Britain and EMU: Assessing the Costs in Macroeconomic Variability

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1. INTRODUCTION

THE British Chancellor of the Exchequer has proposed 'five (economic) tests' for whether the UK should join the euro (HM Treasury, 2003, reports his largely negative assessment). The central macroeconomic issue is embodied in the first and second of these tests which ask how far the UK will suffer in the form of increased macroeconomic volatility – 'boom and bust' – from losing its power to set its own independent interest rate through having its own currency and exchange rate. This issue (alone) is the focus of this paper; we must emphasise that we do not seek to minimise the importance of other issues bearing on the choice. These are discussed in Minford (2002). This paper is intended to discuss the narrow but important technical question of the effects on macro variability; since macro policy loses freedom of action, an efficient government will necessarily face higher variability, at least in the absence of helpful structural changes induced by giving up that freedom, but the extent of it and the possible effects of such changes are an important element in the decision about joining.

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 regions' 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 non-trivial 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 the likely direction of effect but cannot tell us its likely size and therefore its likely painfulness. The same applies to studies of the experience of US states within the US monetary union, with its unique relationships and

The authors are grateful for comments to Ray Barrell and to two anonymous referees of this journal.

history. To find out the consequences for the UK itself with its own particular characteristics we would ideally like to try EMU 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 one course open to us, indeed essentially the only one. 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. Such 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 reasonably 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 counter-inflation (demand-side) and anti-unemployment (supply-side) policies of the UK. 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.

2. 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 dominate 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 forecasting 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 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 forecasting record is reasonable at the very least.

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 1980s and 1990s, now generally considered to have been broadly successful.

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 have 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 has 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 the 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.

Lucas (1976) set out a well-known critique of using such models for analysis of such a fundamental regime change as joining EMU; his point was that the parameters of models that were not totally 'structural' (only the parameters of tastes or technology can be considered such) would shift under the new regime because of the resulting changes in incentives. The Liverpool Model could be vulnerable to such effects in principle, but there is no reliable way of measuring their extent or speed. What we have done to assess the possible errors in our estimates is to carry out sensitivity analysis on the key parameters.

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 12,078 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 their variances from this large sample of observations for the given monetary regime. We can then compare them 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. We can look at these sensitivity tests in two ways. First, we can assume that the relevant changes would have occurred anyway under both regimes; second, that they occur purely as a result of joining EMU – this interpretation could be defended for certain parameter changes such as enhanced labour market flexibility. We report both types of analysis below; our approach is not to attempt any evaluation of the likely extent of parameter changes but merely to investigate their effects within a possible range.

a. Results of Previous Stochastic Simulation Exercises on the UK and EMU

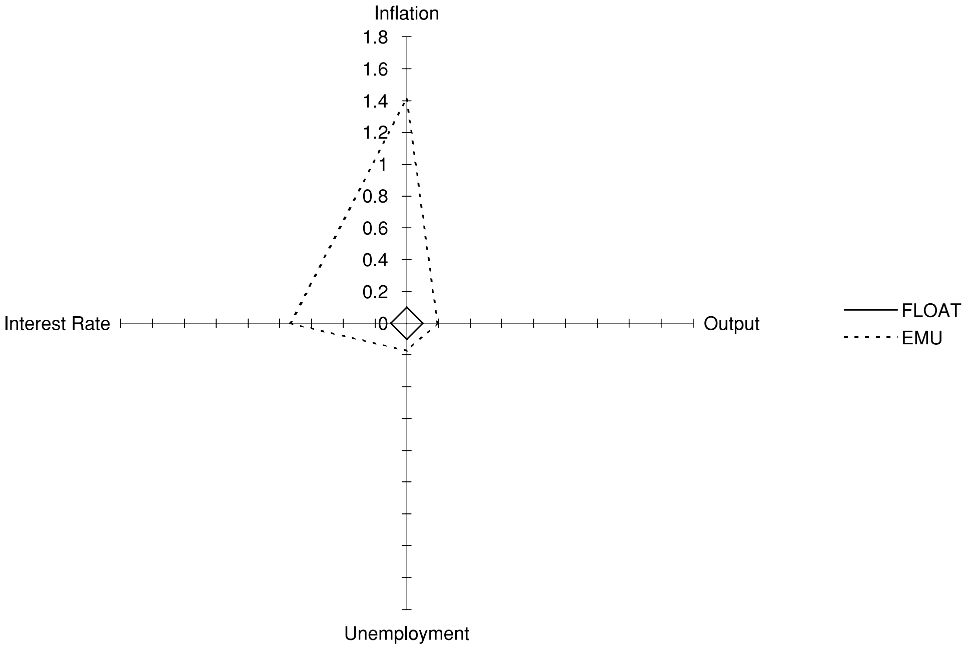
There has been a variety of previous work on the effects of joining EMU, both for European countries generally and for the UK alone. The general conclusion of this work has been that there would be a substantial increase in variability under EMU; the variances of output and inflation are the principal 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 (1992) found rises of inflation variance up to 40 per cent and of output variance up to 30 per cent, 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 per cent 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.

b. 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

FIGURE 1
Floating and EMU Compared (Basic Case)
Comparison of Variances (Basic Case)



graphs; one shows on a logarithmic scale the combination of these variances under floating, the other under EMU. 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. What we see is that all the implied variances are considerably higher under EMU than under floating. The variance is used, as is standard, in our measures of welfare cost. That of output around its trend is nearly a quarter higher; that of unemployment nearly a fifth higher; real interest rates a multiple of over four times; and that of inflation under EMU is approximately twenty times 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 monetary rule we have used under floating. 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 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 per cent (p.a.), of inflation of 2.1 per cent (p.a.), and of output of 2.5 per cent around its trend; these values seem to match reasonably with what we would expect from the current environment under the Monetary Policy Committee – supporting the use of this rule, though different monetary rules could of course be used to change this combination of variabilities.

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), in 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. 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 rate 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 per cent or so and of the sharp depreciation of the euro, inflation – which in spite of Ireland's rapid growth in the previous decade had been muted – rose to a peak of 7 per cent by November 2000 and was still running at 3.9 per cent in mid-2003. 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 1 January, 1999, it too would have experienced these problems to at least some degree. Second, we can inspect the range of inflation currently (July 2003) in the euro-zone: from 0.8 per cent in Germany to 2.9 per cent in Spain and 3.5 per cent in Greece, much like Ireland. The range across countries is 3.1 per cent and has peaked thus far at 6 per cent. By contrast in the past five years UK inflation (RPIX) has stayed well within the range of 1 per cent either side of the Bank of England's 2.5 per cent target.

It is natural to ask what these differences in variability imply for 'welfare' or the degree of painfulness of the EMU option. The usual approach has been to give weights to the different variances that appear to cause political and popular concern, namely the ones we have just discussed, and add them up with a negative sign into a measure of welfare (or with reversed sign of welfare cost). In line with this, we give the variances of output and unemployment each a weight of 1 and those of inflation and real interest rates each a weight of 0.1 (the precise numbers are arbitrary but 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); plainly then we wind up with a big difference in welfare. EMU welfare on this measure is 45 per cent of that under floating – equivalently the EMU welfare cost is 2.21 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 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.

c. Measuring the Welfare of the 'Representative Agent'

We may nevertheless look at a second approach under which one measures the welfare of a representative or average household, bearing in mind that households are the people in our economy who own 'the UK economy' and to whom governments answer. A household 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 generally found to be of the order of 1.5, we come up with a function:

$$\text{Utility} = \left[\frac{(C^{0.7}(1+U)^{0.3})^{(1-1.5)}}{(1-1.5)}\right]$$

where C is consumption and U is the unemployment rate.

To estimate the difference of utility in our stochastic simulations, we take the model-generated values for consumption and unemployment, compute the resulting 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, the difference of utility will reflect the difference of variances. Households then penalise variance (increased risk) through the law of diminishing marginal utility (since a fair bet offering an equal chance of 150 and 50 will be worth less utility than keeping 100 for sure).

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 38 per cent and 18 per cent) 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 per cent 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 per cent and a growth rate of 2.5 per cent, then the present discounted value of this is £24 billion. This is not large relative to the scale of UK wealth; probably about the same small 0.012 per cent 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.

d. Checking the Results for Sensitivity

We begin by investigating what the comparison would be if our assumptions about both regimes were wrong due to an 'exogenous' mistake in the parameter values and applicable to both regimes – in a later section we consider the effects of changes induced, in the manner suggested by Lucas (1976), by the changeover to EMU. The results of this first analysis are brought together in Table 1.

(i) Greater nominal rigidity of wages (no indexation)

The Liverpool Model in its current version has very little nominal wage rigidity – a surprise 1 per cent rise in prices only lowers real wages by 0.3 per cent after one quarter and by 0.1 per cent 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 one quarter was raised to 1 per cent 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, giving 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

TABLE 1
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	2.21	1.24	1.18	4.32	20.17
No indexation	2.74	1.63	1.51	5.56	23.27
Low interest rate sensitivity	2.16	1.03	1.04	5.17	21.62
More labour market flexibility†	2.72	1.18	1.08	4.04	33.19
High unemployment	2.23	1.21	1.21	4.80	20.15
More exchange rate instability	2.04	1.23	1.18	3.27	17.48
Enhanced fiscal stabilisers*	2.29	1.20	1.12	5.50	21.64

Notes:
† The weights used in the political cost are (all divided by the weights total of 2.2):1 for output and unemployment variances; 0.1 for inflation and real interest rate variances.
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.
* Assumes no enhanced fiscal activism under floating.
** Under our Monte Carlo sampling procedure with the number of draws at 12,078 the standard error of the floating regime's variance, VARF, is 0.013VARF (Wallis, 1995). Hence a ratio in excess of 1.026 indicates that the EMU regime's variance is higher than that of floating at the 95 per cent confidence level. Thus all the numbers in this table are statistically significant.

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; the variance of output is now 1.63 times, of unemployment 1.51 times, while that of real interest rates is now 5.56 times and inflation 23.27 times. Our political cost measure of EMU rises to 2.74 times that of floating. We should 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.

(ii) 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 now that inflation has been reduced systematically. If so, 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 (+3 per cent) and unemployment (+4 per cent). The political cost measure falls to 2.16 times. 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.

(iii) The effect of the UK having greater labour market flexibility

Much is made in the debate over the euro of labour market (meaning real wage) flexibility. It is pointed out 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. Our basic case showed that existing UK flexibility is inadequate to provide much alternative adjustment; possibly it is rising under the influence of labour market reforms over the past two decades. Accordingly, we ask what the effect would be of a substantial rise in UK flexibility: we multiplied the response of real wages to unemployment by 1.52 and reran the exercise.

We find that under both regimes unemployment variance drops substantially; and it does so proportionately more under EMU, confirming that enhanced flexibility could indeed be 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. We see that EMU and floating come closer together, with the ratio of the unemployment variance down to 1.08 and that of output down to 1.18; 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 per cent judging from other work). So the comparison of inflation variance under EMU is now correspondingly worse; the ratio rises to 33.19. The political cost of EMU under labour market flexibility therefore actually rises to 2.72 times; but within that the cost of output and unemployment variability falls.

(iv) 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 per cent 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) and 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. 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 1.21 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 three 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 2.7 times to around 800 thousand but that of EMU would rise three times to around 900 thousand. Of course with such high baseline unemployment rates that sort of absolute rise in variability, of 100,000, would add materially to the unpopularity of a switch to EMU.

(v) Could greater volatility of the pound outside EMU change the comparison?

It is sometimes asserted (e.g. Britain in Europe, 2000) that floating exchange rates themselves generate high volatility because of the varying risk-premium attached to the pound (in the manner of a 'bubble'): by eliminating this sterling bubble EMU would reduce UK volatility. 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 Appendix A, 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 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. The political cost of EMU falls somewhat to 2.04 times that of floating.

