

SIMULATING THE EFFECTS OF EMU ENTRY ON AN EMPIRICALLY BASED MACROECONOMIC MODEL

The predictions of an empirically based macroeconomic model are used to highlight the relevant considerations in designing a transition strategy in a more realistic, though still inevitably stylised, context. The model adopted is the National Institute Global Econometric model (NiGEM).

A range of different policy scenarios is examined to illustrate the possible implications of EMU entry, assumed to take place in 2005Q1. Two different baseline scenarios are considered. In the first, the exchange rate is expected to be sustainable in the medium term at 1.48 €-£, close to prevailing levels. In the second, the exchange rate depreciates to 1.37 €-£, consistent with medium-term equilibrium estimates.

For the high exchange rate baseline scenarios, EMU entry at 1.50 €-£, close to prevailing levels and to the assumed equilibrium level, gives rise to relatively small transition costs. But entry at 1.37 €-£, on the mistaken view that this represents the appropriate equilibrium, would lead to considerably higher inflation and growth. Tighter fiscal or monetary policy can moderate this but only by delaying the rise in UK inflation that is necessary to return the real exchange rate to equilibrium.

For the low exchange rate baseline, entry at 1.50 €-£, now too high a rate, gives rise to deflationary pressure and a period when UK output grows below potential.

EMU entry at 1.37 €-£ gives rise to lower transition costs. But even on the low exchange rate baseline, inflation increases because the immediate depreciation to the long-run equilibrium takes the exchange rate below a level more appropriate in the short term. Again, this can be moderated by fiscal or monetary policy.

An alternative policy option, giving rise to low transition costs, is to delay EMU entry, waiting until the exchange rate has returned to equilibrium outside EMU by means of adjustment in the nominal exchange rate.

4.1 Sections 2 and 3 describe the conceptual elements of any analysis of the UK's possible transition into EMU. So far, the possible effects of alternative EMU transition strategies open to the UK economy have been described and modelled in a deliberately stylised way. The emphasis was on highlighting the principles involved rather than analysing the particular circumstances of the UK decision.

4.2 The aim of this section is to use the predictions of an empirically estimated macroeconomic model to highlight the same issues in a more realistic context.

4.3 Of course, the results derived from any empirically based model, even one specifically designed to explain the behaviour of the UK economy and its interaction with the rest of the world, still need to be interpreted with care. However reputable the model, its predictions are inevitably likely to be surrounded by a wide margin of uncertainty and be exposed to challenge. And a range of different modelling assumptions can be made to reflect the different possible responses of households, firms and policymakers. So the particular implications for macroeconomic outcomes can only ever be indicative, either for the counterfactual analysis of the past or in assessing future prospects. Nevertheless, the exercise can be very useful for two main reasons:

- first, in considering how UK entry into EMU might best be implemented, it allows examination of the sensitivity of the predicted outcomes to different aspects of the assumed transition strategy; and

- second, for any assumed transition strategy, it is important to disentangle the contributions of different assumptions about how the UK economy works from those relating to the economic conditions faced when EMU entry occurs.

4.4 The plan of this empirically based section follows the broad outline given in Section 2 that was followed for the stylised analysis in section 3, that is:

- to describe the empirically based macroeconomic model on which the different scenarios will be run;
- to describe the different baseline scenarios (i.e. the expected outcomes if the UK were to stay outside EMU). This will show how the macroeconomic implications of a given transition strategy will depend on the baseline scenario assumed; and
- to model the effects of different transition strategies, in particular;
 - o looking at different entry rates;
 - o looking at how fiscal and monetary policy can help; and
 - o considering how changing the entry date might alter the transition cost.

4.5 While the focus of interest in this section is on simulating the effects of different possible transition strategies associated with the decision to join EMU in the future, it is also possible to use the same analytical approach to examine what might have happened if the UK had entered EMU at its outset in 1999. Annex B examines the predicted macroeconomic outcomes associated with such a ‘counterfactual’ or ‘what if’ experiment using NiGEM. On the basis of this model-based evidence, the decision to stay outside EMU at that time delivered more favourable macroeconomic outcomes than in either of the entry scenarios examined.¹

The empirical model

4.6 To form a view about the size of transition costs and benefits associated with different policy options, NiGEM has been used.² In the context of this paper, it is particularly appropriate since it shares many of the basic properties of the stylised model described in Section 3. But it models them in a more detailed way and in a manner which pays closer attention to explaining historical behaviour.

4.7 As such, it is designed to predict macroeconomic outcomes in all the major countries of the world, and attempts to capture all the important economic interactions between countries, subject to certain plausible properties. Two aspects, as emphasised in the earlier stylised analysis, are particularly important:

¹ There, two alternative transition strategies are examined based on the prevailing nominal exchange rates, first at the time when other EMU members locked their entry rates, second on the basis of the sterling-euro exchange rate prevailing on January 1, 1999.

² This tool is widely used for forecasting purposes in the private sector and in various central banks including the Bank of England. It is described in detail in NIESR (2003).

- NiGEM predicts that outcomes for real activity (and associated 'real' indicators such as the real exchange rate) are not altered in the long run by changes in the monetary policy regime³. As such, the expected level of competitiveness of the UK economy will eventually be the same whether the UK is assumed to join EMU or not⁴; and
- related to the above point, wages and prices are assumed eventually to adjust back to long-run equilibrium in the face of shocks to the economy. But in the short run, they will tend to be sluggish. Importantly, this means that different fiscal and monetary policy options have different implications for inflation and output growth.

The importance of the baseline forecast

4.8 A baseline forecast is also required to represent how macroeconomic outcomes would turn out if the UK did not join EMU. This would form the *ex ante* or 'baseline path' against which to evaluate transition costs. The stylised analysis has already illustrated that this can have a crucial bearing on the analysis. So too with the empirically based exercise, the choice of *ex ante* baseline will prove to be influential. To emphasise this point, the implications of different baseline scenarios are considered.

4.9 The baseline paths adopted are broadly consistent with the January 2003 National Institute world forecast.⁵ But because the purpose of this exercise is partly to illustrate the principles of the transition issue, a number of modifications have been made to that forecast. These are done mainly to clarify the role of those characteristics of the baseline forecast, already identified in Section 3. Two considerations in particular have an important bearing on the design of the transition strategy as modelled here; the specification medium-term interest rate differentials in and out of EMU, and the level of the medium-term equilibrium exchange rate. These issues are considered in turn.

Baseline interest rate differentials between the UK and euro area

4.10 The first important consideration is the extent to which *ex-ante* interest rates in the UK and the euro area differ. To be clear, *ex ante* here refers to the expected outcome under the assumption that the UK stays outside EMU. This *ex ante* interest rate differential matters, because if the UK were to join EMU, this differential would disappear. So it would determine the amount by which UK interest rates would have to change upon entering EMU.

4.11 In the short term, UK short-term interest rates are assumed in the baseline scenarios to remain above those of the euro area in the *ex ante* path. This is explained by cyclical differences in inflation and the output gap, implying that at the beginning of the assumed transition period in mid-2003, UK interest rates are just over 1 per cent higher than in the euro area.

4.12 But in the medium-term, UK and euro area interest rates are assumed to converge even outside EMU⁶. This reflects two plausible assumptions:

³The example of a permanent risk premium that disappears inside EMU, as considered in Section 3, is a hypothetical exception to this rule.

⁴Of course, this means that analysis based on this model will not address the possible '5th test' costs or benefits associated with joining EMU or any possible changes in the equilibrium exchange rate that these effects may entail. The structure of the adopted model also precludes the possibility of hysteresis effects on the real economy arising from EMU entry.

⁵This is described in more detail in Barrell and Holland (2003).

⁶On the forecast base used here, convergence of UK and euro area interest rates occurs by 2007Q1. Euro area interest rates are assumed to increase gradually from currently prevailing levels to achieve a medium-term value of 5.4 by 2010.

- first, that real interest rates should converge in a world of freely mobile capital⁷; and
- second, that the inflation target of the UK outside EMU is roughly equal to the inflation objective of the ECB.⁸

4.13 The assumed equality of the inflation targets in the UK and the euro area implies that the stylised analysis in Section 3 of the transition to EMU when inflation targets differ is not relevant for the rest of this empirically based section.

**The expected
ex ante path
for the real
exchange rate**

4.14 The second important consideration regarding the baseline scenario relates to the extent to which the UK economy is judged to be away from its long run equilibrium path at the point when EMU entry occurs. This was discussed in stylised terms in Section 3 where it was highlighted that the underlying cause of any ‘disequilibrium’ was important when considering the appropriate transition strategy.

**Empirical
estimates of
equilibrium
exchange rates**

4.15 The EMU study *Estimates of equilibrium exchange rates for sterling against the euro* provides a comprehensive review of the available empirical evidence for a range of fundamentals-based concepts as well as some updated FEER (Fundamental Equilibrium Exchange Rate) estimates.

4.16 One striking feature of this range of empirical estimates is the finding that most estimates, either on an effective basis or on a bilateral basis with the euro, suggest that sterling’s equilibrium real exchange rate has in recent years been overvalued. But the extent of this overvaluation varies across studies. So these findings need to be interpreted carefully in the context of the model-based analysis conducted here. Two points are particularly important:

- first, since the derived estimates are based on econometric techniques embodying a range of assumptions, they are inevitably subject to a wide range of uncertainty. In particular, since they draw on historical spans of data, recent changes in the structural characteristics of the UK economy may mean that, although these estimates may provide appropriate indicators of the equilibrium level over the past, they may not necessarily be the best indicator of the equilibrium rate in the immediate future; and
- second, as already emphasised in the stylised analysis of Section 3, different estimates may refer to slightly different concepts of equilibrium, in particular relating to the time horizon at which the equilibrium is supposed to apply. This point is especially important since it goes some way to reconciling the confusing differences of opinion amongst economists over whether any given sterling-euro exchange rate is ‘warranted’ or not.

⁷As in the stylised analysis of Section 3, one alternative assumption would be that there is a permanent risk-premium on sterling-denominated assets that would require UK interest rates to be permanently different from those in the euro area. This assumption is also adopted in the stylised analysis of the transition considered by Walton and Broadbent (2003) and described in Box 4.1. The EMU study *EMU and the cost of capital* by HM Treasury suggests that there is little empirical evidence for such an effect.

⁸The UK inflation target of 2.5 per cent on the RPIX definition is roughly compatible with a rate of inflation of 2 per cent on the HICP definition. The technical reasons underlying the differences between these inflation measures is explained briefly in the EMU study *Policy frameworks in the UK and EMU* by HM Treasury. The ECB’s mandate requires HICP inflation to be kept within a range of 0-2 per cent but, in recent practice, realised HICP inflation in the euro area has averaged close to 2 per cent.

The importance of time horizons in defining equilibrium exchange rates 4.17 In elaborating on this second point, it is important to recognise the factors that determine the ‘equilibrium real exchange rate’ as described in the EMU study *Estimates of equilibrium exchange rates for sterling against the euro*. In simple terms, it is defined as that rate which reconciles the medium-term net trade position (that is when economies are operating at full potential) with the medium-term level of net national savings (that is the difference between domestic supply and domestic demand, sometimes specified in terms of medium-term capital flows)⁹. It implies that real exchange rates can only be expected to be at their ‘warranted’ medium-term levels when net savings are similarly at their medium-term sustainable levels. This is a very important point, as already discussed in Section 3. It implies that the exchange rate is not necessarily ‘misaligned’ even if it is away from its medium-term equilibrium value. And it implies that the medium-term equilibrium exchange rate does not necessarily represent the appropriate choice of entry rate for a country entering monetary union.¹⁰

Two alternative baseline assumptions for the exchange rate 4.18 Since there is considerable uncertainty surrounding how the exchange rate might behave if the UK stays outside EMU, two alternatives are considered in the empirical analysis that follows;

- the first will be referred to as the **high exchange rate baseline**. This assumes that a level of the sterling real exchange rate close to that currently prevailing is sustainable into the medium term; this would imply that the economy was already on its medium term equilibrium path and the effect of all previous shocks on the real exchange rate had dissipated. This would be consistent, for example, with a view that there had been a permanent demand shift in favour of tradable goods made by the UK, thus validating the higher equilibrium of sterling’s real exchange rate compared to estimates based on past behaviour. Or it could be explained by a view that the net UK saving rate in the UK could be permanently lower, perhaps facilitated by financial liberalisation or an increase in borrowing caused by the move to a stable low-inflation environment;
- the second will be referred to as the **low exchange rate baseline**. This assumes instead that a lower medium-term equilibrium real exchange rate would eventually be achieved, representing an outcome where the real exchange rate is temporarily, but fairly persistently, above its medium-to-long-term equilibrium path. This might be explained by its response to a shock to the fundamentals of the economy, and so would be expected to return to the medium-term equilibrium as the effects of the shock wear off. This is directly analogous to the stylised responses examined in Section 3 where different transition strategies were examined in the face of a persistent asymmetric demand shock to the UK. Such a scenario might be explained by a view that the recent and current strength of the real exchange rate partly reflects the strength of UK domestic demand which is ultimately unsustainable.¹¹

⁹ Early FEER calculations tended to be based on relatively *ad hoc* estimates of sustainable capital flows. More recent work at the IMF has attempted to model the equilibrium current account more satisfactorily in terms of the determinants of savings and investment (see, for example, Faruqee and Debelle, 1998, and Masson, 1998).

¹⁰ This point has typically not been explicitly acknowledged in previous studies where an automatic link has usually been assumed between estimates of the medium-term equilibrium exchange rate and the appropriate entry rate, mostly in the context of the conversion rates of the original EMU members (see for example Alberola *et al.*, 1999; Hanson and Roeger, 2000; Couharde and Mazier, 2001). An exception is Wren-Lewis *et al.* (1991) where, as well as identifying the FEER of the adopted model, optimal control analysis was used to recommend an optimal central rate for the UK on entry to the ERM.

¹¹ To the extent that this explanation also applies to the strength of the dollar which may be similarly unsustainable, it might also be consistent with a configuration of real exchange rates where the euro is stronger relative to both sterling and the dollar.

4.19 This study does not examine which of the alternative baseline scenarios is most plausible. A more extended and applied discussion of these different explanations is contained in the EMU study by HM Treasury *The exchange rate and macroeconomic adjustment*. The aim here is to demonstrate how the predicted implications of a particular entry rate and a particular transition strategy might differ according to which baseline scenario is assumed.¹²

4.20 Specifically, the alternative exchange rate paths in the two baseline scenarios are assumed to be as follows:

- for the first baseline scenario, the real exchange rate level is assumed to be sustainable into the medium term at a level consistent with a nominal €-£ exchange rate of 1.48. Over the immediate future, the nominal exchange rate path is assumed to follow a path consistent with the UIP condition. From its starting position 1.53 €-£ in 2003Q3,¹³ this implies a small 3 cent depreciation in the nominal sterling-euro exchange rate until 2006Q4, consistent with the predicted path for UK short-term interest rates which are assumed to be higher than those in the euro area until 2006Q4. Since the UK inflation rate is broadly in line with inflation in the euro area, the real exchange rate similarly depreciates until 2007Q1 and is broadly constant at its sustainable level thereafter.¹⁴
- for the second baseline scenario, the nominal exchange rate falls almost four times more over the next four years, reaching a lower level of 1.37 €-£ (0.73 £-€, also corresponding to 2.68 DM-£ at the DM's EMU conversion rate) by 2007Q1. This is consistent with the estimate of the medium-term equilibrium exchange rate suggested in the EMU study by Professor Simon Wren-Lewis. It is also broadly consistent with the most recent purchasing power parity (PPP) estimates of the OECD (see OECD, 2003).¹⁵ As will be discussed below, however this is by no means a lower bound on the possible assumptions that could be adopted for the sustainable medium-term exchange rate. For expositional simplicity, the predicted outcomes for interest rates, inflation and output are assumed to be as before.¹⁶ So the assumed fall in the nominal exchange rate maps into an equivalent fall in the real exchange rate.

¹² Despite the critical importance of this point, most previous analysis of the transition problem has typically ignored the sensitivity of the conclusions to different possible assumptions about the *ex ante* predicted path for sterling. Exceptions to this include Barrell (2002) where the risks of joining on the basis of mistaken equilibrium estimates are discussed explicitly.

¹³ This baseline value for the nominal exchange rate is obtained from the January 2003 NIESR forecast on which the baseline scenarios are derived.

