded prices would be driven by UK costs and to some degree the pressure from traded prices. This makes up a cocktail of shocks. The euro has been notoriously volatile against the dollar. UK costs have had a roller-coaster ride from the push and pull of Tory and Labour supply-side policies. Finally, euro inflation has had the usual ups and downs.

Meanwhile under EMU euro-interest rates are reacting to their own euro-agenda and not targeted on UK inflation or output except as a small part of an overall euro-average. Hence these interest rates act not as a reactive stabiliser but as an independent source of shocks to the UK economy. We should stress that to the extent there has been any correlation of these interest rates with UK shocks over the past decade and a half it is wholly picked up in our methods described in the Annex below. But because this correlation is small, and inflation variance is raised under EMU by the shocks described in the last paragraph, the variance of the real short-run interest rate (the nominal interest rates minus expected future inflation) also rises sharply.

When we consider the nature of the EMU regime in this way, we should not really be too surprised at the greater variability it creates. We can perhaps see an example of this at work in recent EMU experience in two ways. First, there is the extraordinary case of Ireland, where under the impact of the boom induced by reducing interest rates to euro-levels of 3% or so and of the sharp depreciation of the euro, inflation rose to a peak of nearly 7% last year and is still running at 4-5%. Given some similarities and close trading relations between the UK and Ireland, it is reasonable to expect that had the UK also joined the euro on Jan 1 1999 it too would have experienced these problems to at least some degree. Second, we can inspect the range of inflation currently (June 2001) in the euro-zone: from 1.3% in France and 1.4% in Germany to 3.0% in Spain, 3.1% in Denmark and 4.9% in the Netherlands, much like Ireland. The range across countries is 4% currently and has peaked thus far at 6%. By contrast in the past five years UK inflation (RPIX) has stayed comfortably within the range of 1% either side of the Bank of England's 2.5% target.

It is natural to ask what these differences in variability imply for 'welfare' or the degree of painfulness of the EMU option. The main approach that has been used to this has been to give 'weights' to the different variances that appear to cause political and popular concern, i.e. the ones we have just discussed, and add them up into a measure of welfare cost (the inverse of welfare). To illustrate, let us arbitrarily give the above variances the weights 1 each for output and unemployment, and 0.1 each for inflation and real interest rates (it is usual to give such price variables a lower weight in such 'welfare functions' on the grounds that they affect people's living standards more indirectly, though clearly the choice is a matter of judgement, essentially political); plainly then we wind up with a big difference in welfare. EMU welfare on this measure is 57% of that under floating - equivalently the EMU welfare cost is 1.75 times that of floating. We will use this approach in what follows and refer to it as the popular welfare cost of EMU.

This does not measure the average person's welfare, however one plays with the weights, because it is in effect treating political reaction as equivalent to true dissatisfaction. But of course the extent of politically-expressed displeasure exaggerates the true average discomfort, partly because to get results in the cross-currents of debate one's case must be put as strongly as possible but mainly because the costs of volatility fall disproportionately on groups that are different from the average - for example, those who lose their jobs or have their houses repossessed or whose businesses fail. We will argue nevertheless that we should pay attention to the popular welfare cost because it is the bitterness and displeasure of these groups that gets reflected in the political debate more than the calm of the average person. To give a specific example, if unemployment is more variable, this disproportionately affects a minority most vulnerable to unemployment.

Measuring the welfare of the 'representative agent':

We may however look at a second approach under which one measures the welfare (or 'utility') of a 'representative' (i.e. average) household (households are the people in our economy who own 'the UK economy' and to whom governments answer). We can say that a household likes both consumption and leisure, and that it does so at some diminishing marginal rate (reflecting the law of 'diminishing marginal utility'); such a set-up coheres with people's decisions under uncertainty being governed by risk-aversion. A utility function that seems to fit rather well with what we know about risk-aversion and inter-temporal substitution is the Constant Relative Risk Aversion (CRRA) function with a unitary elasticity of substitution between consumption and leisure. The value shares of consumption and leisure would be set at 0.7 and 0.3 respectively if one says that leisure time excluding unemployment is roughly equal to working time (sleep hours being ignored) and that through unemployment benefits the leisure choice is subsidised so that its marginal utility is perhaps just under a half of an hour spent working and getting consumption. With the risk-aversion parameter being found to be of the order of 1.5, we come up with a function:

Utility= [{(consumption**0.7)[(1+unemployment rate)**0.3]}**(1-1.5)]/(1-1.5)

To estimate the difference of utility in our stochastic simulations is simplicity itself. The model generates values for consumption and unemployment and we just obtain the average value for utility under floating and compare it with that under EMU. Because it is essentially only the variability of outcomes that differ across the two regimes (average GDP and so forth should be more or less the same since the economy gravitates to the same values in the end, it is simply that in response to shocks it fluctuates more and takes more time to get there under EMU than under floating), the difference of utility will reflect the difference of variances. Households will penalise variance through the law of diminishing marginal utility: for example if offered consumption of 100 and then 100, they will prefer it to 150 and then 50 because the extra utility of 50 more is smaller than the reduction of utility from 50 less. (In exactly the same way they penalise risk: since a fair bet offering an equal chance of 150 and 50 will be worth less utility than keeping 100 for sure by exactly the same reduction as that caused by the extra variance above.)

Plainly extra uncertainty (variance in our income) is something that trades off rather weakly against a rise in average living standards (a rise in our mean income). Hence we would not expect these increases in the variances of consumption (which behaves similarly to income in our model) and of unemployment under EMU (respectively 30% and 80%) to generate much of a fall in equivalent living standards, simply because on average people can handle extra variance at moderate cost- for example by insurance or the use of savings. Thus we find that the fall in utility calculated in this way is equivalent to a 0.012% fall in the living standard of the average person. This translates into a current price loss of £0.12 billion per year in 2001 prices; if one assumes a real long-term interest rate of 3% and a growth rate of 2.5%, then the present discounted value of this is £24billion. This is not large relative to the scale of UK wealth; probably about the same small 0.012% as for the fall in living standards. This reflects the ease with which most people can insure themselves against the sort of variability at stake.

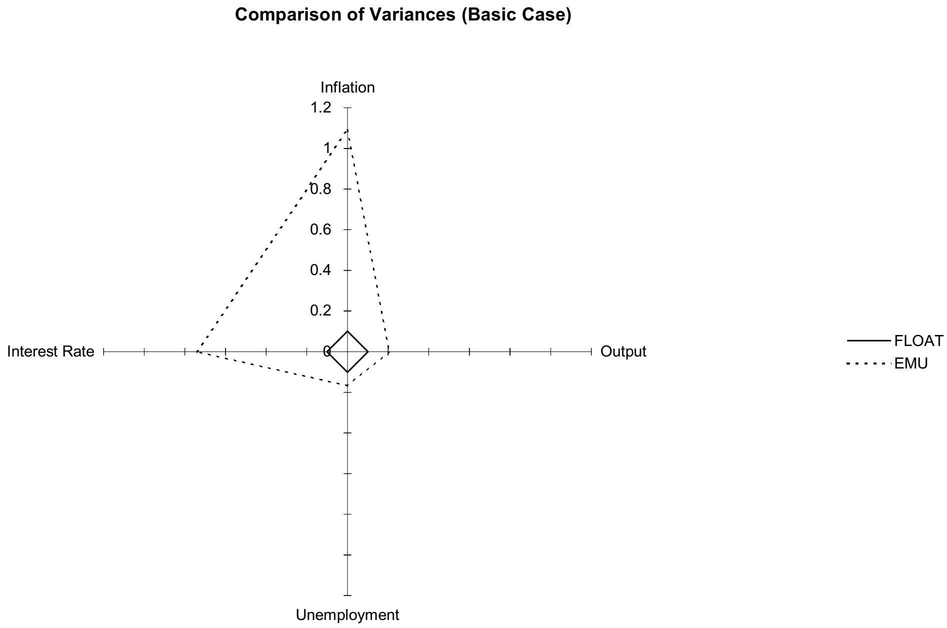


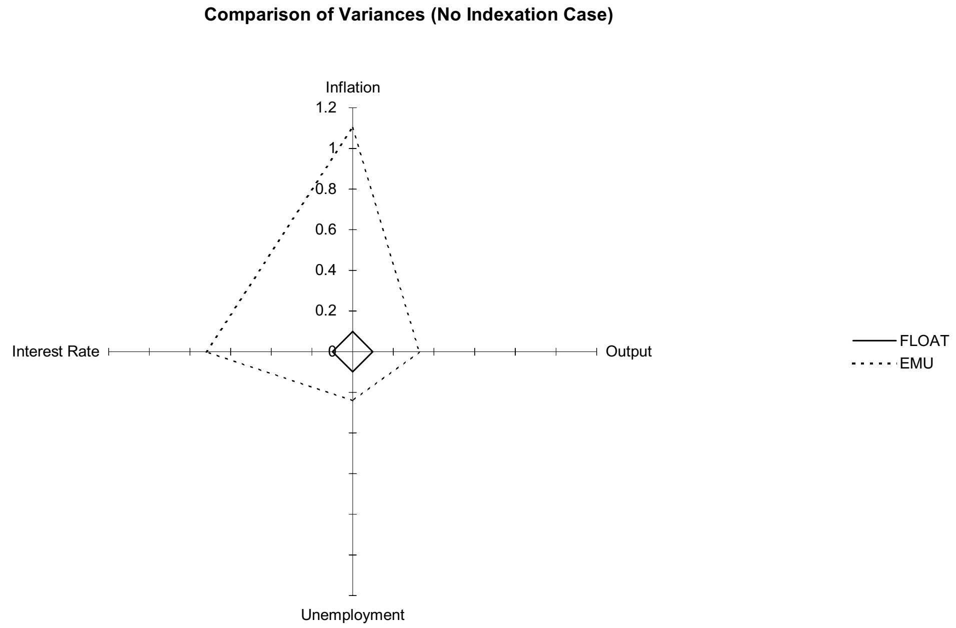
FIGURE 1: Floating and EMU compared (Basic Case)

Checking the results for sensitivity

a) greater nominal rigidity of wages (no indexation)

The Liverpool Model in its current version has very little nominal wage rigidity - a surprise 1% rise in prices only lowers real wages by 0.3% after 1 quarter and by 0.1% after two quarters, and this dies away altogether in another three quarters. In other words there is a great deal of effective indexation of wages to prices. So we check how much effect on the results would occur if the effect after 1 quarter was raised to 1% and thereafter dies out linearly in the next four quarters as contracts are renegotiated. Such a rise to maximum nominal rigidity (effectively zero indexation) makes the Model's Aggregate Supply or Phillips Curve flatter - that is a given rise in demand has a lesser effect on wages and prices but a greater effect on output. (This gives the model a more 'Keynesian' character.) This should reduce inflation variance and lower output variance the lower the variation of demand relative to that of supply. In the UK supply shocks are important and under floating demand can be stabilised by the movement of interest rates so output variance should tend to fall under floating. Under EMU the variation of demand becomes much larger in the absence of interest rate stabilisation and this should mean that output variance would rise, perhaps markedly.

This lessening of indexation under floating does indeed reduce inflation variance significantly and also reduces output variance. But under EMU while inflation variance falls markedly, those of output and unemployment rise sharply. The gap between EMU and floating correspondingly widens (Figure 2); the variance of output is now 1.5 times, of unemployment 1.4 times, while that of real interest rates is about the same multiple as in the basic case; only that of inflation falls somewhat. Our political cost measure of EMU rises to 1.9 times that of floating. We should



Floating Basic Case=100

FIGURE 2: Floating and EMU compared (No-indexation case)

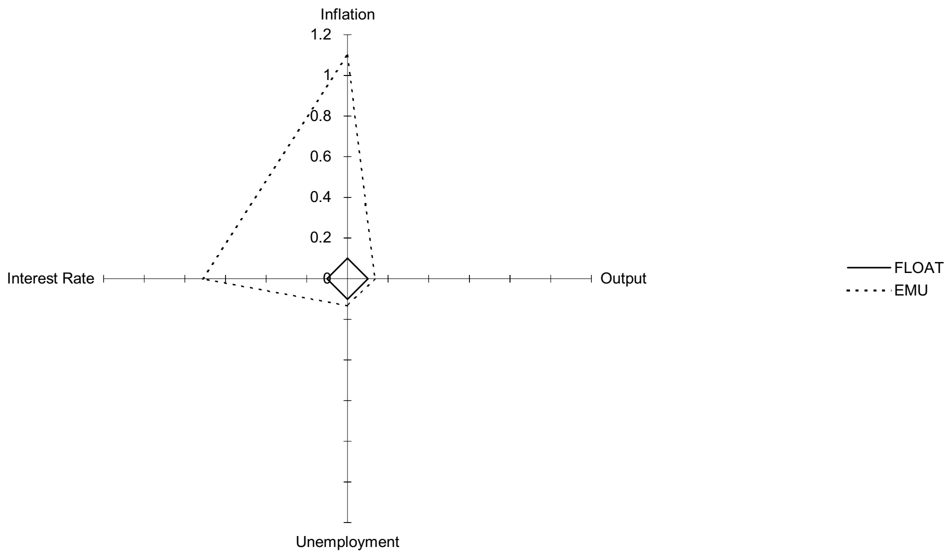
note that the more Keynesian the model (i.e. the more nominal wage rigidity it has) the worse the effect of joining EMU on output and unemployment variability.

b) the effect of the UK having lower demand sensitivity to interest rates

One of the differences between the UK and the continent that exacerbates the asymmetric effect of shocks is the overdraft lending system and the variable rate mortgage. These mean that as short-term interest rates rise they have a big impact on small businesses and consumers because they immediately pay more for their existing borrowings, not merely on any new borrowings. It has been argued that this might change if the UK joined EMU since there would be pressure for banking practices to converge. Clearly to examine the likelihood of this is hard. We merely check what it would do if it happened. We would expect it to narrow the differences between floating and EMU since the stabilising variation of interest rates permitted by floating would have less beneficial effect while the destabilising variation of euro-interest rates would have less damaging effects.

So indeed it proves though the effects on the floating case are essentially negligible. We divide the model's interest rate responses by three. There is a substantial fall in output and unemployment variability under EMU as the lower interest rate sensitivity of the economy reduces the effect of euro-zone interest rate movements on the UK; inflation and real interest rate variability is unaffected. The gap in the variances therefore narrows, especially for output (+9%) and unemployment (+8%). The political cost measure falls to 1.6 times. Figure 3 shows the results. It can be seen that much less interest rate sensitivity is helpful to the EMU case but only modestly and still leaves substantial disruption due to inflation and real interest rate volatility.