(vi) 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 (counter-cyclical) elasticity of –0.125. Consider the example where output falls 3 per cent below potential (i.e. actual output fell by 0.5 per cent), public spending on goods and services would be raised by 0.375 per cent, i.e. approximately 0.1 per cent 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 per cent of GDP in this example. In a recession where this occurred two years running the deficit would thus rise by 3.4 per cent of GDP before any discretionary boost; our suggested boost would push the rise to 3.6 per cent. But we did look at what could be achieved fiscally by tripling the discretionary fiscal response under EMU, leaving floating policy unchanged. The results show a slight relative improvement in EMU variability and the cost drops to 2.19 times. But what this shows is that realistic fiscal activism cannot solve the variance problems created by EMU.

e. 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 C 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.

3. UTILITY LOSSES OF THE REPRESENTATIVE AGENT

As we have seen, the estimates of utility reflect the variances produced. In this section we convert these variances into the equivalent percentage loss of consumption for the representative agent (Appendix B gives details).

Inspection of Table 2 reveals startlingly how little value the representative agent attaches to variance, even on a wide range of values for ρ, the coefficient of relative risk aversion. 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:

$$\frac{\Delta Ec}{\bar{c}} = 0.5\rho\left(\frac{\Delta \text{var } c}{\bar{c}^2}\right).$$

In our basic case simulations the rise in consumption variance on joining EMU as a percentage of base line consumption squared is just 0.048 per cent. Or put another way the rise in the standard deviation of consumption is 0.6 per cent 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 1.0 per cent.) Even with a ρ as high as 9 the implied loss of equivalent consumption only reaches 0.22 per cent, which applied to current GDP would be £2.2 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

TABLE 2
The Welfare Losses Produced by EMU Compared with Floating†

	The Popular Cost (Weighted variance) (Per cent)	*The Representative Agent Equiv. Consumption Loss (Per cent, converted into £bn p.a.)*	
		$\rho = 1$ *(Logarithmic utility)*	$\rho = 9.0$
The central case	121(5)	0.23(2)	1.3(2)
No indexation	174(1)	0.36(1)	2.0(1)
Low interest rate sensitivity	116(6)	0.04(7)	– (7)
More labour market flexibility	172(2)	0.20(6)	1.1(5)
High unemployment	123(4)	0.22(4)	1.0(6)
More exchange rate flexibility	104(7)	0.22(4)	1.3(2)
Enhanced fiscal stabilisers	129(3)	0.23(2)	1.2(4)

Notes:
* UK GDP is approximately £1,000 billion p.a.; hence these numbers can be read as percentages by one point to the left: e.g., £1.3 billion = 0.13 per cent of GDP.
† Order in brackets.

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.

4. EMU AND INDUCED PARAMETER CHANGE

We also wish to examine sensitivity to the possibility that joining EMU would itself induce structural changes in parameters. Plainly, because of the political aspects of the EMU relationship, pressures for change will be exerted not merely by the new behavioural incentives within monetary union but also by the accompanying institutional changes that are part of EMU (Economic and Monetary Union). Minford (2002) notes that the evaluation of the decision must take account of the whole bundle of relationships involved. So it is also with macro variability; its behaviour under EMU will alter with any associated parameter changes.

Of the variations we examined, the more active use of fiscal stabilisers is not a structural change but rather a deliberate act of policy regime adjustment; as such we have in any case already evaluated it above where we compared EMU with this adjustment against floating without it. Whether the UK has more exchange rate bubbles under floating has no connection with EMU and has also already been evaluated.

A higher natural rate of unemployment could be induced by joining EMU through the adoption of general tax and regulative changes; Minford (2002) does point to the possibility that the greater closeness of the EMU relationship (a ‘club within a club') could make it more difficult for the UK to resist the higher tax levels and more union-friendly labour laws of the continent. On the other hand it could be argued that EMU would induce greater general labour market deregulation across the EU in the long term because of the need to limit large swings in unemployment.

Labour market flexibility is a similar issue. On the one hand, it could be that the greater fluctuations of unemployment under the common monetary policy of EMU would induce more flexibility of real wages through the incentive to limit unemployment movement. On the other hand if the UK was less able to resist the greater labour market distortions just discussed then flexibility would be reduced.

A reduction in indexation (more nominal wage rigidity) could result from joining EMU, if for example German-style unionisation and associated long-term nominal wage contracts became more widespread in the UK. Again, the pressures under EMU to limit unemployment swings could induce even more indexation.

Lesser consumer sensitivity to interest rates (e.g. through longer-term mortgages) could occur under EMU. The argument would be that the UK housing market would become more like the continental as monetary policy and regulation became shared. However, financial regulation is specifically not likely to change in the UK, given the special position of the City and the UK government's resistance to proposals such as the EU investment income withholding tax on the grounds of damage to the City. Also, the progress of the Single Market could produce greater deregulation of the housing and financial markets, both on the continent and in the UK. The UK model's high interest rate response appears to be a reflection of consumer and investor choice within relatively deregulated markets (for example, the choice of variable-rate mortgages may well reflect the desire of UK investors to avoid the capital-value risk associated with long-term nominal debt). Hence it could become higher still if deregulation spread.

Dealing with these possibilities therefore involves a double-sided approach in that EMU could induce parameter changes that go both ways in these four dimensions. In the interests of avoiding a plethora of further cases, we compare floating and EMU under our existing high and low assumptions, first assuming the combination of high and low that is the more favourable to EMU and then the alternative. These comparisons – Table 3 – effectively attribute not merely the monetary regime change to joining but also the change due to the altered parameter assumption.

What we see from Table 3 is that if we treat the parameter changes induced by EMU as favourable to stability the comparison becomes most markedly more favourable for quantity variables. The key element is enhanced labour market flexibility (or fairly similarly a reduced natural rate of unemployment) which dramatically reduces unemployment variability. A reduction in interest sensitivity under EMU would also eliminate any rise in output variability, though at a large cost in greater real interest rate variance. If there were to be a reduction in indexation under EMU, this would cut inflation variability compared with

TABLE 3
Effects of EMU-induced Parameter Change – The Welfare Losses (Political Cost) Produced by EMU Compared with Floating (Floating = 1.0) Assuming EMU-induced Parameter Changes†

	Political Welfare Cost (Utility-based)*	*Ratio of Variances (EMU/Floating) – Output; Unemployment; Real Interest Rate; Inflation*			
The central case	2.21 (0.23)	1.24	1.18	4.32	20.17
Indexation – EMU low, Float high	2.24 (0.32)	1.46	1.44	4.49	15.34
Indexation – EMU high, Float low	2.82 (0.27)	1.38	1.24	5.35	30.56
Interest rate sensitivity – EMU low, Float high	2.06 (0.04)	1.00	0.99	5.31	20.21
Interest rate sensitivity – EMU high, Float low	2.32 (0.23)	1.28	1.25	4.21	21.50
Labour market flexibility – EMU high, Float low	1.72 (0.16)	1.12	0.18	4.38	20.53
Labour market flexibility – EMU low, Float high	15.44 (0.27)	1.30	7.01	3.99	32.61
Unemployment Natural rate – EMU low, Float high	1.71 (0.14)	1.23	0.20	3.79	19.60
Unemployment Natural rate – EMU high, Float low	5.06 (0.31)	1.22	7.29	5.48	20.72
Highly favourable combination for EMU**	1.57 (−0.03)	0.90	0.16	4.17	19.80
Highly favourable combination for Float**	5.28 (0.29)	1.45	7.45	4.04	23.20

Notes:
† The table compares welfare under EMU and floating with changed parameters. For each parameter the first row takes the assumption more favourable to EMU, assigning the alternative to Floating; the second row shows the reverse, with the more favourable assumption assigned to Floating.
* 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. The utility-based welfare cost in parentheses is the extra cost (in £billion per annum) of EMU for the representative agent, assuming $\rho = 1$.
** The favourable combination involved is low-interest-rate sensitivity, high labour-market flexibility, and enhanced fiscal stabilisers. The alternative is the central case parameters. In turn the favourable combination is applied to the one regime with the alternative applied to the other.

floating, but at a cost of roughly 20 per cent more output and unemployment variance. None of these has any helpfully stabilising impact on real interest rates or inflation since they do not impinge on the factors (largely the euro's swings against the dollar) that destabilise them.

Switching the assumptions to favour floating implies that EMU dramatically worsens unemployment variance, and moderately worsens output variance; in the unemployment case real interest rate variance and in the labour flexibility case inflation variance are very seriously worse under EMU.

To construct a generally favourable combination for each, we combine the better assumption on interest rate sensitivity and labour market flexibility. (To include the unemployment assumption would effectively duplicate the effect of flexibility, while the effect of indexation is two-edged, not clearly favouring either regime; we also allow the enhanced fiscal stabilisers under EMU and for symmetry we do the same under floating, though it has little importance.) Under these combinations the same features stand out: EMU when generally favoured by structural changes reduces the variances of both output and unemployment compared with floating, the latter massively. Vice versa, when floating is generally favoured, EMU increases the variances of both, and again massively for unemployment. Under both sets of assumptions, EMU greatly increases inflation and real interest rate variance, much as in the base comparison.

Hence a constant in these comparisons is that EMU destabilises real interest rates and inflation very substantially. It is this constant that prevents EMU, even under the most favourable assumptions about structural change, generating an overall reduction in macro variability. The political welfare cost index still rises 57 per cent compared with floating in this situation. In the case of the representative agent's welfare cost, in this situation it only just turns marginally in favour of EMU; in all other comparisons it remains stubbornly against, albeit by small amounts absolutely for reasons we discussed above. Of course if EMU were to produce destabilising structural change, then the political cost index would rise by 428 per cent with appalling quantity variation aggravating this constant source of loss.

We conclude that though structural change could much affect the quantity comparison, turning it potentially in EMU's favour, overall macro variability would be worsened by EMU even under the most optimistic assumptions because of the destabilisation of real interest rates and inflation.

5. COMPARISON WITH BARRELL AND DURY

An earlier study by Barrell and Dury (2000), using the National Institute's multi-country model, found smaller costs than we have. If we translate their findings into the terms of our boom and bust index, their index of welfare cost would be 42 per cent worse under the euro than under floating. They find that under the euro UK output (and so by implication unemployment) would be 51 per cent more volatile as measured by its variance against our 24 per cent; this greater effect is probably the result of their model structure being more Keynesian (with less price and wage flexibility). However, on inflation they find rather strangely that inflation volatility would actually fall by 44 per cent under the euro – our finding was that it would rise by a massive 1,900 per cent, 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. A similar assumption was used by the EU Commission, 1990, in its initial stochastic simulation exercise where it dramatically biased the results in favour of EMU; it was strongly criticised by Minford et al. (1993) and also rejected by Masson and Symansky (1992).

Second, Barrell and Dury 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 discussed above under which the Monetary Policy Committee reacts to deviations from its objectives using the freedom given it by floating exchange rates. 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 1991–97 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 2; 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 our own study here 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 eurozone) 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

FIGURE 2
Euro Per US Dollar (Dm before 1 January, 1999)

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.

6. CONCLUSIONS

We can summarise our findings as follows. Joining EMU would more than double the variability of the UK economy – the 'boom-and-bust' factor. 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 come 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. Only if the highly optimistic assumption is made that both these parameter changes will come about solely as a result of joining EMU does output variability fall under EMU; even then variability in inflation and real interest rates is undiminished and the overall macro variability compared with floating is only halved. Of course it is at least as likely that these parameters could move adversely as a result of joining EMU, in which case macro volatility would be much worse.

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.

APPENDIX A

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 chapter 8 of Minford (1992).

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 Table A1. 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 per cent, 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.

TABLE A1
The Shocks Applied Under EMU and Floating

Shocks (Exogenous variables)		*Standard Error*
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 + 0.503 DlogEURXR(−1) + e	0.02743
Euro CPI, EUCPI (n.a. floating)	DlogEUCPI = c + 0.235 DlogEUCPI(−1) + e	0.00285

(Endogenous variable errors)		*Shock No. in Model Listing*	
1. Net export volume	$e = c + 0.608\ e(-1)$	4	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

Notes:
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.

