The exchange rate and macroeconomic adjustment

EMU study
The exchange rate and macroeconomic adjustment

This study has been prepared by HM Treasury to inform the assessment of the five economic tests
This study has benefited from review by Professor Charles Goodhart and helpful comments from Professor Michael Artis, both working in a personal capacity as academic consultants to HM Treasury. All content, conclusions, errors and omissions in this study are, however, the responsibility of HM Treasury alone.

This is one of a set of detailed studies accompanying HM Treasury’s assessment of the five economic tests. The tests provide the framework for analysing the UK Government’s decision on membership of Economic and Monetary Union (EMU). The studies have been undertaken and commissioned by the Treasury.

These studies and the five economic tests assessment are available on the Treasury website at:
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EXECUTIVE SUMMARY

Key issue: do flexible exchange rates promote macroeconomic adjustment?

1 A central question when considering the costs and benefits of joining a monetary union is the role of the exchange rate in the economic adjustment process. If an independent flexible exchange rate were a mechanism that allowed the domestic economy to adjust to shocks and disturbances, then the loss of this mechanism as a result of joining a monetary union would entail a cost. Conversely, if an independent exchange rate were a source of shocks to the economy, for example if its movements were mainly driven by ‘irrational’ movements in financial markets rather than by economic fundamentals, then foregoing the independent exchange rate could be a benefit.

2 The role of the exchange rate in macroeconomic adjustment has been a feature of the debate over whether the UK should join Economic and Monetary Union (EMU). Currie (1997) argues that both views of the exchange rate have some element of truth: “exchange rates do tend to play a useful role, but also incorporate a large arbitrary and disruptive element” (page 6). Advocates of EMU entry often highlight the potentially disruptive role of exchange rate movements. For example Layard et al. (2002) state: “An independent exchange rate is… …often a source of shocks to the economy rather than a means of offsetting them. These shocks may be large and potentially very damaging for an economy of Britain’s size” (page 9).

3 This issue was not considered in detail in the October 1997 assessment of the five economic tests (HM Treasury, 1997). The issue is more prominent now due to the persistent strength of sterling in relation to the euro during much of the past six years. It has been argued that this represents an overshooting that cannot be explained by economic fundamentals, and is a source of imbalance to the economy. Nevertheless output and inflation outcomes in the UK have compared favourably with those in the euro area.

4 HM Treasury has produced four EMU studies on issues relating to the exchange rate. The EMU study by Professor Simon Wren-Lewis Estimates of equilibrium exchange rates for sterling against the euro, and the studies by HM Treasury Modelling shocks and adjustment mechanisms in EMU and Modelling the transition to EMU complement this study. Professor Wren-Lewis’s study focuses on economic models of the medium and long-run real exchange rate, and estimates a medium-run equilibrium rate for sterling. The two HM Treasury studies consider how the macroeconomic costs of adjustment to economic shocks in the UK compare inside and outside of EMU, and the role of the exchange rate in determining the UK’s transition path, if the UK were to decide to join EMU.

5 This study focuses on short and medium run movements in the exchange rate and considers whether such movements tend to be a stabilising reaction to changes in aggregate supply and demand, or whether they tend to be destabilising. The study contains both theoretical and empirical analysis.

6 The Government believes that exchange rate stability can only be achieved on the basis of sound economic fundamentals, in particular low and steady inflation, steady and sustainable growth and sound public finances. The exchange rate is, therefore, an outcome that reflects other policies, both in the UK and in other countries.

7 The real exchange rate provides one of the adjustment mechanisms that balances aggregate demand and aggregate supply in the medium and long run. The real exchange rate is defined as the nominal (or market) exchange rate adjusted for price levels at home and abroad, and is a measure of the relative competitiveness of domestic and foreign production.
If the UK were to join EMU then there would no longer be a nominal exchange rate between the UK and the current euro area countries. Within EMU, if a shock occurred that required a change in the real exchange rate, this could only be achieved if UK inflation were different from the rest of the euro area for a period of time. Outside of EMU, part or all of any real exchange rate adjustment may be achieved by a change in the nominal exchange rate.

This point may be illustrated by a simple example. Consider an economic shock that leads to excess demand for UK production, for example an increase in demand for UK exports when the UK economy is already operating at full capacity. When exchange rates are fixed, this excess demand will put upward pressure on UK inflation, leading to a real exchange rate appreciation. This will encourage a switching of demand towards foreign suppliers and a switching of supply towards domestic markets. Both effects reduce, and eventually eliminate, the initial excess demand.

By contrast, when nominal exchange rates are flexible, the effect of increased demand for UK exports may cause the nominal exchange rate to appreciate. This provides an alternative route for securing the real exchange rate appreciation needed to eliminate the initial excess demand.

A country’s real exchange rate will ultimately reflect underlying economic conditions, irrespective of whether nominal exchange rates are fixed or floating. But the adjustment mechanism is different, with adjustment in the domestic price level being greater under a fixed exchange rate regime. Under flexible exchange rates, the movement in the nominal exchange rate cushions some of the impact on the domestic price level, and consequently can be viewed as a shock absorber.

The chief advantage of a flexible exchange rate regime is that the nominal exchange rate can react rapidly to changes in economic conditions. Under a fixed exchange rate regime, changes to the level of domestic prices may take longer to occur. This may be especially important when a real exchange rate depreciation is needed, as under a fixed exchange rate system, this would require inflation to be lower than in other countries, and may even require wage cuts. Under both regimes the eventual real effects on the economy will be the same; real relative prices are adjusting even if it is nominal exchange rates that are facilitating the adjustment.

A high proportion of foreign currency transactions is associated with transactions relating to the trade of financial instruments and assets rather than transactions relating to the trade of goods and services. This has led some to argue that the exchange rate will often move in a direction that is inconsistent with restoring the balance of aggregate supply and aggregate demand in the economy. In other words, they claim that the exchange rate may fail to depreciate when UK output and employment are weak, or to appreciate when they are strong. According to this view, exchange rate movements may be at best an unreliable means of stabilising the economy, and at worst may be frequently destabilising. For example, Willem Buiter, in his contribution to the EMU study *Submissions on EMU from leading academics* describes sterling exchange movements in the late 1990s as follows: “the UK exchange rate behaved rather like a rogue elephant, going its own way regardless of the behaviour of nominal interest rates . . . and other observable fundamentals”.

Whether exchange rate movements help to stabilise the economy or not depends in part on the context in which the exchange rate movement is occurring, including the pressures that are generating the exchange rate change itself. For example, if the domestic economy is already operating at full capacity, then the extra demand created by an exchange rate depreciation will tend to raise domestic inflation. This will take the real exchange rate back to its initial level, giving no permanent change in the price competitiveness of UK production in foreign markets. By contrast, if the domestic economy is operating at below full capacity,
domestic inflation is unlikely to offset fully the initial depreciation, leading to a sustained rise in the price competitiveness of UK products in foreign markets, which should raise the demand for UK exports. In the first case, nominal exchange rate changes will tend to destabilise the economy, while in the second case a depreciation can help to stabilise it.