¹⁴ The relative strength of the dollar-euro exchange rate is similarly assumed to be sustained over the forecast horizon. To be specific, the nominal dollar-euro is assumed on the *ex ante* base to depreciate by around 4 per cent up to 2004 before remaining broadly constant thereafter.

¹⁵ The higher medium term level of the euro vis à vis sterling is assumed to be matched by a similar strengthening of the euro against other trading partners, notably the dollar (which might be justified by the argument of footnote 11 above). So the expected 10 per cent depreciation of sterling against the euro in this low exchange rate baseline is only a 5 per cent depreciation when measured in effective terms. This assumption is also broadly consistent with the estimated medium-term configuration of real exchange rates in the EMU study *Estimates of equilibrium exchange rates for sterling against the euro*.

¹⁶ This assumption might be justified if, for example, the exchange rate were weakening in response to slower predicted growth in some component of demand. Even so, it should be acknowledged that the baseline forecast could instead be modified to incorporate the different real exchange rate projection. But for the purposes of this exercise, it was felt that running the simulations on a whole new forecast baseline would complicate the comparison between the scenarios run on the alternative bases.

Defining possible ‘transition strategies’ – policy menu

4.21 Section 2 has already listed the practical aspects to be considered in defining a transition strategy. These related to the choice of entry date and entry rate, and to the choice of monetary and fiscal policy over any available transition period. In the empirical illustrations given here, the following assumptions are made.

4.22 It is assumed that an announcement of an intention to join EMU is made immediately, which for the purposes of these model simulations means 2003Q3. The announced **entry date** is assumed to be January 1st 2005. This complication was ignored in the stylised analysis of Section 3. But here it introduces a role for UK monetary policy over this period.

4.23 Two different entry rates are considered:

- **1.50 €-£** (0.67 £-€, also corresponding to 2.93 DM-£ at the DM’s EMU conversion rate). This is chosen on the grounds that it is broadly consistent with levels expected to prevail in 2005Q1, according to the high exchange rate baseline (and is only slightly higher than the equilibrium real exchange rate of 1.48 €-£ expected to be achieved by 2007Q1); and
- **1.37 €-£** (0.73 £-€, also corresponding to 2.68 DM-£ at the DM’s EMU conversion rate. This is chosen on the grounds that it is consistent with the assumed equilibrium exchange rate in the low exchange rate baseline.

4.24 On **announcement**, the entry rate is assumed to be completely believed by foreign exchange market operators. Further, the exchange rate is assumed to respond so as to eliminate any opportunity for one-way-bets in the markets. These assumptions act as a constraint on how monetary policy is set over the transition period up to EMU entry. They imply that any intended interest rate path has precise implications for the exchange rate path. They also imply that the exchange rate converges smoothly to its entry rate over the transition period: if the exchange rate were expected to jump at the point of entry, this would provide a one-way-bet for currency investors.

Monetary policy options in the transition

4.25 Two different possible ways of setting monetary policy over the period between announcement and entry are modelled:

- The **passive monetary policy** option assumes nominal interest rates are immediately set equal to the ECB’s rate, implying that the exchange rate should immediately jump to its announced entry rate. So although monetary policy is termed passive, it involves a cut in nominal interest rates of just over 1 per cent on announcement in 2003Q3. This is virtually equivalent to joining EMU at once, except that the ECB is not assumed to count the UK as part of the euro area until the entry date in 2005; and
- The **active monetary policy** option assumes that interest rates are set so as to achieve a gradual path for the exchange rate from its initial level at announcement to its eventual entry rate. When this requires a depreciation, it can be achieved by setting UK interest rates above the euro area levels over the whole of the transition period: the larger the required eventual depreciation, the larger the required difference between UK and ECB interest rates.¹⁷

¹⁷ This monetary policy strategy is similar to that followed in Ireland and Greece in advance of their entry to EMU where domestic interest rates were geared towards domestic objectives right up until their point of entry (whereupon interest rates then necessarily fell to euro area levels).

Fiscal policy options during transition

4.26 The analysis also allows for alternative assumptions regarding the setting of fiscal policy over the transition period (where for fiscal policy, the relevant ‘transition period’ may extend beyond EMU entry itself).

- For the **passive fiscal policy option**, it is assumed that automatic fiscal stabilisers alone operate. In this case, the automatic cyclical dependence of budgetary items operates to help smooth disturbances to output. Since government spending is assumed to be held fixed in nominal terms for the duration of the Spending Review period (i.e. to 2005Q1) and fixed in *ex ante* real terms thereafter, then changes in the price level up to 2005Q1 arising from the transition will reinforce the conventional automatic stabilisers;
- Over and above the automatic stabilisers, it is assumed that **fiscal policy can be set actively** to fine-tune the macroeconomic outcomes to lessen the effects on inflation and output due to the immediate cut in interest rates to ECB levels and to the immediate jump in the €-£ exchange rate to its announced nominal entry rate. Two discretionary fiscal policy options are considered:
 - one where nominal government spending (G) is used as the policy instrument; and
 - another where personal income taxes (t) are used as the policy instrument.

4.27 For both discretionary fiscal policy options, the analysis sets to one side the practical problems of operating discretionary fiscal policy. These are considered in the EMU study *Fiscal stabilisation in EMU*.

4.28 In the scenarios to be examined here, the active fiscal policy and active monetary policy options are considered as alternatives for illustrative purposes only. At the end of this section, a scenario combining fiscal and monetary policy action is additionally considered.

4.29 Various combinations of the choices from this policy menu will be compared and evaluated in the rest of this section. The monetary and fiscal policy options already described give a total of four different variants for each entry rate, giving eight for each baseline scenario, and sixteen in total. The implications of these different scenarios will be considered first for the high exchange rate baseline then for the low exchange rate baseline. Table 4.1 summarises.

Table 4.1: Transition path policy scenarios

Variants	Interest rates	Fiscal policy	Entry rate (€-£)
1. High entry rate, policy passive	Set at ECB rate	Automatic stabilisers only	1.50
2. High entry rate, fiscal policy (G) active	Set at ECB rate	Active (government spending)	1.50
3. High entry rate, fiscal policy (t) active	Set at ECB rate	Active (taxes)	1.50
4. High entry rate, monetary policy active	Set to deliver smooth exchange rate path	Automatic stabilisers only	1.50
5. Low entry rate, policy passive	Set at ECB rate	Automatic stabilisers only	1.37
6. Low entry rate, fiscal policy (G) active	Set at ECB rate	Active (government spending)	1.37
7. Low entry rate, fiscal policy (t) active	Set at ECB rate	Active (taxes)	1.37
8. Low entry rate, monetary policy active	Set to deliver smooth exchange rate path	Automatic stabilisers only	1.37

Description of different policy scenarios

General principles **4.30** Before describing the model-based results in detail, it is useful to highlight some general principles to aid interpretation. In particular, it is worth noting that the scenarios to be examined involve EMU entry at two different entry rates and under two different assumptions about the ‘true’ medium term equilibrium exchange rate. Table 4.2 summarises the policy choices in a stylised form but relating the stylised examples to the specific variants already described in Table 4.1.

Table 4.2: Stylised description of policy choices available

Enter EMU at higher rate Higher rate is sustainable (Variants 1-4, high exchange rate baseline)	Enter EMU at higher rate Higher rate is above long run equilibrium (Variants 1-4, low exchange rate baseline)
Enter EMU at lower rate Lower rate is below long-run equilibrium (Variants 5-8, high exchange rate baseline)	Enter EMU at lower rate Lower rate is sustainable (Variants 5-8, low exchange rate baseline)

4.31 All four of these possibilities are considered in the model-based scenarios to be examined here. On the face of it, it may seem perverse to consider the possibility that an entry rate would be deliberately chosen if it were known to be inconsistent with the medium-term equilibrium. But in practice, there is considerable uncertainty surrounding the value of the appropriate medium-term level of the real exchange rate. So it is important to understand the nature of the risks surrounding the choice of entry rate and the policy implications that follow from different choices. Indeed, three simple points follow directly from the stylised analysis already discussed in Section 3:

- if the entry rate is consistent with the medium term equilibrium exchange rate, then the required equilibrium exchange rate will continue to be sustained inside EMU so long as inflation in the UK stays at the same level as inflation in the euro area; but
- if the entry rate is not consistent, then the required return to long run equilibrium must take place inside EMU by means of relative price adjustment. So for example, if EMU entry were to take place at a real exchange rate above its sustainable level, then that equilibrium can only be restored by having a period when UK inflation is below inflation in the euro area. And this can only be achieved by having a period when UK output is below potential and unemployment is above its natural rate;
- outside EMU, on the other hand, more of the burden of real exchange rate adjustment could take place via a depreciation in the nominal exchange rate.¹⁸ This is likely to be less costly in terms of output costs compared to the situation inside EMU.

4.32 This would seem to imply that there is no need to run complicated model-based scenarios that simulate how the transition might be approached. All that needs to be done is to calculate the sustainable medium-term equilibrium exchange rate, and to enter at that rate.

¹⁸ In the limiting case of full price flexibility, all of the relative price adjustment would take place by means of nominal exchange rate adjustment as shown earlier in Chart 3.7 (ignoring second round effects on the euro area price level).

4.33 The stylised analysis of Section 3 demonstrated why that conclusion may be too simplistic. Most importantly, there may be good reasons why the real exchange rate may be away from its medium-to-long term equilibrium over the immediate future (for example, because it is appropriately responding to a real shock to the fundamentals of the economy). Even if the level of the medium term equilibrium exchange rate is known with certainty, it may not necessarily be appropriate to use EMU entry to force the actual real exchange rate to that level. In these more complicated situations, the transition strategy might involve some combination of the following:

- a choice of nominal entry rate somewhere between the short-term and medium-term equilibrium exchange rate;
- a choice of monetary or fiscal policy strategy to affect macroeconomic responses either inside or outside EMU; and
- a choice of entry date, implying that a delay to EMU entry might facilitate adjustment since it might be less costly to bring about the necessary adjustment of the real exchange rate outside EMU while the nominal exchange rate is still available.

Scenarios run on high exchange rate baseline

4.34 The first set of scenarios considered involve adopting the baseline forecast where the real exchange rate is assumed to be sustainable at close to prevailing levels.

4.35 In this case, because the entry rate of 1.50 €-£ is equal to the baseline forecast at the assumed entry date of January 2005, there is little difference between the four 1.50 €-£ entry rate variants, so only one is reported. The focus is therefore on the high entry rate scenario where policy is passive (variant 1) and on all cases for the lower entry rate (i.e. variants 5, 6, 7 and 8 from Table 4.1).

4.36 The three sets of charts 4.1-4.3 illustrate the implications as follows;

- **Chart 4.1** compares the high exchange rate baseline forecast with the cases involving the two different entry rates where convergence to the eventual entry rate takes place immediately and monetary and fiscal policy responses are passive (i.e. variants 1 and 5);
- **Chart 4.2** compares the passive-policy 1.37 €-£ entry (variant 5) with the two other 1.37 €-£ entry variants where discretionary fiscal policy is used: that is, with discretionary fiscal policy action where either nominal government spending is cut (variant 6), or personal income tax rates are increased (variant 7); and
- **Chart 4.3** compares the 1.37 €-£ entry passive policy case (variant 5) with the 1.37 €-£ entry variant where interest rates are held above ECB rates so as to achieve a gradual convergence to the entry rate (variant 8).

4.37 These charts, as for the later charts illustrating the results for the low exchange rate baseline, show macroeconomic outcomes from 2001Q1-2010Q1 for the following: (a) the nominal €-£ exchange rate, (b) the real €-£ exchange rate, (indexed to the value of 100 in 2003Q3 on the baseline scenario), (c) UK RPIX inflation (percentage points), (d) UK output growth (annual percentage change), (e) UK nominal short-term UK interest rates and (f) the UK government budget surplus to GDP ratio.

Enter at 1.50, policy passive (variant 1) **4.38** The 1.50 entry rate involves no change in the nominal exchange rate at the time of entry relative to the base forecast (i.e. the forecast where the UK is assumed to stay out of EMU). However, there is an immediate depreciation of 2 per cent on announcement in 2003Q3 and an immediate fall in nominal interest rates of around 1 per cent. Charts 4.1(a)-(f) illustrate:

- there is little effect on inflation, which remains close to baseline values, increasing by 0.25 percentage points over the transition period and remaining close to baseline thereafter (see Chart 4.1(c)).¹⁹ This is mainly explained by the relatively weak predicted influence of temporary changes in short term interest rates according to the NiGEM model (for more details see the EMU study *EMU and the monetary transmission mechanism* by HM Treasury and also the related discussion in Annex B);
- there is an immediate depreciation of the real exchange rate in 2003Q3 but by the time of EMU entry in 2005Q1, it is taken above the baseline equilibrium (see Chart 4.1(b)). This is partly caused by the small increase in inflation, and also by the fact that the fixed entry rate is above the baseline path for the nominal exchange rate which had continued to depreciate by another three per cent until 2006Q4 (Chart 4.1(a)); and
- output growth remains close to baseline, increasing by 0.5 percentage points during the transition period, but falling slightly below it after entry as a result of the real exchange rate appreciation (see Chart 4.1(d)).

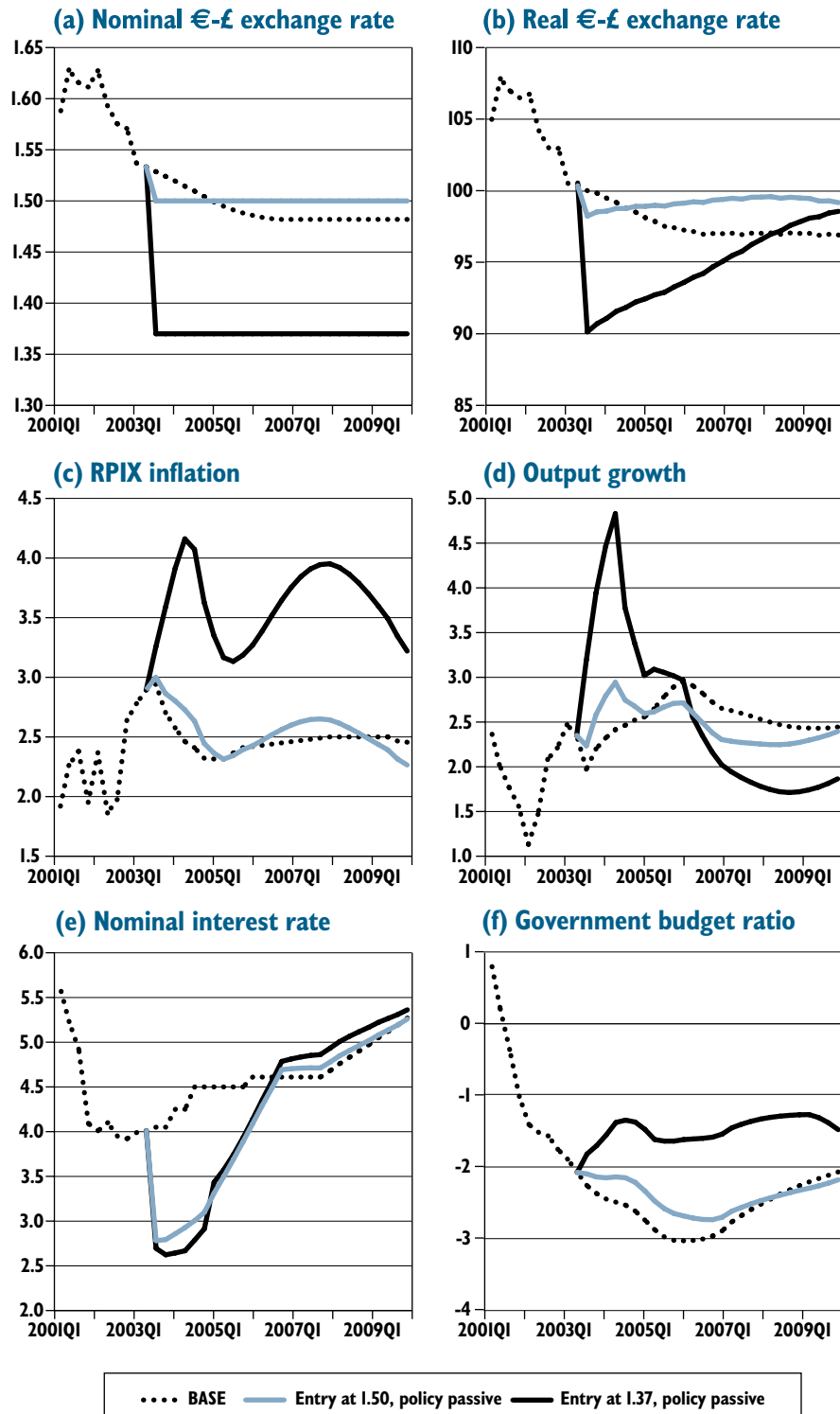
4.39 For this forecast scenario, entry to EMU at an exchange rate close to the expected rate at the time of entry (i.e. expected outside EMU), is relatively costless, with inflation and output close to levels that would have occurred if the UK had stayed outside EMU. Importantly, this conclusion is reached because the assumed *ex ante* exchange rate (i.e. expected outside EMU) would anyway have been expected to stay relatively constant in real and nominal terms (see Charts 4.1(a) and (b)). So apart from the impact of the initial cut in nominal interest rates, macroeconomic outcomes involved with EMU transition are largely unaffected compared to before.