Comparison of Variances (Low Interest Rate Sensitivity Case)



Floating (Basic case)=100

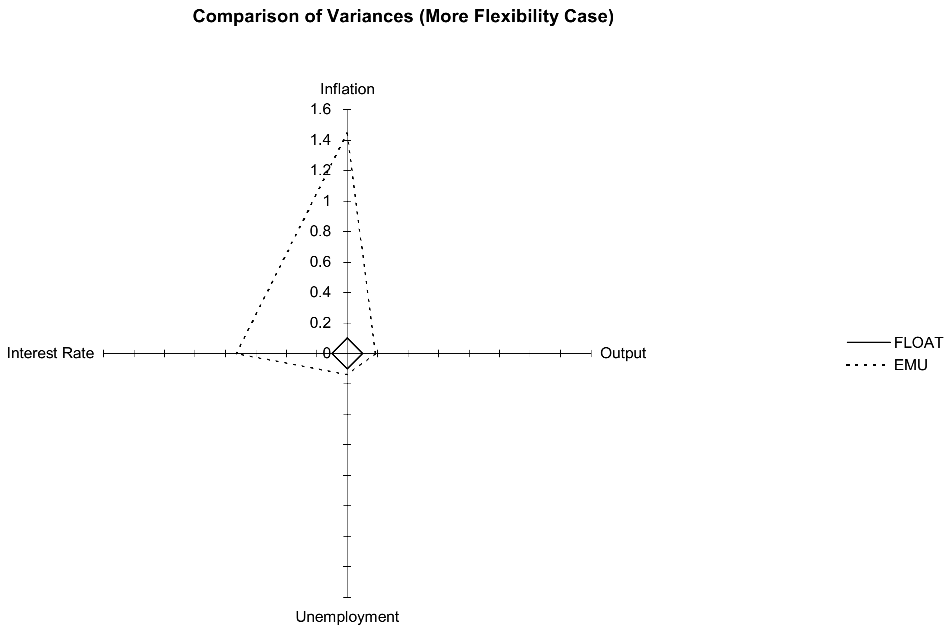
FIGURE 3: Floating and EMU compared (Low Interest sensitivity Case)

c) the effect of the UK having greater labour market flexibility

Much is made in the debate over the euro of labour market (i.e. real wage) flexibility. It is pointed out (as indeed by us above) that if interest rates are unable to stabilise asymmetric shocks then greater flexibility of real wages in response to shocks would dampen unemployment (and so also output) variability in a useful alternative way. It is argued by some that the euro-area will develop greater labour market flexibility because of the pressures of the single market and even more so of those produced by the asymmetry within the euro; unfortunately, even though some developments might seem to point this way, there is some evidence that the political market is producing the opposite, with more labour market regulation, pressure towards cross-border union powers and moves against 'social dumping'. In any case, again we do not attempt to prejudge the matter, merely asking what the effect would be of a substantial rise in UK flexibility. We multiplied the response of real wages to unemployment by 1.5 and reran the exercise.

We find that in both cases unemployment variance drops substantially and proportionately more under EMU, confirming that flexibility is indeed an important help in eradicating the greater imbalances produced by EMU. Output variance drops by less as the change is focused on the labour market; and again output variance drops rather more under EMU. Figure 4 shows the results. We see that EMU and floating come closer together, with the ratio of the unemployment variance down to 1.09 and that of output down to 1.22; however, still a big gap remains. Interestingly the greater labour market flexibility tends to make inflation more volatile under floating which is a source of general instability; to counteract this monetary policy has to respond more fiercely to inflation and worry less about output variability- we assume that the response to inflation rises by a third while that to output diminishes by a third. As a result inflation variability is cut back sharply under floating, with some small cost in higher output variance (of the order of under 10% judging from other work). So the comparison of inflation variance under EMU is now correspondingly worse; the ratio rises to 21.9. The political cost of EMU under labour market flexibility therefore actually rises falls to 2.2 times; but within that the cost of output and unemployment variability falls.

Also relevant from the policy viewpoint is to stress that the variability of the economy under EMU unambiguously falls when the labour market is made more flexible; compared with the standard EMU case, the variance of unemployment falls by 89%, that of output by 12%, while inflation and real interest rate variance remain essentially the same. So labour market flexibility produces a clear macro-stability improvement under EMU. The point here in comparing floating with EMU is that since it also produces improvement under floating, the balance of advantage in staying out of EMU remains strong.



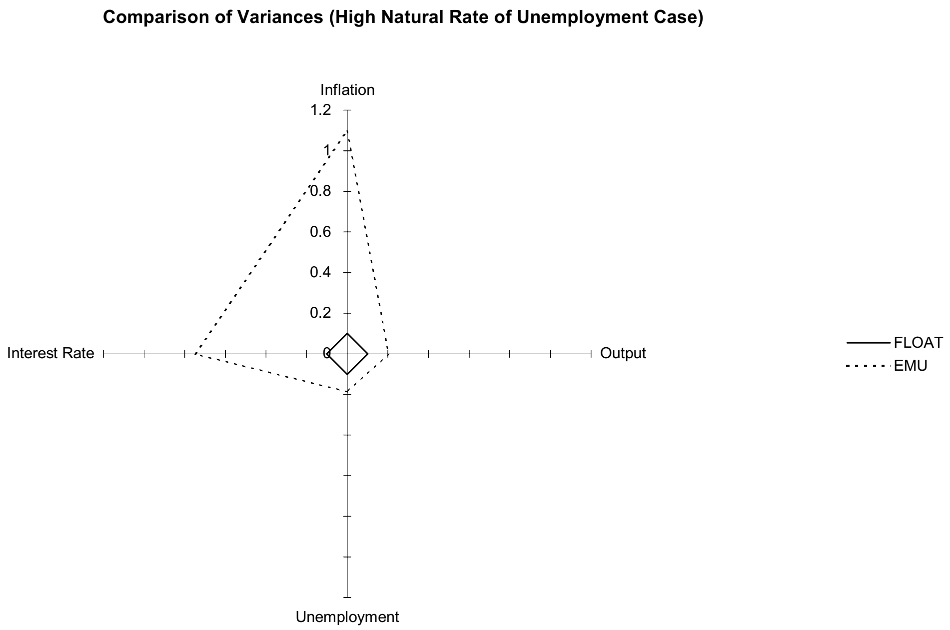
Floating (Basic case)=100

FIGURE 4: Floating and EMU compared (Labour market flexibility Case)

d) what if unemployment is very high?

Our results hitherto have shown the variability of unemployment under EMU relative to the benchmark situation under floating. Since this benchmark has quite a small variability of unemployment (a standard deviation of about 301,000, only 1.1% of the labour force) the difference under EMU, though big proportionally, is small absolutely. However, as the floating benchmark's unemployment rate variability rises, the model exhibits not merely a greater absolute variability differential between floating and EMU but also a larger proportional differential,. The reason for this is that at high rates of unemployment the Model's real wage elasticity to employment falls. There is a constant real wage elasticity to *unemployment*, as widely found empirically - Blanchflower and Oswald, 1994; Minford, 1983. Theoretically, the rationale is that as unemployment rises more people find themselves on the margins between unemployment benefit and the working wage; so when employment falls, real wages drop less as more people opt for benefits.

We checked this for a rise by 2.15 times the benchmark unemployment rate under floating; Figure 5 shows the results. While the relative variability of other elements in our political cost measure remains roughly unchanged (and so therefore does the overall political cost measure), relative unemployment variance under EMU rises to 1.22 times that of floating. In plain terms this means that if due to poor supply-side policies the underlying (non-inflationary) unemployment rate were to rise back to the rates of the early 1980s of around 3 million (which would represent roughly a tripling from the average rate in our floating base line) then the standard deviation of floating unemployment would rise some 3.4 times to around 1 million but that of EMU would rise 3.5 times from to around 1.1 million. Of course with such high baseline unemployment rates that sort of absolute rise in variability, of 100000, would add materially to the unpopularity of a switch to EMU.

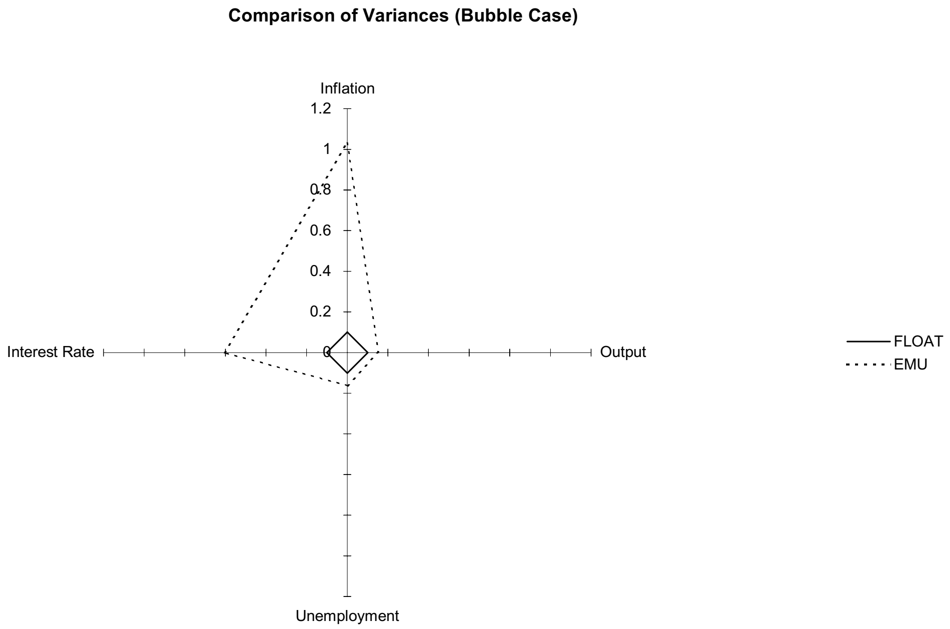


Floating (Basic Case)=100
FIGURE 5: Floating and EMU compared (High Unemployment Case)

e) could greater volatility of the pound outside EMU change the comparison?

It is sometimes asserted that floating exchange rates themselves generate high volatility because of the varying risk-premium attached to the pound; the conclusion is drawn that if this were to be prevented by joining EMU this would be likely to mean that EMU would be a less volatile regime. We already have in our Floating model a varying risk-premium for the pound. It is the error in the real interest rate equation (endogenous error 6 in table A1 in the Annex below, no. 10 in the model listing) which is governed by Uncovered Interest Parity, in other words the speculative market behaviour that forces sterling real interest rates to compensate for sterling risks. So our basic comparison already allows for the variability present over the past decade. However, we also ask further what would happen to our comparison if we were to have a big increase in this variability in the future. So we tripled the standard deviation of this error and reran the comparison.

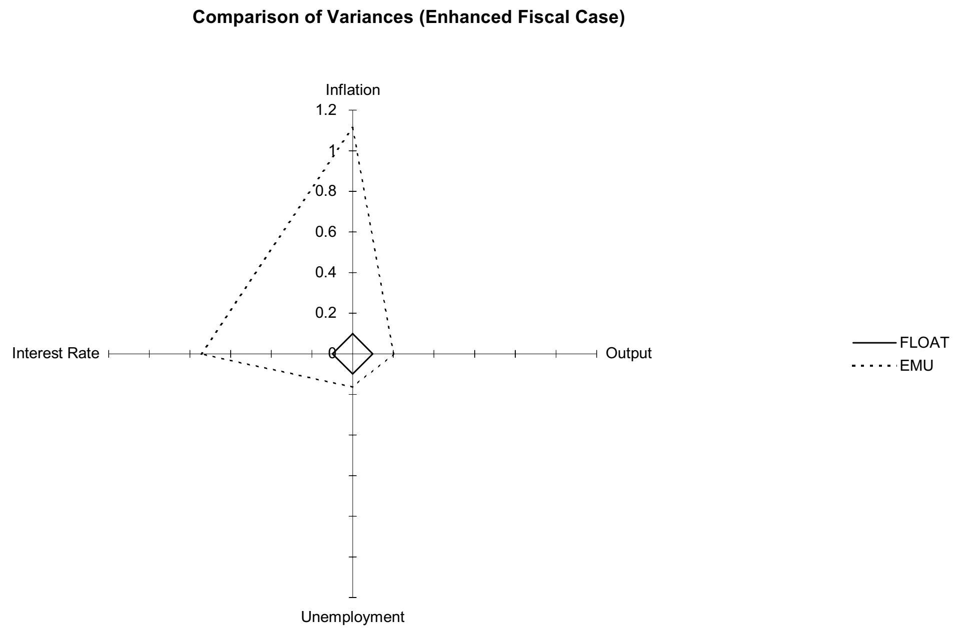
As one would expect there is a narrowing of the difference as this large 'bubble' raises the variability of both the real exchange rate and the real interest rate. However, the model is rather robust to this effect, since monetary policy is able to offset it rather easily. It is as if there is an extraneous agent varying real interest rates in ways unwished-for by the Bank of England; it reacts by altering the money supply to dampen this effect. This then spreads the total effect of the bubble between interest rates and the exchange rate. Consider the following example: the risk-premium rises, pushing up the interest rate at a given exchange rate. The Bank then increases the money supply to stop interest rates rising so much; this drives down the pound. The fall in the pound stimulates output while the rise in interest rates reduces it; if output rises under the balance of these forces, then the demand for money may rise as much as the supply, leaving prices not much affected. Certainly the rises in variability across the board are rather small as Figure 6 shows (that is, the log of floating variances being kept at 0.1, the falls in relative EMU variances are small.). The political cost of EMU falls somewhat to 1.54 times that of floating.



Floating (Basic Case)=100
FIGURE 6: Floating and EMU compared (higher exchange rate volatility Case)

f) Raising the fiscal stabilisers

Another hope of those who advocate EMU is that discretionary fiscal policy could largely replace monetary policy as a stabiliser. Of course the Stability Pact does in fact limit this possibility and even limits the automatic stabilisers. In our basic EMU case as for floating we permit not only the full operation of the automatic fiscal stabilisers but also a certain degree of discretionary fiscal action - public spending reacts to the output cycle contemporaneously with the small negative (countercyclical) elasticity of -0.125. Consider the example where output falls 3% below potential (i.e. actual output fell 0.5%) , public spending on goods and services would be raised by 0.375%, i.e. approximately 0.1% of GDP. Hence our comparison already allows for probably the maximum realistic fiscal action envisageable under the Pact, if we remember that the automatic stabilisers worsen the budget sharply; the Model implies that the budget deficit would rise by 1.7% of GDP in this example. In a recession where this occurred two years running the deficit would thus rise by 3.4% of GDP before any discretionary boost; our suggested boost would push the rise to 3.6%. But we did look at what could be achieved fiscally by tripling the discretionary fiscal response. The results in Figure 7 show no change in the comparison with floating, for the simple reason that more fiscal activism has essentially the same effects under floating. The political cost of EMU remains at 1.8 times floating. If one assumes that this extra fiscal activism is used only under EMU, there is a slight relative improvement in EMU variability and the cost drops to 1.7 times. But what this shows is that realistic fiscal activism cannot solve the variance problems created by EMU.