TABLE A2
Model Listing

Float

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

2 $E^{**}_t = A1*\{\log(W^{**}_t) + \log(1.0 + BO_t)\} + \{1.0 + A1\}*\log(1.0 + VAT_t) + A41 + A2*TREN_t - \{0.064\}*\{UNR_t\} - \{0.0525\}*\{\{TREN_t - 108.0\}/4.0\}*D87_t$

3 $W^{**}_t = \exp(\{A43 + A9*\log(U^{**}_t) + \{0.095\}*\{UNR_t\}*\{-A10\}*D83_t + \{0.04\}*\{\{TREN_t - 108.0\}/4.0\}*\{-A10\}*D87_t + A7*\{UNR_t\} + A8*\{\log(UB_t) + \log(1.0 + LO_t)\}\}/\{-A10\} + res\_W^{**}_t)$

4 $U^{**}_t = \exp(\{A42 + A3*\log(Y^{**}_t) + A4*\{\log(W^{**}_t) + \log(1.0 + BO_t) + \log(1.0 + VAT_t)\} - \{0.095\}*\{UNR_t\}*D83_t - \{0.04\}*\{\{TREN_t - 108.0\}/4.0\}*D87_t + A5*TREN_t\}/\{1.0 - A6\})$

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

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

11 $error(7) = -\{XVAL_{t-5} + \{XVOL_{t-1} - XVOL_{t-5}\} + A31*\{0.32*Y^{**}_{t-1}*\{RXR_{t-1} - RXR_{t-5} - E^{**}_{t-1} + E^{**}_{t-5}\}\}\} + XVAL_{t-1}$

12 $XVAL_t = XVAL_{t-4} + (XVOL_t - XVOL_{t-4}) + A31*\{0.32*Y^{**}_t*(RXR_t - RXR_{t-4} - E^{**} + E^{**}_{t-4})\} + A32*error(7) + res\_XVAL_t + \mathbf{shock}(6)$

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

14 $NRL_t = RL_t + PEXL_t$

15 $M0_t = \exp(A44 + A13*\log(M0_{t-1}) + A14*\{\log(Y_t) + \log(1.0 - TAX_{t-1})\} + A15*UB_{t-2} + A16*TREN_t + A17*NRS_t + A18*\{VAT_t\} + \mathbf{shock}(1) + res\_M0_t)$

16 $MON_t = \exp(\log(MON_{t-1}) + \{1.0 - A34\}*\{PEQ_t/4.0\} + A34*\{\log(MON_{t-1}/MON_{t-2})\} + A52*\{NRS_t - NRS_{t-1}\} + A55*\{\log Y_t - Y^{**}_t\} + A56*\{INFL_t - 0.025\} + \mathbf{shock}(5) + MTEM_t)$

17 $DMXR_t = \{RXR_t - RXR_{t-1} - GERX_t + GERX_{t-1} - \log(P_t/P_{t-1}) + \log(GEP_t/GEP_{t-1}) + 1.0\}*DMXR_{t-1}$

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 $error(22) = -\{A42 + A3*\log(Y_{t-1}) + A4*\{\log(RW_{t-1}) + \log(1.0 + BO_{t-1}) + \log(1.0 + VAT_{t-1})\} - \{0.095\}*UNR_{t-1} - \{0.04\}*\{\{TREN_{t-1} - 108.0\}/4.0\}*D87_{t-1} + A5*TREN_{t-1} + A6*\log(U_{t-2})\} + \log(U_{t-1})$

21 $U_t = \exp(A42 + A3*\log(Y_t) + A4*\{\log(RW_t) + \log(1.0 + BO_t) + \log(1.0 + VAT_t)\} + \mathbf{shock}(9) - \{0.095\}*\{UNR_t\} - \{0.04\}*\{\{TREN_t - 108.0\}/4.0\}*D87_t + A5*TREN_t + A6*\log(U_{t-1}) + A36*error(22) + res\_U_t)$

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

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

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

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

26 $W_t = FIN_t + G_t$

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

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

TABLE A2 *Continued*

Float

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**$(8) + \{0.095\}*\{UNR_t\}*\{-A10\}$
$+ \{0.04/4.0\}*\{TREN_t - 108.0\}*D87_t*\{-A10\} + A10*\log(RW_{t-2}) + A11*ETA_t + A12*ETA_{t-1})$
30 $error(14) = -\{A41 + A1*\{\log(RW_{t-1}) + \log(1.0 + BO_{t-1})\} + A53*\{\log(P_{t-1}) - \log(P_{t-5})\}$
$+ \{1.0 + A1\}*\log(1.0 + VAT_{t-1}) + A2*TREN_{t-1} - \{0.064\}*UNR_{t-1} - \{0.0525\}*\{\{TREN_{t-1}$
$- 108.0\}/4.0\}*D87_{t-1}\} + RXR_{t-1}$
31 $RXR_t = A41 + 0.000 + A1*\{\log(RW_t) + \log(1.0 + BO_t) + A53*\{\log(P_t) - \log(P_{t-4})\}$
$+ \{1.0 + A1\}*\log(1.0 + VAT_t) + A2*TREN_t + A35*error(14) + res\_RXR_t - \{0.064\}*\{UNR_t\}$
$- \{0.0525\}*\{\{TREN_t - 108.0\}/4.0\}*D87_t +$ **shock**(7)
32 $FIN_t = EG_t - Y_t*\{TAX_t\} + XVAL_t + A54*FIN_{t-1} + \{1.0 - A54\}*\{FIN_{t-1}*\{\{P_{t-1}/P_t\}^{0.66}\}\}*\{1.0$
$- 0.155*\{\{NRL_t/NRL_{t-1}\} - 1.0\}\} + res\_FIN_t + RDI_t$
33 $RDI_t = - 0.5*\{NRL_{t-1}/4.0\}*FIN_{t-1}*\{\{\{P_t/P_{t-1}\}^{0.66}\} - 1.0\} + PSBR_t*\{0.32*\{NRS_t/4.0\}$
$+ 0.5*\{NRL_t/4.0\}\} + 0.32*\{NRS_t/4.0\}*FIN_{t-1} - 0.32*\{NRS_{t-1}/4.0\}*FIN_{t-1} + RDI_{t-1}$
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 $RXRN_t = \{RXR_t - RXR_{t-1} - \log(P_t/P_{t-1}) + WINF_t/4.0 + 1.0 + res\_RXRN_t\}*RXRN_{t-1}$

EMU

1 $Y**_t = \exp(\{A29*E**_t + A27*\{\log(WT_t)\} + A47\}/\{0.0 - A28\} + res\_Y**_t)$
2 $E**_t = A1*\{\log(W**_t) + \log(1.0 + BO_t)\} + \{1.0 + A1\}*\log(1.0 + VAT_t) + A41 + A2*TREN_t$
$- \{0.064\}*\{UNR_t\} - \{0.0525\}*\{\{TREN_t - 108.0\}/4.0\}*D87_t$
3 $W**_t = \exp(\{A43 + A9*\log(U**_t) + \{0.095\}*\{UNR_t\}*\{-A10\}*D83_t + \{0.04\}*\{\{TREN_t$
$- 108.0\}/4.0\}*\{-A10\}*D87_t + A7*\{UNR_t\} + A8*\{\log(UB_t) + \log(1.0 + LO_t)\}\}/\{-A10\}$
$+ res\_W**_t)$
4 $U**_t = \exp(\{A42 + A3*\log(Y**_t) + A4*\{\log(W**_t) + \log(1.0 + BO_t) + \log(1.0 + VAT_t)\}$
$- \{0.095\}*\{UNR_t\}*D83_t - \{0.04\}*\{\{TREN_t - 108.0\}/4.0\}*D87_t + A5*TREN_t\}/\{1.0 - A6\})$
5 $EG*_t = Y**_t*\{TAX_t\} + \{PEQ_t/4.0\}*Y**_t*\{FIN_t/Y**_t\} - \{RDI_{t-4} + RDI_{t-5} + RDI_{t-6} + RDI_{t-7}\}/$
$4.0 + res\_EG*_t$
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 $XVOL_t = A40*Y**_t*\{A27*\{\log(WT_t)\} + A28*\log(Y_t) + A47 +$ **shock**$(4) + A29*\{E**_t$
$+ 0.6*\{RXR_t - E**_t\}\} + A30*\{XVOL_{t-1}/\{A40*Y**_{t-1}\}\}\} + res\_XVOL_t$
11 $error(7) = - \{XVAL_{t-5} + \{XVOL_{t-1} - XVOL_{t-5}\} + A31*\{0.32*Y**_{t-1}*\{RXR_{t-1} - RXR_{t-5}$
$- E**_{t-1} + E**_{t-5}\}\}\} + XVAL_{t-1}$
12 $XVAL_t = XVAL_{t-4} + (XVOL_t - XVOL_{t-4}) + A31*\{0.32*Y**_t*(RXR_t - RXR_{t-4} - E**$
$+ E**_{t-4})\} + A32*error(7) + res\_XVAL_t +$ **shock**(6)
13 $RL_t = \{RXR_t - EEXL_t\}/5.0 + RLUS_t + res\_RL_t$
14 $NRL_t = RL_t + PEXL_t$
15 $M0_t = \exp(A44 + A13*\log(M0_{t-1}) + A14*\{\log(Y_t) + \log(1.0 - TAX_{t-1})\} + A15*UB_{t-2}$
$+ A16*TREN_t + A17*NRS_t + A18*\{VAT_t\} +$ **shock**$(1) + res\_M0_t)$
16 $P_t = \exp(0.00625 + RXR_t - RXR_{t-1} + LEUCPI + \log(P_{t-1}) - LEURXR)$
17 $INFL_t = \log(P_t) - \log(P_{t-4}) + res\_INFL_t$

TABLE A2 *Continued*

EMU

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

19 $error(22) = -\{A42 + A3*\log(Y_{t-1}) + A4*\{\log(RW_{t-1}) + \log(1.0 + BO_{t-1}) + \log(1.0 + VAT_{t-1})\} - \{0.095\}*UNR_{t-1} - \{0.04\}*\{\{TREN_t - 108.0\}/4.0\}*D87_{t-1} + A5*TREN_{t-1} + A6*\log(U_{t-2})\} + \log(U_{t-1})$

20 $U_t = \exp(A42 + A3*\log(Y_t) + A4*\{\log(RW_t) + \log(1.0 + BO_t) + \log(1.0 + VAT_t)\} + \textbf{shock}(9) - \{0.095\}*\{UNR_t\} - \{0.04\}*\{\{TREN_t - 108.0\}/4.0\}*D87_t + A5*TREN_t + A6*\log(U_{t-1}) + A36*error(22) + res\_U_t)$

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

22 $NRS_t = EUNRS_t$

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

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 $RW_t = \exp(A43 + A7*\{UNR_t\} + A8*\{\log(UB_t) + \log(1.0 + LO_t)\} + A9*\log(U_t) + A37*\log(RW_{t-1}) + res\_RW_t + \textbf{shock}(8) + \{0.095\}*\{UNR_t)\}*\{-A10\} + \{0.04/4.0\}*\{TREN_t - 108.0\}*D87_t*\{-A10\} + A10*\log(RW_{t-2}) + A11*ETA_t + A12*ETA_{t-1})$

29 $error(14) = -\{A41 + A1*\{\log(RW_{t-1}) + \log(1.0 + BO_{t-1})\} + A53*\{\log(P_{t-1}) - \log(P_{t-5})\} + \{1.0 + A1\}*\log(1.0 + VAT_{t-1}) + A2*TREN_{t-1} - \{0.064\}*UNR_{t-1} - \{0.0525\}*\{\{TREN_{t-1} - 108.0\}/4.0\}*D87_{t-1}\} + RXR_{t-1}$