Enter at 1.37, policy passive (variant 5) **4.40** Now consider the outcome if instead, EMU entry is assumed to take place on the basis of the lower entry rate of 1.37 €-£. This involves a depreciation of 10 per cent in the nominal rate by the time of entry relative to the forecast where the UK stays out of EMU. This lower entry rate is rationalised on the basis of a perceived low value for the medium-term equilibrium exchange rate. But importantly, for the high exchange rate baseline considered here, this lower medium-term equilibrium estimate is mistaken. So this entry rate implies an immediate depreciation in the real exchange rate relative to its 'warranted' path in terms of both its short-term and medium-term equilibrium.

¹⁹ This prediction contrasts with the finding reported in OEF (2003) where, for a similar scenario, inflation and output growth are both predicted to increase by 1 percentage point following EMU entry. This is explained by the much stronger interest elasticity of demand in the Oxford Economic Forecasting model (see the EMU study *EMU and the monetary transmission mechanism* for further discussion of the properties of the various models and their implications).

Chart 4.I: Comparison of two alternative EMU entry scenarios with high exchange rate baseline:

- 1.50 entry, policy passive (variant 1)
- 1.37 entry, policy passive (variant 5)



4.41 Charts 4.1(a) to (f) again illustrate:

- in the case of this lower entry rate, where again there is no active fiscal policy response (variant 5), inflation picks up peaking at just over 4.0 per cent over the transition period, falling slightly to nearly 3.0 per cent during 2005 (Chart 4.1(c));
- output growth is given a large stimulus by the large devaluation in conjunction with the interest rate cut, rising to over 4.5 per cent by the middle of 2004 (Chart 4.1(d));
- the real exchange rate is taken 10 per cent below the baseline 'equilibrium' at the outset, but with higher inflation the gap gradually closes (Chart 4.1(b)); and
- since government spending is assumed to be held fixed in nominal terms until 2005Q1, real government spending falls by 2 per cent. This reinforces the automatic stabilisers to bring about a strong fiscal tightening but this is not sufficient to hold back the surge in inflation and GDP growth. The government budget ratio improves by 1 per cent by the time of entry (see Chart 4.1(f)).

4.42 Of course, these results should not be surprising, since they are conditioned by the 'equilibrium' exchange rate for sterling that, on the high exchange rate baseline, is assumed to be close to its sustainable level at the time EMU entry is announced. It shows what would be expected to happen if a 10 per cent devaluation of the exchange rate relative to its equilibrium was engineered upon announcement of entry to EMU. As discussed earlier, monetary policy (or exchange rate policy) alone cannot permanently alter the long-run level of competitiveness of the UK economy. Certainly in the short run, competitiveness would improve by something close to 10 per cent. But eventually the real exchange rate would necessarily return to equilibrium levels. Since in EMU, the €-£ nominal exchange rate would no longer be available as an adjustment mechanism, this would happen by having the UK price level rise relative to the euro area price level by 10 per cent, which it does in these simulations.

4.43 These striking results raise the question of whether alternative monetary or fiscal policy strategies might mitigate the inflationary consequences of the low entry rate scenario.

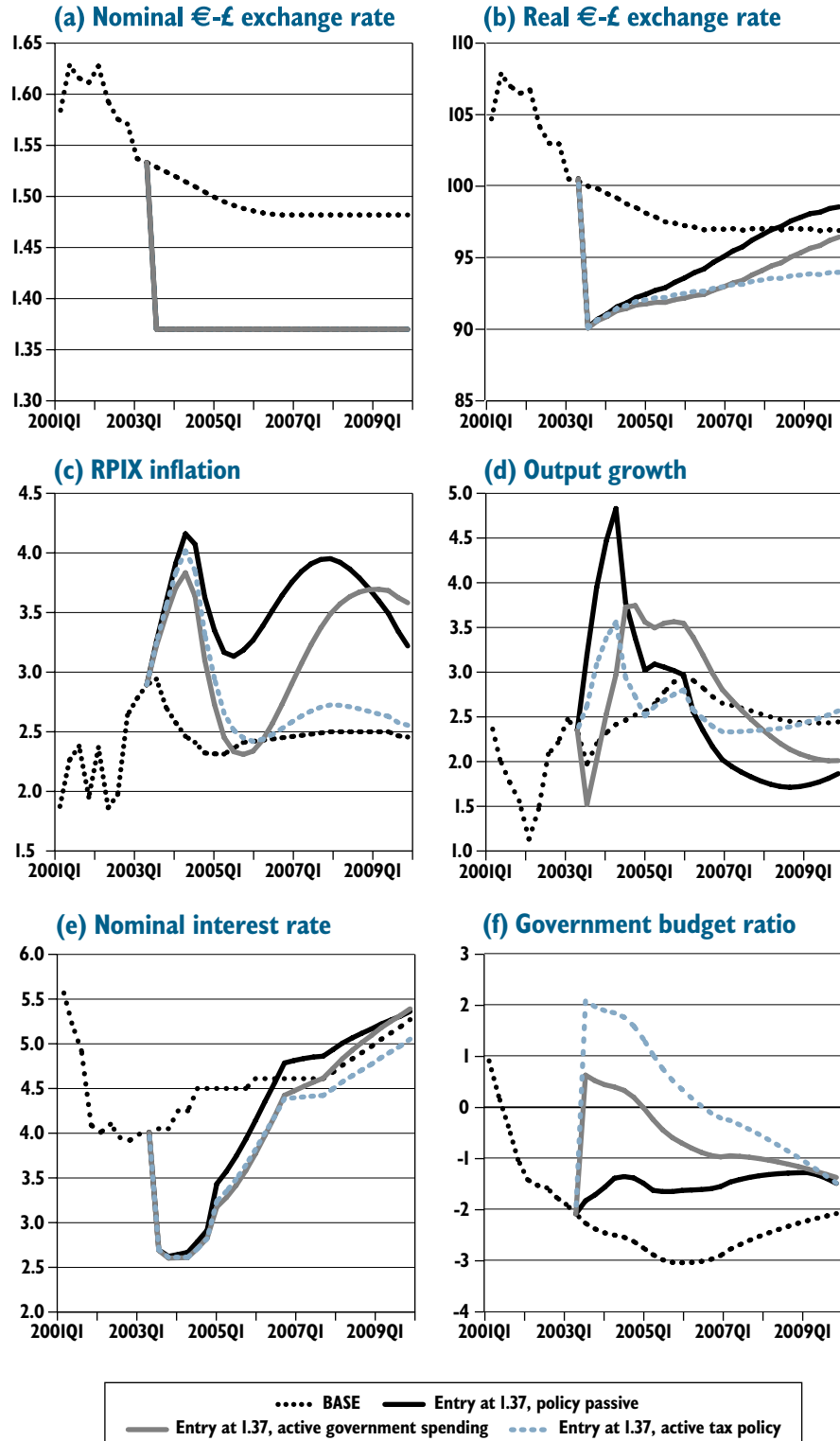
**Enter at I.37,
active fiscal
policy
(variants 6
and 7)**

4.44 Charts 4.2(a) to (f) show a comparison between three versions of the 1.37 €-£ entry rate variant, first as before where fiscal policy is operated passively, then with two additional active fiscal policy scenarios. These are set up to have the effect of moderating the extent of the inflationary response such that average inflation is back at its target level of 2.5 per cent on average for the first two years of EMU (i.e. 2005 and 2006). These active fiscal policy responses take the form of:

- one where fiscal policy is assumed to respond more actively using government spending as the instrument (variant 6). This involves an increase in the government budget ratio by 2.9 percentage points requiring a 12 per cent cut in nominal government spending over the pre-EMU period, which is then gradually brought back to base over the following five years; and
- where the government budget ratio is tightened by 4.4 per cent of GDP, brought about by a large increase of 5 percentage points in the personal income tax rate (variant 7). This discretionary tightening is sustained until the date of EMU entry whereupon it is gradually reduced back to baseline values by the end of 2009.

Chart 4.2: Comparison of alternative transition strategies for 1.37 €/£ entry rate with high exchange rate baseline:

- 1.37 entry, policy passive (variant 5)
- 1.37 entry, active government spending (variant 6)
- 1.37 entry, active tax policy (variant 7)



4.45 The results for these two active fiscal policy variants show:

- when fiscal policy is used very actively, inflationary pressure is curbed but this works only slowly so inflation still rises to just under 4 per cent after one year. This is only slightly less (by 0.1-0.2 percentage points) than in the passive fiscal policy variant where only the automatic stabilisers are allowed to work. Thereafter, the fiscal tightening does succeed in reducing inflation to target levels within the first two years of EMU entry (see Chart 4.2(c));²⁰ but
- since the fiscal policy tightening is not designed to be permanent, inflation rises back above target as fiscal policy is loosened. This is necessary to return the real exchange rate back to its medium term equilibrium level, although this happens more slowly in the tax-based variant (see Chart 4.2(b));
- when government spending is used very actively, output growth is reduced by around 1.5 percentage points in the first year compared to the non-active fiscal policy case. This reduction is 0.5 percentage points more than in the tax-based policy. But thereafter, the tax-based fiscal tightening restricts GDP to grow in line with potential more effectively than in the passive case (where GDP growth surges to 4.5 per cent), and compared to the spending-based fiscal policy where growth stays above potential until 2007 (see Chart 4.2(d)); and
- although both active fiscal policy variants were designed to bring average inflation to target for the first two years of EMU, the required scale of the increase in taxes as a share of GDP is half as large again as the equivalent fiscal tightening needed in terms of government spending. This is because government spending is a direct component of GDP so a cut in spending will have an immediate impact while tax increases will take longer to affect GDP as consumers adjust to their new lower level of real disposable income. Chart 4.2(f) illustrates that the required immediate tightening of fiscal policy amounts to 4 per cent of GDP in the tax-based case compared to just under 3 per cent for the spending-based policy.

²⁰ It is possible within NiGEM to bring about an even faster reduction in inflation by implementing an even sharper fiscal tightening but this can only be achieved at the expense of greater falls in output.

Enter at 1.37, gradual convergence of exchange rate, active monetary policy (variant 8)

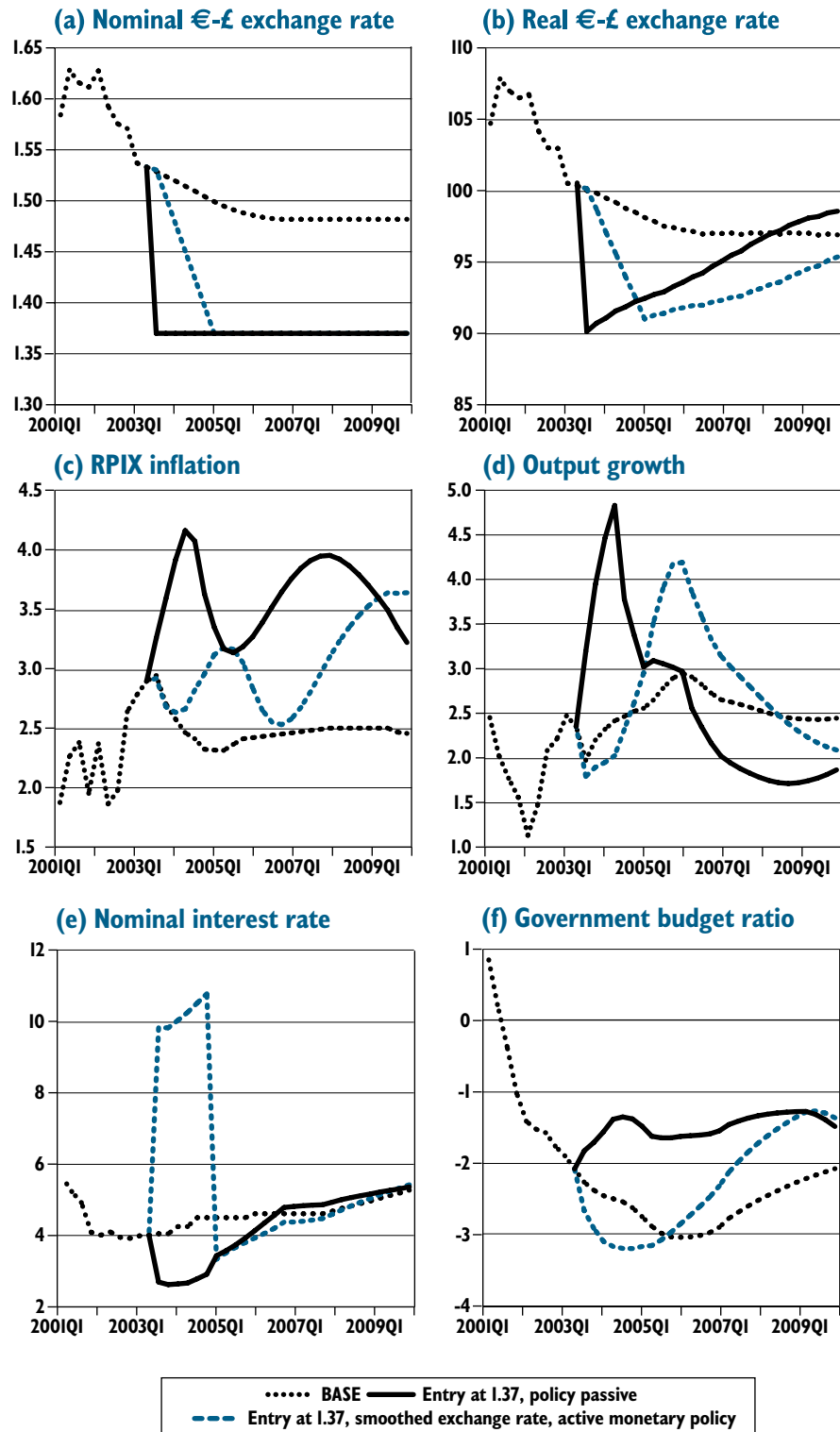
4.46 In this variant, UK monetary policy is used actively over the transition period to moderate the inflationary response. Again for an entry rate of 1.37 €-£, Charts 4.3(a) to (h) compare the passive policy case (variant 5) with the case where now monetary policy is assumed to be used actively (variant 8). This involves setting interest rates to deliver a gradual reduction in the nominal exchange rate to the 1.37 €-£ entry rate between the announcement date and EMU entry. For this to happen, interest rates need to remain at a constant differential above euro area rates. In both cases, there is assumed to be no discretionary fiscal action:

- now, because of the scale of the required depreciation over the eighteen month transition period, interest rates need to rise to around 10-11 per cent, roughly 6 percentage points higher than the base level and 7 percentage points higher than euro area interest rates. At the point of entry, interest rates are immediately set to euro area rates which results in a fall in UK interest rates of 7 percentage points in 2005Q1;
- the high interest rates restrain inflation over the transition period but, because interest rate effects on demand and inflation are relatively weak in NiGEM, the effects of the exchange rate depreciation still cause inflation to reach over 3 per cent in 2005 (implying real rates are very high at around 7 per cent); and
- annual output growth is close to baseline over the transition period but increases to 4 percent after entry as interest rates fall sharply upon entry. However, output growth slows further ahead as a result of the real exchange rate appreciation after entry.