Empirical studies have found that domestic consumer prices tend to react slowly to changes in the nominal exchange rate – a phenomenon known as ‘exchange rate disconnect’. This could imply that the exchange rate has a weaker influence on consumption and production decisions than predicted by standard economic theory, and consequently plays a limited role in macroeconomic adjustment.

However, exchange rate changes have a much greater impact on the prices of imported goods, including imports that are used to produce other goods, than they do on final consumer goods. This implies that nominal exchange rate changes do change price structures in the domestic economy, even if the impact on consumer prices is muted. The changes in prices that do occur may still influence firms’ purchasing and production decisions in a way that is consistent with macroeconomic adjustment. For example a nominal exchange rate depreciation will still tend to raise the domestic price of UK imports and reduce the foreign currency price of UK exports, and hence improves the competitiveness of UK production relative to foreign production.

A number of studies have used a range of empirical methods to evaluate the role of the exchange rate in macroeconomic adjustment. Econometric analysis suggests that exchange rate movements have not been a significant source of shocks to the UK economy as a whole. Instead exchange rate changes appear to have absorbed shocks that might otherwise have had a greater impact on UK output and prices. A striking example of this safety valve role is sterling’s strong appreciation after 1996, which did not result in higher unemployment or a collapse in inflation, but nonetheless restrained the net export contribution to demand and probably alleviated some of the inflationary pressure that might otherwise have occurred.

Whether exchange rate flexibility is a significant stabilising mechanism or not is harder to resolve. Econometric evidence finds that large exchange rate movements do not typically affect other macroeconomic variables. This could be because the exchange rate change helps to absorb an otherwise unobserved shock. But it could be that observed exchange rate movements are purely extraneous. Both the size and the speed of exchange rate changes can be difficult to explain in terms of movements in fundamentals, suggesting that on occasion exchange rate changes may be at least partly driven by other factors, such as financial market sentiment. Without observing the counter-factual of what would have happened had the exchange rate not moved, it is not possible to establish conclusively the extent to which particular exchange rate movements have or have not been warranted.

As the experience of the past few years has confirmed, large exchange rate movements can be destabilising for individual business sectors, even when they help to stabilise the economy as a whole. Exchange rate movements impact more strongly on exporters and importers than on the economy as a whole, with large exchange rate changes posing particular difficulties for those sectors which are highly sensitive to exchange rate changes. But the potential benefit of fixed exchange rates to the traded goods sector may be less than is sometimes claimed. As already noted, real exchange rates can still adjust when nominal rates are fixed, with adjustment coming through movements in relative price levels. Since it is the real exchange rate that influences the price competitiveness of exporters and importers in their respective markets, they will still find their price competitiveness will tend to rise and fall in response to the differences in the strength of economic activity in different markets. Since domestic prices tend to move more slowly than exchange rates, companies tend to have more time to adjust when nominal exchange rates are fixed, but their price competitiveness will still be affected by real exchange rate changes.

EXECUTIVE SUMMARY

Empirical evaluation suggests exchange rate changes act as a safety valve
In recent years, sterling remained persistently above most estimates of its sustainable rate, including the central estimate derived by Professor Wren-Lewis in his EMU study *Estimates of equilibrium exchange rates for sterling against the euro*. This appreciation appears to be partly attributable to the relatively strong domestic demand growth in the UK compared with the euro area. This may have warranted a degree of sterling appreciation against the euro, both to prevent the UK economy overheating and to bolster demand for euro area production. It is important to emphasise that interpretation of recent events is made more difficult by uncertainty about both the scale and persistence of currency market reactions to the particularly high degree of global political and economic uncertainty.

Empirical evidence also suggests that countries with fixed exchange rates do not tend to experience greater macroeconomic volatility than countries with flexible exchange rates. This is consistent with the insight from optimal currency area theory that fixed exchange rate regimes need not impair an economy’s ability to adjust to shocks, provided that alternative adjustment mechanisms operate effectively. These include appropriate levels of wage and price flexibility and the capacity to redeploy resources flexibly in response to changing economic conditions.

A second strand of empirical analysis developed for this study assesses whether entering EMU would lead to an overall reduction in UK nominal exchange rate volatility. If the UK were to join EMU exchange rate volatility against other euro area economies would be eliminated. But exchange rate volatility against other currency areas could conceivably increase. In recent years the euro has been more volatile against the US dollar than sterling has been against the US dollar. If these trends were typical, then the UK exchange rate against the US dollar would be more volatile within EMU than outside. Some studies have claimed that greater volatility against the US dollar would more than offset the elimination of volatility against euro area countries.

Measures of volatility need to be interpreted carefully. To the extent that exchange rate movements aid macroeconomic adjustment, some exchange rate volatility may be useful. But to the extent that exchange rate volatility disrupts the economy then it may be considered unwarranted. Summary measures of volatility are unable to distinguish whether observed volatility is warranted or not.

That said, the analysis in this study shows that, in general, overall exchange rate volatility would tend to be lower if the UK were to join EMU. But this result varies in different contexts. The reduction in volatility is greatest in situations where, if sterling were independent, it would be moving against an unchanged euro-US dollar rate. In these circumstances, fixing the sterling-euro rate not only eliminates volatility against the euro, but also eliminates volatility against other currencies as well. By contrast, in circumstances of sharp adjustment in the euro-US dollar rate, the overall volatility of sterling might be higher within EMU than outside. While such circumstances have arisen in the past, and can be expected to arise in the future, this analysis suggests that more typical scenarios are ones in which the elimination of nominal exchange rate volatility against the euro area economies would outweigh any increase in sterling volatility against non-euro currencies.

Although it can be difficult to relate exchange rate changes to changes in economic fundamentals, they do appear to have generally helped to stabilise the economy. Consequently, fixing the euro-sterling exchange rate would remove one of the adjustment mechanisms that is currently available to the economy. However, this need not be costly, provided that other adjustment mechanisms, such as labour market flexibility and fiscal stabilisation operate effectively. These issues are considered further in the convergence and flexibility tests – the first and second of the Government’s five economic tests for EMU entry.
1.1 A central question when considering the costs and benefits of joining a monetary union is the role of the exchange rate in the economic adjustment process. If an independent flexible exchange rate were an effective mechanism in helping the domestic economy to adjust to shocks and disturbances, then the loss of this mechanism as a result of joining a monetary union would entail a cost to the domestic economy. Conversely, if an independent exchange rate were itself a source of shocks to the economy, for example if its movements were mainly driven by ‘irrational movements’ in financial markets rather than by economic fundamentals, then forgoing the independent exchange rate would be a benefit to the economy.

1.2 This debate has been mirrored in the history of international exchange rate regimes in the twentieth century. Over this period, developed nations alternated between fixed and floating regimes, encountering problems with each. This provides a useful illustration of the dilemmas facing policy makers choosing between fixed and flexible exchange rate systems.