Floating (Basic case)=100

Figure 7: Floating and EMU compared (enhanced fiscal case)

Sensitivity - overall conclusions

What we see in these sensitivity trials is that some worsen the relative position of EMU while some improve it. But in no case does the relative position of EMU become reversed, nor does it even come close to that. Whatever one does to the structure of the British economy, it remains the case that EMU makes our economy much more unstable. In Appendix 2 we look further at the source of this greater instability by type of shock (on the Basic Case assumptions); what we find is that about one quarter of the increase in instability is due to the inability of interest rates and the exchange rate to adjust to shocks under EMU, the other three quarters is due to the additional shocks (mainly the swings of the euro against the dollar) injected into the UK economy by EMU. Thus EMU creates 'boom and bust' for the UK not merely because there is inadequate flexibility provided by other mechanisms within EMU to substitute for the stabilising powers of independent monetary policy; but also because EMU itself creates important new sources of instability for the UK because the euro-zone behaves quite differently from the rest of the world (i.e. basically the dollar area) with which the UK has trading relations as important as those with the euro-zone.

Table: The welfare losses (political cost) produced by EMU compared with floating (floating=1.0)+

		ratio of variances (EMU/floating)- output; unemployment; real interest rate; inflation			
The central case	1.75	1.27	1.17	4.39	9.80
No indexation	1.88	1.51	1.43	4.57	7.36
Low interest rate sensitivity	1.63	1.09	1.08	4.11	9.99
More labour market flexibility+	2.24	1.22	1.09	4.30	21.9
High unemployment	1.78	1.27	1.22	4.45	9.91
More exchange rate instability	1.57	1.13	1.15	3.19	8.54
Enhanced fiscal stabilisers*	1.69	1.18	1.14	4.37	9.70

+the weights used in the political cost are (all divided by the weights total of 2.2):1 for output and unemployment variance; 0.1 for inflation and real interest rate variances

*assumes no enhanced fiscal activism under floating

+ monetary policy response to inflation under floating raised by a third (to 1.3), to output lowered by a third (to 0.7), to counteract greater inflation volatility from greater wage volatility.

Utility losses of the representative agent

As we have seen, the estimates of utility reflect the variances produced. It might seem that we can take the percentage change in utility between EMU and floating as percentage change in UK welfare. However, the utility unit is not invariant to units. For example take logarithmic utility: U= a lnc+(1-a)ln(1+u). If we double the unit of consumption we add aln2 to U; thus cutting the percentage difference produced by changes.

What we would like to know is the equivalent percentage change in expected consumption (‘living standard’) of our changes in expected utility. To discover this we take a second-order Taylor-series expansion of expected utility around its value at some fixed point (given by cbar and ubar, for example) and set the total differential to zero:

0=DEU/N= dU/dcD(Ec-cbar)/N +dU/duD(Eu-ubar)/N
+D0.5 [(d^2U/dc^2)varc+ (d^2U/dc^2)varu+(2dU/dcxdU/du)(covc,u)]/N

where N is the number of observations we have (in this case all our 12078 stochastic periods). It follows that in order to hold expected utility constant,

-dU/dcD(Ec-cbar)/N +dU/duD(Eu-ubar) =
+D0.5 [(d^2U/dc^2)varc+ (d^2U/dc^2)varu+(2dU/dcxdU/du)(covc,u)/N

Since the move to the euro involves no change in mean, it follows that the last term due to changing variances is the effect we are picking up in our simulations and there is no change in EC or Eu. If we want to know what percentage consumption change is required to offset this simulated change, we solve this equation for:

D[(Ec-cbar)/cbar]/N= 1/[cbar(dU/dc)]x
{D0.5 [(d^2U/dc^2)varc+ (d^2U/dc^2)varu+(2dU/dcxdU/du)(covc,u)]}/N

Table: The welfare losses produced by EMU compared with floating+:

	The popular cost (weighted variance) (%)	**The representative agent Equiv. Consumption loss (%, converted into £billion p.a.)***	
		rho=1 (logarithmic utility)	**9.0**
The central case	75(4)	0.25(2)	1.8(2)
No indexation	88(2)	0.38(1)	2.6(1)
Low interest rate sensitivity	63 (6)	0.06(7)	0.5(7)
More labour market flexibility	124(1)	0.20 (5)	1.5(4)
High unemployment	78(3)	0.24(3)	1.3(6)
More exchange rate instability	57(7)	0.08(6)	1.4(5)
Enhanced fiscal stabilisers	69(5)	0.24(3)	1.7(3)

- *UK GDP is approximately £1000 billion p.a. hence these numbers can be read as percentages by one point to the left: eg £1.8 billion= 0.18% of GDP.
- +Order in brackets.

Inspection of this table reveals startlingly how little value the representative agent attaches to variance, on plausible values of rho from financial market data. However, one can see that this would be the case by considering the trade-off between mean consumption and its variance for an agent experiencing no unemployment. In this case the Taylor expansion yields:

DEc/cbar= 0.5rho [Dvarc/(cbar)^2]

In our basic case simulations the rise in consumption variance on joining EMU as a percentage of base line consumption squared is just 0.005%. Or put another way the rise in the standard deviation of consumption is 0.69% of consumption. (This is non-durable consumption; adding in the whole of private investment, as if this non-durable spending could be included in consumption would nearly double it to 1.23%.) Even with a rho as high as 9 this only reaches 0.025%, or £0.25 billion per annum.

Hence, in summary, though the ordering of the losses by expected utility is very largely the same as that by the political cost measure we (and others) have used, the scale of effect in terms of percentage change in welfare is massively smaller. Nevertheless, as noted earlier, political experience suggests that popular opinion as reflected in polls and elections is highly sensitive to macroeconomic volatility; consequently we take it, as do other studies, that the relevant measure is what we have termed the political or popular cost, the weighted variance measure.

Comparison with Barrell and Dury

An earlier study by Barrell and Dury (2000), using the National Institute's multi-country model, found that the costs would be less. If we translate their findings into the terms of our boom and bust index, their index would be 41% lower under the euro than under floating. They find that under the euro UK output (and so by implication unemployment) would be 51% more volatile as measured by its variance against our 27%; this greater effect is probably the result of their model structure being more Keynesian (with less price/wage flexibility). However, on inflation they find rather strangely that inflation volatility would actually fall 44% under the euro- our finding was that it would rise by a massive 880%, essentially because the euro's volatility against the dollar would move traded goods prices around sharply, rather as has happened recently in Ireland. On inspection we can account for this different finding in terms of three major differences in the methods they use. First, they assume that the risk-premium on sterling is given by the 'forecasting error' between the forward rate and the exchange rate outturn. However, these two things are different; the risk-premium is an element included in the forward rate as the price of risk, whereas the forecast error is an element occurring later after the price has been quoted. Plainly, the price of risk reflects the anticipation of possible future errors on average (typically their variance); it cannot be assumed to be equal to any and every actual future error. To assume it in a stochastic simulation exercise like this one will in practice make the assumed risk-premium excessively volatile by a large margin. The same criticisms were made of the EU Commission study above where it dramatically biased the results in favour of EMU.

Second, they assume that UK monetary policy is set according to somewhat arbitrary rules- they impose a rigid postulated 'inflation target' operating rule. We assume by contrast that UK interest rates are set according to the rule under which the Monetary Policy Committee does the best possible job it can within the freedom given it by floating exchange rates; this involves interest rates reacting to both inflation and output % deviations from target with a unit coefficient- rather similar to what we observe the MPC do in practice. Given that the MPC has done a rather good job of stabilising both inflation and output in an essentially pragmatic way, and can presumably learn to adjust to changes both in circumstances and the UK's economic behaviour, to assume otherwise as done by Barrell and Dury puts the floating regime under an unfair handicap.

Third, the period from which they draw the shocks with which their model is peppered is 1991-7 during which the crucial euro-dollar exchange rate happens to have been more stable than in the fuller 1986-2000 period we use. One can understand this point more clearly by reference to Figure 8 below; there one can see that from 1986 to 1991 the dollar fell considerably against the euro (Dm before January 1999); from 1991-97 it moved up and down moderately; before then rising again in the latest period to 2000. Thus by omitting both the earlier and the later period the euro-dollar rate's instability is markedly understated. It is likely that were the Barrell-Dury study to be rerun on this basis they too would find that inflation volatility would increase under the euro quite substantially. If so then their overall boom-and-bust index would be comparable to ours, thus joining a series of studies of models indicating this cost would be substantial.

In a recent article Barrell (2002) has criticised this study on a number of grounds. The first is that we drew shocks from the 1980s 'for a currency that nobody then assumed would exist'. However we have to have a sample of shocks for a duration long enough to represent the range of experience the UK might face. 1991-97, chosen by Barrell and Dury, has the problems we saw above; yet even then the euro did not exist. Given the existence of active exchange rate coordination by France (as well as most other countries later forming the euro-zone) with the Dm during the 1980s, it seems reasonable to assume that, had the euro existed, it would have behaved something like the average of the euro currencies. As it happens its behaviour since 1997 has echoed the volatility of the late 1980s as explained already; it would seem safer, given that we must factor in the euro's behaviour, to use a longer period rather than focus on an artificially less volatile, shorter period.

Secondly, Barrell argues that we neglect the reaction of the ECB through its interest-rate setting to the euro's behaviour and in general to UK shocks which are correlated with euro-zone shocks. However, we allowed fully for any correlations between the euro interest rate and both the euro and all UK shocks; the drawings of shocks made for our stochastic simulation are done by the bootstrap method in which the whole set of shocks for a quarter is drawn at once. This means that the correlations between the shocks in the data are fully preserved in the simulations. Hence we are allowing fully for the historical reaction of euro-zone interest rates to UK and euro shocks. Barrell asserts that this can be done better by simulating a multi-country model in which an assumption is made about the ECB's reaction function. But this would be to substitute assumptions for actual historical reactions.

On the particular point that UK inflation volatility would be greater inside the euro, Barrell counters that the ECB would react to dampen it down (unlike in the case of Ireland). Would it do so more than by the average of euro-zone behaviour already captured in the historical correlations? One must doubt it given that the UK would be one country of 13, with a GDP weight of about a fifth.

Interestingly, when all is said and done Barrell and Dury find a much greater increase of UK output volatility on going into EMU than we do. It is over inflation that they differ; and there it is hard to resist the conclusion that they have made a variety of special assumptions that have the effect of greatly understating the inflationary problems the UK would experience, along the lines that Ireland has so dramatically found.

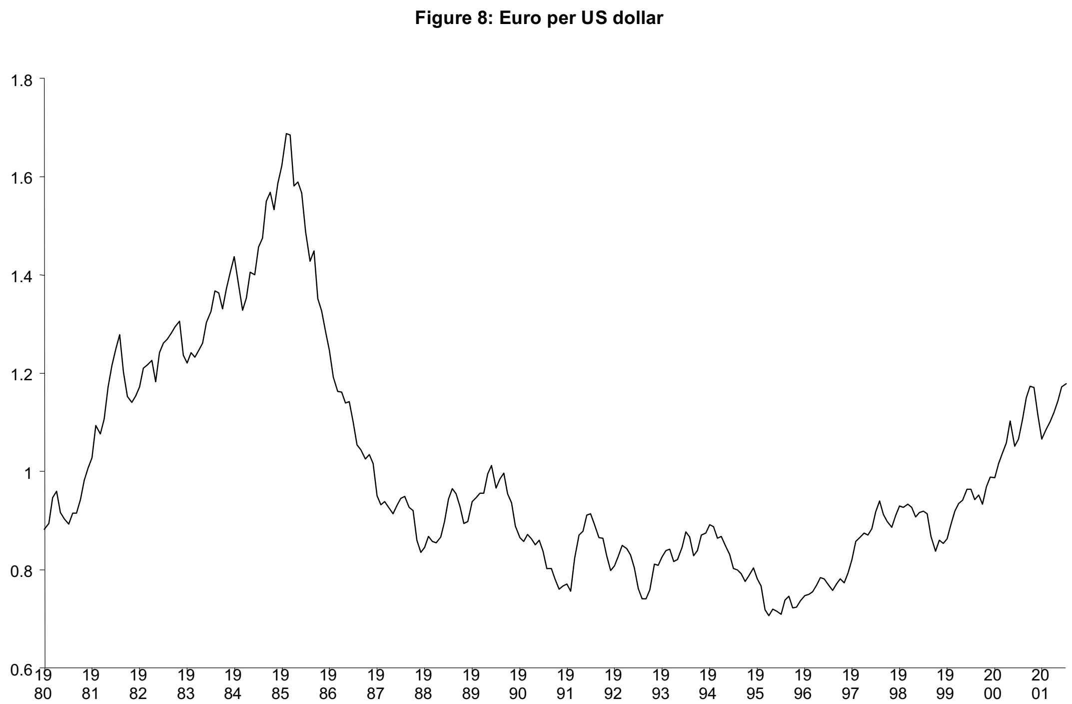


Figure 8: Euro per US dollar (Dm before Jan 1, 1999)

Conclusions

We can summarise our findings as follows. Joining EMU would increase the variability of the UK economy - the 'boom-and-bust' factor - by about 75%. This is also a widely-used measure of the cost, as experienced by politicians facing popular pressures. One quarter of this extra cost comes from the loss of the stabilising powers of independent UK monetary policy; the other three quarters comes from the instability of the euro-zone's own interest rates and exchange rates (which when the UK is floating are absorbed within the general world instability to which UK monetary policy reacts but which when the pound is fixed to the euro actually become the UK's own interest rate and exchange rate, hence impacting directly on the economy.)

This increased cost is largely insensitive to the sort of ameliorative changes that euro advocates have put forward. Greater UK labour market flexibility helps; so does smaller UK responsiveness to interest rates. But the extent is limited; the big difference remains. The reason is that the UK is both unable to respond to shocks optimally with its own interest rate and also is destabilised by euro shocks (especially against the dollar), given that we trade so heavily with the rest of the world. This is the case even though we freely allow fiscal stabilisers full play, not merely the automatic ones but also extra discretionary public spending response to the cycle; tripling that discretionary response helps a little more but the major differential volatility under EMU remains. Were unemployment to reach the double-digit rates we have seen in the early 1980s and early 1990s the difference of variability would be even larger, and it would be more serious too, as the absolute variation in unemployment would rise proportionately more than this higher baseline unemployment. Euro advocates claim that outside EMU the pound would suffer enhanced volatility; our estimates allow for the volatility in the pound's risk-premium experienced in the past decade but we checked what would happen to the comparison if we allowed for a tripling of it. Again, the difference is reduced but not much, basically because the economy's built-in monetary shock absorbers work pretty well. That then remains the key point; running a modern economy with popular consent requires efficient shock absorbers and joining EMU not merely removes them but provides an additional source of shocks from the euro itself.

References:

Andrews, M.J., P. Minford and J. Riley `On comparing macroeconomic models using forecast encompassing tests', *Oxford Bulletin of Economics and Statistics*, Vol. 58, No. 2, 1996, pp. 279-305.

Barrell, R. (2002) 'The UK and EMU: choosing the regime', *National Institute Economic Review*, 180, April, 54-71.

Barrell, R. and K. Dury (2000) 'Choosing the regime: macroeconomic effects of UK entry into EU', *Journal of Common Market Studies*, November 2000, 625-44.

Blanchflower, D.G., and A.J. Oswald (1994), *The Wage Curve*, MIT.