4.47 But even in this case where interest rates are increased sharply, the price level still eventually has to rise by over 10 per cent relative to the euro area (see Chart 4.3(a), active case). It simply takes much longer; note that the real exchange rate is still below base levels even four years after entry. So the increase in UK inflation implied by EMU entry at a rate below the true equilibrium rate can only be postponed, but not indefinitely.

Chart 4.3: Comparison of alternative transition strategies for 1.37 €/£ entry rate on high exchange rate baseline:

- 1.37 entry, policy passive (variant 5)
- 1.37 entry, smoothed exchange rate, active monetary policy (variant 8)



4.48 To summarise the preceding discussion, it would seem apparent that if the prevailing real exchange rate at the time of EMU entry were assumed to be somewhere near its medium-term equilibrium rate, then:

- a strategy of entering EMU at or around that rate would appear to be relatively costless;
- but a strategy of forcing the exchange rate down to levels consistent with some perceived medium-to-long term equilibrium level may be highly disruptive if this lower real exchange rate turns out to be inappropriate;
- if such a strategy is nevertheless adopted, a policy of active fiscal policy or interest rate policy might be able to mitigate the inflationary consequences of the lower exchange rate. But since the maintained assumption here is that any tightening of policy can only be temporary, the *ex ante* level of competitiveness must eventually be restored. So this only works in as far as the inflationary costs are spread into the future; unless
- a policy is adopted where a long-run shift in the stance of fiscal policy is permitted to bring about a permanent shift in the equilibrium real exchange rate. This approach is implicitly adopted in the transition exercise conducted in Walton and Broadbent (2003). Box 4.1 provides more details, highlighting where that exercise has similarities to the scenario analysis carried out here.

Box 4.1: The Goldman Sachs analysis of the transition

Walton and Broadbent (2003) have conducted an analysis of the EMU transition issue which has some similarities with the analysis conducted in this study. They use a single country version of the stylised model used in Section 3^a and use this to simulate alternative scenarios, as in Section 4 of this study, regarding the likely macroeconomic consequences of UK entry to EMU.

The main features of their analysis are as follows:

- on the basis of a range of estimates provided by other authors, for example Alberola *et al.* (1999), OECD (2003) and Barrell (2002), they conclude that the equilibrium exchange rate for sterling is likely to be consistent with a level of 1.37 €-£ (i.e. consistent with the equilibrium assumption on the low exchange rate baseline in this study and some 5 per cent below prevailing levels of 1.45 on their adopted base as of early February 2003);
- they run scenarios of EMU entry at 1.37 €-£ embodying a baseline scenario (to use the terminology of this study) where the exchange rate is, in fact, sustainable at current levels. So the scenario examined by Goldman Sachs is directly analogous to the 1.37 entry case on the high exchange rate baseline in the current study;
- in the absence of any autonomous slowdown in domestic demand which might cause the exchange rate to depreciate of its own accord, they find that fiscal policy would need to be tightened by over 1 per cent of GDP (approximately £10 billion, which they assume takes the form of higher taxation) to enable the real exchange rate to depreciate by 5 per cent from the assumed starting level of 1.45; and
- EMU entry is also assumed to involve a 1 per cent fall in the risk premium associated with sterling, so real interest rates are 1 percentage point lower inside EMU, requiring a further fiscal tightening of 0.5 per cent of GDP.

^a In fact, their model is explicitly based on the earlier single-country open economy stylised models of Blake and Westway (1996) and Batini and Haldane (1999) which were themselves used as the basis of the country blocks in the 'Three Bears' model used in Section 3.

The Walton and Broadbent study is rare in attempting a systematic and up to date analysis of the transition issue and it provides some interesting insights. But it is important to emphasise the differences between their analysis and that conducted in this study:

- they examine how a permanent shift in the stance of fiscal policy might validate a lower level of the real exchange rate. The focus of the present study, by contrast, is to examine how fiscal policy might be used as a temporary measure to ease the costs of transition (for the high exchange rate baseline, this has been shown to be ultimately futile, though this role will be shown to be more effective later in the case of the low exchange rate baseline);
- they embody an assumption in their modelling work that EMU entry for the UK would involve a permanent change in the real equilibrium of the economy because of the removal of the UK-specific risk premium. As explained earlier, no such assumption is made in this study;
- Walton and Broadbent's analysis adopts a stylised model where fiscal policy affects the exchange rate relatively promptly. By contrast, the effect of changes in fiscal policy on the real exchange rate in NiGEM, as used in Section 4, is much more protracted. So their analysis may exaggerate the extent to which fiscal policy might be used to manipulate the real exchange rate in the transition to EMU.

Scenarios run on low-exchange rate baseline

An alternative assumption about the appropriate medium-term exchange rate 4.49 Those policy scenarios discussed so far and illustrated in Charts 4.1-4.3 were run on a baseline forecast that embodied the assumption that the prevailing level of the real exchange rate at the time of EMU announcement was at or near its sustainable value. EMU entry scenarios are now run on the low exchange rate baseline forecast where a lower medium-term equilibrium value for sterling of 1.37 €-£ is expected to be achieved (as compared to 1.48 in the original set of entry scenarios)

4.50 To recall the earlier description of this alternative baseline:

- the lower equilibrium is assumed to be consistent, for illustrative purposes, with the medium-to-long term horizon of the equilibrium exchange rate estimates described in the EMU study *Estimates of equilibrium exchange rates for sterling against the euro*.
- the alternative 'baseline' forecast has been constructed with the nominal and real bilateral euro-sterling exchange rates both predicted to depreciate by 10 per cent over the next three and a half years.²¹ They are assumed to reach their new lower equilibrium exchange rate level by 2007, two years after the assumed possible entry of the UK into EMU.

4.51 Under this alternative set of assumptions, it is again possible to consider a range of eight policy options as previously described in Table 4.2 i.e. enter EMU at either 1.50 €-£²² or 1.37 €-£ with one of four possible policy settings; passive policy, active fiscal policy (using government spending or taxes) or active monetary policy.

²¹ In the medium term, the euro is expected to be 10 per cent stronger in effective terms too, while the sterling real exchange rate is lower by around 5 per cent in effective terms.

²² The 1.50€-£ entry rate was justified on the grounds that it was the level of the sterling-euro nominal exchange rate expected to be achieved according to the 'high real exchange rate' baseline forecast by the assumed date of EMU entry in 2005Q1. In the alternative baseline forecast, the nominal exchange rate expected to prevail at the time of EMU entry in 2005Q1 is now lower, at 1.48. But for ease of comparison with the earlier results, the assumed 'high' EMU entry rate will continue to be 1.50 €-£.

4.52 Charts 4.4-4.6 illustrate the implications of some of these variants,²³ as follows:

- **Chart 4.4** compares the low exchange rate baseline forecast with the cases involving the two different entry rates where convergence to the eventual entry rate takes place immediately and monetary and fiscal policy responses are passive (i.e. variants 1 and 5);
- **Chart 4.5** examines the case when EMU entry takes place at the high entry rate of 1.50 €-£, comparing the alternative *ex ante* forecast with the passive policy case (variant 1) and an entry variant where government spending is used actively (variant 2); and
- **Chart 4.6** is as Chart 4.5 except that EMU entry is now assumed to take place at the low entry rate of 1.37 €-£. Again, the low exchange rate baseline forecast is compared with the passive policy case (in this case variant 5) and entry variants where government spending is actively used (variant 6) and where monetary policy is used to deliver a smooth transition path for the nominal exchange rate (variant 8).

Enter at 1.50, low exchange rate baseline, policy passive (variant 1)

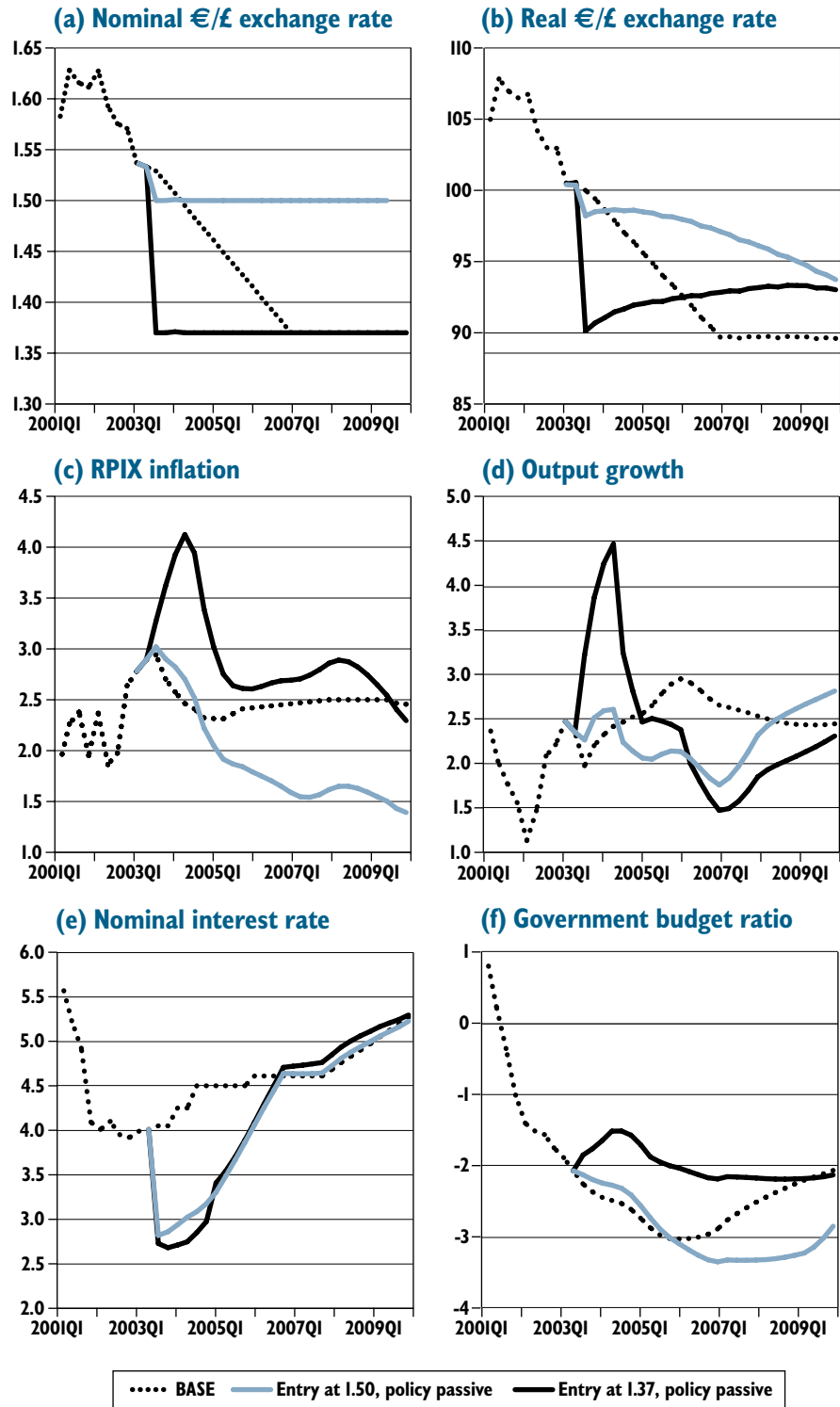
4.53 In the first case, EMU entry is assumed to take place at the higher rate of 1.50 €-£. This might be rationalised by a view that such a level of the real exchange rate was broadly sustainable at these levels based on recent history. Charts 4.1(a)-(f) have already shown how EMU entry would be relatively costless when the real exchange rate was indeed sustainable at this rate. But for this baseline forecast shown in Charts 4.4(a)-(f), the high entry rate represents an initial setting of the real exchange rate some 10 per cent above the eventual medium-term equilibrium. The implications of EMU entry at this rate are now quite different to the earlier case. And these differences arise purely because of the different assumptions made regarding the baseline forecast:

- in the passive policy case (variant 1), interest rates are again immediately brought down to the euro area levels, involving an immediate cut of 1.2 percentage points. Now, however, the entry rate involves a 3 per cent appreciation of the nominal exchange rate by the time of entry relative to the alternative baseline forecast. Compared to the earlier results (Charts 4.1(a) to (f)), the implications are now much less benign;
- inflation stays close to baseline values for the first year, but then falls below baseline and remains on average nearly 1 percentage point lower over the period. This is the mechanism whereby the real exchange rate is brought back to its lower, and in this case appropriate, equilibrium path. But this process is slow. Even by 2009, the real exchange rate is still 9 per cent above the *ex ante* baseline; and
- this lower inflation rate can only be achieved by having a period when UK output is below potential. So after the first year, output growth falls below baseline after entry as a result of the increasing real exchange rate appreciation and the output level stays below potential for the whole of the period shown (up to 2009).

²³ Since the tax rate was shown to be less efficient as a fiscal stabilisation tool in Charts 4.2(a)-(f), the only active fiscal policy responses shown in Charts 4.5 and 4.6 are those where government spending is used as the fiscal instrument.

Chart 4.4: Comparison of two alternative EMU entry scenarios with low exchange rate baseline:

- 1.50 entry, policy passive (variant 1)
- 1.37 entry, policy passive (variant 5)



Enter at 1.50, low exchange rate baseline, active fiscal policy (variant 2) **4.54** As before, it is possible to mitigate some of these adverse affects by appropriate use of fiscal policy. Charts 4.5(a)-(f) compare the passive policy case with one where government spending is used actively to keep inflation at target and output close to potential (variant 2). In this scenario, to achieve this, it is necessary to implement a loosening of fiscal policy (though here this loosening only needs to be half as large as the tightening in the earlier case amounting to a fall in the government budget ratio of 1.5 percentage points, brought about by a 9 per cent increase in nominal government spending). This strategy actually causes inflation to rise slightly more above target in the first year but for the first two years of EMU membership, inflation stays close to 2.5 per cent. But as in the earlier scenarios, this strategy can only be successful as long as fiscal policy is operating. As soon as the baseline fiscal policy is restored, the need for a lower real exchange rate reasserts itself and inflation inevitably falls below target to achieve this. Output correspondingly falls below potential to bring this about.

4.55 This alternative forecast scenario illustrates the potentially important deflationary effects and adverse implications for output that entering at an exchange rate above the 'short-term equilibrium' path. Referring back to the broad policy choices depicted in Table 4.1, these are the costs associated with entering EMU at a rate that is higher than the sustainable rate (shown in the top right panel of Table 4.2). So these scenarios demonstrate the risk of assuming that the prevailing level of the real exchange rate is sustainable when it turns out not to be.

4.56 It is worth adding that the model-based predictions do not capture possible 'hysteresis effects' which may cause potential output to be adversely affected by prolonged misalignment of the real exchange rate. To the extent that these effects are present, so the risks associated with EMU entry at an overvalued exchange rate may be even greater.

Enter at 1.37, low exchange rate baseline, policy passive (variant 5) **4.57** Now consider the alternative case where EMU entry is assumed to take place at the eventual medium-term equilibrium rate, i.e. at 1.37 €-£.²⁴ This is the most important scenario of any considered so far. Under the assumption that sterling is overvalued at its current level (as many studies referred to earlier have suggested), EMU entry potentially represents the ideal opportunity to 'correct' any overvaluation of the exchange rate by choosing an entry rate which re-establishes the 'warranted' medium term rate.