1.3 The role of the exchange rate in macroeconomic adjustment has been a feature of the debate over whether the UK should join Economic and Monetary Union (EMU). Currie (1997) argues that both views of the exchange rate, as either a source of shocks or a shock absorber, have some element of truth: “exchange rates do tend to play a useful role, but also incorporate a large arbitrary and disruptive element” (page 6).

1.4 Those who advocate EMU entry often highlight the potentially disruptive role of exchange rate movements. For example, Layard et al. (2002) state: “An independent exchange rate is... often a source of shocks to the economy rather than a means of offsetting them. These shocks may be large and potentially very damaging for an economy of Britain’s size” (page 9).

1.5 Chart 1.1 shows the bilateral nominal exchange rates of sterling-deutschmark (sterling-euro from 1 January 1999), sterling-US dollar and the sterling exchange rate index (ERI) since 1975. It is clear that the exchange rate is fairly volatile. The question is the extent to which these movements in nominal, and real, exchange rates are stabilising responses to actual, or perceived, changes in fundamental factors affecting the economy, and the extent to which they are simply unwarranted and destabilising shocks. This issue was not considered in detail in the October 1997 assessment of the Government’s five economic tests (HM Treasury, 1997). However, the issue is more prominent now, partly due to the persistent strength of sterling in relation to the euro during much of the intervening five and a half years.

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1 For a brief history of exchange rate regimes in the twentieth century, see the 2002 Cairnross lecture given by Ed Balls, Chief Economic Adviser to the Treasury (Balls, 2002).

1 The exchange rate index is a weighted average of sterling’s bilateral exchange rates against other countries. The weights broadly reflect each currency’s importance in UK foreign trade. See Annex B of this study for more detail.
Internal balance is defined as the level of output consistent with maintaining inflation at target. External balance is a sustainable external current account balance.

1.6 To inform the assessment of the five economic tests, HM Treasury has produced four EMU studies relating to the exchange rate. The EMU study by Professor Simon Wren-Lewis estimates of equilibrium exchange rates for sterling against the euro and the studies by HM Treasury Modelling shocks and adjustment mechanisms in EMU and Modelling the transition to EMU complement this study. Professor Wren-Lewis’s study focuses on economic models of the medium and long-run real exchange rate, and estimates a medium-run equilibrium rate for sterling. This is done using a methodology that calculates the exchange rate that is consistent with internal and external balance. The HM Treasury studies consider how the macroeconomic costs of adjustment to economic shocks in the UK compare inside and outside of EMU, and the role of the exchange rate in determining the UK’s transition path, if the UK were to decide to join EMU.

1.7 This study focuses on the role of the nominal exchange rate when the economy is away from equilibrium. It considers how the real exchange rate responds to imbalances between aggregate supply and demand, and the part that real exchange rate movements play in enabling the economy to adjust to unexpected events or shocks. The real exchange rate is an important concept since it represents the price competitiveness of UK production relative to foreign production. It is defined as the level of the nominal exchange rate adjusted for relative price levels at home and abroad. In practice, this adjustment can be done in a number of different ways and there are several different measures of the real exchange rate (see Box 1.1).

1.8 The analysis presented in this study helps to provide an explanation of why the real exchange rate may depart from the equilibrium level in the short to medium run. The implications of this for the possible exchange rate for entry to EMU are considered further in the EMU study Modelling the transition to EMU. All these studies inform HM Treasury’s assessment of the convergence test – the first of the five economic tests for EMU entry.

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3 Internal balance is defined as the level of output consistent with maintaining inflation at target. External balance is a sustainable external current account balance.
The study is structured as follows:

- Section 2 of the study considers how the exchange rate is determined;
- Section 3 considers the role of the exchange rate in the adjustment process, and also the question as to whether nominal exchange rate flexibility provides an additional source of shocks to the economy;
- Section 4 examines the empirical evidence on the role of the exchange rate;
- Section 5 provides an interpretation of sterling's strength against the euro since 1996;
- Section 6 looks at how the overall volatility of the exchange rate might compare inside and outside of EMU;
- Section 7 sets out the study's conclusions on the role of the exchange rate;
- Annex A presents the results of a new structural vector autoregression (SVAR) model of the UK economy; and
- Annex B examines the weightings used to construct the UK ERI.

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**Box 1.1: Nominal, real and effective exchange rates**

A number of different exchange rate concepts are used in this study.

**Nominal exchange rates** are the rates that are determined in the currency markets. They simply represent the price of one currency in terms of another.

**Real exchange rates** adjust the nominal exchange rate to take account of cross-country differences in price levels. By using different measures of prices, different real exchange rate measures can be derived. There are two main approaches:

- the first approach is relevant for assessing the extent to which nominal exchange rate movements affect the price competitiveness of its exports. If country A has a higher inflation rate than country B, then its products will lose price competitiveness unless there is an offsetting depreciation of its nominal exchange rate. Real exchange rate measures based on price measures such as relative export prices or relative unit labour costs show whether a nominal exchange rate change has changed a country’s price competitiveness or merely served to offset the effect of difference in inflation rates; or
- alternatively, measures based on relative consumer prices provide an indication of how nominal exchange rate changes have affected consumers’ purchasing power. Such measures include the prices of goods and services that are not traded across borders.

**Effective (or trade-weighted) exchange rate indices** are a weighted average of bilateral exchange rates. For example, if sterling appreciated against the euro but depreciated against the dollar, the effective exchange rate provides a measure of whether these movements cancel each other out or not. The weights in an effective exchange rate generally reflect the relative importance of different foreign currencies for the home country’s trade. Effective exchange rate indices can be constructed either as a weighted average of nominal bilateral exchange rates or real bilateral exchange rates.
At any point in time, the exchange rate is determined in the currency markets, as the price which clears the supply of and demand for currencies. The aggregate supply and demand for currency is generated by different types of transaction: trade in goods and services, investment income flows and asset market transactions.

The uncovered interest parity (UIP) condition states that the interest rate differential between two currencies must be equal to the expected change in the exchange rate between those currencies. This suggests that interest rate differentials provide some information about expected short-term movements in the exchange rate, and also that the current exchange rate should be determined in large part by expectations of its future value. But it provides no information about what influences these expectations.

Purchasing power parity (PPP) provides a long run explanation of exchange rate levels. It states that the exchange rate moves to equate the price of goods across countries. However, there are several reasons, both theoretical and empirical, why PPP may not hold over shorter time horizons.

Macroeconomic models note that the exchange rate must move to balance the external balance of payments and that this will entail balancing current account flows with financial account flows. This balancing will determine the level of the exchange rate.

To the extent that misalignments in relation to the medium-term level assist the short run adjustment process, they may not be undesirable. But large and persistent deviations from medium-term levels may be of greater concern, since they may affect the equilibrium to which the economy eventually returns.