30 $RXR_t = A41 + 0.000 + A1*\{\log(RW_t) + \log(1.0 + BO_t)\} + A53*\{\log(P_t) - \log(P_{t-4})\} + \{1.0 + A1\}*\log(1.0 + VAT_t) + A2*TREN_t + A35*error(14) + res\_RXR_t - \{0.064\}*\{UNR_t\} - \{0.0525\}*\{\{TREN_t - 108.0\}/4.0\}*D87_t + \textbf{shock}(7)$

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

32 $RDI_t = -0.5*\{NRL_{t-1}/4.0\}*FIN_{t-1}*\{\{\{P_t/P_{t-1}\}^{0.66}\} - 1.0\} + PSBR_t*\{0.32*\{NRS_t/4.0\} + 0.5*\{NRL_t/4.0\}\} + 0.32*\{NRS_t/4.0\}*FIN_{t-1} - 0.32*\{NRS_{t-1}/4.0\}*FIN_{t-1} + RDI_{t-1}$

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 $RXRN_t = \{RXR_t - RXR_{t-1} - \log(P_t/P_{t-1}) + WINF_t/4.0 + 1.0 + res\_RXRN_t\}*RXRN_{t-1}$

Notes:
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 deposit interest rate with local authorities (3 month)
RL	Real 5 year interest rate
RS	Real deposit interest rate 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
DMXR	German exchange rate v. £

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
LEURXR	Change in log euro real effective exchange rate
LEUCPI	Change in log euro area consumer price index
WINF	World inflation (year-on-year)
GEP	German prices
GERX	German real exchange rate

TABLE A3
Listing of All Simulation Results

Float (basic case)	*nrl*	*nrs*	*w*	*m0*	*g*	*fin*	*xval*	*y*
Variance	0.000119	0.000801	2.2E+10	3711885	1.32E+10	1.94E+09	15161133	22465389
St. Dev	0.010903	0.028303	148194.6	1926.625	115027.7	44084.1	3893.73	4739.767
Average	0.001094	0.003192	−15492.8	−259.554	−10218.4	−5266.72	67.48218	29.72129
	bdef	*xvol*	*rl*	*rs*	*infl*	*rxr*	*c*	*eg*
Variance	7043237	9231424	0.000116	0.000737	0.000217	0.011352	9283989	78794638
St. Dev	2653.91	3038.326	0.010756	0.027149	0.014719	0.106548	3046.964	8876.634
Average	−115.571	166.4819	0.000614	0.002044	0.001274	−0.00391	−586.704	935.9343
	rw	*y**	*e**	*w**	*u**	*u*	*dy*	*afc*
Variance	0.007196	10014349	0.003753	0.005278	41239.3	109285.2	0.000741	525687.3
St. Dev	0.08483	3164.546	0.061265	0.072647	203.0746	330.5831	0.027226	725.0429
Average	−0.00373	313.4304	−0.0055	−0.00271	18.07004	39.33082	0.000235	4.28844
	q	*psbr*	*rdi*	*yafc*	*eg**	*ur**	*rxrn*	*ginv*
Variance	0.000681	7987661	603860.5	29863112	65627005	4.92E−05	96.75649	53345089
St. Dev	0.026099	2826.245	777.0846	5464.715	8101.05	0.007017	9.836488	7303.772
Average	−0.002	18.48419	132.8041	34.0699	843.6342	0.000623	−1.22841	−481.596
	mon	*p*	*dmxr*	*leurxr*	*leucpi*	*pop*		
Variance	13849894	0.010107	0.061549	0	0	0		
St. Dev	3721.545	0.100534	0.24809	0	0	0		
Average	−141.349	0.018659	−0.02706	0	0	0		

EMU (basic case)

	nrl	*nrs*	*w*	*m0*	*g*	*fin*	*xval*	*y*
Variance	7.59E−05	0.000313	3.01E+10	3113029	1.67E+10	3.7E+09	15663411	26948245
St. Dev	0.008711	0.017694	173351.3	1764.378	129122.3	60802.83	3957.703	5191.17
Average	8.2E−05	0.000385	−23979.5	−168.966	−17257.1	−6713.64	194.9503	−132.729
	bdef	*xvol*	*rl*	*rs*	*infl*	*rxr*	*c*	*eg*
Variance	8456395	9253813	0.000211	0.003186	0.00437	0.012774	12855035	82060947
St. Dev	2907.988	3042.008	0.01452	0.056442	0.066103	0.11302	3585.392	9058.75
Average	96.01488	295.2198	0.000342	0.000937	0.000462	−0.0046	−764.584	1102.209
	rw	*y**	*e**	*w**	*u**	*u*	*dy*	*afc*
Variance	0.007245	10014418	0.003753	0.005278	41239.63	129069.2	0.000871	631476.2
St. Dev	0.085117	3164.556	0.061265	0.072647	203.0754	359.262	0.029515	794.6548
Average	−0.00498	313.3906	−0.00549	−0.00271	18.07132	55.49672	0.000188	−21.1339
	q	*psbr*	*rdi*	*yafc*	*eg**	*ur**	*rxrn*	*ginv*
Variance	0.000844	8496701	571961.8	35828415	68513919	4.92E−05	696.134	65912374
St. Dev	0.029044	2914.91	756.2815	5985.684	8277.314	0.007017	26.38435	8118.644
Average	−0.00315	55.84001	−41.0225	−153.989	985.1326	0.000624	1.669791	−786.538
	mon	*p*	*dmxr*	*leurxr*	*leucpi*	*pop*		
Variance	69623715	0.26401	0	0.000941	8.38E−06	0		
St. Dev	8344.083	0.513819	0	0.030679	0.002894	0		
Average	786.6501	0.074803	0	0.000164	2E−05	0		

TABLE A3 *Continued*

Float (no indexation case)	*nrl*	*nrs*	*w*	*m0*	*g*	*fin*	*xval*	*y*
Variance	0.000108	0.000673	2.16E+10	3529134	1.3E+10	1.82E+09	14882124	21076143
St. Dev	0.010383	0.025937	147011.3	1878.599	114218.6	42704.56	3857.736	4590.876
Average	0.001086	0.0026	−15926.8	−221.922	−10329.4	−5586.35	68.13982	37.97551
	bdef	*xvol*	*rl*	*rs*	*infl*	*rxr*	*c*	*eg*
Variance	6713032	9111974	0.000102	0.000596	0.000143	0.011131	8612954	78381230
St. Dev	2590.952	3018.605	0.010102	0.024403	0.01196	0.105503	2934.784	8853.317
Average	−113.981	167.869	0.00049	0.001245	0.001283	−0.00469	−574.408	935.9653
	rw	*y**	*e**	*w**	*u**	*u*	*dy*	*afc*
Variance	0.007571	10014364	0.003753	0.005278	41239.39	104229.4	0.000691	492721
St. Dev	0.087009	3164.548	0.061265	0.072647	203.0748	322.8458	0.026284	701.9409
Average	−0.00377	313.4258	−0.0055	−0.00271	18.07032	27.92679	0.000139	4.474015
	q	*psbr*	*rdi*	*yafc*	*eg**	*ur**	*rxrn*	*ginv*
Variance	0.000611	7276068	495505.9	28014733	65260161	4.92E−05	95.55489	51772503
St. Dev	0.024715	2697.419	703.9218	5292.895	8078.376	0.007017	9.775218	7195.311
Average	−0.00186	27.89942	140.0931	42.30291	844.062	0.000623	−1.22743	−486.773
	mon	*p*	*dmxr*	*leurxr*	*leucpi*	*pop*		
Variance	13325538	0.009056	0.061097	0	0	0		
St. Dev	3650.416	0.095166	0.247179	0	0	0		
Average	−157.084	0.015332	−0.02855	0	0	0		

EMU (no indexation case)

	nrl	*nrs*	*w*	*m0*	*g*	*fin*	*xval*	*y*
Variance	7.43E−05	0.000313	3.11E+10	3080573	1.71E+10	4.1E+09	16282436	30256578
St. Dev	0.00862	0.017694	176440.2	1755.156	130794.4	64049	4035.15	5500.598
Average	9.89E−05	0.000385	−23166.1	−170.045	−17159.4	−5997.32	191.2512	−113.158
	bdef	*xvol*	*rl*	*rs*	*infl*	*rxr*	*c*	*eg*
Variance	8976660	9656258	0.000298	0.003313	0.003329	0.014388	14502424	82038541
St. Dev	2996.107	3107.452	0.017272	0.057559	0.057694	0.119948	3808.205	9057.513
Average	62.08679	293.8766	0.000295	0.000898	0.000437	−0.00477	−737.022	1082.177
	rw	*y**	*e**	*w**	*u**	*u*	*dy*	*afc*
Variance	0.008679	10014425	0.003753	0.005278	41239.68	157147.9	0.000964	709175.3
St. Dev	0.09316	3164.558	0.061265	0.072647	203.0756	396.4188	0.031043	842.1255
Average	−0.00496	313.3814	−0.00549	−0.00271	18.07168	68.46458	0.000246	−17.1527
	q	*psbr*	*rdi*	*yafc*	*eg**	*ur**	*rxrn*	*ginv*
Variance	0.000994	9021913	611078.1	40226927	68561450	4.92E−05	696.1015	68678046
St. Dev	0.031534	3003.65	781.7149	6342.47	8280.184	0.007017	26.38374	8287.222
Average	−0.00312	47.69694	−15.1748	−130.266	967.9593	0.000624	1.671111	−769.323
	mon	*p*	*dmxr*	*leurxr*	*leucpi*	*pop*		
Variance	65375059	0.243166	0	0.000941	8.38E−06	0		
St. Dev	8085.484	0.493119	0	0.030679	0.002894	0		
Average	716.4067	0.0692	0	0.000164	2E−05	0		

TABLE A3 *Continued*

Float (low interest rate sensitivity case)

	nrl	*nrs*	*w*	*m0*	*g*	*fin*	*xval*	*y*
Variance	0.000128	0.000809	2.21E+10	3722559	1.35E+10	1.8E+09	15065889	21919577
St. Dev	0.01132	0.028449	148697.7	1929.393	116236.9	42397.02	3881.48	4681.835
Average	0.001117	0.003416	−15286.1	−272.913	−10262.8	−5021.52	74.81998	21.22236
	bdef	*xvol*	*rl*	*rs*	*infl*	*rxr*	*c*	*eg*
Variance	7029317	9425131	0.000126	0.000757	0.000203	0.011589	9265095	78782254
St. Dev	2651.286	3070.038	0.01122	0.02751	0.014242	0.107651	3043.862	8875.937
Average	−118.323	174.1411	0.000614	0.002203	0.00129	−0.00404	−602.906	932.1926
	rw	*y**	*e**	*w**	*u**	*u*	*dy*	*afc*
Variance	0.007195	10014368	0.003753	0.005278	41239.37	103652.9	0.000735	512685.5
St. Dev	0.084825	3164.549	0.061265	0.072647	203.0748	321.9518	0.027103	716.0206
Average	−0.00376	313.4268	−0.0055	−0.00271	18.07004	38.7173	0.000248	3.097489
	q	*psbr*	*rdi*	*yafc*	*eg**	*ur**	*rxrn*	*ginv*
Variance	0.000658	7832349	557387.4	29135731	65615207	4.92E−05	101.3529	54023283
St. Dev	0.025643	2798.633	746.5838	5397.752	8100.321	0.007017	10.06742	7350.053
Average	−0.00205	22.25022	139.0152	24.40087	840.0265	0.000623	−1.39166	−479.055
	mon	*p*	*dmxr*	*leurxr*	*leucpi*	*pop*		
Variance	13384160	0.009258	0.064477	0	0	0		
St. Dev	3658.437	0.096217	0.253924	0	0	0		
Average	−152.457	0.018899	−0.03226	0	0	0		