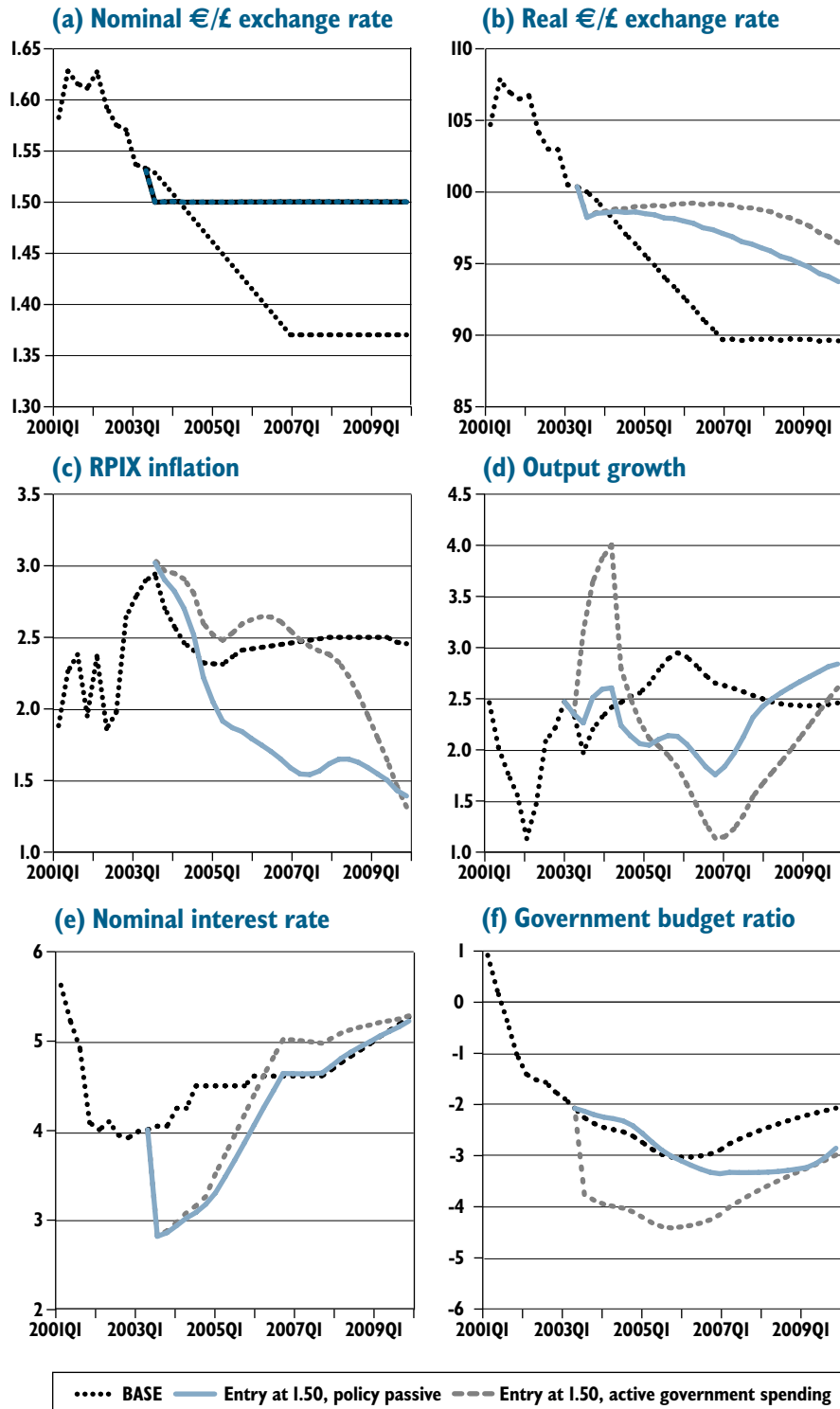
4.58 In fact, the appropriate policy response may be rather more complicated than this. Chart 4.4 illustrates the implications of immediately moving to the medium-term equilibrium rate in 2003Q3 in advance of EMU entry in 2005Q1, again with interest rates cut immediately to euro area levels. As with the 1.37 €-£ entry rate case considered earlier (in Charts 4.1-4.3), this involves an initial 10 per cent depreciation of the nominal exchange rate relative to prevailing levels in the baseline forecast. But the important new feature with this alternative baseline is that the gap between the entry rate and the expected *ex ante* path is expected to close so that by 2007Q1, the level of the implicit euro-sterling nominal exchange rate is the same as it was expected to have been outside EMU.

4.59 Significantly, this implies that EMU entry at 1.37 €-£ under this alternative baseline scenario would only represent a temporary devaluation of the exchange rate relative to what was otherwise expected, not a permanent devaluation as occurred with the earlier high exchange rate baseline scenario.

²⁴ Referring back to the stylised analysis of Section 3, this is analogous to the case where EMU entry was examined under conditions of disequilibrium.

Chart 4.5: Comparison of alternative transition strategies for 1.50 €/£ entry rate on low exchange rate baseline:

- 1.50 entry, policy passive (variant 1)
- 1.50 entry, active government spending (variant 2)



4.60 This has interesting implications. Compared to the earlier results for the passive policy case (variant 5), the inflationary implications are now more benign after entry because, in the long run, there is no need for all of the devaluation to be unwound through higher prices. But because there is still a ‘forced’ devaluation, the short-run effects on inflation and output are similar to the previous case where the equilibrium exchange rate stayed close to current levels. Since in this case the exchange rate is being forced down to its long-run equilibrium level too quickly, there is an increase in competitiveness that has an inflationary impact. As before this gradually causes the real exchange rate to appreciate, moving some 4 per cent above its *ex ante* equilibrium level by 2007. As a consequence, output needs to move below potential to bring about the necessary fall in inflation (relative to the euro area) to restore the appropriate real exchange rate.

4.61 This forecast scenario reinforces the important point demonstrated in Section 3 with the stylised model. Even if the ‘equilibrium’ exchange rate of the economy is lower than prevailing levels, it does not necessarily follow that it is appropriate to force the devaluation too quickly.

Enter at 1.37, low exchange rate baseline, active fiscal and monetary policy

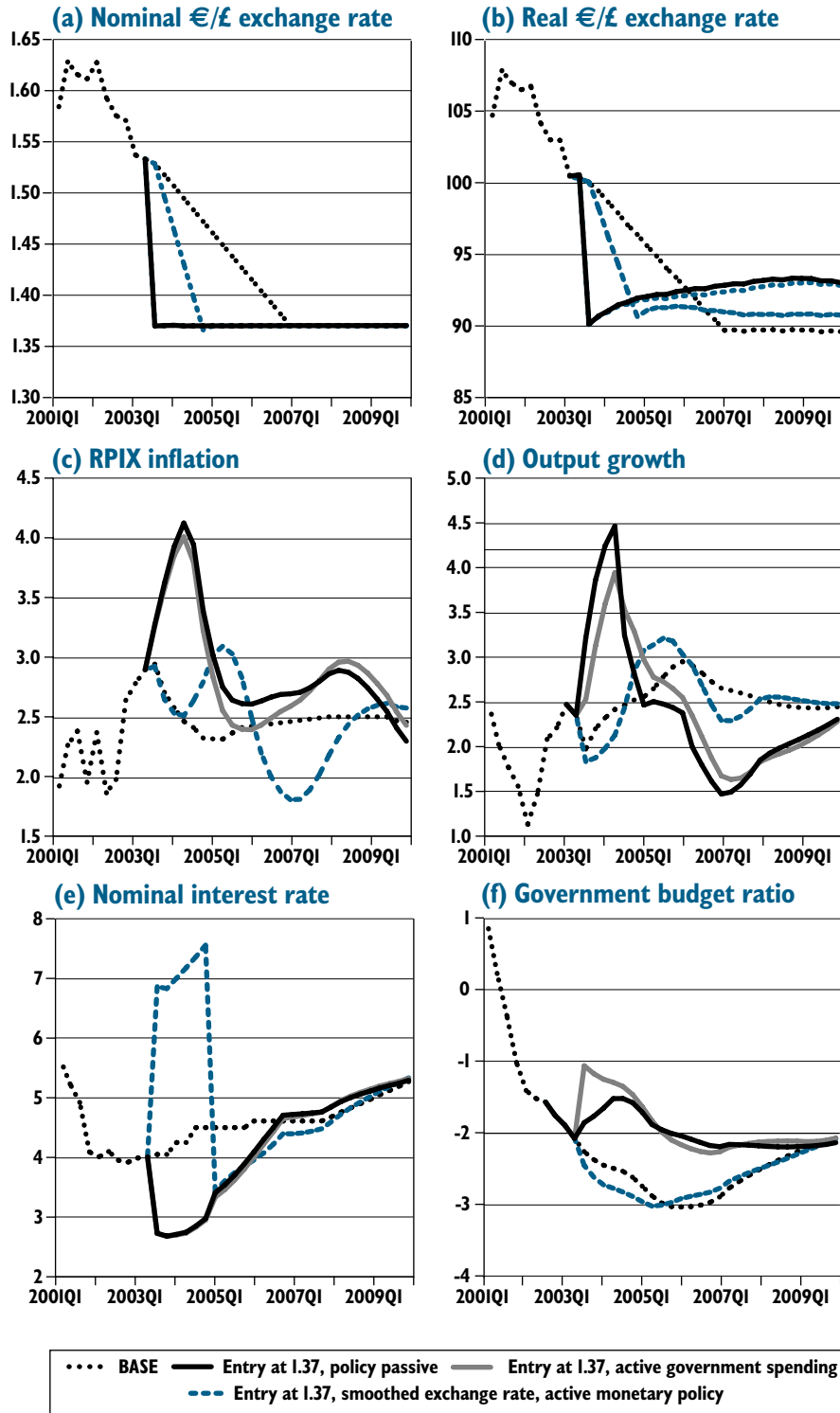
4.62 Again, it is possible to illustrate how policy action can influence these outcomes:

- by a tightening in government spending (variant 6, but where the tightening does not need to be as large as in the analogous scenario considered on the high exchange rate baseline requiring an increase in the government budget ratio of 1.2 per cent of GDP, involving a 3 per cent cut in nominal government spending).²⁵ Inflation over the eighteen month transition period is very slightly lower but not enough to prevent the real exchange rate appreciating back above its medium term equilibrium rate after 2006. So the falls in output required to cut inflation and restore the real exchange rate to its warranted medium term levels are still not avoided. So overall, fiscal policy is a relatively blunt instrument of policy for improving the transition in this case; on the other hand
- by implementing the active monetary policy option (variant 8) whereby interest rates are set to achieve a smooth path for the exchange rate between the prevailing rate and the required entry rate in 2005Q1. Since the required depreciation of the exchange rate relative to the *ex ante* predicted path is only half as large as with the original baseline scenario, interest rates only rise by 3 percentage points (compared to 6 percentage points in variant 8 on the high exchange rate baseline). But the effects of this monetary tightening, combined with the effects of the much slower depreciation to 1.37 €-£, imply that the inflation and output consequences are much more muted. The convergence of the real exchange rate to its warranted medium term level is much quicker and smoother. Even so, inflation does fluctuate above and then below its target by some 0.5 percentage points and output growth does rise above 3 per cent just after the date of EMU entry.

²⁵ The effects of fiscal policy as modelled on NiGEM are broadly linear so, for example, a doubling in the movement of the fiscal policy instrument would double the effect on inflation and output. In practice, fiscal policy may not work in this way (for further discussion, see the EMU study by HM Treasury on *Fiscal stabilisation and EMU*).

Chart 4.6: Comparison of alternative transition strategies for 1.37 €/£ entry rate on low exchange rate baseline:

- 1.37 entry, policy passive (variant 5)
- 1.37 entry, active government spending (variant 6)
- 1.37 entry, smoothed exchange rate, monetary fiscal action (variant 8)



4.63 All the scenarios considered so far have demonstrated that, whichever particular fiscal or monetary policy strategy is chosen over the transition period, there are costs associated with EMU entry whenever the nominal exchange rate is required to be fixed at a time when the ‘warranted’ real exchange rate is required to depreciate. Inside EMU, this places the burden of adjustment on the relative price level between the UK and euro area, requiring lower inflation in the UK than the euro area.²⁶ And this in turn requires output to fall below potential for as long as is necessary to bring about the required relative price change. So long as the UK economy is characterised by stickiness in the response of inflation, this is always likely to be more costly than with the alternative strategy of following an independent monetary policy strategy where the nominal exchange rate can additionally facilitate adjustment.

4.64 But one additional policy scenario naturally arises from consideration of the case where policy is set to achieve a smooth path for the exchange rate causing it to depreciate from its prevailing rate at the time of announcement in 2003Q3 to its medium-to-long run equilibrium of 1.37 €-£ by 2005Q1. This entry rate happens to occur two years before the real exchange rate itself had been expected, outside EMU, to converge on its medium-term equilibrium level.

Considering the option of delayed entry

4.65 One alternative strategy to consider in this modelling exercise is therefore the option of delaying UK entry into EMU until the required depreciation in the short-term equilibrium exchange rate has taken place. In the stylised situation modelled here, this would involve waiting until 2007 at which time the expected real exchange rate from that point on would be expected to remain constant.

4.66 In fact, if UK interest rates were set for the period from 2003Q3 to 2006Q4 at exactly the same level as had been expected to prevail outside EMU, then the exchange rate itself would follow exactly the same path as in the baseline scenario. And importantly, the transition costs associated with this strategy would be identical to those associated with the *ex ante* forecast of the UK staying outside EMU. In other words, with such a strategy, the overall transition costs are lower than in any of the scenarios where EMU entry is assumed to take place in 2005.²⁷

4.67 This option has an added advantage. If there is uncertainty about whether the high or low exchange rate baseline is valid, a period of waiting may allow more information to be obtained on the likely sustainable level of the exchange rate. In such circumstances, the delay is said to have an ‘option value’; see Dixit and Pindyck, 1994, for a formal treatment of the option value of waiting in the context of investment.

4.68 In practice, since there is always uncertainty about the current and expected state of the economy, this study does not attempt to evaluate whether the delay option should be exercised. This is left for the assessment itself.

²⁶ A fuller discussion of the role of inflation as an adjustment mechanism in EMU is contained in the EMU study *Modelling shocks and adjustment mechanisms in EMU*. For a discussion of this issue in the context of interpreting recent inflation differentials in EMU since 1999, see Blanchard, 2001, for example.

²⁷ It should be noted that the stylised assumptions made in constructing the alternative baseline scenario may exaggerate the ease with which it is possible for the real exchange rate to change outside EMU. The imposed fall in the nominal exchange rate to its equilibrium level by 2007Q1 was assumed to have no consequences for inflation or output in bringing about the equivalent fall in the baseline real exchange rate. More realistically, in the presence of sticky prices, the endogenous adjustment of the economy to a lower real exchange rate may involve transitional increases in inflation and output too (as demonstrated in Section 3 for the responses to the asymmetric demand shock outside EMU, as shown in Charts 3.7(a)-(f)). But this does not invalidate the main argument here which is that adjustment to the same shock inside EMU is likely to be more costly.

Interpreting the results of the scenario analysis in a policy context

4.69 Having presented a wide range of model-based results covering a host of different policy assumptions and modelling scenarios, it is useful to attempt to summarise their findings and re-emphasise the potential policy-relevant implications.

4.70 In Section 3, outcomes were derived from the stylised model analysis for the variability of inflation relative to its target level and of output relative to potential presented in Tables 3.1 and 3.2. Charts 4.7(a) and (b) below present the same information in graphical format:²⁸

- each diamond on the scatter plot represents the outcome of a particular model-based scenario where average squared inflation deviations from target (discounted at 1 per cent per quarter) is plotted on the vertical axis and average squared output gaps (similarly discounted) on the horizontal axis;
- black squares show the outcomes for the scenarios run using the high exchange rate baseline (where the real exchange rate was assumed to be sustainable around its current level); light blue diamonds show the outcomes for scenarios run on the low exchange rate baseline (where the medium-term exchange rate was assumed to be much lower than current levels). The baseline scenario itself is denoted by a grey circle;²⁹
- Chart 4.7(a) shows the cumulated sum of inflation and output variability over the six quarters prior to EMU entry in 2005Q1; Chart 4.7(b) shows the cumulated sum over a longer period covering the pre-entry period and the first five years of the UK's EMU membership to 2009Q4;
- as before, no attempt is made to ascribe a preferred weighting to inflation volatility compared to output volatility. But to the extent that any given scenario lies inside another on both the horizontal and vertical axes, so this outcome would be preferred on any weighting of inflation relative to output; and
- as in the earlier stylised analysis of Section 3, no attempt is made to attribute costs to the active use of fiscal or monetary policy instruments.