Over the short term, no structural model of the exchange rate provides better forecasts of future exchange rates than simple models which predict the exchange rate will be unchanged from current levels. This has sparked research into characteristics of foreign exchange markets that may explain why the exchange rate moves independently of fundamentals over the short run.

2.1 This section contains a brief review of models of exchange rate determination, emphasising the role of product market and asset market demands in influencing the overall supply of and demand for different currencies. The section also examines the unpredictability of short-term movements in the exchange rate and considers how this is related to the efficient markets principle.

2.2 At any point in time, the exchange rate moves to clear the supply of, and demand for, currencies. For analytical purposes, it is helpful to distinguish between the demand for foreign currency associated with product market flows and the demand associated with asset market flows. By focusing on each of these in turn, economic theory has developed plausible models of the factors that determine exchange rates in the short, medium and long term.

2.3 For the purposes of this study, the short term simply reflects the existing state of the economy; the medium term reflects expectations as to how the economy will evolve, as the economy adjusts to bring aggregate supply and demand into balance, and the long term reflects the further evolution of the economy in response to slower moving trends, such as changes in demographic structure. By combining these theories, it is possible to provide a coherent view of exchange rate determination. However, as is explained below, that does not make exchange rates predictable, particularly over short horizons.

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1 The EMU study by HM Treasury The five tests framework considers various different definitions of the short, medium and long run, and their relevance to analysis of EMU.
2.4 Financial asset holders aim to maximise their return from holding either domestic or overseas assets. The return from holding overseas assets depends on both the nominal return from these assets, in foreign currency terms, and the expected capital gain from movements in the exchange rate. In perfect capital markets and abstracting from risk, this leads to the uncovered interest parity condition (UIP), which states that the interest rate differential between two currencies (comparing domestic and foreign assets that have the same characteristics apart from their currency of denomination) must be equal to the expected change in the exchange rate between those currencies. Hence if interest rates were one percentage point higher in the UK than in the euro area, the expected return on holding sterling and euro area assets would only be equal if investors expected sterling to depreciate by one per cent over the following 12 months.

2.5 This relationship suggests that interest rate differentials should determine the path that the exchange rate is expected to take in the future. But it also highlights that the expected future value of the exchange rate is an important influence. This determines not only the eventual level of the exchange rate, but also, when combined with the expected paths of domestic and foreign interest rates, the current level of the exchange rate. Hence the UIP condition needs to be combined with theories that consider medium and long-term influences on the exchange rate, with the UIP relation helping to explain the path by which the exchange rate is expected to adjust to its long term level.

2.6 Purchasing power parity (PPP) provides a long run explanation of exchange rate levels. It states that the exchange rate moves to equate the price of goods across countries. Suppose there was just one, uniformly traded, good and transport costs were zero. If this good could be bought more cheaply overseas than in the UK, everyone would buy the good overseas. The demand for sterling would fall, leading to a depreciation, which would continue until the two goods had the same sterling price.

2.7 There are several reasons, both theoretical and empirical, why PPP may not hold. The extent to which purchasing power parity holds depends on how easy it is to engage in arbitrage when price differentials exist. This varies considerably depending on the characteristics of individual goods and services. Many financial instruments can be arbitrated readily and at low cost, while arbitraging of goods and services may be slow and costly. This may be a result of the time and cost required to set up distribution networks. Arbitrage opportunities may also be affected by transport costs, regulations and currency risk. For a more detailed discussion see the EMU study by HM Treasury *Prices and EMU*.

2.8 PPP, in terms of consumer prices, would also break down if consumers’ preferences differed between countries (so they bought a different basket of goods). For goods that are traded, barriers to trade will also lead to a ‘home bias’ in consumption, causing an effect similar to that arising from different preferences. In addition, if producers of any type of good have market power, then this will enable them to price to market (see Section 3), so the mark-up on costs becomes specific to the destination where the goods are sold. A fuller account of the theory of PPP can be found in the EMU study by Professor Simon Wren-Lewis *Estimates of equilibrium exchange rates for sterling against the euro*.

2.9 Macroeconomic balance models highlight the fact the exchange rate must move to balance the external balance of payments. This will entail balancing current account flows with financial account flows.
2.10 The EMU study by Professor Simon Wren-Lewis *Estimates of equilibrium exchange rates for sterling against the euro* uses a medium-term version of this approach. It considers the exchange rate consistent with internal and external balance, where internal balance is defined as the level of output consistent with maintaining inflation at target, and external balance as a sustainable external current account balance. These additional conditions may not be satisfied in the short run, when the economy is in the process of adjusting to a supply or demand shock, but they need to be satisfied once the adjustment processes are complete.

Exchange rate misalignments

2.11 Deviations of the exchange rate from its medium to long run levels are often viewed as misalignments or evidence of over or under valuation. Such descriptions need to be interpreted with care. In particular, it is important to recognise that deviations of the exchange rate from its medium or long-term level may be an important part of the process that restores equilibrium following a shock, just as fluctuations of the real interest rate around its long-run level can help to bring the economy back to balance. To the extent that misalignments in relation to the medium term level assist the short-run adjustment process, they may not be undesirable (see Section 5). But large and persistent deviations from medium-term levels may be of greater concern, since they may affect the equilibrium to which the economy eventually returns.

Exchange rate predictability...

2.12 Although the models discussed above provide valuable insights into exchange rate determination, they are only of limited use in making short-term predictions of future exchange rate movements. In practice, exchange rates have exhibited much greater volatility over short-term horizons than these models would suggest. Analysis presented in Section 6 shows that the sterling-euro exchange rate has typically fluctuated by 1.3 per cent around its average value over a 60 day period, and the US dollar-euro exchange rate by 2 per cent (Table 6.1). It should be noted that these are average values, and in some periods the fluctuation has been much greater, and in other periods much less.

2.13 Meese and Rogoff (1983) found that no structural model of the exchange rate, including variants of all the models described above, could provide better forecasts of future exchange rates than a simple ‘random walk’ model that predicts that the exchange rate will be unchanged from its existing level. Subsequent research suggests that the explanatory power of structural models is superior over the long run, which is consistent with the idea that, for example, PPP holds over the long run. And some researchers are now optimistic about the forecasting ability of short and medium-run models. Nonetheless, the conclusion that, over short-run time horizons, the current level of the exchange rate is as good a predictor of future exchange rates as other models is generally accepted.

... and the role of the market

2.14 The efficient markets hypothesis provides an explanation of why exchange rate changes are difficult to predict. Markets are considered to be efficient if prices incorporate all publicly available information, including expectations of future policies. If the price of an asset were generally expected to rise tomorrow, traders, anticipating this, would buy the asset today. This would drive the price of the asset up until the total expected return was the same. If the markets were not efficient, the possibility of making arbitrage profits would exist, and traders could consistently make quick speculative gains. In efficient markets, the possibility of making speculative gains still exists but, provided that the individual trader does not have privileged information that is unavailable to the market as a whole, any speculative position is as likely to yield losses as gains.