EMU (low interest rate sensitivity case)

	nrl	*nrs*	*w*	*m0*	*g*	*fin*	*xval*	*y*
Variance	7.64E−05	0.000313	2.76E+10	3262479	1.69E+10	2.3E+09	14725280	22820666
St. Dev	0.008743	0.017694	166023.1	1806.233	130179.5	47952.49	3837.353	4777.098
Average	0.000101	0.000385	−28837.8	−197.229	−21653.7	−7175.86	329.2213	−326.474
	bdef	*xvol*	*rl*	*rs*	*infl*	*rxr*	*c*	*eg*
Variance	7715249	9078435	0.000401	0.003914	0.004385	0.01292	9106476	81364495
St. Dev	2777.634	3013.044	0.020029	0.062566	0.066219	0.113668	3017.694	9020.227
Average	127.7196	435.9078	0.000303	0.000896	0.000395	−0.00555	−952.599	1090.269
	rw	*y**	*e**	*w**	*u**	*u*	*dy*	*afc*
Variance	0.007131	10014453	0.003753	0.005278	41239.44	107999.7	0.000768	533869.6
St. Dev	0.084445	3164.562	0.061265	0.072647	203.075	328.633	0.027713	730.6638
Average	−0.00608	313.3502	−0.00549	−0.00271	18.07301	58.07401	9.65E−05	−47.6621
	q	*psbr*	*rdi*	*yafc*	*eg**	*ur**	*rxrn*	*ginv*
Variance	0.00068	7753428	354203.1	30333679	67806514	4.92E−05	695.7647	61836510
St. Dev	0.026076	2784.498	595.1497	5507.602	8234.471	0.007017	26.37735	7863.619
Average	−0.00433	99.23999	−29.1264	−373.834	971.2885	0.000624	1.667883	−947.937
	mon	*p*	*dmxr*	*leurxr*	*leucpi*	*pop*		
Variance	73835088	0.265371	0	0.000941	8.38E−06	0		
St. Dev	8592.735	0.515142	0	0.030679	0.002894	0		
Average	749.9794	0.073521	0	0.000164	2E−05	0		

TABLE A3 *Continued*

Float (more flexibility case)	*nrl*	*nrs*	*w*	*m0*	*g*	*fin*	*xval*	*y*
Variance	0.000101	0.000765	2.2E+10	3783285	1.33E+10	1.91E+09	14774325	20684881
St. Dev	0.010033	0.02766	148420	1945.067	115246.5	43758.27	3843.738	4548.063
Average	0.000876	0.002926	−14295.8	−244.514	−9292.26	−4994.84	21.51018	61.16389
	bdef	*xvol*	*rl*	*rs*	*infl*	*rxr*	*c*	*eg*
Variance	7133512	8768359	0.000114	0.000799	0.000134	0.01005	8826429	78083309
St. Dev	2670.863	2961.142	0.010686	0.028258	0.011587	0.100249	2970.931	8836.476
Average	−102.682	113.8582	0.000643	0.002273	0.000807	−0.00266	−557.514	952.4644
	rw	*y**	*e**	*w**	*u**	*u*	*dy*	*afc*
Variance	0.004052	10014370	0.003753	0.005278	41239.36	18414.23	0.000752	483931.8
St. Dev	0.063659	3164.549	0.061265	0.072647	203.0748	135.6991	0.02742	695.6521
Average	−0.00256	313.4271	−0.0055	−0.00271	18.07022	13.40907	0.000239	10.53728
	q	*psbr*	*rdi*	*yafc*	*eg**	*ur**	*rxrn*	*ginv*
Variance	0.000651	8168151	558549.6	27496267	65004832	4.92E−05	76.77895	53273823
St. Dev	0.025517	2857.998	747.3618	5243.688	8062.557	0.007017	8.76236	7298.892
Average	−0.00177	16.94148	118.0449	71.87897	858.8327	0.000624	−1.21698	−437.111
	mon	*p*	*dmxr*	*leurxr*	*leucpi*	*pop*		
Variance	10615827	0.003531	0.049582	0	0	0		
St. Dev	3258.194	0.059423	0.222671	0	0	0		
Average	−234.495	0.011509	−0.02897	0	0	0		

EMU (more flexibility case)

	nrl	*nrs*	*w*	*m0*	*g*	*fin*	*xval*	*y*
Variance	7.55E−05	0.000313	2.77E+10	3285892	1.63E+10	2.85E+09	15055832	23690510
St. Dev	0.008687	0.017694	166362	1812.703	127553.1	53403.14	3880.185	4867.29
Average	8.41E−05	0.000385	−30118.1	−195.141	−21629	−8481.07	337.5624	−329.833
	bdef	*xvol*	*rl*	*rs*	*infl*	*rxr*	*c*	*eg*
Variance	8163214	8830758	0.000186	0.003225	0.004456	0.011482	11447527	81454064
St. Dev	2857.134	2971.659	0.013631	0.056788	0.066753	0.107154	3383.419	9025.191
Average	126.9666	443.3866	6.99E−05	0.001078	0.000368	−0.00585	−919.745	1084.207
	rw	*y**	*e**	*w**	*u**	*u*	*dy*	*afc*
Variance	0.004051	10014392	0.003753	0.005278	41239.48	19817.78	0.000856	554737.2
St. Dev	0.063646	3164.552	0.061265	0.072647	203.0751	140.7756	0.02925	744.8068
Average	−0.00559	313.4164	−0.00549	−0.00271	18.06982	22.3	8.79E−05	−50.219
	q	*psbr*	*rdi*	*yafc*	*eg**	*ur**	*rxrn*	*ginv*
Variance	0.000766	8202092	415374.8	31493786	67890681	4.92E−05	696.1387	62368918
St. Dev	0.027676	2863.929	644.4958	5611.933	8239.58	0.007017	26.38444	7897.399
Average	−0.00434	96.78676	−30.9798	−379.958	964.8155	0.000623	1.669424	−987.924
	mon	*p*	*dmxr*	*leurxr*	*leucpi*	*pop*		
Variance	72398707	0.258841	0	0.000941	8.38E−06	0		
St. Dev	8508.743	0.508764	0	0.030679	0.002894	0		
Average	721.6583	0.071596	0	0.000164	2E−05	0		

TABLE A3 *Continued*

Float (high natural rate of unemployment case)

	nrl	*nrs*	*w*	*m0*	*g*	*fin*	*xval*	*y*
Variance	0.00012	0.000817	2.02E+10	3289274	1.25E+10	1.63E+09	14424169	20664849
St. Dev	0.010943	0.028592	142243.9	1813.636	111896.3	40324.01	3797.916	4545.861
Average	0.001114	0.003237	−13862.1	−244.082	−9623.02	−4244.47	31.1103	56.83806
	bdef	*xvol*	*rl*	*rs*	*infl*	*rxr*	*c*	*eg*
Variance	6445440	8453984	0.000125	0.000841	0.000223	0.011392	8955699	71841505
St. Dev	2538.787	2907.574	0.011181	0.029007	0.014936	0.106733	2992.607	8475.937
Average	−83.7987	127.8644	0.000605	0.002263	0.001183	−0.00323	−545.506	923.2775
	rw	*y**	*e**	*w**	*u**	*u*	*dy*	*afc*
Variance	0.008798	9086758	0.003754	0.006475	252142.3	660670	0.000764	483596.4
St. Dev	0.093799	3014.425	0.061267	0.080466	502.1377	812.8161	0.027637	695.4109
Average	−0.00349	298.5368	−0.0055	−0.00301	44.68703	103.6397	0.000266	10.24626
	q	*psbr*	*rdi*	*yafc*	*eg**	*ur**	*rxrn*	*ginv*
Variance	0.000687	7278343	520563.1	27470066	59828483	0.000301	126.6546	49402093
St. Dev	0.026207	2697.84	721.5006	5241.189	7734.887	0.017351	11.25409	7028.662
Average	−0.00184	17.82237	101.2386	67.46296	832.2004	0.001543	−1.63744	−438.575
	mon	*p*	*dmxr*	*leurxr*	*leucpi*	*pop*		
Variance	11894342	0.010085	0.080829	0	0	0		
St. Dev	3448.817	0.100422	0.284304	0	0	0		
Average	−131.071	0.018004	−0.0385	0	0	0		

EMU (high natural rate of unemployment case)

	nrl	*nrs*	*w*	*m0*	*g*	*fin*	*xval*	*y*
Variance	7.74E–05	0.000313	2.66E+10	2775992	1.53E+10	2.95E+09	14816164	24201706
St. Dev	0.0088	0.017694	163161	1666.131	123596.7	54278.52	3849.177	4919.523
Average	4.99E–05	0.000385	–22311.8	–155.681	–16534.9	–5772.85	167.0887	–94.939
	bdef	*xvol*	*rl*	*rs*	*infl*	*rxr*	*c*	*eg*
Variance	7578992	8376967	0.000385	0.004038	0.004496	0.012607	11959684	74334609
St. Dev	2752.997	2894.299	0.019616	0.063543	0.067056	0.112282	3458.278	8621.752
Average	92.86697	270.2905	0.00019	0.000334	0.000482	–0.00523	–697.141	1056.682
	rw	*y**	*e**	*w**	*u**	*u*	*dy*	*afc*
Variance	0.008824	9086044	0.003753	0.006474	252123	796754.2	0.00088	566925.9
St. Dev	0.093936	3014.307	0.061265	0.080463	502.1185	892.6109	0.029658	752.9448
Average	–0.00588	298.4719	–0.00549	–0.00301	44.68753	127.1993	0.000215	–13.0145
	q	*psbr*	*rdi*	*yafc*	*eg**	*ur**	*rxrn*	*ginv*
Variance	0.000832	7637029	445791.6	32175449	62011229	0.000301	695.8867	59263199
St. Dev	0.028853	2763.518	667.6762	5672.341	7874.721	0.01735	26.37966	7698.26
Average	–0.00293	50.87913	–42.4649	–107.819	945.2377	0.001543	1.672693	–737.874
	mon	*p*	*dmxr*	*leurxr*	*leucpi*	*pop*		
Variance	84191197	0.358106	0	0.000941	8.38E–06	0		
St. Dev	9175.576	0.59842	0	0.030679	0.002894	0		
Average	862.4056	0.086437	0	0.000164	2E–05	0		

TABLE A3 *Continued*

Float (bubble case)	*nrl*	*nrs*	*w*	*m0*	*g*	*fin*	*xval*	*y*
Variance	0.00012	0.000991	2.18E+10	3769653	1.32E+10	1.93E+09	15218153	22480513
St. Dev	0.010973	0.031484	147724.1	1941.559	114755.9	43949.16	3901.045	4741.362
Average	0.001087	0.003288	−17246.3	−269.433	−11430.2	−5808.25	109.4965	−21.9859
	bdef	*xvol*	*rl*	*rs*	*infl*	*rxr*	*c*	*eg*
Variance	7080474	9300847	0.000117	0.000973	0.00025	0.011404	9219571	78810677
St. Dev	2660.916	3049.729	0.010795	0.031201	0.01581	0.106788	3036.375	8877.538
Average	−104.362	210.5855	0.000553	0.002038	0.001422	−0.00436	−630.173	935.3464
	rw	*y**	*e**	*w**	*u**	*u*	*dy*	*afc*
Variance	0.007208	10014350	0.003753	0.005278	41239.32	109795.2	0.000758	526095.2
St. Dev	0.084902	3164.546	0.061265	0.072647	203.0747	331.3536	0.027526	725.3242
Average	−0.00408	313.4291	−0.0055	−0.00271	18.07009	41.2462	0.000224	−3.66595
	q	*psbr*	*rdi*	*yafc*	*eg**	*ur**	*rxrn*	*ginv*
Variance	0.000687	7927149	689637.3	29884452	65656569	4.92E−05	97.11308	53206726
St. Dev	0.026214	2815.519	830.4441	5466.667	8102.874	0.007017	9.854597	7294.294
Average	−0.00233	26.38922	129.4102	−25.5935	841.6953	0.000623	−1.56715	−541.309
	mon	*p*	*dmxr*	*leurxr*	*leucpi*	*pop*		
Variance	14035632	0.010274	0.061761	0	0	0		
St. Dev	3746.416	0.101359	0.248518	0	0	0		
Average	−125.588	0.020673	−0.03569	0	0	0		