4.71 The results displayed in this way confirm the findings from the stylised scenario analysis of Section 3 and the empirically based scenario analysis of this section:

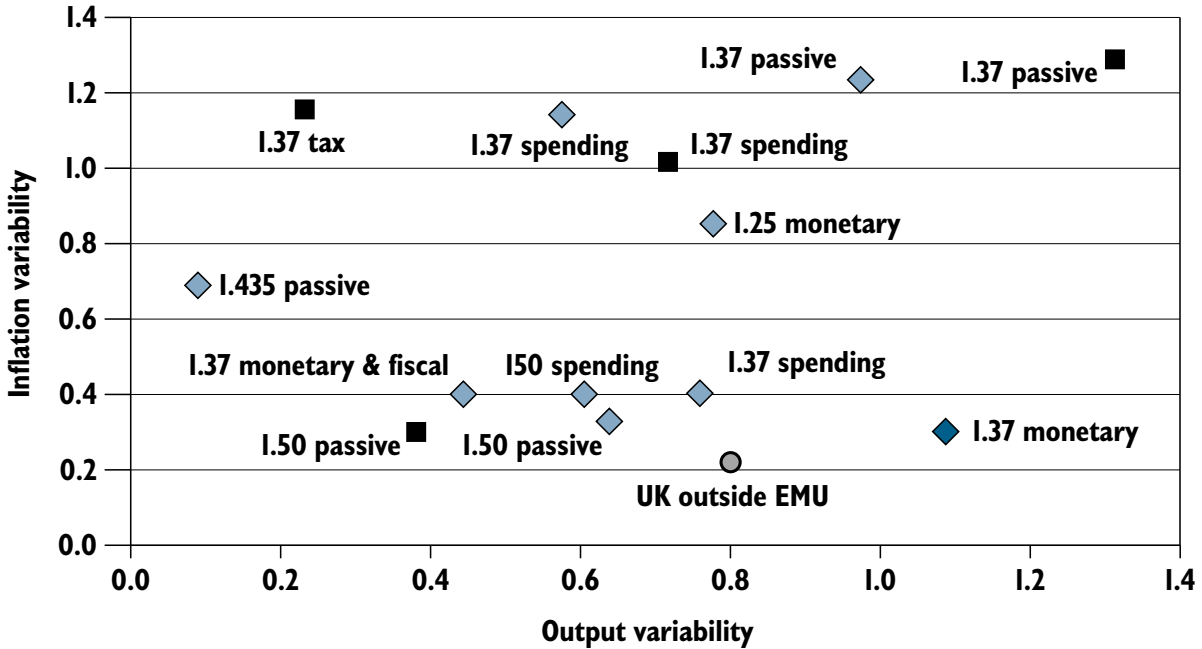
- the macroeconomic consequences of EMU entry for the UK at particular entry rates will depend crucially on what *ex ante* path is expected for the exchange rate, that is, what would be expected to happen to the exchange rate if the UK stayed outside EMU;
- for the scenarios run on the high exchange rate baseline, where the exchange rate is assumed to be sustainable around current levels, the costs of transition for an entry rate of 1.50 are relatively small. Indeed, in the years leading up to EMU entry, the output and inflation consequences are even more favourable;

²⁸ A similar chart was used in Barrell (2002) to illustrate the implications for UK entry into EMU of different entry rates, assuming entry took place in 2003Q3 (see chart 7, p. 68 of Barrell, 2002). There, cumulated inflation and output deviations are plotted rather than average squared deviations, as here.

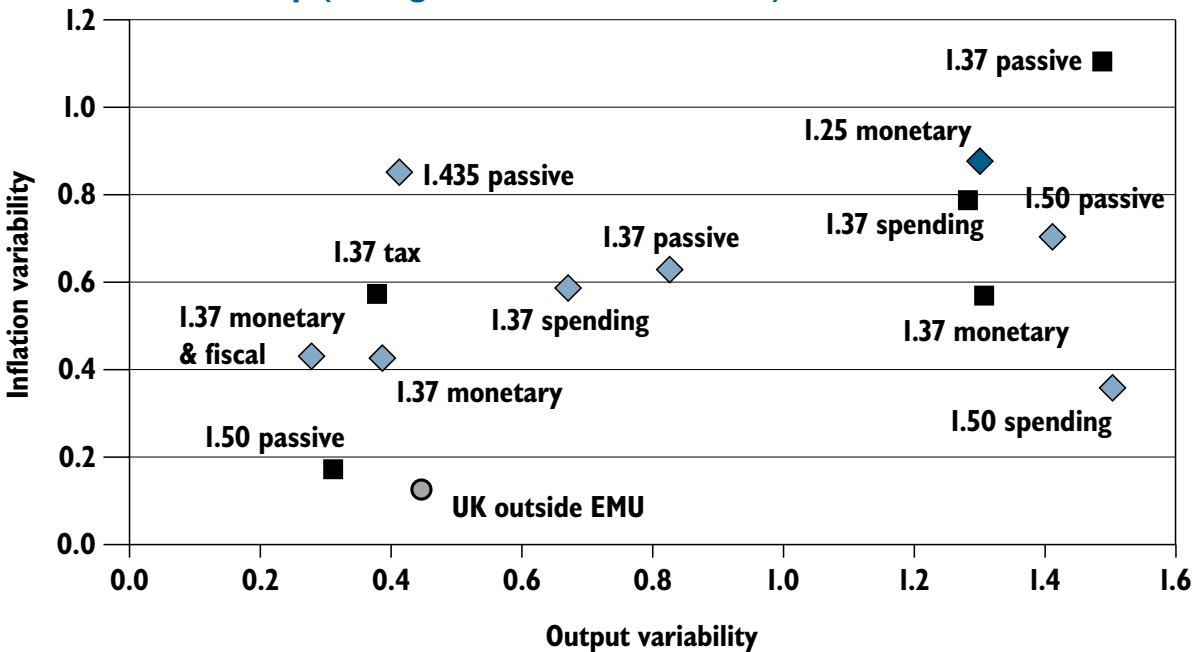
²⁹ In terms of inflation and output variability, this scenario is equivalent to the option of delaying entry until after 2007Q1.

Chart 4.7: Inflation and output variability under different model-based scenarios

(a) Calculated for pre-entry period only (averaged over 2003Q3-2004Q4)



(b) Calculated for pre-entry period and first five years of EMU membership (averaged over 2003Q3-2009Q4)



Scenarios run on high exchange rate baseline
 Scenarios run on low exchange rate baseline
 Baseline scenario

- for the same high exchange rate baseline, a policy of entering EMU at a lower entry rate under the mistaken belief that the 'true' medium-term equilibrium exchange rate is lower, turn out to be costly in terms on inflation and output volatility. These costs are slightly lessened by the active use of fiscal or monetary policy. But over a longer horizon (shown in Chart 4.7(b)), the gain is minimal since policy action is not able to postpone the required increase in inflation indefinitely;
- for the scenarios run on the low exchange rate baseline where the 'true' exchange rate is indeed expected to be lower at some point in the future, the costs in terms of volatility are different. Now, entering EMU at 1.50 on the mistaken grounds that it is permanently sustainable, would give rise to deflationary pressures;
- for entry at 1.37 on the low exchange rate baseline, the costs are still high but these costs can be modified by the use of active fiscal or monetary policy. Over the long horizon, this scenario gives the lowest degree of inflation and output volatility; but
- entry costs are also shown to be minimised if entry is delayed until 2007 when the costs coincide exactly with the *ex ante* outcome outside EMU.

4.72 One shortcoming of presenting the results of the scenario analysis in this way is that it tends to suggest that, for any given entry rate, fiscal and monetary policy instruments must be considered as alternatives rather than as complements. And it misleadingly suggests that only two entry rates are possible. But in practice, the range of choices available to policymakers is much wider than this.

4.73 These simplifying assumptions have been made in this study consistent with its role as a toolkit which might aid policymakers in their thinking about UK transition to EMU. It is not intended to provide an explicit and exhaustive menu of policy choices. This wider set of options will need to be considered in the assessment of the five tests itself.

4.74 Nevertheless, it is important to emphasise that the range of policy choices available for the transition strategy, even in the context of this stylised modelling exercise, should not be constrained by the subset of the possible range of scenarios considered here.

4.75 To illustrate, this point, three additional policy scenarios have been simulated on the low exchange rate baseline and included on Chart 4.7 showing the scatter plot of the inflation-output variability outcomes.

- First, an additional active policy variant is included where both monetary and fiscal policy are used in tandem (but to half the extent of variants 6 and 8 shown earlier, so nominal government spending is tightened by 2.5 per cent and interest rates are raised by two percentage points in the pre-EMU period) It is labelled 'monetary & fiscal' on Chart 4.7. Such a policy represents an improvement on those transition strategies considered where fiscal or monetary policy were used alone. But according to Chart 4.7, this dual strategy is still dominated by one of staying outside EMU or delaying entry.

- Second, an additional scenario is simulated representing EMU entry at 1.25€-£ on the low exchange rate baseline with active monetary policy. This is labelled ‘1.25 monetary’ on Chart 4.7. It is included to emphasise the fact that although 1.37€-£ is the main estimate of the medium term equilibrium rate in the EMU study by Professor Simon Wren-Lewis, it does not represent a lower bound, either in his or other studies. For example 1.25€-£ is consistent with an estimate of the equilibrium €-£ real exchange rate obtained by IMF researchers (see Alberola *et al.*, 1999). But here, because this represents an entry rate some 10 per cent below the assumed ‘true’ equilibrium rate of 1.37, and almost 20 per cent below the initially prevailing rate, then this scenario leads to high inflation and output variability despite the unrealistically high increase in UK interest rates by 10 percentage points above ECB levels over the pre-EMU transition period. This demonstrates clearly the risk of choosing too low an entry rate.³⁰
- Third, an entry rate scenario of 1.435€-£ is simulated and represented in Chart 4.7, labelled as ‘1.435 passive’. This entry rate is chosen as a halfway house between entry at 1.50 which implied lower inflation, and 1.37 where short-term prospects were inflationary. This is done in the spirit of the stylised analysis of Sections 2 and 3 where the entry rate was explicitly considered as a choice variable for policymakers. As might be expected, the short term pick-up in inflation is less marked, peaking below 3.5 per cent in 2004, while output is closer to potential (indeed, more so than in the baseline scenario). But over the longer horizon shown in Chart 4.7(b), the overvaluation of the entry rate requires a period of inflation below target and output below potential. So inflation and output variability is again higher than in the baseline case (and compared to the 1.37 entry scenarios with active fiscal policy).

4.76 Table 4.3 below summarises the key messages from the model-based scenario analysis in more qualitative and descriptive terms.

³⁰Other scenarios were simulated for the 1.25 €/£ entry rate on both the high and low exchange rate baseline, but these outcomes are not shown in charts 4.7(a) and (b) because they gave rise to high inflation and output variability which distorted the scale of the charts.

Table 4.3: Summary information on model-based scenario analysis

<i>Ex ante</i> baseline	EMU decision	Fiscal option	Monetary option	Macroeconomic consequences
Exchange rate sustainable at close to current levels	Stay outside	Automatic stabilisers only	UK rates set to ECB levels	Inflation close to target, output at potential
	Enter at 1.50	Automatic stabilisers only	UK rates set to ECB levels	Very similar to option of staying outside
	Enter at 1.37	Automatic stabilisers only	UK rates set to ECB levels	Large persistent increase in inflation with output above potential
		Tighten nominal government spending by 12 per cent over 2 years	UK rates set to ECB levels	Slightly improved relative to passive case but increase in inflation only delayed
		Raise income tax by 5 points for 2 years	UK rates set to ECB levels	Slightly improved relative to passive case but increase in inflation only delayed
		Automatic stabilisers only	UK rates raised 7 points above ECB levels to achieve smooth depreciation of exchange rate	More effective than fiscal options at curbing short-term inflation but increase in inflation only delayed
	Delay entry	Automatic stabilisers only	UK rates set to ECB levels	Identical to option of staying outside and similar to entering in 2005
	Stay outside	Automatic stabilisers only	UK rates set to ECB levels	Inflation close to target, output at potential, nominal exchange rate depreciates to bring about required real exchange rate depreciation
	Enter at 1.50	Automatic stabilisers only	UK rates set to ECB levels	Inflation needs to fall below target to bring about real exchange rate fall, so output below potential
		Raise nominal government spending by 9 per cent over 2 years	UK rates set to ECB levels	Fall in inflation and output postponed temporarily
	Cut income tax by 3.5 points for 2 years	UK rates set to ECB levels	As for government spending case	
Exchange rate sustainable at lower levels but not expected to be achieved immediately	Enter at 1.435	Automatic stabilisers only	UK rates set to ECB levels	Inflation increases and is more subdued initially but deflation is required later
	Enter at 1.37	Automatic stabilisers only	UK rates set to ECB levels	Temporary surge in inflation and output subsequently requiring unwind to equilibrate real exchange rate
		Tighten nominal government spending by 3 per cent over 2 years	UK rates set to ECB levels	Slightly improved relative to passive case but otherwise similar
		Raise income tax by 1.5 points for 2 years	UK rates set to ECB levels	As for government spending case
		Automatic stabilisers only	UK rates raised 4 points above ECB levels to achieve smooth depreciation of exchange rate	Inflation only rises moderately above target with small increase in output above potential
		Tighten nominal government spending by 2.5 per cent over 2 years	UK rates raised 2 points above ECB levels to smooth depreciation	Output slightly more stable than active fiscal or active monetary policy alone
	Enter at 1.25	Automatic stabilisers only	Raise interest rates by 10 points	Large increase in inflation and output variability
	Delay entry until real exchange rate has depreciated	Automatic stabilisers only	UK rates set to ECB levels	Identical to option of staying outside. Real exchange rate depreciation occurs via nominal exchange rate

4.77 Another potential criticism of this model-based analysis is that the predictions become redundant once the baseline conditions assumed in the exercise change, for example because the euro-sterling exchange rate alters, or because UK or euro area interest rates are changed.³¹ This is true to a limited extent, but the exercise has been designed to illustrate the principles of the transition issue independent of subsequent changes in market rates.

4.78 This raises the following question: suppose the nominal exchange rate were to fall as a result of market forces rather than because of policy measures, as assumed here? Should the macroeconomic consequences be the same? Would a fall in the sterling-euro rate to 1.37 €-£ have the same effect as predicted here if the devaluation were to occur spontaneously. In fact, the analytical approach of this study provides the answer. It will depend on why the market moved the exchange rate. So a devaluation caused by a perceived weakening of UK cyclical conditions relative to the euro area would have a different effect to an 'exogenous' change caused by market expectations of a perceived entry rate to EMU.

4.79 The question of how to interpret the prevailing level of the exchange rate at the time of the EMU assessment and its implications for any possible transition strategy is not considered further here but dealt with in the assessment itself.

³¹ Indeed, since the NIESR January 2003 world forecast was constructed and taken as the basis for the baseline scenarios for the modelling exercise of this study, sterling has depreciated relative to the euro and nominal interest rates have been cut in the UK and the euro area.

5.1 The overall aim of this study has been to provide some analytical rigour to the discussion of how the UK might minimise transition costs in entering monetary union. In doing this, it has provided a conceptual framework with three main elements.

5.2 First, it has set out a practical checklist of decisions that comprise a generic ‘transition strategy’, and which must inevitably face policymakers both in weighing up transition costs and in implementing transition in the event of a decision to join EMU. To an extent, this checklist is obvious. But it is useful because it deliberately disentangles a number of different dimensions to the policy problem that in much popular discussion are either conflated or neglected. In particular, it attempts to argue that there is more to the transition strategy than simply ‘choosing the rate’.

5.3 The second element of the study has been to use a small stylised model to provide a framework for analysing the transition into a monetary union for a country which previously has its own independent monetary policy. Again, much of this analysis is relatively straightforward and to an extent obvious. And inevitably, the particular simulation results derived using the stylised model are dependent on the particular calibration used. But this type of analysis is useful because, independent of the details of the results, it allows a number of key aspects of the problem to be disentangled. The following seem to be particularly important:

- a clear understanding of the difference between the characteristics of the implied inflation target before and after EMU;
- a clear understanding of the extent of disequilibrium of the UK economy relative to the euro area, not only relative to some long-run notion of equilibrium, but also relative to a shorter-run measure of equilibrium which may be more relevant over the horizon of the transition to EMU;
- an appreciation of the additional policy instruments available over the transition period, in particular, of the extent to which fiscal policy could be used to ease the transition process (although the study does not go into the practical problems of operating active fiscal policy, which are dealt with in the EMU study *Fiscal stabilisation and EMU*); and
- an understanding of the extent to which price flexibility might be available as a mechanism which might mitigate EMU transition costs.