European Commission (1990) 'One Market One Money - an evaluation of the potential benefits and costs of forming an economic and monetary union', *European Economy*, 44, October 1990.

Masson, P. and S. Symansky (1992) 'Evaluating the EMS and EMU using stochastic simulations: some issues', mimeo, IMF, Washington, DC.

Minford, P. (1980) `A Rational Expectations Model of the UK Under Fixed and Floating Exchange Rates', in *The State of Macroeconomics*, (eds. K. Brunner and A. Meltzer), *Carnegie-Rochester Series on Public Policy*, 1980, Vol. 12.

-----------(1983) `Labour Market Equilibrium in an Open Economy', *Oxford Economic Papers*, November 1983 Supplement on Unemployment, Vol. 35(4), reprinted in *The Causes of Unemployment*, (eds. C.A. Greenhalgh, P.R.G. Layard and A.J. Oswald), Oxford University Press, 1983, pp. 207-44.

----------(1992) *Rational Expectations Macroeconomics- an introductory handbook*, Blackwell, Oxford, UK and Cambridge, USA.

----------, A. Rastogi and A. Hughes (1993) 'The price of EMU revisited', *Greek Economic Review*, Vol. 15, No. 1, pp 191-226.

Appendix 1 - methods and assumptions in the stochastic simulations of floating and EMU

The method of stochastic simulation involves applying shocks to a model of the economy. The Liverpool Model of the UK has two versions - the currently used one under floating exchange rates with an independent monetary committee and an EMU variant in which interest rates are set by the ECB. A full listing of each model is appended. An exposition of the nature of the modelling differences that have been applied here can be found in Minford (1992, chapter 8).

It is potentially important to allow for the inter-correlations of the shocks. In order to do this faithfully we use the method of bootstrapping. The shocks used are the sample residuals from the fitted equations over the period 1987(3) to 2000(4), set out in the table below. They have been purged within the equations of any serial correlation so that each shock is independent of past and future shocks. However, contemporaneously one shock can be correlated with another. In bootstrapping one draws all the shock residuals for just one randomly chosen period of the sample; this is then applied to the model; one then replaces it and repeats the process, applying the new shocks to the model; and so on. Hence one obtains a scenario in which all the shocks are repetitions of the actual shocks experienced over 1987-2000; any correlations between the shocks are preserved because all the different shocks are drawn together. It is as if one repeats the experience of all the quarters of actual history but randomly reshuffled.

We filtered out those scenarios that produced very large variability (defined as one with a deviation of output from the base run of more than 10%, under floating with our default monetary rule). This would have created unrealistic overall variances. The source of such extreme drawings are the supply-side shocks in the data; most of these are policy shifts and are found to be 'random walks', because policy changes of these sorts are unpredictable; this means that each random change accumulates permanently in the new 'level' of policy. When a scenario is formed automatically by picking the policy errors in a random order, it is possible that a series of large policy errors could be picked, that would together cumulate to a very large policy shift; however, politically such a large shift would be very likely to generate a backlash, causing the policy to be rescinded because of the large and damaging effect on the economy. One might be tempted to argue that were the cumulation to be good for the economy, it would be permitted (indeed welcomed); however, again it would be likely that any such very large shift in policy would be opposed by vested interests that would lose out, hence delaying or somehow reducing the size of the shift. We decided to filter out all scenarios therefore that produced extreme variability. Out of 400 randomly drawn scenarios that we tried, this left us with the 183 we used. If under particular changes of regime we investigated some scenarios would not solve under either floating or EMU, then they were omitted from the comparison- this occurred under the low-interest-sensitivity case (1 omitted) and the labour-market-flexibility case (4 omitted).

Table A1 The shocks applied under EMU and floating

Period of estimation: 1987(2)-2000(4); c is the constant (not used) and e is the equation error whose standard deviation is shown in the last column

Shocks		Standard error
(Exogenous variables)		
World short-term real interest rates, RSUS (n.a. EMU) fraction p.a.	RSUS = c + 0.899RSUS(-1) +e	0.00396
Euro nominal short-term interest rates, EUNRS (n.a. floating) fraction p.a.	EUNRS = c + 0.977EUNRS(-1) +e	0.00471
World trade, WT	DlogWT = c + e	0.01196
Employers' NI contributions, BO (fraction)	DBO = c + e	0.00216
VAT (fraction)	DVAT = c - 0.286 DVAT(-1) + e	0.00273
Unionisation rate, UNR (fraction)	DUNR = c + 0.869 DUNR(-1) + e	0.00106
Real Unemployment benefits, UB (fraction of initial average wages)	DUB = c + e	0.00266
Employees' tax and NI contributions, LO (fraction)	DLO =c + e	0.00419
Average rate of tax net of transfers, TAX (fraction)	DTAX = c -0.365 DTAX(-1) +e	0.01191
Euro real exchange rate index, EURXR (n.a. floating)	DlogEURXR = c + 0.235 DlogEURXR(-1) + e	0.02743
Euro CPI, EUCPI (n.a. floating)	DlogEUCPI = c + 0.503 DlogEUCPI(-1) + e	0.00285

(Endogenous variable errors)		Shock no. in model listing	
1. Net export volume	e = c + 0.608 e(-1)	17	0.02234
2. Current account (£ millions at constant prices)	e = c + 0.186 e(-1)	6	1166.2
3. Real M0 demand, log (n.a. EMU)	e= c + 0.793 e(-1)	1	0.01141
4. Nominal M0 supply, log (n.a. EMU)	e= c + 0.658 e(-1)	5	0.00863
5. Unemployment (000's), log	e= c + 0.913 e(-1)	9	0.01844
6. Uncovered interest parity (n.a. EMU), fraction p.a.	e= c + 0.652 e(-1)	10	0.00844
7. Stock of all durable goods, log	e= c - 0.272 e(-1	2	0.00187
8. Non-durable consumption, log	e= c + 0.376 e(-1	3	0.00628
9. Real wages, log	e= c + 0.683 e(-1)	8	0.01495
10.Price-cost equation, log	e= c + 0.142 e(-1)	7	0.03396

Table A2 MODEL LISTING

FLOAT

1 $Y^{**}_t=\exp(\{A29*E^{**}_t+A27*\{\log(WT_t)\}+A47\}/\{0.0-A28\}+res\_Y^{**}_t)$

2 $E^{**}_t=A1*\{\log(W^{**}_t)+\log(1.0+BO_t\}+\{1.+A1\}*\log(1.0+VAT_t+A41+A2*TREN_t-\{0.064\}*\{UNR_t\}-\{0.0525\}*\{\{TREN_t-108.\}/4.\}*D87_t$

3 $W^{**}_t=\exp(\{A43+A9*\log(U^{**}_t)+\{.095\}*\{UNR_t\}*\{-A10\}*D83_t+\{.04\}*\{\{TREN_t-108.\}/4.\}*\{-A10\}*D87_t+A7*\{UNR_t\}+A8*\{\log(UB_t)+\log(1.0+LO_t)\}\}/\{-A10\}+res\_W^{**}_t)$

4 $U^{**}_t=\exp(\{A42+A3*\log(Y^{**}_t)+A4*\{\log(W^{**}_t)+\log(1.0+BO_t)+\log(1.0+VAT_t)\}-\{.095\}*\{UNR_t\}*D83_t-\{.04\}*\{\{TREN_t-108.\}/4.\}*D87_t+A5*TREN_t\}/\{1.0-A6\})$

5 $EG^{*}_t=Y^{**}_t*\{TAX_t\}+\{PEQ_t/4.\}*Y^{**}_t*\{FIN_t/Y^{**}_t\}-\{RDI_{t-4}+RDI_{t-5}+RDI_{t-6}+RDI_{t-7}\}/4.0+res\_EG^{*}_t$

6 $EG_t=\exp(\log(EG^{*}_t)+A39*\log(Y_t/Y^{**}_t)+res\_EG_t)$

7 $BDEF_t=EG_t-\{2.0*TAX_t\}*Y_t+TAX0*Y0$

8 $AFC_t=Y_t*\{0.6588318*\{AFC_{t-1}/Y_{t-1}\}+0.1966416*\{AFC_{t-3}/Y_{t-3}\}+0.1454006*\{AFC_{t-4}/Y_{t-4}\}+res\_AFC_t\}$

9 $PSBR_t=BDEF_t+RDI_t$

10 $XVOL_t=A40*Y^{**}_t*\{A27*\{\log(WT_t)\}+\mathbf{shock(17)}+A28*\log(Y_t)+A47+A29*\{E^{**}_t+0.6*\{RXR_t-E^{**}_t\}\}+A30*\{XVOL_{t-1}/\{A40*Y^{**}_{t-1}\}\}\}+res\_XVOL_t$

11 $XVAL_t=XVAL_{t-4}+(XVOL_t-XVOL_{t-4})+A31*\{.32*Y^{**}_t(RXR_t-RXR_{t-4}-E^{**}+E^{**}_{t-4})\}+A32*error(7)+res\_XVAL_t+\mathbf{shock}(6)$

12 $error(7)=-\{XVAL_{t-5}+\{XVOL_{t-1}-XVOL_{t-5}\}+A31*\{.32*Y^{**}_{t-1}*\{RXR_{t-1}-RXR_{t-5}-E^{**}_{t-1}+E^{**}_{t-5}\}\}\}+XVAL_{t-1}$

13 $RL_t=\{RXR_t-EEXL_t\}/5.0+RLUS_t+res\_RL_t$

14 $NRL_t=RL_t+PEXL_t$

15 $M0_t=\exp(A44+A13*\log(M0_{t-1})+A14*\{\log(Y_t)+\log(1.-TAX_{t-1})\}+A15*UB_{t-2}+A16*TREN_t+A17*NRS_t+A18*\{VAT_t\}+\mathbf{shock}(1)+res\_M0_t)$

16 $MON_t=\exp(\log(MON_{t-1})+\{1.-A34\}*\{PEQ_t/4.\}+A34*\{\log(MON_{t-1}/MON_{t-2})\}+A52*\{NRS_t-NRS_{t-1}\}+A55*\{\log Y_t-Y^{**}_t\}+A56*\{INFL_t-0.025\}+\mathbf{shock}(5)+MTEM_t)$

17 $DMXR_t=\{RXR_t-RXR_{t-1}-GERX_t+GERX_{t-1}-\log(P_t/P_{t-1})+\log(GEP_t/GEP_{t-1})+1.00\}*DMXR_{t-1}$

18 $P_t=\exp(\log(P_{t-4})+INFL_t)+res\_P_t$

19 $INFL_t=\log(MON_t)-\log(MON_{t-4})-\log(M0_t)+\log(M0_{t-4})$

20 $error(22)=-\{A42+A3*\log(Y_{t-1})+A4*\{\log(RW_{t-1})+\log(1.0+BO_{t-1})+\log(1.0+VAT_{t-1})\}-\{.095\}*UNR_{t-1}-\{.04\}*\{\{TREN_{t-1}-108.\}/4.\}*D87_{t-1}+A5*TREN_{t-1}+A6*\log(U_{t-2})\}+\log(U_{t-1})$

21 $U_t=\exp(A42+A3*\log(Y_t)+A4*\{\log(RW_t)+\log(1.0+BO_t)+\log(1.0+VAT_t)\}+\mathbf{shock}(9)-\{.095\}*\{UNR_t\}-\{.04\}*\{\{TREN_t-108.\}/4.\}*D87_t+A5*TREN_t+A6*\log(U_{t-1})+A36*error(22)+res\_U_t)$

22 $RS_t=\{RXR_t-EEX_t\} +RSUS_t +$**shock**$(10)+res\_RS_t$

23 $NRS_t=PEXP_t +RS_t +res\_NRS_t$

24 $G_t=exp(A45 +A19*RL_t +A20*\{log(G_{t-1})-log(FIN_{t-1})\} +A21*\{log(G_{t-1})-log(G_{t-2})\} +log(G_{t-1})$ $+$**shock**$(2)+res\_G_t)$

25 $GINV_t=G_t-G_{t-1} +A38*G_{t-1} +res\_GINV_t$

26 $W_t=FIN_t +G_t$

27 $C_t=exp(A46 +A22*RL_t +A23*log(W_t) +A24*QEXP_t +A25*log(C_{t-1}) +$**shock**$(3)+res\_C_t)$

28 $Y_t=GINV_t +C_t +EG_t +XVOL_t-AFC_t +res\_Y_t$

29 $RW_t=exp(A43 +A7*\{UNR_t\} +A8*\{log(UB_t)+log(1.0 +LO_t\} +A9*log(U_t) +A37*log(RW_{t-1})$ $+res\_RW_t +$**shock**$(8)+\{.095\}*\{UNR_t \}*\{-A10\} +DELTA +\{.04/4.\}*\{TREN_t -108.\}*D87_t*\{-A10\} +A10*log(RW_{t-2}) +A11*ETA_t +A12*ETA_{t-1})$

30 $error(14)=-\{A41 +A1*\{log(RW_{t-1}) +log(1.0 +BO_{t-1})\} +A53*\{log(P_{t-1})-log(P_{t-5})\} +\{1. +A1\}*log(1. +VAT_{t-1}) +A2*TREN_{t-1}-\{0.064\}*UNR_{t-1}-\{0.0525\}*\{\{TREN_{t-1}-108.\}/4.\}*D87_{t-1}\} +RXR_{t-1}$

31 $RXR_t=A41 +0.000 +A1*\{log(RW_t) +log(1.0 +BO_t) +A53*\{log(P_t)-log(P_{t-4})\} +\{1. +A1\}*log(1. +VAT_t) +A2*TREN_t +A35*error(14) +res\_RXR_t-\{0.064\}*\{UNR_t\}-\{0.0525\}*\{\{TREN_t-108.\}/4.\}*D87_t +$**shock**$(7)$

32 $FIN_t=EG_t-Y_t*\{TAX_t\} +XVAL_t +A54*FIN_{t-1} +\{1.-A54\}*\{FIN_{t-1}*\{\{P_{t-1}/P_t\}^{0.66}\}\}*\{1.0-0.155*\{\{NRL_t/NRL_{t-1}\}-1.0\}\} +res\_FIN_t +RDI_t$

33 $RDI_t=-.5*\{NRL_{t-1}/4.0\}*FIN_{t-1}*\{\{\{P_t/P_{t-1}\}^{0.66}\}-1.0\} +PSBR_t*\{.32*\{NRS_t/4.0\} +.5*\{NRL_t/4.0\}\} +.32*\{NRS_t/4.\}*FIN_{t-1}-.32*\{NRS_{t-1}/4.\}*FIN_{t-1} +RDI_{t-1}$

34 $UR*_t=U**_t/POP_t$

35 $DY_t=Y_t/Y_{t-4}-1.0$

36 $Q_t=log(Y_t/Y**_t)$

37 $YAFC_t=Y_t +AFC_t$

38 $RXRN_t=\{RXR_t-RXR_{t-1}-log(P_t/P_{t-1}) +WINF_t/4. +1.0 +res\_RXRN_t\}*RXRN_{t-1}$