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2 The EMU study *Modelling shocks and adjustment mechanisms in EMU* examines in detail the role that the exchange rate plays in facilitating this adjustment.

2.15 If this is the case, then movements in the exchange rate away from the expected path given by UIP should be driven by unanticipated developments (including economic shocks). These should be equally likely to cause the exchange rate to appreciate as to depreciate. Empirical evidence suggests that the effect of such unpredictable information will tend to dominate the short-term predictability arising from the UIP condition.*

Alternative explanations

2.16 The weak relationship between the actual exchange rate and longer-term determinants has sparked research into characteristics of the foreign exchange market that might cause the exchange rate to move independently of economic fundamentals. This includes how the positions taken by foreign exchange traders and by investors operating on technical analysis might influence outcomes. This research indicates that while such behaviour may influence day-to-day movements, it typically has limited effects over longer horizons when flows associated with fundamental factors are more dominant (Box 2.1). However, such strategies may be influential when there is increased uncertainty about whether existing levels are sustainable or not.

**Box 2.1: Effect of trading strategies on the exchange rate.**

One strand of research on exchange rate determination analyses how trading strategies may affect exchange rate levels by examining the microstructure of the foreign exchange market (for example see Lyons, 1993). This approach is made more difficult because foreign exchange traders deal bilaterally, rather than through a central exchange like a stock market. This means that transactions have generally not been observable, though this condition is now changing as more trading takes place through electronic market places. This research suggests that traders in the foreign exchange market operate at very short-term horizons, and the average holding period for foreign exchange transactions is found to be short, i.e. less than one day. Surveys of market players suggest that, over the short-term, non-fundamental factors dominate trading, but that over the long run traders believe fundamental economic factors are important (Cheung et al., 2000).

Another line of research has focused on whether expectations are stabilising or destabilising. An example of the latter case is the ‘bandwagon’ effect, where, for example, an exchange rate appreciation leads to expectations of a further appreciation. Empirical research suggests different types of expectations operating over different time periods. Over the short term, expectations can be shown to be destabilising, with traders extrapolating current currency movements. But over the longer-term expectations can be shown to be stabilising, consistent with the idea that over the long run fundamentals anchor the exchange rate (Frankel and Froot 1987, 1990; Ito 1994).

Research has also considered the influence of technical analysts, such as ‘chartists’, who advise traders on the basis of historical patterns in prices. Surveys by Allen and Taylor (1989) find that the advice of such analysts is used widely in the markets. An implication is that the foreign exchange market is far from the homogeneous entity implied in most of the theoretical models. Rather it is made up of diverse groups of agents who interpret the same information in different ways. Goodhart (1988) and Frankel and Froot (1990) devise models where chartists operate alongside ‘fundamentalists’. These models show that exchange rate movements may be influenced by chartists for a period but that fundamentals eventually reassert themselves.

*Some recent research, for example Taylor et al. (2001) suggests that the real exchange rate may revert to equilibrium (in this case given by PPP) more quickly than previously thought, and that the rate of reversion is non linear, i.e. it is faster the further away the actual rate is from equilibrium. A possible explanation for this is that transaction costs create a real exchange rate band, inside which PPP will not hold because the marginal cost of arbitrage exceeds the marginal benefits. However, outside the band arbitrage opportunities increase rapidly, so the pressures for the real exchange rate to return to equilibrium are much greater.
3 Macroeconomic Adjustment Under Fixed and Floating Exchange Rates

Under both floating and fixed nominal exchange rate regimes, the real exchange rate provides one of the adjustment mechanisms that balances aggregate demand and aggregate supply in the medium and long run.

When nominal exchange rates are fixed, all of the adjustment in real exchange rates is brought about by differential movements in domestic and foreign price levels.

When nominal exchange rates are flexible, part or all of any real exchange rate adjustment may be achieved through adjustment of nominal exchange rates.

Even though the pass-through from exchange rate changes into consumer prices is slow in the UK, the pass-through into the domestic prices of intermediate goods and import prices is relatively rapid. This provides a channel through which exchange rate changes affect purchasing, supply and investment decisions.

The foreign exchange market is dominated by asset market flows. Some have argued that this makes flexible exchange rates an additional source of shocks to the economy.

But asset market flows are likely to reflect the strength or weakness of economic activity in different countries. Asset inflows into strong economies will tend to contribute to an exchange rate appreciation, and outflows from weak economies to contribute to an exchange rate depreciation. Hence it is likely that exchange rate movements generated by asset market flows will, on average, tend to assist macroeconomic adjustment.

3.1 This section reviews how nominal exchange rate changes impact on the wider economy, with a particular focus on whether or not the exchange rate moves to stabilise the economy when there is an imbalance between aggregate supply and aggregate demand:

- the starting point is a review of optimal currency area (OCA) theory which investigates the conditions under which nominal exchange rate flexibility may enable an economy to adjust to macroeconomic imbalances more efficiently than fixed exchange rates;

- the second subsection considers how flexible exchange rates may promote macroeconomic adjustment, comparing this with how real exchange rate adjustment is achieved when nominal exchange rates are fixed;

- the third subsection considers how the pass-through from exchange rates into domestic prices may affect the extent to which exchange rate movements promote macroeconomic adjustment; and

- the final subsection considers contexts in which exchange rate flexibility fails to promote macroeconomic adjustment, and the argument that exchange rate flexibility more often destabilises than stabilises the economy, notably when volatile asset market flows dominate exchange rate movements.

Optimal currency areas

3.2 Economists have long debated the merits of fixed versus flexible exchange rates. One of the central themes of this debate has been whether flexible exchange rates provide a mechanism that allows economies to make adjustments to economic change and disturbances, or whether the exchange rate is itself a source of volatility to the economy. This
MACROECONOMIC ADJUSTMENT UNDER FIXED AND FLOATING EXCHANGE RATES

debate led to the theory of optimal currency areas, first set out by Mundell in 1961, which addresses the issue of how best to choose which geographical areas should share a single currency.¹

3.3 OCA theory suggests that the balance of advantages and disadvantages between fixed and floating exchange rates varies according to the manner and extent of economic integration between countries. It identifies those features that tend to favour countries maintaining fixed exchange rates and those that tend to favour flexible exchange rates. Flexible exchange rates would be preferred where they enhance the ability of the economy to absorb economic shocks. Fixed exchange rates would be preferred where their benefits outweigh the additional cost of achieving macroeconomic adjustment via other mechanisms, such as relative wage and price movement and/or factor mobility.

3.4 OCA theory assumes that factors of production, such as labour and capital, are mobile internally but immobile externally. For example, it is assumed that labour moves between regions of an OCA, but does not move significantly into or out of the OCA. OCA theory also assumes that there is limited price and wage flexibility in the economy. With limited price and wage flexibility, it is the internal mobility of factors of production which allows the OCA's economy to adjust smoothly to an internal asymmetric shock. For example, if demand for a good produced in a sub-region of the OCA falls, mobility of labour prevents unemployment from occurring in the sub-region.