5.4 The final element of the paper has been an attempt to illustrate the possible transition costs for the UK entering EMU using an empirically based macroeconomic model. Since the responses of the macroeconomic model are importantly determined by econometrically estimated model relationships, the findings are hopefully less arbitrary than those derived from the stylised model. Nevertheless, the predictions to be derived from a macroeconomic model are only likely to be as precise as the underlying equation estimates.

5.5 In the specific case of the macroeconometric model, NiGEM, used for the empirically based scenario analysis of Section 4, certain features of that model may have a particular bearing on the results. For example:

- since NiGEM tends to predict relatively weak effects from short-term interest rates on output and inflation, the model based predictions may underestimate the impact of lower short-term UK interest rates upon entry to EMU;
- additionally, to the extent that NiGEM predicts that fiscal policy is relatively ineffective as a total of demand management, the scenario analysis may have underestimated the degree to which active fiscal policy might be used effectively as part of the transition strategy.

5.6 Even so, this empirically based analysis has tended to reinforce the conclusions already tentatively derived from the stylised approach. The main lessons or insights would seem to be as follows:

- in modelling the transition costs associated with joining EMU, it was shown that the estimated costs could be considerably mitigated by judicious use of:
 - the assumed decision over the timing of when to enter, particularly in circumstances when the economy is assessed currently to be some distance away from its long-run equilibrium. In that case, waiting for at least some of the adjustment to take place outside of EMU by means of a depreciation of the nominal exchange rate would tend to be a less risky strategy; and
 - the assumed degree of discretionary fiscal policy over the transition period (where a relevant consideration is likely to be the costs associated with the active use of fiscal policy, not to mention the subsequent implications in terms of the credibility of the overall fiscal stance);
- for any given assumption about a date for joining, empirical calculations of the equilibrium exchange rate, and the implicit assumptions related to this embodied in the adopted forecast base, have an important role in informing judgements on what would be the appropriate rate at which to enter. This crucial consideration has often been neglected in previous analysis of the transition issue; but
- the analysis on both the stylised model and the macroeconometric model have suggested that the problem is considerably more complicated than simply joining at the ‘equilibrium exchange rate’. In particular, an important distinction has been drawn between the short-term equilibrium (or flexible price equilibrium) rate and the medium to long-run or sustainable equilibrium rate. The equilibrium estimates most often quoted in empirical work (see the survey in the EMU study on *Estimates of equilibrium exchange rates for sterling against the euro* by Professor Simon Wren-Lewis) typically

relate to the longer-term concepts. But here, it has been argued that , whereas it is the shorter-term equilibrium rate that is likely to be the more relevant in determining the appropriate level of the entry rate to EMU for any given entry date.

5.7 In concluding, it is important to emphasise that the model-based scenario analysis of this study has been carried out by making a range of specific assumptions about the likely evolution of the fundamentals of the UK economy, inside or outside EMU. And it has focused on a few possible transition strategies that might be adopted in these circumstances. But the analysis of this study is intended to be of more general use. In particular, it is intended to provide a toolkit for policymakers to allow them to apply the underlying economic principles to the transition problem, whatever the position of the economy at that time and whenever it is analysed.

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**Relationship of
'Three Bears'
model to
previous work**

A1 This annex describes the 'Three Bears' model used in the stylised analysis of Section 3. A more comprehensive account of the model's equations and the calibration of its parameters is contained in Annex A of the EMU study *Modelling shocks and adjustment mechanisms in EMU* by Dr Peter Westaway. That study examines the simulation properties of the 'The Three Bears' model in more detail.

A2 The model adopted has very conventional properties in the spirit of recent simple models adopted for use in the analysis of the design of monetary policy in a single-country context (see Clarida *et al.*, 1999, for a survey of this approach). But it is specifically tailored to reveal the key aspects of the interaction between the UK and euro area economies.

A3 There are three country blocks in the model representing the UK, the euro area and the rest of the world (and since these three country blocks in the model can broadly be characterised as small, medium-sized and large, this gives the model its name). In its full form, the model can be run with all three countries endogenous, but here, since the focus of interest is on the interaction between the UK and euro area, the rest of the world is held constant for simplicity.

Model overview

A4 The key equations for each country block in the model are as follows:

- a fixed level of potential output;
- an IS curve where aggregate demand depends negatively on the real interest rate; negatively on the respective bilateral real exchange rates and positively with respect to foreign demand pressures;
- a Phillips curve where changes in inflation are driven by the output gap (i.e. the gap between aggregate demand and supply) with important additional dynamics from the real exchange rate;
- bilateral exchange rates between pairs of countries driven by the relevant UIP condition, itself driven by the relevant interest rate differential; and
- a policy rule for nominal interest rates of the 'Taylor' form, specifying a positive response to deviations in inflation from target and to the output gap.

Equation listing

A5 A detailed listing of the model equations for the UK and the euro area now follows:

- equations are numbered where version (a) refers to the UK version and (b) to that for the euro area. The country to which model variables and coefficients apply is denoted by the superscript (in upper case for variables, lower case for coefficients);
- in most cases, except where specified, the accompanying description of the model equations will refer to those for the UK but the description will in all cases apply to the euro area too (with a suitable change of superscripts in the model description);
- all model variables are defined in natural logarithms, except for the real and nominal interest rate variables which are linear; and
- the description will explain how the 'reduced form' coefficients in the equations of the model can be broken down into influences from structural and behavioural parameters.

Output potential (supply):

$$ys_t^{UK} = ysshock_t^{UK} + ysshock_t^{SYMM} \quad [1a]$$

$$ys_t^{EA} = ysshock_t^{EA} + ysshock_t^{SYMM} \quad [1b]$$

A6 Output potential in the UK (ys_t^{UK}):

- is assumed to be exogenous to the model; and
- is affected by two types of shock, those specific to the UK ($ysshock_t^{UK}$) and shocks which symmetrically hit the euro area too ($ysshock_t^{SYMM}$).

Output determination (IS curve):

$$y_t^{UK} = cy_{lead}^{uk} \cdot y_{t+1,e}^{UK} + cy_{lag}^{uk} \cdot y_{t-1}^{UK} + (1 - cy_{lead}^{uk} - cy_{lag}^{uk}) \cdot [cy_1^{uk} \cdot r_t^{UK} + cy_2^{uk} \cdot er_t^{UKv.EA} + cy_3^{uk} \cdot er_t^{UKv.ROW} + cy_4^{uk} \cdot y_t^{EA} + cy_5^{uk} \cdot y_t^{ROW} + fisc_t^{UK} + ydshock_t^{UK} + ydshock_t^{SYMM}] \quad [2a]$$

$$y_t^{EA} = cy_{lead}^{ea} \cdot y_{t+1,e}^{EA} + cy_{lag}^{ea} \cdot y_{t-1}^{EA} + (1 - cy_{lead}^{ea} - cy_{lag}^{ea}) \cdot [cy_1^{ea} \cdot r_t^{EA} + cy_2^{ea} \cdot er_t^{EAu.UK} + cy_3^{ea} \cdot er_t^{EAu.ROW} + cy_4^{ea} \cdot y_t^{UK} + cy_5^{ea} \cdot y_t^{ROW} + fisc_t^{EA} + ydshock_t^{EA} + ydshock_t^{SYMM}] \quad [2b]$$

A7 UK output (y_t^{UK}) is determined by an IS curve with the following properties:

- in its general form, it is assumed to include backward and forward-looking elements (with a lag and lead of cy_{lag}^{uk} and cy_{lead}^{uk} respectively) where $y_{t+1,e}^{UK}$ refers to the expectation of UK output in period $t+1$ formed at period t . This is consistent with optimising models augmented to include elements of inertia, caused for example by habit persistence (see for example McCallum and Nelson, 1999, and Fuhrer, 2000). Since the theory of the optimising IS curve is less well-founded in the open economy case, the constraint that the ‘structural’ coefficients on the leads and lags of output should add to unity is not imposed in the ‘Three Bears’ implementation of the model;
- real interest rates impinge negatively on demand with a coefficient cy_1^{uk} , which is a behavioural parameter;
- each bilateral real exchange rate (i.e. between the UK and the euro area and rest of the world, respectively) impinges negatively on UK demand, where the reduced form coefficients (cy_2^{uk} and cy_3^{uk}) appropriately reflect the openness of the UK economy ($open^{uk}$), the share of euro area and rest-of-the-world trade in total UK trade ($t^{uk,ea}$ and $t^{uk,row} = 1 - t^{uk,ea}$), the sensitivity of UK trade to real exchange rate movements (γ^{uk}) and the degree of pricing-to-market in UK trade prices (ptm^{uk}),
i.e. $cy_2^{uk} = 2 \cdot open^{uk} \cdot t^{uk,ea} \cdot \gamma^{uk} \cdot ptm^{uk}$ and $cy_3^{uk} = 2 \cdot open^{uk} \cdot t^{uk,row} \cdot \gamma^{uk} \cdot ptm^{uk}$;
- openness and trade shares can be viewed as ‘structural’ parameters in the sense that they can be easily measured and are unlikely to evolve rapidly, while exchange rate sensitivity and the degree of pricing to market are considered ‘behavioural’, since they must be estimated;

- foreign demand impinges positively on demand implicitly via the demand for exports, where the reduced form coefficients on euro area and rest-of-the-world demand (i.e. c_4^{uk} and c_5^{uk}) are scaled by openness and trade shares, i.e. $cy_4^{uk} = open^{uk}t^{uk.ea}$ and $cy_5^{uk} = open^{uk}t^{uk.row}$; and
- demand in the UK is assumed to be directly affected by two types of shock, those specific to the UK ($ydashock_t^{UK}$) and shocks that symmetrically hit the euro area too ($ydashock_t^{SYMM}$).

Fiscal policy:

$$fisc_t^{UK} = cf_{AS}^{uk}y_t^{UK} + cf_1^{UK}.dp_t^{UK} = cf_2^{UK}.(y_t^{UK} - y_t^{UK}) \quad [3a]$$

$$fisc_t^{EA} = cf_{AS}^{ea}y_t^{EA} + cf_1^{ea}.dp_t^{EA} = cf_2^{ea}.(y_t^{EA} - y_t^{EA}) \quad [3b]$$

A8 Fiscal policy ($fisc_t^{UK}$) is assumed to impinge directly on demand:

- in the benchmark case, fiscal policy is assumed to respond only to the automatic stabilisers (with a sensitivity to output fluctuations of cf_{AS}^{uk}); but
- inside EMU, additional discretionary fiscal stabilisation is assumed to operate responding to inflation deviations from target and the output gap (with coefficients cf_1^{uk} and cf_2^{uk} respectively).

Inflation determination (Phillips curve):

$$\begin{aligned} dp_t^{UK} = & cp_1^{uk}.dp_{t+1,e}^{UK} + (1 - cp_1^{uk}).dp_{t-1}^{UK} \\ & + cp_2^{uk}.(er_{t+1,e}^{UKv,EA} - er_t^{UKv,EA}) + cp_3^{uk}.(er_t^{UKv,EA} - er_{t-1}^{UKv,EA}) \\ & + cp_4^{uk}.(er_{t+1,e}^{UKv,ROW} - er_t^{UKv,ROW}) + cp_5^{uk}.(er_t^{UKv,ROW} - er_{t-1}^{UKv,ROW}) \\ & + cp_6^{uk}.(y_t^{UK} + y_{t-1}^{UK} - y_t^{UK} - y_{t-1}^{UK}) \end{aligned} \quad [4a]$$

$$\begin{aligned} dp_t^{EA} = & cp_1^{ea}.dp_{t+1,e}^{EA} + (1 - cp_1^{ea}).dp_{t-1}^{EA} \\ & + cp_2^{ea}.(er_{t+1,e}^{UKv,EA} - er_t^{UKv,EA}) + cp_3^{ea}.(er_t^{UKv,EA} - er_{t-1}^{UKv,EA}) \\ & + cp_4^{ea}.(er_{t+1,e}^{UKv,ROW} - er_t^{UKv,ROW}) + cp_5^{ea}.(er_t^{UKv,ROW} - er_{t-1}^{UKv,ROW}) \\ & + cp_6^{ea}.(y_t^{EA} + y_{t-1}^{EA} - y_t^{EA} - y_{t-1}^{EA}) \end{aligned} \quad [4b]$$

A9 Inflation in the UK (dp_t^{UK}) is determined by a dynamic open-economy Phillips curve. Box A1 in Annex A of the EMU study *Modelling shocks and adjustment mechanisms in EMU* provides a more detailed justification of the specification:

- inflation dynamics are based on the Fuhrer and Moore (1995) overlapping contracts model where inflation is determined as an equally weighted sum of lagged and future inflation (where $dp_{t+1,e}^{UK}$ is the expectation of UK inflation in period $t+1$ formed at period t) This imparts inertia into the inflation process. Following Blake and Westaway (1996), the implementation of this approach here is generalised to allow the weight on backward-looking inflation to be higher to capture additional nominal inertia though the weights are constrained to add to unity to ensure dynamic homogeneity;
- the output gap appears in the Phillips curve via a two-period moving average effect, consistent with the dynamic contracting model;
- the price level (p_t^{uk}) is defined as the cumulated inflation rate;

- the price modelled is a consumer price index¹ defined as an appropriately weighted sum of domestic prices and import prices (where μ^{UK} is the weight of UK-produced goods in the domestic CPI) captured by a weighted average of competitors' prices deflated by the relevant bilateral exchange rates. Pricing to market effects modify the pass-through of exchange rates into import prices;
- the dynamics of the real exchange rate terms are also determined by the dynamic contract model, involving a change term in each of the expected and current bilateral real exchange rates, with respective coefficients of cp_2^{uk} and cp_3^{uk} for the UK-euro area real exchange rate, and cp_4^{uk} and cp_5^{uk} for the UK-rest-of-the-world real exchange rate. The related coefficients depend on the degree of inflation inertia (cp_1^{uk}), the share of domestic goods in the consumer price basket (μ^{uk}) and the degree of pricing to market (ptm^{uk}),

$$\text{i.e. } cp_2^{uk} = cp_1^{uk} \cdot \phi^{uk} t^{uk,ea}, \quad cp_3^{uk} = -(1 - cp_1^{uk}) \cdot \phi^{uk} t^{uk,ea}$$

$$\text{and } cp_4^{uk} = cp_1^{uk} \cdot \phi^{uk} t^{uk,row}, \quad cp_5^{uk} = -(1 - cp_1^{uk}) \cdot \phi^{uk} t^{uk,row}$$

$$\text{where } \phi^{uk} = 2 \cdot (1 - \mu ptm^{uk}) / \mu ptm^{uk}$$

$$\text{and where } \mu ptm^{uk} = \mu^{uk} / (1 - (1 - \mu^{uk}) \cdot ptm^{uk}); \text{ and}$$

- supply shocks to the UK ($ysshock_t^{uk}$ and $ysshock_t^{SYMM}$) impinge on the model via their effect on supply potential (ys_t^{UK}) which enters via the output gap terms in the Phillips curve.

Real exchange rate determination:

When the UK sets monetary policy independently:

$$er_t^{UKv,EA} = er_{t+1,e}^{UKv,EA} + r_t^{UK} - r_t^{EA} - sig_t^{UKv,EA} \quad [5a]$$

When UK in EMU:

$$er_t^{UKv,EA} = p_t^{UK} - p_t^{EA} \quad [5a']$$

When the UK is outside or inside EMU:

$$er_t^{UKv,ROW} = er_{t+1,e}^{UKv,ROW} + r_t^{UK} - r_t^{ROW} - sig_t^{UKv,ROW} \quad [5b]$$

A10 The equations for the bilateral real exchange rate will depend on the UK's monetary regime:

- outside EMU, real bilateral exchange rates of the UK against the euro area ($er_t^{UKv,EA}$) and the rest-of-the-world ($er_t^{UKv,ROW}$) are determined by the uncovered interest parity condition containing the relevant expected exchange rate terms ($er_{t+1,e}^{UKv,EA}$ and $er_{t+1,e}^{UKv,ROW}$, where for example $er_{t+1,e}^{UKv,EA}$ is the expected bilateral UK v euro area real exchange rate in period $t+1$ formed in period t) and the relevant real interest rate differentials (i.e. r_t^{UK} relative to r_t^{EA} and r_t^{ROW} respectively) plus a risk premium ($sig_t^{UKv,EA}$ and $sig_t^{UKv,ROW}$);
- inside EMU, when the nominal exchange rate between the UK and the euro area is irrevocable fixed (here at unity for presentational simplicity), the real exchange rate becomes equivalent to the relative price between the UK (p_t^{UK}) and euro area (p_t^{EA}); and
- shocks to the real exchange rate occur via the risk premium terms (see below).