EMU

1 $Y^{**}_t=\exp(\{A29*E^{**}_t+A27*\{\log(WT_t)\}+A47\}/\{0.0-A28\}+res\_Y^{**}_t)$

2 $E^{**}_t=A1*\{\log(W^{**}_t)+\log(1.0+BO_t)\}+\{1.+A1\}*\log(1.0+VAT_t)+A41+A2*TREN_t-\{0.064\}*\{UNR_t\}-\{0.0525\}*\{\{TREN_t-108.\}/4.\}*D87_t$

3 $W^{**}_t=\exp(\{A43+A9*\log(U^{**}_t)+\{.095\}*\{UNR_t\}*\{-A10\}*D83_t+\{.04\}*\{\{TREN_t-108.\}/4.\}*\{-A10\}*D87_t+A7*\{UNR_t\}+A8*\{\log(UB_t)+\log(1.0+LO_t+)\}\}/\{-A10\}+res\_W^{**}_t)$

4 $U^{**}_t=\exp(\{A42+A3*\log(Y^{**}_t)+A4*\{\log(W^{**}_t)+\log(1.0+BO_t)+\log(1.0+VAT_t)\}-\{.095\}*\{UNR_t\}*D83_t-\{.04\}*\{\{TREN_t-108.\}/4.\}*D87_t+A5*TREN_t\}/\{1.0-A6\})$

5 $EG^{*}_t=Y^{**}_t*\{TAX_t\}+\{PEQ_t/4.\}*Y^{**}_t*\{FIN_t/Y^{**}_t\}-\{RDI_{t-4}+RDI_{t-5}+RDI_{t-6}+RDI_{t-7}\}/4.0+res\_EG^{*}_t$

6 $EG_t=\exp(\log(EG^{*}_t)+A39*\log(Y_t/Y^{**}_t)+res\_EG_t)$

7 $BDEF_t=EG_t-\{2.0*TAX_t\}*Y_t+TAX0*Y0$

8 $AFC_t=Y_t*\{0.6588318*\{AFC_{t-1}/Y_{t-1}\}+0.1966416*\{AFC_{t-3}/Y_{t-3}\}+0.1454006*\{AFC_{t-4}/Y_{t-4}\}+res\_AFC_t\}$

9 $PSBR_t=BDEF_t+RDI_t$

10 $XVOL_t=A40*Y^{**}_t*\{A27*\{\log(WT_t)\}+A28*\log(Y_t)+A47+\mathbf{shock}(4)+A29*\{E^{**}_t+0.6*\{RXR_t-E^{**}_t\}\}+A30*\{XVOL_{t-1}/\{A40*Y^{**}_{t-1}\}\}\}+res\_XVOL_t$

11 $error(7)=-\{XVAL_{t-5}+\{XVOL_{t-1}-XVOL_{t-5}\}+A31*\{.32*Y^{**}_{t-1}*\{RXR_{t-1}-RXR_{t-5}-E^{**}_{t-1}+E^{**}_{t-5}\}\}\}+XVAL_{t-1}$

12 $XVAL_t=XVAL_{t-4}+(XVOL_t-XVOL_{t-4})+A31*\{.32*Y^{**}_t(RXR_t-RXR_{t-4}-E^{**}+E^{**}_{t-4})\}+A32*error(7)+res\_XVAL_t+\mathbf{shock}(6)$

13 $RL_t=\{RXR_t-EEXL_t\}/5.0+RLUS_t+res\_RL_t$

14 $NRL_t=RL_t+PEXL_t$

15 $M0_t=\exp(A44+A13*\log(M0_{t-1})+A14*\{\log(Y_t)+\log(1.-TAX_{t-1})\}+A15*UB_{t-2}+A16*TREN_t+A17*NRS_t+A18*\{VAT_t\}+\mathbf{shock}(1)+res\_M0_t)$

16 $P_t=\exp(0.00625+RXR_t-RXR_{t-1}+DLEUCPI+\log(P_{t-1})-DEURXR)$

17 $INFL_t=\log(P_t)-\log(P_{t-4})+res\_INFL_t$

18 $MON_t=\exp(INFL_t+\log(MON_{t-4})+\log(M0_t)-\log(M0_{t-4}))$

19 $error(22)=-\{A42+A3*\log(Y_{t-1})+A4*\{\log(RW_{t-1})+\log(1.0+BO_{t-1})+\log(1.0+VAT_{t-1})\}-\{.095\}*UNR_{t-1}-\{.04\}*\{\{TREN_{t-1}-108.\}/4.\}*D87_{t-1}+A5*TREN_{t-1}+A6*\log(U_{t-2})\}+\log(U_{t-1})$

20 $U_t=\exp(A42+A3*\log(Y_t)+A4*\{\log(RW_t)+\log(1.0+BO_t)+\log(1.0+VAT_t)\}+\mathbf{shock}(9)-\{.095\}*\{UNR_t\}-\{.04\}*\{\{TREN_{t-1}-108.\}/4.\}*D87_t+A5*TREN_t+A6*\log(U_{t-1})+A36*error(22)+res\_U_t)$

21 $RS_t=NRS_t-PEXP_t+res\_RS_t$

22 $NRS_t=EUNRS_t$

23 $G_t=\exp(A45+A19*RL_t+A20*\{\log(G_{t-1})-\log(FIN_{t-1})\}+A21*\{\log(G_{t-1})-\log(G_{t-2})\}+\log(G_{t-1})+\mathbf{shock}(2)+res\_G_t)$

24 $GINV_t=G_t-G_{t-1} +A38*G_{t-1} +res\_GINV_t$

25 $W_t=FIN_t +G_t$

26 $C_t=exp(A46 +A22*RL_t +A23*log(W_t) +A24*QEXP_t +A25*log(C_{t-1}) +\textbf{shock}(3)+res\_C_t)$

27 $Y_t=GINV_t +C_t +EG_t +XVOL_t-AFC_t +res\_Y_t$

28 $RW_t=exp(A43 +A7*\{UNR_t)\} +A8*\{log(UB_t)+log(1.0 +LO_t)\} +A9*log(U_t) +A37*log(RW_{t-1}) +res\_RW_t +\textbf{shock}(8)+\{.095\}*\{UNR_t)\}*\{-A10\} +DELTA +\{.04/4.\}*\{TREN_t -108.\}*D87_t*\{-A10\} +A10*log(RW_{t-2}) +A11*ETA_t +A12*ETA_{t-1})$

29 $error(14)=-\{A41 +A1*\{log(RW_{t-1}) +log(1.0 +BO_{t-1})\} +A53*\{log(P_{t-1})-log(P_{t-5})\} +\{1. +A1\}*log(1. +VAT_{t-1}) +A2*TREN_{t-1}-\{0.064\}*UNR_{t-1}-\{0.0525\}*\{\{TREN_{t-1}-108.\}/4.\}*D87_{t-1}\} +RXR_{t-1}$

30 $RXR_t=A41 +0.000 +A1*\{log(RW_t) +log(1.0 +BO_t)\} +A53*\{log(P_t)-log(P_{t-4})\} +\{1. +A1\}*log(1. +VAT_t)+A2*TREN_t +A35*error(14) +res\_RXR_t-\{0.064\}*\{UNR_t\}-\{0.0525\}*\{\{TREN_t-108.\}/4.\}*D87_t +\textbf{shock}(7)$

31 $FIN_t=EG_t-Y_t*\{TAX_t\} +XVAL_t +A54*FIN_{t-1} +\{1.-A54\}*\{FIN_{t-1}*\{\{P_{t-1}/P_t\}^{0.66}\}\}*\{1.0-0.155*\{\{NRL_t/NRL_{t-1}\}-1.0\}\} +res\_FIN_t +RDI_t$

32 $RDI_t=-.5*\{NRL_{t-1}/4.0\}*FIN_{t-1}*\{\{\{P_t/P_{t-1}\}^{0.66}\}-1.0\} +PSBR_t*\{.32*\{NRS_t/4.0\} +.5*\{NRL_t/4.0\}\} +.32*\{NRS_t/4.\}*FIN_{t-1}-.32*\{NRS_{t-1}/4.\}*FIN_{t-1} +RDI_{t-1}$

33 $UR*_t=U**_t/POP_t$

34 $DY_t=Y_t/Y_{t-4}-1.0$

35 $Q_t=log(Y_t/Y**_t)$

36 $YAFC_t=Y_t +AFC_t$

37 $RXRN_t=\{RXR_t-RXR_{t-1}-log(P_t/P_{t-1}) +WINF_t/4. +1.0 +res\_RXRN_t\}*RXRN_{t-1}$

38 $LEUCPI_t=0.502789*LEUCPI_{t-1}$

39 $LEURXR_t=0.23475*LEURXR_{t-1}$

Coefficient values in order A1-56:

1.528	-0.003	-2.150	0.792	0.010	0.804	0.470	0.210	-0.018	-0.224
-0.290	0.189	0.870	0.150	0.000	-0.002	-0.349	0.839	-0.016	-0.004
0.640	-0.215	0.056	0.153	0.870	0.000	0.529	-1.205	-0.388	0.429
0.103	0.193	0.000	0.000	0.931	0.271	1.000	0.012	-0.125	0.320
0.170	25.262	0.102	-0.337	0.013	0.666	11.503	-0.016	-0.011	0.017
0.011	0.750	-0.750	0.300	-1.000	-1.000				

GLOSSARY of model variables:

Endogenous Variable

Y	GDP at factor cost
XVOL	Net exports of goods and services
C	Non-Durable Consumption
GINV	Private Sector Gross Investment Expenditure
EG	Government Expenditure
AFC	Adjustment to Factor Cost
DY	Percentage growth rate of Y (year-on-year)
G	Stock of Physical Goods
FIN	Financial Assets
W	Wealth
NRL	Nominal 5 year interest rate
NRS	Nominal deposits with local authorities (3 month)
RL	Real 5 year interest rate
RS	Real deposits with local authorities (3 month)
P	Consumer Price Level
INFL	Percentage growth rate of P (year-on-year)
XVAL	Current account deflated by P
MON	Nominal Money Stock (M0)
M0	MON divided by P
RXRN	Trade-weighted exchange rate
RXR	Real exchange rate
AE	Average Earnings
RW	Real wages (AE/P)
Y**	Equilibrium output
E**	Equilibrium real exchange rate
W**	Equilibrium real wage
U**	Equilibrium unemployment
U	Unemployment
Q	Output deviation from trend (Y/Y**)
PSBR	Public Sector Borrowing Requirement
RDI	Real Debt Interest
YAFC	GDP at market prices
EG*	Equilibrium government expenditure
UR*	Equilibrium unemployment rate
BDEF	Budget deficit

Exogenous Variable

TREND	Time trend
TAX	Tax Rate
WT	Volume of world trade
RLUS	Foreign real long interest rate
PEQ	Growth of money supply
RSUS	Foreign real short-term interest rate
MTEM	Temporary growth of money supply
BO	Employers national insurance contributions
LO	Average amount lost in taxes and national insurance
UB	Unemployment benefit
UNR	Trade Unionisation rate
POP	Working population
RPI	Growth of retail prices (year-on-year)
DMXR	German exchange rate
LEURXR	Log Euro real effective exchange rate
LEUCPI	Log Euro area consumer price index

Table A3 Listing of all simulation results

FLOAT

	nrl	nrs	w	m0	g	fin	xval	y
Variance	0.000118	0.00089	2.13E+10	3955231	1.31E+10	1.73E+09	15584243	21232361
St. Dev	0.010844	0.029827	145793.2	1988.776	114531	41549.44	3947.688	4607.859
Average	0.002961	0.007924	-22868.1	-524.926	-16463.9	-6458.49	374.0765	-350.039

	bdef	xvol	rl	rs	infl	rxr	c	eg
Variance	7017828	9771800	8.77E-05	0.000674	0.000445	0.01179	8541905	79534390
St. Dev	2649.118	3125.988	0.009367	0.025958	0.021099	0.108581	2922.654	8918.206
Average	-149.915	492.882	0.000702	0.003861	0.00407	-0.00785	-1000.39	823.005

	rw	y*	e*	w*	u*	u	dy	afc
Variance	0.007348	10013598	0.003753	0.005277	41236.01	90827.65	0.000704	496302.3
St. Dev	0.085721	3164.427	0.061262	0.072644	203.0665	301.3763	0.026541	704.4872
Average	-0.00669	313.6802	-0.0055	-0.00271	18.06171	42.82563	9.59E-05	-48.0741

	q	psbr	rdi	yafc	eg*	ur*	rxrn	ginv
Variance	0.000639	7742460	570136.3	28220112	66396871	4.92E-05	143.5533	51213790
St. Dev	0.025287	2782.528	755.0737	5312.261	8148.428	0.007017	11.98137	7156.381
Average	-0.00431	96.35173	243.9671	-396.595	732.598	0.000623	-2.30826	-713.867

	mon	p	dmxr	leurxr	leucpi	pop
Variance	21789548	0.030316	0.087917	0.00082	2.79E-05	0
St. Dev	4667.928	0.174115	0.296508	0.028636	0.005278	0
Average	157.8405	0.054425	-0.04789	0.000123	2.63E-05	0

EMU

	nrl	nrs	w	m0	g	fin	xval	y
Variance	6.69E-05	0.000313	2.91E+10	3349859	1.73E+10	3E+09	15495228	26512233
St. Dev	0.008178	0.017694	170443.1	1830.262	131418.4	54771.06	3936.398	5149.003
Average	-0.00069	0.000385	-29167	-198.185	-22095.1	-7067.53	339.4966	-330.202

	bdef	xvol	rl	rs	infl	rxr	c	eg
Variance	8360353	9350078	0.000179	0.002959	0.004346	0.012818	13050174	81485530
St. Dev	2891.427	3057.79	0.013362	0.054399	0.065925	0.113215	3612.502	9026.934
Average	135.6328	448.7025	5.42E-05	0.00127	0.000387	-0.0058	-1004.74	1103.406

	rw	y*	e*	w*	u*	u	dy	afc
Variance	0.007282	10013361	0.003753	0.005277	41235.17	106299.5	0.000858	620800.3
St. Dev	0.085332	3164.39	0.061262	0.072644	203.0645	326.036	0.029291	787.9088
Average	-0.00633	313.5301	-0.0055	-0.00272	18.06947	55.47575	0.000141	-49.315

	q	psbr	rdi	yafc	eg*	ur*	rxrn	ginv
Variance	0.000814	8428751	417125.9	35243678	68037473	4.92E-05	696.0874	65016174
St. Dev	0.028529	2903.231	645.8529	5936.639	8248.483	0.007017	26.38347	8063.261
Average	-0.00436	99.92628	-40.9181	-379.329	983.5998	0.000624	1.668608	-926.856

	mon	p	dmxr	leurxr	leucpi	pop
Variance	67684057	0.240241	0	0.000941	8.37E-06	0
St. Dev	8227.032	0.490144	0	0.030678	0.002894	0
Average	705.4423	0.069268	0	0.000164	2E-05	0