3.5 Because it is assumed that factors are not as mobile externally, this adjustment mechanism cannot stabilise the economy following a shock with asymmetric effects on the domestic and foreign economies. Instead, and in the absence of price and wage flexibility, stabilisation is achieved by adjustment of the nominal exchange rate, which brings about the necessary adjustment of the real exchange rate to restore balance of payments equilibrium. An OCA hit by a shock that decreases demand for its exports would undergo a nominal exchange rate depreciation, as decreased foreign demand for exports drives down the price of domestic currency. This depreciation will decrease the price of exports and so increase foreign demand, countering the impact of the shock without causing domestic unemployment. Conversely, a positive demand shock will lead to a nominal exchange rate appreciation rather than cause domestic inflation.

3.6 In each case, nominal exchange rate flexibility has smoothed the effects of a shock; preventing inflation in the case of the positive demand shock, and unemployment in the case of the negative demand shock. The flexible exchange rate has in effect allowed real wages to adjust quickly to a disturbance; this adjustment could not easily take place directly through wages and prices, due to their limited flexibility.

3.7 The subsequent development of OCA theory has deepened the analysis of the conditions that determine whether the exchange rate is an efficient stabilising mechanism. Various authors have argued that other conditions may affect the OCA criteria, including the extent of trade integration, fiscal integration and whether an economy's production structure is concentrated in a few industries or is diversified across industries. Mundell (1973) noted that a common currency could enable different regions to share risks more efficiently.

Conclusions on OCA theory

3.8 Although these extensions provide for a richer analysis, they do not alter the two main insights from optimal currency area theory, namely:

¹The EMU study by HM Treasury The five tests framework has a detailed discussion of the theory of optimal currency areas. McKinnon (1963) and Kenen (1969) made important early contributions to this literature. McKinnon (2002) and the contributions of Robert Mundell, Peter Kenen and George Tavlas to the EMU study Submissions on EMU from leading academics consider how OCA theory applies to EMU.
the ease with which labour and capital can flow between different activities in response to changing patterns of supply and demand will determine how well an economy can respond to economic shocks; and

that, under certain conditions, for example in the absence of wage and price flexibility, exchange rate flexibility may be a useful way of aiding macroeconomic adjustment.

**The exchange rate as a stabilising mechanism**

3.9 This section considers the role of real exchange rate adjustment in stabilising the economy under both fixed and floating exchange rate regimes.

3.10 Box 1.1 in Section 1 explains that the real exchange rate is defined as the level of the nominal exchange rate adjusted for relative price levels at home and abroad. When nominal exchange rates are fixed, all of the adjustment in real exchange rates must be brought about by differential movements in the domestic and foreign price levels. But when nominal exchange rates are flexible, part or all of any real exchange adjustment may be achieved through adjustment of nominal exchange rates.

3.11 The real exchange rate is an important concept, since it represents a country’s terms of trade – the relative price of domestic and foreign production. Movements in the real exchange rate can therefore influence the balance of supply and demand between domestic and foreign goods and services. In doing so, real exchange rate adjustment can help to eliminate macroeconomic imbalances and stabilise the economy.

3.12 At a macroeconomic level, unexpected economic events, or ‘shocks’, affect the balance between aggregate demand and aggregate supply. By definition, they will mean that an economy that was previously in internal and external balance will no longer be so. This section describes the impact of macroeconomic imbalances on the real exchange rate, and how, in principle, movements in the real exchange rate can act to eliminate the initial imbalances, and hence to stabilise the economy.

3.13 When exchange rates are fixed, and there is a situation where there is excess demand for domestic production, then upward pressures on the domestic price level will cause the real exchange rate to appreciate. This will encourage a switching of demand towards foreign suppliers, and a switching of supply towards domestic markets. Both effects reduce, and eventually eliminate, the initial excess demand. A similar argument can be used to demonstrate that a real exchange rate depreciation, brought about by falling relative price levels, will eliminate excess supply. If wages and prices are slow to adjust, this could lead to prolonged periods of real exchange rate misalignment. This may be particularly so if the requisite shift in relative prices should require a cut in nominal wage levels domestically, an outcome that is more likely in a low inflation environment.²

3.14 In other words, when nominal exchange rates are fixed, any adjustment in the real exchange rate that may be needed to maintain or restore macroeconomic balance can only come about through differential movements in inflation. That means that if the UK were in EMU, then UK inflation would tend to be higher or lower than the euro area average if a real exchange rate appreciation or depreciation were needed. Such changes have already occurred within the existing euro area, where inflation in the Netherlands and Ireland has been relatively strong and inflation in Germany relatively weak (see Box 3.1).

²The possibility that it may be more difficult to achieve a real depreciation than a real appreciation within EMU is considered further in the EMU study by Professor Simon Wren-Lewis Estimates of equilibrium exchange rates for sterling against the euro. The issue of wage flexibility is reviewed in the EMU study EMU and labour market flexibility.
3.15 However, other adjustment mechanisms are also available. The EMU study *Modelling shocks and adjustment mechanisms in EMU* examines alternative mechanisms that can reduce the required response of the real exchange rate to external shocks when the nominal rate is fixed. The study also further examines how the UK economy would respond to shocks in EMU compared to outside.

3.16 Similar adjustment processes operate in a floating exchange rate regime. But in this case, movements in the nominal exchange rate provide an alternative route for achieving the required real exchange rate adjustment. Some, or indeed all, of the required real exchange rate adjustment may be achieved by an appropriate change in the nominal exchange rate, so that the required adjustment in domestic and foreign price levels will tend to be smaller.

3.17 A particular case to note is where both the home and foreign economies are following identical inflation targets. Under these conditions both monetary authorities will tend to adjust their respective policies to ensure that they meet their targets, with the result that the real exchange rate adjustment will be predominantly achieved through the nominal exchange rate. By contrast, in a monetary union, when a country experiences a shock that requires its real exchange rate with respect to other countries in the union to change, this can only be achieved by a period in which its inflation rate is temporarily above or below inflation in the rest of the monetary union.

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### Box 3.1: Inflation divergence within the euro area

The experiences of the Netherlands, Ireland and Germany illustrate the point that national inflation rates may be different within EMU, depending on whether demand is relatively weak or relatively strong.

Between 1999 and 2002 euro area inflation averaged 2 per cent a year. But inflation in Ireland averaged 4.1 per cent a year and in the Netherlands 3.3 per cent a year. In both cases these figures were boosted by tax changes, but even allowing for this, their inflation rates remained higher than in other euro area countries. This reflected strong demand growth and tight labour markets. By contrast, relatively weak demand growth and high unemployment has contributed to lower inflation in Germany, averaging 1.4 per cent a year.