¹ To simplify the model, the real exchange rate is defined using consumer prices rather than trade prices which a richer model would additionally incorporate.

Exchange rate risk premium:

$$sig_t^{UKvEA} = risk_t^{UK} - risk_t^{EA} \quad [6a]$$

When UK is outside EMU:

$$sig_t^{UKvROW} = risk_t^{UK} - risk_t^{ROW} \quad [6b]$$

When UK in EMU:

$$sig_t^{UKvROW} = w.risk_t^{UK} + (1-w)risk_t^{EA} - risk_t^{ROW} \quad [6b']$$

where w is the share of UK GDP in euro area GDP post UK-entry.

All Exchange rate risk premia can be defined in a variety of ways:

- in the simplest case where independent risks can be associated with particular countries, the risk premium on a particular bilateral is defined as the difference between the risks associated with the respective countries. Inside EMU, it is assumed that the risk associated with an extended euro area including the UK is a weighted sum of the previous risks in the UK and euro area; and

Nominal exchange rate:

$$e_t^{UKvEA} = er_t^{UKvEA} + p_t^{EA} - p_t^{UK}$$

$$e_t^{UKvROW} = er_t^{UKvROW} + p_t^{ROW} - p_t^{UK}$$

The bilateral nominal exchange rates (e_t^{UKvEA} and e_t^{UKvROW}) are defined by identity:

- in the case when the UK is inside EMU, the nominal exchange rate is held constant at unity (zero in logarithms).

Real interest rates:

$$r_t^{UK} = i_t^{UK} - dp_{t+1,e}^{UK} \quad [7a]$$

$$r_t^{EA} = i_t^{EA} - dp_{t+1,e}^{EA} \quad [7b]$$

A12 Real interest rates (r_t^{UK}) are defined in forward-looking terms, i.e. as the difference between the nominal interest rate (i_t^{UK}) and a forward-looking measure of expected inflation ($dp_{t+1,e}^{UK}$).

Nominal interest rate reaction functions:

When the UK sets monetary policy set independently:

$$i_t^{UK} = dp_{t+1,e}^{UK} + cr_1^{uk} \cdot (dp_t^{UK} - dp_{targ}^{UK}) + cr_2^{uk} (y_t^{UK} - ys_t^{UK}) + ishock_t^{UK} + ishock_t^{SYMM} \quad [8a]$$

$$i_t^{EA} = dp_{t+1,e}^{EA} + cr_1^{ea} \cdot (dp_t^{EA} - dp_{targ}^{EA}) + cr_2^{ea} (y_t^{EA} - ys_t^{EA}) + ishock_t^{EA} + ishock_t^{SYMM} \quad [8b]$$

When the UK is in EMU:

$$i_t^{UK} = i_t^{EA} \quad [8a']$$

$$\begin{aligned} i_t^{EA} = & w.dp_{t+1,e}^{UK} + (1-w).dp_{t+1,e}^{EA} \\ & + w.[cr_1^{ea} (dp_t^{UK} - dp_{targ}^{EA}) + cr_2^{ea} \cdot (y_t^{UK} - ys_t^{UK})] \\ & + (1-w).[cr_1^{ea} (dp_t^{EA} - dp_{targ}^{EA}) + cr_2^{ea} (y_t^{EA} - ys_t^{EA})] \end{aligned} \quad [8b']$$

where w is the share of UK GDP in euro area GDP *post* entry.

A13 The policy rule for nominal interest rates will depend on whether the UK is in EMU or not:

- outside EMU, nominal interest rates (i_t^{uk}) are set according to a Taylor-type rule responding to deviations in UK inflation from target and in the UK output gap (with coefficients cr_1^{uk} and cr_2^{uk} respectively); and
- inside EMU, UK nominal interest rates are set equal to interest rates in the euro area, which are now assumed to be set by the ECB in response to an appropriately weighted average of inflation deviations and output gaps in the euro area including the UK (and where the Taylor rule parameters and inflation target for the euro area are assumed to be unaffected by UK entry to EMU).

Model solution A14 The model is programmed up in the Winsolve modelling package (see Pierse, 2000). It is solved using a Gauss-Newton solution method. All forward-looking expectations in the model are solved using a stacked Newton method under the assumption of model consistent expectations with conventional terminal conditions.

Calibration of the model A15 The model is calibrated in order to reproduce in a realistic but inevitably rather stylised manner, the dynamic properties of the UK and euro area economies and their interaction with the rest of the world. As such, parameter values have largely been chosen to provide response patterns that are consistent with SVAR responses and with those observed in larger empirically based macromodels.

A16 In describing the calibration of the model for the UK and euro area equations, it is useful to separate the model's parameters into three categories, long-run structural, behavioural and policy-related.

A17 Long-run structural parameters relate to features of the economy that tend to be measured, here based on national accounts statistics for GDP and expenditure shares, rather than estimated. As such, they are unlikely to be altered in the short-to-medium term by the monetary regime in place. These are detailed in the table below:

Long-run structural parameters	UK	Euro area
Openness defined as average of import and export to GDP ratio	$open^{uk} = 0.33$	$open^{ea} = 0.165$
Trade shares ($t^{a,b}$ = share of A in B's trade)	$t^{uk,ea} = 0.5$ $t^{uk,row} = 1 - 0.5 = 0.5$	$t^{ea,uk} = 0.18$ $t^{ea,row} = 1 - 0.18 = 0.82$
Domestic content of CPI	$\mu^{uk} = 0.8$	$\mu^{ea} = 0.9$
Share of GDP in world output	$w^{uk} = 0.04$	$w^{ea} = 0.16$
Share of GDP in output of euro area plus UK	$w = w^{uk} / (w^{uk} + w^{ea}) = 0.2$	$1 - w = 0.8$

A18 Behavioural parameters relate to features of the economy that tend to be estimated or calibrated. These parameters may be more likely to alter endogenously once monetary union begins. Details are given in the table below:

Behavioural parameters	UK	Euro area
Sensitivity of trade to real exchange rate	$\gamma^{uk} = -1.5$	$\gamma^{ea} = -1.5$
Degree of pricing to market	$ptm^{uk} = 0.25$	$ptm^{ea} = 0.25$
Degree of inertia in output	$cy_{lag}^{uk} = 0.5, cy_{lead}^{uk} = 0$	$cy_{lag}^{ea} = 0.5, cy_{lead}^{ea} = 0$
Interest sensitivity of output	$cy_1^{uk} = -0.2$	$cy_1^{ea} = -0.2$
Degree of forward-lookingness in price setting	$cp_1^{uk} = 0.25$	$cp_1^{ea} = 0.25$
Output sensitivity of price setting	$cp_6^{uk} = 0.25$	$cp_6^{ea} = 0.25$

A19 A detailed justification of these behavioural parameter settings used to calibrate the ‘Three Bears’ Model is contained in Annex A of the EMU study *Modelling shocks and adjustment mechanisms in EMU*.

A20 Policy-related parameters relate

- to the feedback responses of monetary policy in the ‘Taylor’ specification; and
- to the responsiveness of fiscal policy comprising two components; first, the automatic stabiliser component involving a response coefficient of 0.5 to output changes (see Van den Noord, 2000); and second, an additional discretionary feedback element to inflation deviations and the output gap. This may be required inside EMU to compensate for the loss of independent monetary policy as an adjustment mechanism.

A21 No attempt is made in the paper to choose policy-response coefficients that are ‘optimal’ in any sense.

Policy rules	UK	Euro area
Monetary policy	$cr_1^{uk} = 0.5$	$cr_1^{ea} = 0.5$
	$cr_2^{uk} = 0.5$	$cr_2^{ea} = 0.5$
Fiscal policy	$cf_{AS}^{uk} = -0.5$	$cf_{AS}^{ea} = -0.5$
	$cf_1^{uk} = cf_2^{uk} = 0.0$	$cf_1^{ea} = cf_2^{ea} = 0.0$

A22 These 13 sets of parameters (five structural, six behavioural and two policy-related) completely define the coefficients of the model. All that remains is to express the reduced-form coefficients in the output and inflation equations in terms of these parameters. Details are given below:

Output determination (IS curve)	UK	Euro area
Degree of inertia	$cy_{lag}^{uk} = 0.5, cy_{lead}^{uk} = 0$	$cy_{lag}^{ea} = 0.5, cy_{lead}^{ea} = 0$
Interest sensitivity	$cy_1^{uk} = -0.2$	$cy_1^{ea} = -0.2$
Coefficients on real exchange rate terms (derivation given in 2)	$cy_2^{uk} = -0.37125$ $cy_3^{uk} = -0.37125$	$cy_2^{ea} = -0.06683$ $cy_3^{ea} = -0.30443$
Foreign demand elasticity (derivation given in 2)	$cy_4^{uk} = 0.165$ $cy_5^{uk} = 0.165$	$cy_4^{ea} = 0.0297$ $cy_5^{ea} = 0.1353$
Inflation determination (Phillips curve)	UK	Euro area
Degree of forward-lookingness	$cp_1^{uk} = 0.25$	$cp_1^{ea} = 0.25$
Coefficients on real exchange rate terms (derivation given below equation 3)	$cp_2^{uk} = 0.0469$ $cp_3^{uk} = -0.141$ $cp_4^{uk} = 0.0469$ $cp_5^{uk} = -0.141$	$cp_2^{ea} = 0.0075$ $cp_3^{ea} = -0.0225$ $cp_4^{ea} = 0.0342$ $cp_5^{ea} = -0.1025$
Output sensitivity	$cp_6^{uk} = 0.25$	$cp_6^{ea} = 0.25$

B

ANNEX B: A COUNTERFACTUAL ANALYSIS OF UK ENTRY INTO EMU IN 1999

What would have happened if the UK had entered EMU in 1999Q1?

B1 The aim of this Annex is to use the same empirical macroeconomic model used in Section 4 to illustrate how the UK economy would have performed if the UK had entered EMU in 1999Q1. Two scenarios are considered. One where it is assumed that the sterling-euro nominal exchange rate was locked at the rate prevailing at the time of announcement of the intention to join EMU, and one where it is assumed the UK entered at the rate prevailing at the time EMU commenced.

Defining the strategies

B2 It is assumed that an announcement of the intention to join EMU was made in May 1998 with entry taking place at the beginning of 1999.

B3 Two different entry rates are considered:

- 1.52 €-£ (0.66 £-€, also corresponding to 2.97 DM-£ at the DM's EMU conversion rate); this higher entry rate represents the prevailing rate upon announcement; and
- 1.46 €-£ (0.68 £-€, also corresponding to 2.86 DM-£ at the DM's EMU conversion rate); this lower entry rate was chosen on the grounds that it was the prevailing rate at the time EMU commenced.

B4 On announcement, these entry rates are assumed to be completely believed by foreign exchange market operators. Further, it is assumed that the exchange rate responds so as to eliminate any opportunity for one-way-bets in the markets.

B5 In this illustration, UK nominal interest rates are assumed to be set immediately equal to the ECB's rate at the time of announcement. This implies that the exchange rate immediately jumps to its announced entry rate. This is virtually equivalent to assuming the UK joined EMU at once except that the ECB is not assumed to count the UK as part of the euro area until the UK actually joins in 1999.

B6 On fiscal policy, the same assumption is adopted as was done in the scenarios examined in Section 4 of this study; the automatic stabilisers are assumed to operate in the face of shocks which push the predicted path away from the *ex ante* outcome, and since nominal government spending is assumed to be held fixed for the remaining duration of the Spending Review period (in this case up to 2001Q1), the effect of changes in the price level on real government spending reinforce the automatic stabilisers

Description of different policy scenarios

B7 Charts B1 (a) - (f) illustrate the different policy scenarios under these assumptions, showing the macroeconomic variables as defined for Charts 4.1-4.6 in Section 4, except for chart B1 (f) which shows the UK real interest rate (defined as short term interest rates minus RPIX inflation).

Enter at 1.52 €-£ (0.66 £-€, 2.97 DM-£) in 1999Q1

B8 In the first scenario the nominal euro-sterling conversion rate is fixed on announcement at the prevailing rate at the time (i.e. in 1998Q2), 1.52 €-£. Chart B1 (a) shows that, between announcement and the time of entry, the actual exchange rate fell to 1.46 €-£. So if the UK had entered EMU in 1999Q1 at 1.52 €-£, this would have been at a level four per cent higher than the actual prevailing rate that was observed. From 1999 onwards, however, there was a sharp appreciation of sterling against the euro. So for the later period of 2000 to

2002, the fixed exchange rate of 1.52 €-£ would have been on average six per cent lower than the rate actually experienced:

- when nominal interest rates are immediately brought down to euro area levels upon announcement, this implies an immediate cut in UK interest rates of 3.5 percentage points (see Chart B1 (e)) while real interest rates fall to around 1 per cent (see Chart B1 (f)). Thereafter the gap between UK nominal interest rates in the counterfactual and those which actually occurred gradually closes; it is 2.5 percentage points lower at the point of EMU entry in 1999, and less than 0.5 percentage points lower in 2001 (though the gap grows above 1 percentage point in 2003). Real interest rates (on the measure shown here) fall below zero in 2002 and 2003;
- upon entry, the initially stronger exchange rate causes UK inflation to be 0.6 percentage points lower. But, by the end of 2000, inflation would have risen by 2 percentage points as a result of the lower level of the nominal exchange rate. Inflation then gradually falls but by 2002 is still 1 percentage point above the *ex ante* outcome (see Chart B1 (c));
- as a result of the fixed nominal exchange rate at 1.52 €-£ combined with the resulting effects on inflation, the real exchange rate is taken 5 per cent above actual levels over the transition period and on entry is 4 per cent higher (see Chart B1 (b)). But thereafter, because of the strong appreciation of the sterling-euro exchange rate which actually occurred, the real exchange rate is on average 4 per cent lower over the period up to the end of 2002;
- output growth initially remains close to the actual levels observed but after entry it rises as a result of the real exchange rate depreciation and the sharp fall in interest rates (see Chart B1 (d)). Over the period 1999 to 2000 output growth would have been on average over 1 percentage point higher than that actually observed. However, by 2001 output growth falls below observed levels as a result of the real exchange rate appreciation and remains lower than the forecast baseline until the end of 2007.

Enter at 1.46 €-£ (0.68 £-€, 2.86 DM-£) in 1999Q1 **B9** In the alternative scenario, the nominal €-£ entry rate is fixed on announcement (1998Q2) at the rate which subsequently prevailed at the time EMU commenced (1999Q1), 1.46 €-£, some 4 per cent lower than the level of 1.52 €-£ prevailing at the time of announcement. Under this scenario, the sharp subsequent appreciation of sterling against the euro after 1999 would imply that the irrevocably fixed euro-sterling exchange rate would have been even lower relative to the *ex ante* case by some 10 per cent. This initially feeds through into a lower level of the real exchange rate which stimulates UK demand by more than in the first case. As a consequence, relative to the first scenario, the macroeconomic consequences are broadly similar with output growth slightly stronger and inflation turning out slightly higher by 0.2 percentage points, peaking just below 5 per cent at the end of 2000.

Conclusions

Higher inflation and output **B10** The simulations suggest that if the UK had entered EMU in 1999Q1 then inflation and output growth would have been considerably higher than actually observed.¹

B11 Historically, there was a strong appreciation of the exchange rate after 1999. So if the bilateral rate between the UK and the Euro area had been fixed at a rate lower than that actually observed, this would have meant large inflationary consequences for the UK economy. This, along with the strong monetary stimulus from a large reduction in interest rates to Euro area levels, would have meant that UK inflation would have reached over 4 per cent.

B12 Output growth would have risen compared to observed levels as UK exporters benefited from a more competitive exchange rate but by 2002 output growth would have been lower than that observed historically, as the level of output produced returned to sustainable levels.

¹A similar conclusion is drawn in OEF (2003) although their predicted increase in inflation and output is slightly larger and the subsequent downturn more severe (where they predict a technical recession with output levels falling in late 2001). Their analysis additionally places emphasis on the implications of lower interest rates for UK house price inflation.

Chart BI: The counterfactual. A comparison of alternative entry rates for the UK entering EMU in 1999Q1.