FLOAT (no indexation case)

	nrl	nrs	w	m0	g	fin	xval	y
Variance	0.000113	0.000905	2.11E+10	3992348	1.3E+10	1.63E+09	15192019	19930554
St. Dev	0.010637	0.030078	145342.9	1998.086	114222.3	40349.24	3897.694	4464.365
Average	0.002811	0.006002	-23507.4	-414.685	-16569.2	-6984.68	340.6618	-242.145

	bdef	xvol	rl	rs	infl	rxr	c	eg
Variance	6665926	9678235	8.75E-05	0.000739	0.000327	0.012061	8204301	79018165
St. Dev	2581.846	3110.986	0.009354	0.027176	0.018072	0.109821	2864.315	8889.216
Average	-149.639	467.7371	0.000104	0.001596	0.003419	-0.01101	-898.197	843.4946

	rw	y*	e*	w*	u*	u	dy	afc
Variance	0.00827	10013581	0.003753	0.005277	41235.69	94057.41	0.00065	465624.3
St. Dev	0.090941	3164.424	0.061262	0.072644	203.0657	306.6878	0.025503	682.3667
Average	-0.00888	313.6883	-0.0055	-0.00271	18.06134	10.33851	7.57E-05	-34.6155

	q	psbr	rdi	yafc	eg*	ur*	rxrn	ginv
Variance	0.000569	7044873	539611.8	26489510	65897522	4.92E-05	143.6516	49957623
St. Dev	0.023853	2654.218	734.5828	5146.796	8117.729	0.007017	11.98547	7068.071
Average	-0.00347	76.05683	222.6188	-275.691	754.5468	0.000623	-1.97617	-689.648

	mon	p	dmxr	leurxr	leucpi	pop
Variance	20146879	0.02683	0.088734	0.00082	2.79E-05	0
St. Dev	4488.528	0.163798	0.297883	0.028636	0.005278	0
Average	-26.0406	0.036847	-0.03918	0.000123	2.62E-05	0

EMU (no indexation case)

	nrl	nrs	w	m0	g	fin	xval	y
Variance	6.45E-05	0.000313	3E+10	3317939	1.77E+10	3.34E+09	16123775	29761416
St. Dev	0.008033	0.017694	173266	1821.521	133125.7	57759.36	4015.442	5455.402
Average	-0.00069	0.000385	-28491.5	-197.987	-22083.2	-6400.04	334.5486	-300.016

	bdef	xvol	rl	rs	infl	rxr	c	eg
Variance	8845976	9795663	0.000261	0.003083	0.003273	0.014497	14890765	81450208
St. Dev	2974.219	3129.802	0.016159	0.055525	0.05721	0.120402	3858.855	9024.977
Average	103.5404	447.4065	-3.9E-05	0.001009	0.000315	-0.00638	-971.988	1087.059

	rw	y*	e*	w*	u*	u	dy	afc
Variance	0.008824	10013348	0.003753	0.005277	41234.88	130146.4	0.000948	697034.1
St. Dev	0.093934	3164.388	0.061262	0.072644	203.0637	360.758	0.030783	834.8857
Average	-0.00659	313.541	-0.0055	-0.00272	18.06908	63.14481	0.000216	-43.9527

	q	psbr	rdi	yafc	eg*	ur*	rxrn	ginv
Variance	0.000963	8919954	441956	39564681	68067969	4.92E-05	695.7439	67962028
St. Dev	0.031026	2986.629	664.7977	6290.046	8250.331	0.007017	26.37696	8243.909
Average	-0.00424	88.96297	-19.7337	-343.684	970.0182	0.000624	1.653499	-906.403

	mon	p	dmxr	leurxr	leucpi	pop
Variance	63512177	0.22134	0	0.000941	8.37E-06	0
St. Dev	7969.453	0.470467	0	0.030678	0.002894	0
Average	636.6969	0.063874	0	0.000164	2.01E-05	0

FLOAT (low interest rate sensitivity case)

	nrl	nrs	w	m0	g	fin	xval	y
Variance	0.000124	0.000897	2.12E+10	3984876	1.32E+10	1.64E+09	15474845	21025008
St. Dev	0.011149	0.029947	145610.8	1996.215	114971.7	40440.07	3933.808	4585.303
Average	0.0027	0.007442	-24483.5	-507.015	-17778.9	-6755.71	349.669	-340.002

	bdef	xvol	rl	rs	infl	rxr	c	eg
Variance	7040870	9803203	9.56E-05	0.000696	0.000421	0.011796	8581842	78742427
St. Dev	2653.464	3131.007	0.009779	0.026382	0.020517	0.10861	2929.478	8873.693
Average	-129.001	459.9271	0.000733	0.003795	0.003906	-0.00674	-993.806	913.2101

	rw	y*	e*	w*	u*	u	dy	afc
Variance	0.00735	9983863	0.003744	0.005299	41290.31	88599.95	0.000704	491441.1
St. Dev	0.085734	3159.725	0.061191	0.072797	203.2002	297.6574	0.02654	701.0286
Average	-0.00629	295.9065	-0.00516	-0.00256	18.97455	43.47471	0.000111	-48.4133

	q	psbr	rdi	yafc	eg*	ur*	rxrn	ginv
Variance	0.000623	7663613	539941.5	27943530	65730906	4.93E-05	147.5493	52265145
St. Dev	0.024968	2768.323	734.8071	5286.164	8107.46	0.007022	12.14699	7229.464
Average	-0.00414	95.37871	221.6764	-387.413	814.834	0.000655	-2.29193	-767.728

	mon	p	dmxr	leurxr	leucpi	pop
Variance	20924344	0.027905	0.090532	0.000819	2.79E-05	0
St. Dev	4574.314	0.167048	0.300885	0.028626	0.005285	0
Average	154.2935	0.051692	-0.04775	0.000135	2.27E-05	0

EMU (low interest rate sensitivity case)

	nrl	nrs	w	m0	g	fin	xval	y
Variance	6.64E-05	0.000314	2.75E+10	3340051	1.71E+10	2.26E+09	14691455	23100828
St. Dev	0.00815	0.01773	165927.5	1827.581	130829.5	47530.67	3832.943	4806.332
Average	-0.00079	0.000375	-29640.4	-198.956	-22766.9	-6867.75	302.9659	-308.893

	bdef	xvol	rl	rs	infl	rxr	c	eg
Variance	7842940	9104969	0.000193	0.00286	0.004205	0.013019	9625500	80654713
St. Dev	2800.525	3017.444	0.013884	0.053476	0.064847	0.114101	3102.499	8980.797
Average	135.6021	405.5007	0.000102	0.001248	0.000539	-0.00487	-1001.3	1176.405

	rw	y*	e*	w*	u*	u	dy	afc
Variance	0.0072	9983655	0.003744	0.005299	41289.37	95807.13	0.000767	540299.1
St. Dev	0.084853	3159.692	0.061191	0.072798	203.1979	309.5273	0.027689	735.0504
Average	-0.00592	295.6964	-0.00516	-0.00257	18.98462	51.32401	0.000124	-46.6867

	q	psbr	rdi	yafc	eg*	ur*	rxrn	ginv
Variance	0.000677	7924365	352560.2	30703618	67324687	4.93E-05	697.9249	62002174
St. Dev	0.026022	2815.025	593.7678	5541.085	8205.162	0.007022	26.41827	7874.146
Average	-0.00405	95.62537	-45.1639	-355.43	1051.125	0.000656	1.637758	-936.15

	mon	p	dmxr	leurxr	leucpi	pop
Variance	67918564	0.240773	0	0.00094	8.38E-06	0
St. Dev	8241.272	0.490687	0	0.030662	0.002895	0
Average	748.0191	0.071609	0	0.000179	1.91E-05	0

FLOAT (more flexibility case)

	nrl	nrs	w	m0	g	fin	xval	y
Variance	7.92E-05	0.00072	2.26E+10	4457748	1.41E+10	1.77E+09	14623628	20283046
St. Dev	0.008897	0.026829	150218.5	2111.338	118620.7	42074.43	3824.085	4503.67
Average	0.001704	0.006255	-28841.3	-504.76	-21423.3	-7443.4	347.892	-392.803

	bdef	xvol	rl	rs	infl	rxr	c	eg
Variance	7709998	8615980	8.45E-05	0.000698	0.0002	0.009751	9266541	76200897
St. Dev	2776.688	2935.299	0.009192	0.026426	0.01413	0.098749	3044.099	8729.313
Average	-67.0525	437.6866	0.000665	0.003992	0.002334	-0.00463	-1069.54	1085.481

	rw	y*	e*	w*	u*	u	dy	afc
Variance	0.004266	9967493	0.003737	0.005249	41452.66	10906.52	0.000708	474068.5
St. Dev	0.065311	3157.134	0.06113	0.072451	203.5993	104.4343	0.026602	688.5263
Average	-0.0057	269.7118	-0.00462	-0.00227	20.6295	14.18137	0.000119	-58.2464

	q	psbr	rdi	yafc	eg*	ur*	rxrn	ginv
Variance	0.000591	8499642	368615.6	26957881	63852390	4.95E-05	66.93973	52718765
St. Dev	0.024313	2915.414	607.1372	5192.098	7990.769	0.007036	8.18167	7260.769
Average	-0.0043	70.19813	133.9966	-450.58	972.3141	0.000713	-2.08255	-904.592

	mon	p	dmxr	leurxr	leucpi	pop
Variance	9737966	0.005077	0.040941	0.000818	2.8E-05	0
St. Dev	3120.571	0.071251	0.202339	0.028605	0.005291	0
Average	-154.893	0.027796	-0.04856	0.000169	7.56E-06	0

EMU (more flexibility case)

	nrl	nrs	w	m0	g	fin	xval	y
Variance	6.68E-05	0.000316	2.94E+10	3671577	1.79E+10	2.75E+09	14707662	24331501
St. Dev	0.008174	0.017777	171584.1	1916.136	133844.3	52461.47	3835.057	4932.697
Average	0.000513	0.000359	-29990	-222.559	-23217.8	-6769.06	326.5523	-405.906

	bdef	xvol	rl	rs	infl	rxr	c	eg
Variance	8865540	8659324	0.000157	0.002979	0.004372	0.011195	12799582	80066855
St. Dev	2977.506	2942.673	0.012511	0.054579	0.06612	0.105808	3577.65	8948.008
Average	112.9576	405.6287	0.000929	0.002171	0.000669	-0.00204	-1128.29	1255.705

	rw	y*	e*	w*	u*	u	dy	afc
Variance	0.004291	9967507	0.003737	0.005249	41452.06	11932.02	0.00083	569600.3
St. Dev	0.065509	3157.136	0.061131	0.072451	203.5978	109.2338	0.028812	754.7187
Average	-0.0046	269.7393	-0.00462	-0.00227	20.63081	26.46545	0.000132	-62.5916

	q	psbr	rdi	yafc	eg*	ur*	rxrn	ginv
Variance	0.000719	9089364	422184.5	32342694	67215824	4.95E-05	694.4464	64925310
St. Dev	0.026817	3014.857	649.7573	5687.064	8198.526	0.007036	26.35235	8057.624
Average	-0.00456	90.98101	-26.6563	-468.556	1123.2	0.000713	1.512212	-1001.43

	mon	p	dmxr	leurxr	leucpi	pop
Variance	43354737	0.14473	0	0.000939	8.39E-06	0
St. Dev	6584.431	0.380435	0	0.030644	0.002896	0
Average	640.0889	0.059345	0	0.000221	1.52E-05	0

FLOAT (high natural rate of unemployment case)

	nrl	nrs	w	m0	g	fin	xval	y
Variance	0.000119	0.000881	1.97E+10	3508452	1.24E+10	1.44E+09	14617084	19544262
St. Dev	0.010924	0.029685	140281.8	1873.086	111574.2	37881.73	3823.23	4420.889
Average	0.002259	0.006261	-19507	-397.406	-14233	-5316.86	230.9102	-191.947

	bdef	xvol	rl	rs	infl	rxr	c	eg
Variance	6392589	8892795	8.65E-05	0.000666	0.00044	0.011738	8337054	72390793
St. Dev	2528.357	2982.079	0.0093	0.025811	0.020977	0.108344	2887.396	8508.278
Average	-68.5385	340.0516	0.000703	0.003207	0.003254	-0.00592	-811.473	888.0451

	rw	y*	e*	w*	u*	u	dy	afc
Variance	0.008926	9085367	0.003753	0.006474	252103.2	544666.5	0.00072	456867.2
St. Dev	0.094476	3014.194	0.061262	0.080459	502.0988	738.0152	0.026824	675.9195
Average	-0.0059	298.775	-0.0055	-0.00301	44.66246	106.3313	0.000137	-21.622

	q	psbr	rdi	yafc	eg*	ur*	rxrn	ginv
Variance	0.00064	6996862	478188.6	25975959	60415202	0.000301	197.6934	47419816
St. Dev	0.025298	2645.158	691.5118	5096.662	7772.722	0.01735	14.06035	6886.205
Average	-0.0034	64.92296	131.1242	-211.788	795.2711	0.001542	-1.96557	-630.765

	mon	p	dmxr	leurxr	leucpi	pop
Variance	18067021	0.028728	0.120978	0.00082	2.79E-05	0
St. Dev	4250.532	0.169495	0.347818	0.028636	0.005278	0
Average	119.4392	0.042322	-0.03985	0.000123	2.62E-05	0

EMU (high natural rate of unemployment case)

	nrl	nrs	w	m0	g	fin	xval	y
Variance	6.68E-05	0.000313	2.57E+10	2977536	1.57E+10	2.39E+09	14680304	23914071
St. Dev	0.008171	0.017694	160273.8	1725.554	125298.4	48929.12	3831.488	4890.202
Average	-0.00024	0.000385	-25901.7	-178.176	-20144	-5752.94	276.4876	-230.223

	bdef	xvol	rl	rs	infl	rxr	c	eg
Variance	7520732	8492085	0.000178	0.002967	0.004359	0.012829	12101349	73820353
St. Dev	2742.395	2914.118	0.013359	0.054474	0.066024	0.113264	3478.699	8591.877
Average	104.8852	385.3918	-0.00019	-1.1E-05	0.000445	-0.00657	-872.952	1045.653

	rw	y*	e*	w*	u*	u	dy	afc
Variance	0.008906	9085113	0.003753	0.006474	252096.6	666268.9	0.000874	559502.8
St. Dev	0.09437	3014.152	0.061262	0.08046	502.0923	816.2529	0.029566	747.9992
Average	-0.0073	298.6344	-0.0055	-0.00301	44.67757	125.4707	0.000203	-34.2968

	q	psbr	rdi	yafc	eg*	ur*	rxrn	ginv
Variance	0.000814	7602742	322571.4	31785955	61593264	0.000301	696.0924	58349470
St. Dev	0.02853	2757.307	567.9537	5637.903	7848.138	0.01735	26.38356	7638.682
Average	-0.00382	79.84346	-29.5875	-264.391	934.1021	0.001544	1.668624	-822.679

	mon	p	dmxr	leurxr	leucpi	pop
Variance	81555346	0.324602	0	0.000941	8.38E-06	0
St. Dev	9030.8	0.569739	0	0.030678	0.002894	0
Average	779.4782	0.079716	0	0.000164	2E-05	0