EMU (bubble case)

	nrl	*nrs*	*w*	*m0*	*g*	*fin*	*xval*	*y*
Variance	7.59E−05	0.000313	3.01E+10	3113029	1.67E+10	3.7E+09	15663411	26948245
St. Dev	0.008711	0.017694	173351.3	1764.378	129122.3	60802.83	3957.703	5191.17
Average	8.2E−05	0.000385	−23979.5	−168.966	−17257.1	−6713.64	194.9503	−132.729
	bdef	*xvol*	*rl*	*rs*	*infl*	*rxr*	*c*	*eg*
Variance	8456395	9253813	0.000211	0.003186	0.00437	0.012774	12855035	82060947
St. Dev	2907.988	3042.008	0.01452	0.056442	0.066103	0.11302	3585.392	9058.75
Average	96.01488	295.2198	0.000342	0.000937	0.000462	−0.0046	−764.584	1102.209
	rw	*y**	*e**	*w**	*u**	*u*	*dy*	*afc*
Variance	0.007245	10014418	0.003753	0.005278	41239.63	129069.2	0.000871	631476.2
St. Dev	0.085117	3164.556	0.061265	0.072647	203.0754	359.262	0.029515	794.6548
Average	−0.00498	313.3906	−0.00549	−0.00271	18.07132	55.49672	0.000188	−21.1339
	q	*psbr*	*rdi*	*yafc*	*eg**	*ur**	*rxrn*	*ginv*
Variance	0.000844	8496701	571961.8	35828415	68513919	4.92E−05	696.134	65912374
St. Dev	0.029044	2914.91	756.2815	5985.684	8277.314	0.007017	26.38435	8118.644
Average	−0.00315	55.84001	−41.0225	−153.989	985.1326	0.000624	1.669791	−786.538
	mon	*p*	*dmxr*	*leurxr*	*leucpi*	*pop*		
Variance	69623715	0.26401	0	0.000941	8.38E−06	0		
St. Dev	8344.083	0.513819	0	0.030679	0.002894	0		
Average	786.6501	0.074803	0	0.000164	2E−05	0		

TABLE A3 *Continued*

Float (enhanced fiscal case)

	nrl	*nrs*	*w*	*m0*	*g*	*fin*	*xval*	*y*
Variance	0.000116	0.000782	2.23E+10	3700787	1.34E+10	2E+09	14818082	21480892
St. Dev	0.01079	0.027967	149341.4	1923.743	115753.4	44687.53	3849.426	4634.748
Average	0.001087	0.003184	−15458.2	−259.934	−10266.8	−5187.36	62.60193	31.57903
	bdef	*xvol*	*rl*	*rs*	*infl*	*rxr*	*c*	*eg*
Variance	7547732	8692059	0.000116	0.000731	0.000207	0.011303	9103156	77643513
St. Dev	2747.314	2948.23	0.010773	0.027031	0.014389	0.106313	3017.144	8811.556
Average	−109.187	161.6981	0.000603	0.002046	0.001255	−0.00386	−582.058	939.1866
	rw	*y**	*e**	*w**	*u**	*u*	*dy*	*afc*
Variance	0.007141	10014344	0.003753	0.005278	41239.28	106216.5	0.000692	502489.4
St. Dev	0.084505	3164.545	0.061264	0.072647	203.0746	325.9088	0.026309	708.8649
Average	−0.00371	313.448	−0.0055	−0.00271	18.06946	38.54779	0.000217	4.586779
	q	*psbr*	*rdi*	*yafc*	*eg**	*ur**	*rxrn*	*ginv*
Variance	0.000631	8577043	620443.1	28552874	65789196	4.92E−05	94.32542	53914930
St. Dev	0.025124	2928.659	787.6821	5343.489	8111.054	0.007017	9.712128	7342.679
Average	−0.00197	21.57854	129.4694	36.26904	847.8806	0.000623	−1.23827	−482.547
	mon	*p*	*dmxr*	*leurxr*	*leucpi*	*pop*		
Variance	13358059	0.009104	0.060066	0	0	0		
St. Dev	3654.868	0.095416	0.245084	0	0	0		
Average	−145.777	0.018173	−0.02724	0	0	0		

EMU (enhanced fiscal case)

	nrl	*nrs*	*w*	*m0*	*g*	*fin*	*xval*	*y*
Variance	7.69E−05	0.000313	2.88E+10	3291492	1.68E+10	3.12E+09	15048583	24927897
St. Dev	0.008769	0.017694	169673.1	1814.247	129597.4	55834.03	3879.25	4992.784
Average	9.73E−05	0.000385	−30152.9	−197.115	−22220.8	−7922.82	340.7361	−335.67
	bdef	*xvol*	*rl*	*rs*	*infl*	*rxr*	*c*	*eg*
Variance	8946990	8505949	0.000385	0.004017	0.00448	0.012587	12404528	80486586
St. Dev	2991.152	2916.496	0.019628	0.063379	0.066931	0.112191	3522.006	8971.432
Average	151.854	447.7225	0.000282	0.000923	0.000383	−0.00564	−942.124	1105.934
	rw	*y**	*e**	*w**	*u**	*u*	*dy*	*afc*
Variance	0.007159	10014420	0.003753	0.005278	41239.53	119382.5	0.000796	584197.6
St. Dev	0.084613	3164.557	0.061265	0.072647	203.0752	345.5177	0.028218	764.3282
Average	−0.00617	313.3707	−0.00549	−0.00271	18.07219	61.81407	8.07E−05	−49.642
	q	*psbr*	*rdi*	*yafc*	*eg**	*ur**	*rxrn*	*ginv*
Variance	0.000755	9016597	440830.5	33142983	68071421	4.92E−05	695.7989	64571082
St. Dev	0.027482	3002.765	663.9507	5756.994	8250.541	0.007017	26.378	8035.613
Average	−0.00442	127.7888	−24.8119	−385.139	963.5026	0.000624	1.666171	−996.903
	mon	*p*	*dmxr*	*leurxr*	*leucpi*	*pop*		
Variance	73824731	0.265087	0	0.000941	8.38E−06	0		
St. Dev	8592.132	0.514866	0	0.030679	0.002894	0		
Average	748.2067	0.073445	0	0.000164	2E−05	0		

TABLE A3 *Continued*

Float (highly favourable combination)	*nrl*	*nrs*	*w*	*m0*	*g*	*fin*	*xval*	*y*
Variance	0.000118	0.000813	2.19E+10	3748608	1.34E+10	1.75E+09	14549397	19166221
St. Dev	0.010857	0.028516	147839.6	1936.132	115618	41875.45	3814.367	4377.924
Average	0.001084	0.003426	−14890.3	−269.653	−9908.76	−4980.35	49.14953	31.91144
	bdef	*xvol*	*rl*	*rs*	*infl*	*rxr*	*c*	*eg*
Variance	7498625	8802909	0.000122	0.000787	0.000188	0.010337	8458082	77468979
St. Dev	2738.362	2966.97	0.01104	0.028056	0.013715	0.101669	2908.278	8801.646
Average	−110.898	143.8706	0.000595	0.002336	0.001224	−0.00331	−580.497	937.1269
	rw	*y**	*e**	*w**	*u**	*u*	*dy*	*afc*
Variance	0.004009	10014363	0.003753	0.005278	41239.32	17322.89	0.000681	447949.9
St. Dev	0.063317	3164.548	0.061265	0.072647	203.0747	131.6164	0.026095	669.2906
Average	−0.00281	313.4202	−0.0055	−0.00271	18.0705	12.72227	0.000229	7.528129
	q	*psbr*	*rdi*	*yafc*	*eg**	*ur**	*rxrn*	*ginv*
Variance	0.000583	8425515	565594.4	25473109	65587852	4.92E−05	91.18965	53464708
St. Dev	0.02414	2902.674	752.0601	5047.089	8098.633	0.007017	9.549327	7311.957
Average	−0.00192	25.63089	135.0704	39.79293	845.5359	0.000623	−1.41126	−461.27
	mon	*p*	*dmxr*	*leurxr*	*leucpi*	*pop*		
Variance	12900087	0.007964	0.058042	0	0	0		
St. Dev	3591.669	0.089239	0.24092	0	0	0		
Average	−165.664	0.01734	−0.03413	0	0	0		

EMU (highly favourable combination)

	nrl	*nrs*	*w*	*m0*	*g*	*fin*	*xval*	*y*
Variance	7.48E–05	0.000313	2.86E+10	3121666	1.72E+10	2.5E+09	14368210	20354974
St. Dev	0.008646	0.017694	169037.5	1766.824	131327.3	50003.73	3790.542	4511.649
Average	8.46E–05	0.000385	–23374.6	–166.399	–17300.6	–6064	161.3881	–116.956
	bdef	*xvol*	*rl*	*rs*	*infl*	*rxr*	*c*	*eg*
Variance	8392247	8737852	0.000209	0.003075	0.004301	0.011852	8562396	81181843
St. Dev	2896.937	2955.986	0.014444	0.05545	0.065581	0.108868	2926.157	9010.097
Average	106.5758	260.3643	0.000246	0.00094	0.000541	–0.00421	–744.411	1113.837
	rw	*y**	*e**	*w**	*u**	*u*	*dy*	*afc*
Variance	0.003907	10014405	0.003753	0.005278	41239.35	17351.79	0.000721	476057.1
St. Dev	0.062503	3164.554	0.061265	0.072647	203.0747	131.7262	0.026842	689.9689
Average	–0.00405	313.351	–0.00549	–0.00271	18.07262	16.96652	0.000173	–14.6157
	q	*psbr*	*rdi*	*yafc*	*eg**	*ur**	*rxrn*	*ginv*
Variance	0.000614	8505281	466270.6	27054674	68675077	4.92E–05	696.1543	63218694
St. Dev	0.024778	2916.381	682.8401	5201.411	8287.043	0.007017	26.38474	7951.018
Average	–0.00293	67.32179	–39.9156	–131.197	988.3913	0.000624	1.669978	–761.673
	mon	*p*	*dmxr*	*leurxr*	*leucpi*	*pop*		
Variance	68865574	0.259593	0	0.000941	8.38E–06	0		
St. Dev	8298.528	0.509503	0	0.030679	0.002894	0		
Average	786.0265	0.074195	0	0.000164	2E–05	0		

APPENDIX B

Taylor-series Expansion of Expected Utility

It might seem that we can take the percentage change in utility between EMU and floating as the percentage change in UK welfare. However, the utility unit is not invariant to units. For example take logarithmic utility: $U = a \ln(c) + (1 - a) \ln(1 + u)$. If we double the unit of consumption we add $a \ln(2)$ 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 $\bar{c}$ and $\bar{u}$, for example) and set the total differential to zero.

$$0 = \frac{\Delta EU}{N} = \frac{\delta U}{\delta c}\frac{\Delta(Ec - \bar{c})}{N} + \frac{\delta U}{du}\frac{\Delta(Eu - \bar{u})}{N} + \Delta 0.5 \frac{\left[\left(\frac{\delta^2 U}{\delta c^2}\right)\text{var } c + \left(\frac{\delta^2 U}{\delta c^2}\right)\text{var } u + \left(\frac{2\delta U}{\delta c}\frac{\delta U}{\delta u}\right)\text{cov}(c, u)\right]}{N}$$

where N is the number of observations we have (in this case all our 12,078 stochastic periods). It follows that in order to hold expected utility constant,

$$-\frac{\delta U}{\delta c}\frac{\Delta(Ec - \bar{c})}{N} - \frac{\delta U}{\delta u}\Delta(Eu - \bar{u}) = \Delta 0.5 \frac{\left[\left(\frac{\delta^2 U}{\delta c^2}\right)\text{var } c + \left(\frac{\delta^2 U}{\delta c^2}\right)\text{var } u + \left(\frac{2\delta U}{\delta c}\frac{\delta U}{\delta u}\right)\text{cov}(c, u)\right]}{N}.$$

Since the move to the euro involves no change in mean, it follows that the term on the right-hand side of the equation due to changing variances is the effect we are picking up in our simulations and there is no change in Ec or Eu; hence the left-hand side of the equation is zero. If we want to know what percentage consumption change would be equivalent (i.e. would just offset the simulated change in variances), we solve this equation for:

$$\frac{\Delta \dfrac{Ec - \bar{c}}{\bar{c}}}{N} = \frac{1}{\bar{c}\dfrac{\delta U}{\delta c}} \left\{ \Delta 0.5 \frac{\left[\left(\dfrac{\delta^2 U}{\delta c^2} \right) \operatorname{var} c + \left(\dfrac{\delta^2 U}{\delta c^2} \right) \operatorname{var} u + \left(\dfrac{2\delta U}{\delta c} \dfrac{\delta U}{\delta u} \right) \operatorname{cov}(c, u) \right]}{N} \right\}.$$

This is what we report in the text: the expected percentage consumption fall that is the equivalent of the losses created by the higher variances and covariances.