#### Average inflation rates since 1999

<table>
<thead>
<tr>
<th></th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>0.6</td>
<td>1.5</td>
<td>2.1</td>
<td>1.3</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>2.0</td>
<td>2.3</td>
<td>5.1</td>
<td>3.9</td>
</tr>
<tr>
<td>Ireland</td>
<td>2.5</td>
<td>5.3</td>
<td>4.0</td>
<td>4.7</td>
</tr>
<tr>
<td>Euro area</td>
<td>1.1</td>
<td>2.1</td>
<td>2.4</td>
<td>2.2</td>
</tr>
</tbody>
</table>

These developments have been recognised as providing each economy with appropriate real exchange rate changes. For example, Blanchard (2001) argues that inflation had a clear role to play in alleviating excess demand in Ireland and warns against ‘demonising’ inflation differentials in EMU. The OECD (2002) concluded that inflation had played an important role in eroding the overly competitive position of the Netherlands in relation to other euro area countries. Similarly, the European Commission (2001) note that “domestic inflation may well be a desirable part of an adjustment process in a monetary union. If external demand is the main source of overheating, inflation is the natural instrument to return to equilibrium”.

---

**Adjustment in a floating exchange rate regime**
The preceding analysis implies a country’s real exchange rate will ultimately reflect underlying economic conditions, irrespective of whether nominal exchange rates are fixed or floating. But the adjustment mechanism is different, with adjustment in the domestic price level being greater under a fixed exchange rate regime. Under flexible exchange rates, the movement in the nominal exchange rate can cushion some of the impact on the domestic price level, and consequently may act as a shock absorber.

Exchange rate changes and domestic prices

For a flexible nominal exchange rate to act as an effective stabilisation mechanism, nominal exchange rate changes must ‘pass-through’ into changes in the domestic price level. Pass-through is defined as a relationship between the nominal exchange rate and the domestic price level. If a flexible nominal exchange rate is to operate as an adjustment mechanism, a nominal depreciation must raise the consumer price of imported goods relative to domestic goods, thereby encouraging consumers to buy domestic rather than foreign goods. But some evidence suggests that nominal exchange rate movements are not fully passed through to consumer prices. This limits the impact on relative prices experienced by consumers, which determines whether they opt to buy domestic or foreign goods.

The effect of an exchange rate change on relative prices experienced by domestic consumers will depend on the pricing strategy of exporting firms:

- the effect is greatest when exporters set prices in domestic currency and then translate this price into foreign currency at the prevailing exchange rate (known as producer currency pricing – PCP); or
- an alternative is that an exporting firm keeps its price fixed in foreign currency and accepts the resulting domestic price at the prevailing exchange rate (this is local currency pricing – LCP). In this case, a nominal exchange rate appreciation reduces the exporter’s profit margin, but may not affect the consumer price or the quantity sold in the importing country.

Exporting firms may use LCP in order to maintain price stability for their consumers. This may occur when firms trading overseas operate in markets dominated by domestically produced goods, and so ‘price to market’. Krugman (1989) argues that if there are high sunk costs to trading, for example in setting up trading infrastructure and establishing relationships, then exchange rate fluctuations, within a certain range, are unlikely to cause a firm to exit the market. Rather, firms may remain in the market in the expectation that the exchange rate movement will be temporary. He observes that the large nominal appreciation and then depreciation of the US dollar in the mid 1980s did not have as big an impact on US manufacturing exports and production as might have been expected. He attributes this in large part to the presence of ‘price to market’ strategies.

A firm’s pricing strategy may also depend on the price elasticity for its goods and on the structure of costs:

- if demand is price inelastic, the firm may prefer to pass-through a domestic currency rate appreciation to the foreign currency price, as the quantity sold will not fall significantly;
- if demand is price elastic, the firm may prefer to keep the foreign price fixed to maintain output levels; and
• similar, if the firm has increasing returns to scale or high fixed costs, it may prefer to keep foreign price levels stable in the face of an appreciation in order to maintain output levels, but there may be some resultant cost to profit margins that will make it cease to export at all.

3.23 Another explanation for the weak pass-through of exchange rate changes to consumer prices is that for many goods, the production cost of the good is only a small part of the final price paid by the consumer. Other costs such as retail, transport, marketing costs may be little affected by exchange rate changes.

Exchange rate adjustment with LCP

3.24 For goods and services where local currency pricing is strong, adjustment to exchange rate changes may be primarily driven by the way that firms react to changes in their profit margins. For example, exporters may decide that margins are too low to continue trading, or low margins may deter other firms from entering the export market.

3.25 In addition, if imports are intermediate goods then the effect of exchange rate changes on firms' input costs may be much greater than the effect on consumer prices. If this is the case, expenditure switching behaviour by firms rather than consumers allows exchange rates to have an adjustment role. For example, importing companies may switch between domestic and foreign suppliers in the face of exchange rate changes. Equally, firms that have production facilities in a number of overseas locations may switch the source of imports in the face of exchange rate changes. In each case, consumer prices may not change after an exchange rate change, but there will have been a change in the demand for foreign and domestic goods.

Empirical evidence on pass-through

3.26 Empirical studies offer evidence in support of the argument that there is not a strong pass-through from exchange rate changes to consumer prices, but that there is at least partial pass-through to import prices:

• McCarthy (2000) looks at surveys of pass-through from exchange rate to domestic inflation, reporting several studies that have found this effect to be comparatively weak. The author then analyses pass-through to domestic inflation for several industrialised countries and finds evidence of only a modest pass-through of the exchange rate to consumer prices — including in the UK, Germany and France — over the 1980s and 1990s. Debelle and Wilkinson (2002) find that pass-through to inflation is also muted, and that in the case of Australia it has become more muted over the past two decades. However, for the UK the relationship has been fairly constant; and

• Goldberg and Knetter (1996) review the empirical evidence on pass-through from nominal exchange rate changes to import prices. They conclude: “although there is substantial variation across industries, in many cases half or more of the effect of an exchange rate change is offset by destination specific adjustments of mark-ups over costs” (Goldberg and Knetter 1996, page 37).

3.27 Tables 3.1 and 3.2 reproduce analysis by Kara and Nelson, which presents correlations between nominal UK exchange rates and UK import and consumer prices. Table 3.1 shows a weak relationship between the nominal exchange rate and UK retail price inflation, both over the period since 1958 and in a sub-sample since 1980. The results hold even after controlling for the impact of large tax changes on the retail price index. However, there is found to be a stronger relationship between UK import prices and the nominal exchange rate (Table 3.2).

1 See, for example, Obstfeld (2002).
Table 3.1: Correlations between UK retail price inflation and the nominal effective exchange rate

<table>
<thead>
<tr>
<th>Period</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1958 Q4 – 2002 Q2</td>
<td>0.103</td>
</tr>
<tr>
<td>1958 Q4 – 2002 Q2, controlling for 1979 and 1990 tax changes</td>
<td>0.153*</td>
</tr>
<tr>
<td>1958 Q4 – 1979 Q2</td>
<td>0.289*</td>
</tr>
<tr>
<td>1980 Q1 – 2002 Q2</td>
<td>–0.073</td>
</tr>
<tr>
<td>1980 Q1 – 2002 Q2, controlling for 1990 tax changes</td>
<td>–0.071</td>
</tr>
</tbody>
</table>

*Statistically different from zero at 0.05 significance level.