FLOAT (bubble case)

	nrl	nrs	w	m0	g	fin	xval	y
Variance	0.00012	0.001099	2.09E+10	4000559	1.3E+10	1.81E+09	16792154	22013878
St. Dev	0.010951	0.033157	144579.8	2000.14	114164.1	42539.9	4097.823	4691.895
Average	0.00305	0.008281	-29346.1	-567.113	-21540	-7860.78	475.4787	-497.342

	bdef	xvol	rl	rs	infl	rxr	c	eg
Variance	7332189	10528977	8.93E-05	0.000926	0.000509	0.011773	8487961	79360724
St. Dev	2707.801	3244.838	0.009452	0.030424	0.022566	0.108505	2913.411	8908.464
Average	-135.985	609.3479	0.000585	0.003793	0.00474	-0.00874	-1132.16	897.009

	rw	y*	e*	w*	u*	u	dy	afc
Variance	0.007515	10027939	0.003761	0.005321	41472.23	92039.75	0.000857	514380.7
St. Dev	0.086687	3166.692	0.061324	0.072944	203.6473	303.3805	0.029272	717.2034
Average	-0.00747	295.2881	-0.00514	-0.00265	19.21175	48.36771	9.28E-05	-70.5893

	q	psbr	rdi	yafc	eg*	ur*	rxrn	ginv
Variance	0.000719	7978562	785596.3	29257238	66261055	4.95E-05	145.9203	54997224
St. Dev	0.026816	2824.635	886.3387	5408.996	8140.089	0.007037	12.07975	7416.011
Average	-0.00513	133.5072	267.2338	-566.434	795.9075	0.000663	-2.92389	-942.343

	mon	p	dmxr	leurxr	leucpi	pop
Variance	23198686	0.033173	0.088996	0.00082	2.79E-05	0
St. Dev	4816.501	0.182133	0.298322	0.028642	0.005277	0
Average	237.2209	0.062526	-0.06274	0.000166	5.44E-05	0

EMU (bubble case)

	nrl	nrs	w	m0	g	fin	xval	y
Variance	6.69E-05	0.000313	2.91E+10	3349859	1.73E+10	3E+09	15495228	26512233
St. Dev	0.008178	0.017694	170443.1	1830.262	131418.4	54771.06	3936.398	5149.003
Average	-0.00069	0.000385	-29167	-198.185	-22095.1	-7067.53	339.4966	-330.202

	bdef	xvol	rl	rs	infl	rxr	c	eg
Variance	8360353	9350078	0.000179	0.002959	0.004346	0.012818	13050174	81485530
St. Dev	2891.427	3057.79	0.013362	0.054399	0.065925	0.113215	3612.502	9026.934
Average	135.6328	448.7025	5.42E-05	0.00127	0.000387	-0.0058	-1004.74	1103.406

	rw	y*	e*	w*	u*	u	dy	afc
Variance	0.007282	10013361	0.003753	0.005277	41235.17	106299.5	0.000858	620800.3
St. Dev	0.085332	3164.39	0.061262	0.072644	203.0645	326.036	0.029291	787.9088
Average	-0.00633	313.5301	-0.0055	-0.00272	18.06947	55.47575	0.000141	-49.315

	q	psbr	rdi	yafc	eg*	ur*	rxrn	ginv
Variance	0.000814	8428751	417125.9	35243678	68037473	4.92E-05	696.0874	65016174
St. Dev	0.028529	2903.231	645.8529	5936.639	8248.483	0.007017	26.38347	8063.261
Average	-0.00436	99.92628	-40.9181	-379.329	983.5998	0.000624	1.668608	-926.856

	mon	p	dmxr	leurxr	leucpi	pop
Variance	67684057	0.240241	0	0.000941	8.37E-06	0
St. Dev	8227.032	0.490144	0	0.030678	0.002894	0
Average	705.4423	0.069268	0	0.000164	2E-05	0

FLOAT (enhanced fiscal case)

	nrl	nrs	w	m0	g	fin	xval	y
Variance	0.000115	0.000865	2.17E+10	3966379	1.34E+10	1.78E+09	15139460	20417756
St. Dev	0.010713	0.029403	147168.5	1991.577	115544.2	42143.55	3890.946	4518.601
Average	0.002319	0.005823	-24337	-413.468	-17792.7	-6590.49	330.4294	-298.146

	bdef	xvol	rl	rs	infl	rxr	c	eg
Variance	7482929	9261552	8.82E-05	0.000666	0.000421	0.011712	8667542	77998318
St. Dev	2735.494	3043.28	0.009392	0.025809	0.020526	0.108221	2944.069	8831.666
Average	-57.1405	446.2176	0.000728	0.002773	0.00377	-0.0073	-961.41	923.5136

	rw	y*	e*	w*	u*	u	dy	afc
Variance	0.007277	10013617	0.003753	0.005277	41235.93	89602.03	0.000659	477376.8
St. Dev	0.085305	3164.43	0.061262	0.072643	203.0663	299.336	0.025664	690.9246
Average	-0.00636	313.6716	-0.0055	-0.00271	18.06221	39.99596	0.000111	-40.6231

	q	psbr	rdi	yafc	eg*	ur*	rxrn	ginv
Variance	0.000595	8292657	574957.7	27137701	66475045	4.92E-05	137.0712	51904749
St. Dev	0.024388	2879.697	758.2597	5209.386	8153.223	0.007017	11.70774	7204.495
Average	-0.00395	106.2383	160.761	-337.512	811.726	0.000623	-2.01727	-747.073

	mon	p	dmxr	leurxr	leucpi	pop
Variance	20544493	0.027188	0.084031	0.00082	2.79E-05	0
St. Dev	4532.603	0.164887	0.289881	0.028636	0.005278	0
Average	194.1116	0.04666	-0.04083	0.000123	2.63E-05	0

EMU (enhanced fiscal case)

	nrl	nrs	w	m0	g	fin	xval	y
Variance	6.69E-05	0.000313	2.94E+10	3359146	1.74E+10	3.05E+09	15094090	25188925
St. Dev	0.008177	0.017694	171353.6	1832.797	132080.6	55234.69	3885.111	5018.857
Average	-0.00069	0.000385	-29114.3	-195.861	-22192.5	-6917.19	323.9897	-312.293

	bdef	xvol	rl	rs	infl	rxr	c	eg
Variance	9060720	8807916	0.000179	0.002947	0.004333	0.012792	12800767	80339995
St. Dev	3010.103	2967.813	0.013389	0.054285	0.065827	0.113103	3577.816	8963.258
Average	153.1117	432.5113	5.65E-05	0.001233	0.000408	-0.00572	-993.133	1120.561

	rw	y*	e*	w*	u*	u	dy	afc
Variance	0.007218	10013426	0.003753	0.005277	41235.15	103926.6	0.000798	590012.9
St. Dev	0.084959	3164.4	0.061262	0.072644	203.0644	322.3765	0.028246	768.1229
Average	-0.00622	313.5824	-0.0055	-0.00272	18.06748	53.89415	0.000137	-47.0362

	q	psbr	rdi	yafc	eg*	ur*	rxrn	ginv
Variance	0.000752	9173605	436070	33486125	68251213	4.92E-05	696.0824	65565519
St. Dev	0.027418	3028.796	660.356	5786.72	8261.429	0.007017	26.38337	8097.254
Average	-0.00423	120.9259	-37.2313	-359.216	981.8296	0.000624	1.668353	-919.16

	mon	p	dmxr	leurxr	leucpi	pop
Variance	67627537	0.240009	0	0.000941	8.37E-06	0
St. Dev	8223.596	0.489907	0	0.030678	0.002894	0
Average	711.017	0.069364	0	0.000164	2E-05	0

Appendix 2: Decomposing the results by types of shock:

In the work reported above we lump all shocks together. This makes sense because shocks are correlated with one another; to run one and then another separately when the two are connected, distorts the effect of each. Nevertheless it can shed some light on the main sources of our results to run groups of shocks separately, provided one bears this in mind.

We first separated out the supply shocks: Tables A2.1-2. The ratios of variances (EMU/floating) are 1.20 for output, 1.03 for unemployment, 1.43 for real interest rates, and 2.04 for inflation. The political cost would be 1.17. Supply shocks alone would therefore produce about a quarter of the total political cost (three quarters of the outout variance).

Tables A2.3-4 show the demand shocks on their own. It can readily be seen that floating and EMU are rather similar in dealing with these; in fact EMU appears to have a slight advantage, apparently associated with a monetary response under floating that is sub-optimal for dealing with demand shocks alone (one sign of this is that one of the scenarios does not solve under floating).

In Tables A2.5-6 we examine the external shocks on their own. It can be seen that under EMU the effect of external shocks is many multiples of their effect under floating, reflecting two things; that floating insulates the economy from external shocks whereas EMU does not, and secondly that EMU introdues new external, EMU-specific, shocks. One can see that external shocks are thus by far the most important source of the gap between floating and EMU variability.

It is more informative to break the external shocks from EMU down further. In Tables A2. 7-9 we include all the external shocks present in both EMU and floating- world real interest rates and world trade - but only enter in turn and alone the three external shocks from EMU: those from the euro real exchange rate, from euro prices, and from euro interest rates. We can see that the last is the least important in destabilising the UK under EMU. However the other two each on their own heavily destabilise the UK under EMU; clearly they must be negatively correlated since the two together have less effect than separately.

The matter in which we are most interested is how far the problem created by EMU stems from the fact that interest rates and the exchange rate cannot react to shocks, how much from the fact that the movement in euro interest rates, prices and the euro real exchange rate injects additional shocks into the UK economy. Table A3.10 shows what happens under EMU if all shocks enter it except these last three sets of euro shocks - this is 'EMU Passive case'.

It can be seen that the ratio of EMU (Passive) to floating variances are: 1.12 for output, 1.05 for unemployment; 0.87 for real interest rates; 2.74 for inflation. The political cost would be 1.15 times. As we can see above, these figures are quite similar to the effect of the supply shocks on their own; so we could say that supply shocks provoke a helpful response from domestic monetary policy that is of course absent under EMU because it is a passive monetary system from the UK's viewpoint.

Compare these with the ratios to floating for the total EMU case (1.27, 1.17, 4.39 and 9.8) and one can by subtraction see that how important is also the active part of EMU, the additional shocks. Specifically they contribute the following percentages of the extra EMU variances: output 55%, unemployment 7%, real interest rates 104%, and inflation 80%, with an additional political cost of 0.6. We can summarise this as saying that EMU, in so far as it does not permit interest rates and exchange rates to react to UK shocks, would increase political costs by about 17%; in so far as it injects additional shocks into the UK, it raises costs by a further 58%.

In sum, about a quarter of the political cost of EMU is due to its passive inability to stabilise the economy in the face of shocks, mainly supply shocks; about three quarters is due to its active injection into the UK economy of EMU-specific shocks.

A2.1FLOAT (demand shocks)

	nrl	nrs	w	m0	g	fin	xval	y
Variance	7.71E-05	0.000357	1.91E+10	3147199	1.08E+10	1.96E+09	16028360	19532471
St. Dev	0.00878	0.018883	138085.6	1774.035	103836	44294.33	4003.543	4419.555
Average	0.002107	0.004621	-22393.1	-396.976	-19061.7	-3385.05	164.9245	-226.369

	bdef	xvol	rl	rs	infl	rxr	c	eg
Variance	8803650	10170256	2.75E-05	0.000226	0.00042	0.006267	5373200	79293917
St. Dev	2967.094	3189.084	0.005246	0.015026	0.020484	0.079166	2318.016	8904.713
Average	-159.725	301.4897	0.00042	0.002202	0.00237	-0.00516	-638.737	979.8682

	rw	y*	e*	w*	u*	u	dy	afc
Variance	0.006792	10582565	0.00391	0.005451	44695.72	155324.7	0.000764	457754.5
St. Dev	0.082411	3253.085	0.062528	0.073828	211.4136	394.1125	0.027632	676.5755
Average	-0.00089	117.7015	-0.00175	0.001744	29.66024	45.42765	9.22E-05	-29.3876

	q	psbr	rdi	yafc	eg*	ur*	rxrn	ginv
Variance	0.000678	8149177	2643529	25970464	66266203	5.31E-05	177.8043	39738685
St. Dev	0.026032	2854.676	1625.893	5096.122	8140.406	0.007287	13.33433	6303.863
Average	-0.00228	8.095154	165.6286	-254.32	887.206	0.001021	-0.42702	-898.573

	mon	p	dmxr	leurxr	leucpi	pop
Variance	25764427	0.048424	0.106012	0	0	0
St. Dev	5075.867	0.220055	0.325594	0	0	0
Average	76.03319	0.037247	-0.00129	0	0	0

A2.2 EMU (demand shocks)

	nrl	nrs	w	m0	g	fin	xval	y
Variance	4.8E-07	0	2.28E+10	2709878	1.26E+10	2.24E+09	12782954	18870044
St. Dev	0.000693	0	150869.2	1646.171	112345	47341.48	3575.326	4343.966
Average	-0.0008	0	-19917.9	-168.023	-16233.8	-3686.59	-44.9231	17.5429

	bdef	xvol	rl	rs	infl	rxr	c	eg
Variance	7074658	5756538	2.98E-05	0.000177	0.00022	0.004261	6940610	77902862
St. Dev	2659.823	2399.279	0.005459	0.013311	0.014829	0.065279	2634.504	8826.26
Average	-12.4744	77.47644	-9.3E-05	0.000583	-7.1E-05	-0.00235	-426.697	1177.429

	rw	y*	e*	w*	u*	u	dy	afc
Variance	0.006489	10582259	0.00391	0.005451	44695.56	86009.5	0.000265	442066.5
St. Dev	0.080553	3253.038	0.062528	0.073828	211.4132	293.2738	0.016294	664.8808
Average	0.001209	117.3748	-0.00176	0.001736	29.67568	38.38643	-9.6E-06	4.748495

	q	psbr	rdi	yafc	eg*	ur*	rxrn	ginv
Variance	0.00048	7423371	102058.7	25070065	65078643	5.31E-05	8.06E-06	35228476
St. Dev	0.021898	2724.586	319.4663	5007.002	8067.134	0.007287	0.002839	5935.358
Average	-0.0007	-56.3795	-48.7866	22.4511	1070.673	0.001022	-0.0017	-805.812

	mon	p	dmxr	leurxr	leucpi	pop
Variance	9996541	0.010995	0	0	0	0
St. Dev	3161.731	0.104858	0	0	0	0
Average	-275.233	-0.00021	0	0	0	0