TABLE A4
Decomposition of Simulation Results

A4 Float (demand shocks)	*nrl*	*nrs*	*w*	*m0*	*g*	*fin*	*xval*	*y*
Variance	3.84E−05	9.46E−05	1.75E+10	1201201	9.5E+09	1.61E+09	12704747	10346048
St. Dev	0.0062	0.009725	132312.5	1095.993	97446.29	40103.9	3564.372	3216.527
Average	0.00044	0.000834	−20871	−166.611	−15954.3	−4912.16	−14.4686	−121.773
	bdef	*xvol*	*rl*	*rs*	*infl*	*rxr*	*c*	*eg*
Variance	6461142	6489436	9.28E−06	6E−05	9.63E−05	0.000566	4582094	78986774
St. Dev	2541.878	2547.437	0.003047	0.007749	0.009814	0.023792	2140.583	8887.45
Average	−81.373	96.69008	0.000148	0.000323	0.000624	−0.00101	−382.327	980.7598
	rw	*y**	*e**	*w**	*u**	*u*	*dy*	*afc*
Variance	0.000371	0.021815	0	0	4.4E−05	19447.66	0.000224	240777.4
St. Dev	0.019264	0.1477	0	0	0.00663	139.4549	0.014962	490.6907
Average	−0.00086	0.042096	0	0	−0.00244	11.45652	−5.8E−05	−17.5771
	q	*psbr*	*rdi*	*yafc*	*eg**	*ur**	*rxrn*	*ginv*
Variance	0.000435	6869769	183090.8	13740703	65926182	0	36.29942	25695941
St. Dev	0.020847	2621.024	427.8912	3706.845	8119.494	0	6.0249	5069.116
Average	−0.0009	−71.0526	9.735009	−139.008	892.9631	0	−0.1434	−834.591
	mon	*p*	*dmxr*	*leurxr*	*leucpi*	*pop*		
Variance	9528412	0.010707	0.022014	0	0	0		
St. Dev	3086.813	0.103475	0.148373	0	0	0		
Average	−93.6687	0.009185	0.000389	0	0	0		

A4 EMU (demand shocks)

	nrl	*nrs*	*w*	*m0*	*g*	*fin*	*xval*	*y*
Variance	1.34E−07	0	1.93E+10	1123391	1.04E+10	1.87E+09	12609637	10380344
St. Dev	0.000366	0	138836.3	1059.901	101797.7	43196.77	3551.005	3221.854
Average	−5.2E−05	0	−20633.3	−123.322	−15872.4	−4765.24	−52.6263	−55.7074
	bdef	*xvol*	*rl*	*rs*	*infl*	*rxr*	*c*	*eg*
Variance	6655081	5616250	5.91E−06	3.22E−05	4E−05	0.000256	5077585	79124296
St. Dev	2579.744	2369.863	0.002432	0.005673	0.006323	0.016007	2253.35	8895.184
Average	−35.9544	57.27697	−0.00011	−0.00059	−7.6E−05	−0.00136	−329.03	1032.876
	rw	*y**	*e**	*w**	*u**	*u*	*dy*	*afc*
Variance	0.000353	0.024435	0	0	4.74E−05	23112.33	0.000248	239678.9
St. Dev	0.0188	0.156317	0	0	0.006887	152.0274	0.015744	489.5701
Average	−0.0012	0.07434	0	0	−0.00378	3.435032	−1.2E−05	−4.96679
	q	*psbr*	*rdi*	*yafc*	*eg**	*ur**	*rxrn*	*ginv*
Variance	0.000441	6894627	66776.76	13759274	65957243	0	2.5E−06	28377448
St. Dev	0.021005	2625.762	258.412	3709.35	8121.406	0	0.001581	5327.049
Average	−0.00045	−77.0061	−42.1147	−60.1235	940.0649	0	−0.00201	−822.262
	mon	*p*	*dmxr*	*leurxr*	*leucpi*	*pop*		
Variance	2986810	0.000753	0	0	0	0		
St. Dev	1728.239	0.027436	0	0	0	0		
Average	−263.11	−0.00185	0	0	0	0		

TABLE A4 *Continued*

Float (supply shocks)	*nrl*	*nrs*	*w*	*m0*	*g*	*fin*	*xval*	*y*
Variance	1.42E−05	0.000155	2.77E+09	1570912	1.53E+09	3.21E+08	641274.8	9377968
St. Dev	0.00377	0.012469	52646.94	1253.36	39110.99	17920.33	800.7964	3062.347
Average	−6.9E−05	1.72E−05	3879.979	−11.7318	2239.953	1655.507	49.52094	248.0063
	bdef	*xvol*	*rl*	*rs*	*infl*	*rxr*	*c*	*eg*
Variance	86925.23	707054.3	1.59E−05	0.000143	3.47E−05	0.00436	1097995	758661.9
St. Dev	294.8309	840.8652	0.003985	0.011968	0.005887	0.066034	1047.853	871.012
Average	11.50661	53.17621	8.64E−06	1.47E−05	0.00025	−0.006	18.42378	72.78777
	rw	*y**	*e**	*w**	*u**	*u*	*dy*	*afc*
Variance	0.005667	10016344	0.003753	0.005276	41249.99	78819.6	2.83E−05	221703.6
St. Dev	0.075279	3164.861	0.061263	0.072636	203.1009	280.7483	0.005315	470.8541
Average	−0.00312	313.2092	−0.00549	−0.00271	18.0806	20.34024	0.000166	37.44382
	q	*psbr*	*rdi*	*yafc*	*eg**	*ur**	*rxrn*	*ginv*
Variance	5.01E−05	248168.3	88305.42	12483098	616760.5	4.92E−05	38.47177	4652439
St. Dev	0.007078	498.1649	297.1623	3533.143	785.341	0.007018	6.202562	2156.951
Average	−0.00042	35.67462	23.34106	285.3374	64.24479	0.000624	−0.32224	141.2993
	mon	*p*	*dmxr*	*leurxr*	*leucpi*	*pop*		
Variance	3471708	0.000825	0.024103	0	0	0		
St. Dev	1863.252	0.028729	0.15525	0	0	0		
Average	32.65722	0.004205	−0.00359	0	0	0		

EMU (supply shocks)

	nrl	*nrs*	*w*	*m0*	*g*	*fin*	*xval*	*y*
Variance	3.72E−08	0	3.75E+09	1465602	2.09E+09	4.9E+08	589653.7	10777795
St. Dev	0.000193	0	61219.98	1210.62	45766.82	22126.72	767.8891	3282.955
Average	2.14E−06	0	5290.637	−10.0467	2952.549	2336.073	7.359717	296.1657
	bdef	*xvol*	*rl*	*rs*	*infl*	*rxr*	*c*	*eg*
Variance	135699.7	549896.1	3.15E−05	0.000205	0.000263	0.003616	1793551	721783.6
St. Dev	368.3745	741.5498	0.005612	0.014334	0.016208	0.060133	1339.235	849.5785
Average	9.573781	7.134156	−7.7E−06	0.000235	−0.0005	−0.00529	63.35065	83.43586
	rw	*y**	*e**	*w**	*u**	*u*	*dy*	*afc*
Variance	0.005591	10015433	0.003753	0.005276	41250.54	79836.35	3.26E−05	256090.4
St. Dev	0.074775	3164.717	0.061263	0.072638	203.1023	282.5533	0.005706	506.0538
Average	−0.00275	312.9922	−0.00549	−0.00271	18.0812	22.79485	0.00021	47.59241
	q	*psbr*	*rdi*	*yafc*	*eg**	*ur**	*rxrn*	*ginv*
Variance	7.49E−05	160542.8	15367.43	14353848	580733.6	4.93E−05	5.36E−06	6452755
St. Dev	0.008654	400.6779	123.9654	3788.647	762.0588	0.007018	0.002315	2540.227
Average	−0.00016	24.67583	14.5679	344.1407	74.75653	0.000623	−0.00052	189.4806
	mon	*p*	*dmxr*	*leurxr*	*leucpi*	*pop*		
Variance	6957779	0.009936	0	0	0	0		
St. Dev	2637.76	0.099679	0	0	0	0		
Average	−122.022	−0.00574	0	0	0	0		

TABLE A4 *Continued*

Float (external shocks)	*nrl*	*nrs*	*w*	*m0*	*g*	*fin*	*xval*	*y*
Variance	4.46E−08	1.02E−06	140687.6	310.7505	93227.37	50690.92	111.1419	1302.926
St. Dev	0.000211	0.001008	375.0835	17.62812	305.3316	225.1464	10.54239	36.09607
Average	2.54E−05	−0.00022	276.5811	11.2383	262.9516	16.60434	4.106694	−4.15069
	bdef	*xvol*	*rl*	*rs*	*infl*	*rxr*	*c*	*eg*
Variance	394.5767	146.6754	6.44E−08	1.53E−06	2.52E−07	1.96E−06	338.4212	257.546
St. Dev	19.86396	12.11096	0.000254	0.001237	0.000502	0.001401	18.39623	16.04824
Average	−4.32776	5.520371	−2.2E−05	−0.00047	1.01E−05	−0.00014	−13.2445	−5.91947
	rw	*y**	*e**	*w**	*u**	*u*	*dy*	*afc*
Variance	2.07E−06	414.9802	1.77E−08	2.18E−08	0.266149	36.21963	7.51E−08	32.28405
St. Dev	0.001439	20.37106	0.000133	0.000148	0.515896	6.018274	0.000274	5.681906
Average	1.23E−05	0.111623	−2.1E−07	2.57E−07	−0.00382	−1.22991	−1.4E−05	−2.34875
	q	*psbr*	*rdi*	*yafc*	*eg**	*ur**	*rxrn*	*ginv*
Variance	5.39E−08	1082.877	360.4444	1708.381	213.9023	9.04E−11	0.017839	678.4217
St. Dev	0.000232	32.9071	18.98537	41.33257	14.6254	9.51E−06	0.133563	26.04653
Average	−2.6E−05	4.422435	7.511033	−6.86594	−5.47615	8.45E−07	0.085666	7.514958
	mon	*p*	*dmxr*	*leurxr*	*leucpi*	*pop*		
Variance	430.7441	1.01E−06	2.49E−05	0	0	0		
St. Dev	20.75438	0.001003	0.004993	0	0	0		
Average	11.65511	0.000188	0.004477	0	0	0		

EMU (external shocks)

	nrl	*nrs*	*w*	*m0*	*g*	*fin*	*xval*	*y*
Variance	7.33E–05	0.000313	1.57E+09	537346.2	8.55E+08	4.1E+08	711007.4	1977007
St. Dev	0.008564	0.017694	39684.67	733.039	29244.47	20244.7	843.2125	1406.061
Average	8.05E–05	0.000385	–17397.7	–65.3963	–12899.8	–4493.55	430.4356	–557.058
	bdef	*xvol*	*rl*	*rs*	*infl*	*rxr*	*c*	*eg*
Variance	525649.1	872148	8.5E–05	0.002467	0.003514	0.002598	1346723	265624.6
St. Dev	725.0166	933.8886	0.009218	0.049668	0.059276	0.050968	1160.484	515.3879
Average	113.9311	448.258	–0.00041	7.79E–05	0.000493	–0.00364	–480.151	–21.8347
	rw	*y**	*e**	*w**	*u**	*u*	*dy*	*afc*
Variance	0.000203	415.1834	1.77E–08	2.18E–08	0.266401	4673.95	5.77E–05	46159.31
St. Dev	0.014247	20.37605	0.000133	0.000148	0.516141	68.3663	0.007598	214.8472
Average	–0.00349	0.103513	6.71E–07	9.19E–07	–0.00385	25.5051	–0.00028	–84.1285
	q	*psbr*	*rdi*	*yafc*	*eg**	*ur**	*rxrn*	*ginv*
Variance	7.96E–05	309810	282427.7	2628084	211670.1	8.87E–11	696.1801	2888415
St. Dev	0.008921	556.6058	531.4392	1621.137	460.0762	9.42E–06	26.38523	1699.534
Average	–0.00359	121.3529	6.806195	–640.798	–34.1807	8.28E–07	1.670289	–587.756
	mon	*p*	*dmxr*	*leurxr*	*leucpi*	*pop*		
Variance	82070214	0.26535	0	0.000941	8.37E–06	0		
St. Dev	9059.261	0.515122	0	0.030679	0.002894	0		
Average	1200.45	0.075903	0	0.000164	2.02E–05	0		

TABLE A4 *Continued*

A4 EMU (eucpi shock only)

	nrl	*nrs*	*w*	*m0*	*g*	*fin*	*xval*	*y*
Variance	4.83E−07	0	7112031	71.67187	3493276	2161691	3513.649	11136.45
St. Dev	0.000695	0	2666.839	8.465924	1869.031	1470.269	59.27604	105.5294
Average	3.16E−06	0	−19.6259	−0.51648	−2.62022	−17.629	2.848863	−5.37573
	bdef	*xvol*	*rl*	*rs*	*infl*	*rxr*	*c*	*eg*
Variance	2075.995	4310.418	5.52E−07	1.41E−05	1.9E−05	1.52E−05	6582.881	348.6578
St. Dev	45.56309	65.65377	0.000743	0.003752	0.004354	0.003898	81.13496	18.67238
Average	0.279755	2.605241	1.25E−05	5.71E−05	−3.2E−05	5.65E−05	−3.39892	−1.33773
	rw	*y**	*e**	*w**	*u**	*u*	*dy*	*afc*
Variance	4.79E−06	415.0267	1.77E−08	2.18E−08	0.266176	40.19652	4.12E−07	262.6815
St. Dev	0.002189	20.3722	0.000133	0.000148	0.515922	6.340073	0.000642	16.20745
Average	−1.4E−05	0.119355	2.82E−07	9.19E−07	−0.00413	1.006054	−1.6E−05	−1.42552
	q	*psbr*	*rdi*	*yafc*	*eg**	*ur**	*rxrn*	*ginv*
Variance	4.54E−07	1623.256	342.8472	14797.61	231.5801	8.96E−11	3.143851	15271.4
St. Dev	0.000674	40.28965	18.51613	121.6454	15.21776	9.46E−06	1.773091	123.5775
Average	−3.6E−05	2.397297	1.501233	−6.88917	−1.35269	8.36E−07	0.058336	−4.61767
	mon	*p*	*dmxr*	*leurxr*	*leucpi*	*pop*		
Variance	333034.3	0.001048	0	0	8.36E−06	0		
St. Dev	577.0913	0.032373	0	0	0.002892	0		
Average	−10.0563	−0.00048	0	0	2.06E−05	0		

A4 EMU (eurxr shock only)

	nrl	*nrs*	*w*	*m0*	*g*	*fin*	*xval*	*y*
Variance	7.01E–05	0	1.58E+09	14266.4	8.55E+08	4.07E+08	688698	1914463
St. Dev	0.008374	0	39806.41	119.4421	29236.99	20166.43	829.8783	1383.641
Average	8.7E–05	0	–16692.3	–60.864	–12414.3	–4270.69	404.0875	–521.26
	bdef	*xvol*	*rl*	*rs*	*infl*	*rxr*	*c*	*eg*
Variance	335759.7	844617.6	8.23E–05	0.00219	0.00341	0.002519	1312970	51057.35
St. Dev	579.4477	919.0308	0.009074	0.046793	0.058397	0.050188	1145.849	225.9587
Average	121.7545	420.9525	–0.0004	–0.00035	0.000529	–0.00348	–454.579	–5.07392
	rw	*y**	*e**	*w**	*u**	*u*	*dy*	*afc*
Variance	0.000196	415.1823	1.77E–08	2.18E–08	0.266399	4515.465	5.56E–05	44720.13
St. Dev	0.014001	20.37602	0.000133	0.000148	0.516138	67.19721	0.007455	211.4714
Average	–0.00329	0.10416	6.38E–07	9.36E–07	–0.00388	23.99538	–0.00025	–78.8438
	q	*psbr*	*rdi*	*yafc*	*eg**	*ur**	*rxrn*	*ginv*
Variance	7.7E–05	265448.2	59422.79	2545162	32725.33	8.87E–11	680.837	2862710
St. Dev	0.008776	515.2167	243.7679	1595.356	180.9014	9.42E–06	26.09285	1691.954
Average	–0.00337	111.3816	–10.9792	–599.753	–18.1431	8.28E–07	1.589686	–561.664
	mon	*p*	*dmxr*	*leurxr*	*leucpi*	*pop*		
Variance	80283689	0.257735	0	0.000941	0	0		
St. Dev	8960.117	0.507676	0	0.030679	0	0		
Average	1235.448	0.075337	0	0.000164	0	0		

TABLE A4 *Continued*

A4 EMU (eunrs shock only)

	nrl	*nrs*	*w*	*m0*	*g*	*fin*	*xval*	*y*
Variance	7.34E–10	0.000313	81119342	512147.8	46049843	8074876	2056.934	5381.937
St. Dev	2.71E–05	0.017694	9006.628	715.6451	6786.003	2841.633	45.35343	73.36169
Average	4.53E–06	0.000385	287.8034	–1.40225	181.1882	106.9388	1.097852	–2.44744
	bdef	*xvol*	*rl*	*rs*	*infl*	*rxr*	*c*	*eg*
Variance	222874	2168.818	4.92E–08	0.000314	7.91E–07	1.16E–06	14634.35	227701
St. Dev	472.0953	46.57057	0.000222	0.017725	0.000889	0.001078	120.9725	477.1803
Average	–13.2218	0.932461	6.22E–06	0.000413	–1.3E–05	3.83E–05	1.161067	–13.7817
	rw	*y**	*e**	*w**	*u**	*u*	*dy*	*afc*
Variance	3.54E–06	414.935	1.78E–08	2.18E–08	0.266113	21.60411	2.23E–07	125.0502
St. Dev	0.001882	20.36995	0.000133	0.000148	0.515861	4.648023	0.000473	11.18258
Average	–1.8E–05	0.118954	4.97E–08	8.28E–07	–0.00395	0.906881	–4.2E–06	–0.44352
	q	*psbr*	*rdi*	*yafc*	*eg**	*ur**	*rxrn*	*ginv*
Variance	2.17E–07	46482.77	249438.6	7147.94	187464.8	9.04E–11	2.77E–09	115598.8
St. Dev	0.000465	215.5986	499.4383	84.54549	432.9721	9.51E–06	5.26E–05	339.9982
Average	–2E–05	3.352923	16.02392	–2.89527	–12.5159	8.45E–07	–0.00016	8.795947
	mon	*p*	*dmxr*	*leurxr*	*leucpi*	*pop*		
Variance	1401703	3.24E–06	0	0	0	0		
St. Dev	1183.935	0.001801	0	0	0	0		
Average	–1.6232	8.25E–06	0	0	0	0		

EMU (passive case – all shocks except eunrs, eucpi and eurxr)

	nrl	*nrs*	*w*	*m0*	*g*	*fin*	*xval*	*y*
Variance	1.04E–07	0	2.6E+10	2747912	1.47E+10	2.81E+09	15318834	25085820
St. Dev	0.000322	0	161093.9	1657.683	121338.8	53038.57	3913.928	5008.575
Average	2.65E–05	0	–10997.1	–120.718	–7110.29	–3887.6	–114.794	259.4484
	bdef	*xvol*	*rl*	*rs*	*infl*	*rxr*	*c*	*eg*
Variance	7654582	8335883	0.000106	0.000657	0.001229	0.00898	11253067	79912608
St. Dev	2766.691	2887.193	0.010303	0.02564	0.035061	0.094762	3354.559	8939.385
Average	–3.52837	–28.397	0.000704	0.000898	–0.00014	–0.00179	–434.69	1098.707
	rw	*y**	*e**	*w**	*u**	*u*	*dy*	*afc*
Variance	0.007223	10014380	0.003753	0.005278	41239.2	117071.2	0.000794	587976
St. Dev	0.084988	3164.551	0.061265	0.072647	203.0744	342.1567	0.028183	766.7959
Average	–0.00248	313.3714	–0.0055	–0.00271	18.07201	35.63409	0.000351	36.69232
	q	*psbr*	*rdi*	*yafc*	*eg**	*ur**	*rxrn*	*ginv*
Variance	0.000749	7918037	134378.4	33350585	66534643	4.92E–05	1.96E–06	60233900
St. Dev	0.027363	2813.901	366.5766	5774.997	8156.877	0.007017	0.0014	7761.05
Average	–0.0006	–34.0762	–31.5361	295.7191	995.1724	0.000624	0.000261	–339.095
	mon	*p*	*dmxr*	*leurxr*	*leucpi*	*pop*		
Variance	11229038	0.023659	0	0	0	0		
St. Dev	3350.976	0.153815	0	0	0	0		
Average	–188.68	0.004118	0	0	0	0		

APPENDIX C

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 demand shocks: first two parts of Table A4. The ratios of variances (EMU/floating) are 1.02 for output, 1.19 for unemployment, 0.54 for real interest rates, and 0.42 for inflation. The political cost would be 1.22. Demand shocks alone would therefore produce very little of the total political cost – notice the small size of the variances.

Table A4, Float and EMU (supply shocks), shows the supply shocks on their own. Here the variances are much larger than from demand shocks. The ratio of variances for EMU/Floating are 1.49 for output, 1.01 for unemployment, 1.43 for real interest rates and 7.58 for inflation, with a political cost of 1.54. Thus supply shocks contribute more than demand shocks.

In Table A4, Float and EMU (external shocks), 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 introduces 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 Table A4, EMU (eucpi, eurxr and eunrs shock only), 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 two are of modest importance in destabilising the UK under EMU. However, the euro real exchange rate on its own heavily destabilises the UK under EMU; this can be understood in the light of Figure 2 above which shows the massive swings in the euro against the dollar.

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. The last part of Table A4 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: 1.10 for output; 1.07 for unemployment; 0.89 for real interest rates; 5.64 for inflation. The political cost would be 1.29 times. As we can see above, these figures are not too dissimilar 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 (1.21, 1.18, 4.32 and 20.17) 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 52 per cent, unemployment 61 per cent, real interest rates 103 per cent, and inflation 76 per cent, with an additional political cost of 0.92. 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 30 per cent; in so far as it injects additional shocks into the UK, it raises costs by a further 70 per cent.

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.

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