A2.3 FLOAT (supply shocks)

	nrl	nrs	w	m0	g	fin	xval	y
Variance	1.3E-05	0.000149	2.77E+09	1728287	1.54E+09	3.11E+08	644246.5	9411594
St. Dev	0.003606	0.012218	52607.83	1314.643	39305.6	17628.2	802.6497	3067.832
Average	0.001173	0.002879	5260.494	-139.305	2372.762	2848.036	93.57832	193.0942

	bdef	xvol	rl	rs	infl	rxr	c	eg
Variance	85562.71	725602	1.24E-05	0.000123	6.16E-05	0.004418	1019455	798504.4
St. Dev	292.511	851.8228	0.003518	0.011089	0.007851	0.066465	1009.681	893.5907
Average	-24.783	97.18634	0.000348	0.001657	0.000868	-0.00651	-116.733	23.15508

	rw	y*	e*	w*	u*	u	dy	afc
Variance	0.005719	10014751	0.003753	0.005276	41232.95	66687.7	2.79E-05	221799.6
St. Dev	0.075627	3164.609	0.061261	0.072637	203.059	258.2396	0.005284	470.956
Average	-0.00394	315.0257	-0.0055	-0.0027	18.00548	16.66687	0.000178	31.32008

	q	psbr	rdi	yafc	eg*	ur*	rxrn	ginv
Variance	4.72E-05	205315.8	75770.13	12522475	650074.5	4.92E-05	44.82317	4685337
St. Dev	0.00687	453.1179	275.2637	3538.711	806.272	0.007016	6.69501	2164.564
Average	-0.00078	61.65124	83.89614	225.0439	17.89556	0.000622	-0.4108	221.0415

	mon	p	dmxr	leurxr	leucpi	pop
Variance	3392386	0.001779	0.02723	0	0	0
St. Dev	1841.843	0.042174	0.165015	0	0	0
Average	-13.2168	0.011857	-0.00144	0	0	0

A2.4 EMU (supply shocks)

	nrl	nrs	w	m0	g	fin	xval	y
Variance	5.9E-07	0	3.69E+09	1489652	2.12E+09	4.54E+08	525586.6	10748511
St. Dev	0.000768	0	60774.37	1220.513	46033.27	21298.78	724.9735	3278.492
Average	-0.00084	0	4333.312	-11.6762	2244.89	2091.393	30.21892	270.8641

	bdef	xvol	rl	rs	infl	rxr	c	eg
Variance	115457.9	490622.6	2.51E-05	0.000175	0.000256	0.003597	1669538	718559.7
St. Dev	339.7909	700.4445	0.005013	0.013243	0.016011	0.059978	1292.106	847.679
Average	31.06064	26.94919	-0.00021	0.000577	-0.00052	-0.00536	3.847757	97.60454

	rw	y*	e*	w*	u*	u	dy	afc
Variance	0.005602	10014069	0.003752	0.005276	41227.37	69156.83	3.04E-05	256065.3
St. Dev	0.074848	3164.501	0.061256	0.072638	203.0452	262.9769	0.005511	506.029
Average	-0.00291	315.1197	-0.0055	-0.00269	18.00028	20.01546	0.000184	42.29158

	q	psbr	rdi	yafc	eg*	ur*	rxrn	ginv
Variance	6.79E-05	137657.4	13974.74	14320537	579678.4	4.92E-05	5.05E-05	6358284
St. Dev	0.008237	371.0221	118.2148	3784.249	761.3661	0.007016	0.007104	2521.564
Average	-0.00029	35.03943	-0.12986	313.0877	87.27024	0.000621	-0.00117	184.3713

	mon	p	dmxr	leurxr	leucpi	pop
Variance	6381623	0.008966	0	0	0	0
St. Dev	2526.187	0.094689	0	0	0	0
Average	-121.668	-0.00555	0	0	0	0

A2.5 FLOAT (external shocks)

	nrl	nrs	w	m0	g	fin	xval	y
Variance	7.74E-07	1.1E-05	6779678	12565.54	4489224	1521883	6116.448	11918.76
St. Dev	0.00088	0.003317	2603.781	112.0961	2118.779	1233.646	78.20772	109.1731
Average	0.000556	0.002246	2941.371	-97.8924	1938.82	942.8707	-29.7746	9.595581

	bdef	xvol	rl	rs	infl	rxr	c	eg
Variance	5985.457	7244.779	3.84E-07	1.18E-05	3.31E-06	1.21E-05	10154.41	5645.726
St. Dev	77.36573	85.11627	0.00062	0.00344	0.001819	0.003476	100.7691	75.13805
Average	-37.6329	-33.3339	0.000238	0.001662	6.27E-05	0.001001	-5.08988	-35.2535

	rw	y*	e*	w*	u*	u	dy	afc
Variance	7.58E-06	415.1664	1.77E-08	2.19E-08	0.266562	330.0561	5.1E-07	430.3434
St. Dev	0.002753	20.37563	0.000133	0.000148	0.516296	18.16745	0.000714	20.74472
Average	-0.00027	0.412967	-5.1E-06	-7E-07	-0.01135	-4.68409	2.47E-05	8.752363

	q	psbr	rdi	yafc	eg*	ur*	rxrn	ginv
Variance	6.21E-07	9659.893	6786.629	17094.52	4829.867	8.87E-11	0.400296	14758.75
St. Dev	0.000788	98.28476	82.381	130.746	69.49724	9.42E-06	0.63269	121.4856
Average	5.31E-05	-6.05095	33.45593	20.81581	-31.6081	8.28E-07	0.630777	91.25882

	mon	p	dmxr	leurxr	leucpi	pop
Variance	10024.33	2.34E-05	0.00042	0.000816	2.74E-05	0
St. Dev	100.1216	0.004841	0.020487	0.02857	0.005238	0
Average	-70.0744	0.000853	0.025786	0.000125	2.38E-05	0

A2.6 EMU (external shocks)

	nrl	nrs	w	m0	g	fin	xval	y
Variance	6.28E-05	0.000313	1.55E+09	548899.5	8.97E+08	3.87E+08	784409.3	2027413
St. Dev	0.007926	0.017694	39316.88	740.8775	29944.74	19683.17	885.6689	1423.872
Average	-0.00066	0.000385	-16630.5	-62.8884	-12886.4	-3740.57	411.1955	-537.978

	bdef	xvol	rl	rs	infl	rxr	c	eg
Variance	518538.9	967334.6	7.64E-05	0.002297	0.003495	0.00262	1504764	257359.7
St. Dev	720.0965	983.5317	0.008739	0.047924	0.059118	0.051184	1226.688	507.3064
Average	126.9406	430.8374	-0.00044	0.000453	0.000517	-0.00356	-521.452	-5.14274

	rw	y*	e*	w*	u*	u	dy	afc
Variance	0.000211	415.1531	1.77E-08	2.19E-08	0.266488	4250.483	5.76E-05	47295.5
St. Dev	0.014521	20.37531	0.000133	0.000148	0.516225	65.19572	0.007587	217.4753
Average	-0.00339	0.196779	-9.7E-06	-7.5E-06	-0.00103	20.5491	-0.00025	-80.6137

	q	psbr	rdi	yafc	eg*	ur*	rxrn	ginv
Variance	8.15E-05	303485.6	272563.2	2695668	205035.5	9.44E-11	696.2988	3034302
St. Dev	0.009026	550.8953	522.0759	1641.849	452.8085	9.72E-06	26.38747	1741.925
Average	-0.00341	127.0521	-4.85796	-618.228	-18.3169	9.02E-07	1.669874	-523.01

	mon	p	dmxr	leurxr	leucpi	pop
Variance	75769617	0.242108	0	0.000941	8.36E-06	0
St. Dev	8704.575	0.492045	0	0.030678	0.002891	0
Average	1157.168	0.072401	0	0.000164	2.03E-05	0

A2.7 EMU (eucpi shock only)

	nrl	nrs	w	m0	g	fin	xval	y
Variance	6E-05	0	1.56E+09	15516.01	8.99E+08	3.84E+08	761586.8	1967779
St. Dev	0.007743	0	39478.56	124.5633	29976.92	19606.89	872.6894	1402.775
Average	-0.00064	0	-15932	-58.1679	-12393.4	-3537.13	384.8242	-502.484

	bdef	xvol	rl	rs	infl	rxr	c	eg
Variance	341401.7	938605.6	7.4E-05	0.002013	0.003392	0.002541	1471898	52790.62
St. Dev	584.2959	968.8166	0.008602	0.04487	0.05824	0.050406	1213.218	229.7621
Average	136.0304	403.3887	-0.00042	3.34E-05	0.00055	-0.00338	-495.316	12.65757

	rw	y*	e*	w*	u*	u	dy	afc
Variance	0.000204	415.1436	1.77E-08	2.19E-08	0.266493	4118.783	5.55E-05	45908
St. Dev	0.014281	20.37507	0.000133	0.000148	0.516229	64.17775	0.00745	214.2615
Average	-0.00317	0.19687	-9.7E-06	-7.5E-06	-0.00102	19.16351	-0.00023	-75.1845

	q	psbr	rdi	yafc	eg*	ur*	rxrn	ginv
Variance	7.9E-05	260617.7	59460.88	2616380	33862.31	9.44E-11	680.8165	3015217
St. Dev	0.008889	510.5073	243.846	1617.523	184.0171	9.72E-06	26.09246	1736.438
Average	-0.00319	117.3351	-23.6531	-577.32	-1.34416	9.02E-07	1.588682	-498.564

	mon	p	dmxr	leurxr	leucpi	pop
Variance	74121587	0.235111	0	0.000941	0	0
St. Dev	8609.389	0.484882	0	0.030678	0	0
Average	1190.938	0.071868	0	0.000164	0	0

A2.8 EMU (eurxr shock only)

	nrl	nrs	w	m0	g	fin	xval	y
Variance	6.29E-05	0	1.59E+09	15973.91	9.22E+08	3.92E+08	780343.4	2021656
St. Dev	0.007928	0	39935.79	126.3879	30361.73	19805.03	883.3705	1421.849
Average	-0.00065	0	-16894.2	-61.9018	-13077.3	-3813.85	409.34	-535.541

	bdef	xvol	rl	rs	infl	rxr	c	eg
Variance	349824.8	962646.2	7.63E-05	0.002086	0.003495	0.002619	1516996	53718.52
St. Dev	591.4599	981.1453	0.008735	0.045673	0.059118	0.051174	1231.664	231.7726
Average	142.3883	428.9386	-0.00044	6.98E-05	0.000519	-0.00355	-523.08	10.84737

	rw	y*	e*	w*	u*	u	dy	afc
Variance	0.000211	415.162	1.77E-08	2.19E-08	0.26649	4243.31	5.72E-05	47171.06
St. Dev	0.014515	20.37552	0.000133	0.000148	0.516227	65.1407	0.007564	217.189
Average	-0.00337	0.196601	-9.7E-06	-7.4E-06	-0.00103	20.44397	-0.00025	-80.2183

	q	psbr	rdi	yafc	eg*	ur*	rxrn	ginv
Variance	8.12E-05	268446.8	60612.44	2688158	34444.52	9.44E-11	696.2527	3077889
St. Dev	0.009013	518.1185	246.1959	1639.56	185.5923	9.72E-06	26.3866	1754.391
Average	-0.0034	124.5842	-22.7749	-615.413	-3.83223	9.02E-07	1.669913	-532.607

	mon	p	dmxr	leurxr	leucpi	pop
Variance	76267696	0.242133	0	0.000941	8.36E-06	0
St. Dev	8733.138	0.49207	0	0.030678	0.002891	0
Average	1193.934	0.072423	0	0.000164	2.03E-05	0

A2.9 EMU (eunrs shock only)

	nrl	nrs	w	m0	g	fin	xval	y
Variance	2.79E-07	0.000313	77586442	521309.3	44072801	9273566	7018.387	21339
St. Dev	0.000529	0.017692	8808.317	722.0175	6638.735	3045.253	83.77581	146.0787
Average	-0.00068	0.000386	57.57867	-3.05037	11.96572	51.25989	17.26409	-27.7813

	bdef	xvol	rl	rs	infl	rxr	c	eg
Variance	213170.9	7836.26	6.07E-07	0.000321	1.73E-05	1.58E-05	38730.87	216321.1
St. Dev	461.7044	88.52265	0.000779	0.017905	0.00416	0.003972	196.8016	465.1033
Average	0.541815	20.16875	-0.00011	0.001189	-5.6E-05	-0.00012	-57.0489	-7.97945

	rw	y*	e*	w*	u*	u	dy	afc
Variance	1.96E-06	414.8619	1.77E-08	2.19E-08	0.266387	42.31678	7.21E-07	505.857
St. Dev	0.001401	20.36816	0.000133	0.000148	0.516127	6.505135	0.000849	22.49126
Average	-0.00025	-0.07997	-6.4E-06	-8E-06	0.008013	-0.10328	-3.9E-05	-4.48368

	q	psbr	rdi	yafc	eg*	ur*	rxrn	ginv
Variance	8.53E-07	46263.88	235125.6	28426.3	178393	9.85E-11	3.133532	124050.1
St. Dev	0.000924	215.0904	484.8976	168.601	422.3659	9.92E-06	1.770178	352.2074
Average	-0.00014	15.19474	10.49826	-32.2804	-7.80429	9.44E-07	0.076691	12.74832

	mon	p	dmxr	leurxr	leucpi	pop
Variance	1499990	0.000942	0	0	8.25E-06	0
St. Dev	1224.741	0.030699	0	0	0.002873	0
Average	-20.5435	-0.0007	0	0	2.4E-05	0

A2.10 EMU (passive case- all shocks except eunrs, eucpi, and eurxr)

	nrl	nrs	w	m0	g	fin	xval	y
Variance	1.42E-06	0	2.58E+10	2979546	1.55E+10	2.39E+09	14967141	24794811
St. Dev	0.001191	0	160652.3	1726.136	124483	48861.78	3868.739	4979.439
Average	-0.00074	0	-11732.8	-130.145	-8361.06	-3375.25	-79.3247	207.1729

	bdef	xvol	rl	rs	infl	rxr	c	eg
Variance	7701485	8272419	8.46E-05	0.000586	0.001221	0.008973	11382728	79605956
St. Dev	2775.155	2876.181	0.009199	0.024215	0.034948	0.094725	3373.83	8922.217
Average	12.46908	13.24673	0.000425	0.001283	-0.00016	-0.00212	-537.641	1109.215

	rw	y*	e*	w*	u*	u	dy	afc
Variance	0.007235	10012954	0.003753	0.005277	41234.87	95344.57	0.000784	580874
St. Dev	0.085059	3164.325	0.061261	0.072644	203.0637	308.7792	0.028006	762.1509
Average	-0.00289	313.5012	-0.0055	-0.00272	18.06966	32.14679	0.000352	32.43492

	q	psbr	rdi	yafc	eg*	ur*	rxrn	ginv
Variance	0.000716	7947334	89649.33	32957635	66316649	4.92E-05	9.64E-06	60449958
St. Dev	0.026763	2819.102	299.415	5740.874	8143.503	0.007017	0.003105	7774.957
Average	-0.0009	-20.9866	-38.6111	239.6266	1005.088	0.000624	-0.00114	-344.93

	mon	p	dmxr	leurxr	leucpi	pop
Variance	11089192	0.021331	0	0	0	0
St. Dev	3330.044	0.14605	0	0	0	0
Average	-201.521	0.003364	0	0	0	0