Table 3.2: Correlations between UK import price inflation and the nominal effective exchange rate

<table>
<thead>
<tr>
<th>Period</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1958 Q4 – 2002 Q1</td>
<td>0.499*</td>
</tr>
<tr>
<td>1958 Q4 – 1979 Q2</td>
<td>0.478*</td>
</tr>
<tr>
<td>1980 Q1 – 2002 Q1</td>
<td>0.575*</td>
</tr>
</tbody>
</table>

*Statistically different from zero at 0.05 significance level.

3.28 Campa and Goldberg (2002) examine the degree of pass-through from exchange rates into import prices across 25 OECD countries. Their main findings are:

- there is strong evidence of partial pass-through in the short run — average pass-through across countries is around 60 per cent after three months and around 75 per cent over the longer run;
- UK pass-through is found to be lower than the average at 39 per cent in the short run and 47 per cent in the long run; and
- there is a trend toward lower pass-through over time, which can mainly be attributed to changes in the composition of imports toward manufactured goods as intra-industry trade has increased.

3.29 Taylor (2000) argues that there may be lower pass-through in low inflation countries, as overseas producers are unlikely to raise prices if they expect relative price stability in domestic prices. If firms are less willing to increase prices where inflation is low and stable, then if EMU is a low inflation environment this may lead to convergence in the degree of pass-through in participating countries. Campa and Goldberg (2002) find some evidence to support Taylor’s hypothesis, though the relationship is found to be weak.

3.30 The substantial empirical evidence on the limited pass-through of nominal exchange rate movements has recently led to the development of theoretical models of ‘exchange rate disconnect’. In these models the presence of LCP alongside some additional assumptions means that the nominal exchange rate becomes entirely ‘disconnected’ from the real economy; movements in the nominal exchange rate do not affect the underlying situation of the real economy. This is because low rates of pass-through mean that there is little response of consumer and producer behaviour to nominal exchange rate movements. In this scenario, a flexible nominal exchange rate is unable to provide the equilibrating real exchange rate adjustment anticipated in the earlier analysis.

Exchange rate ‘disconnect’

3.30 The substantial empirical evidence on the limited pass-through of nominal exchange rate movements has recently led to the development of theoretical models of ‘exchange rate disconnect’. In these models the presence of LCP alongside some additional assumptions means that the nominal exchange rate becomes entirely ‘disconnected’ from the real economy: movements in the nominal exchange rate do not affect the underlying situation of the real economy. This is because low rates of pass-through mean that there is little response of consumer and producer behaviour to nominal exchange rate movements. In this scenario, a flexible nominal exchange rate is unable to provide the equilibrating real exchange rate adjustment anticipated in the earlier analysis.

*See, for example, Devereux and Engel (2002).
Overall, pricing to market effects show that the stabilising role of the nominal exchange rate is unlikely to be as straightforward as predicted in simple models. But the evidence suggests that nominal exchange rates can influence the price of domestic production relative to foreign production. Studies show that pass-through to domestic inflation is not complete, but that there is significant pass-through to import prices. Firm level adjustment to import price changes may then provide the necessary economic adjustments. Even assuming full LCP, firms may adjust trade in the face of movements in profit margins.

The effect of the existence of pricing to market is to modify rather than eliminate the role of flexible exchange rates in the adjustment mechanism. It suggests that the stabilising role of flexible rates may operate more gradually and through different channels than simple theory predicts. But this does not necessarily imply that the additional adjustment mechanism available under flexible rates can be relinquished costlessly to a system of fixed exchange rates.

Circumstances where nominal exchange rates do not stabilise the economy

Optimal currency area theory highlights the circumstances in which flexible nominal exchange rates can play an important role in aiding adjustment. However, these particular circumstances may often not apply. For example, Buiter (1999a) sets out circumstances under which flexible exchange rates may not, in practice, serve as a useful adjustment mechanism as:

- nominal exchange rate flexibility does not provide adjustment to imbalances caused by long-term real rigidities in the economy;
- over the short and medium run the nominal exchange rate often fails to play a stabilisation role; and
- instead, in the short and medium term the exchange rate is frequently an exogenous source of shocks to the economy.

The first strand of Buiter’s critique is that nominal exchange rate flexibility does not provide a solution to problems caused by real rigidities. Such rigidities impede the required adjustment of relative prices within a currency area, whereas exchange rate changes can only change relative prices between currency areas. Real structural problems, such as excessive non-wage labour costs, rigid industrial structure and weak corporate governance cannot be addressed through the exchange rate, but only by microeconomic reform. Worse, repeated use of nominal devaluations may actually delay much needed structural reforms, as they provide countries with a short-term way of alleviating the cost of adjustment, which may appear more attractive than undertaking difficult structural reforms.

This rightly suggests that exchange rate flexibility does not provide a solution to problems that require a change in relative prices within the currency area. But this does not mean that nominal exchange rate flexibility does not provide a solution to other problems. In particular, as OCA theory highlights, exchange rate flexibility can be helpful in a context when real exchange rates need to adjust but the adjustment of domestic and/or foreign prices is sluggish. As noted earlier in this section, nominal exchange rate flexibility is the only way in which the real exchange rate can change when two authorities are independently targeting their domestic price levels.

The second part of Buiter’s critique is that, in practice, nominal exchange rates have largely failed to aid the adjustment process in the short and medium term. As already noted, nominal exchange rate flexibility is only helpful when it facilitates the real exchange rate changes needed to adjust to a particular shock. So it is useful to analyse the contexts under which this condition may fail.
3.37 The relationship between nominal and real exchange rates is influenced by the openness of the economy. In an open economy, changes in the nominal exchange rate may feed through quickly into the domestic wage and price level. For example, a nominal exchange rate depreciation will raise the price of imported goods. If these account for a high proportion of consumer purchases, and/or of inputs into non-traded goods and services, then the domestic wage and price level may rise in response. This will counteract the impact of the nominal exchange rate depreciation. This gives small, open economies less scope to use nominal exchange rate flexibility as a means of obtaining a real exchange rate devaluation.\(^5\)

3.38 The UK is a relatively open economy, with exports and imports each accounting for around 28 per cent of GDP. But the size of the non-traded sector is sufficiently large to mean that nominal exchange rate changes are not necessarily offset by changes in UK inflation and especially so when aggregate demand for UK products is weak.

3.39 The relation between nominal and real exchange rate changes varies according to context, including the pressures that are causing the exchange rate to move. If the domestic economy is already operating at full capacity, domestic prices will tend to rise in response to the extra demand created by a nominal depreciation, taking the real exchange rate back to its initial level. But if the domestic economy is operating at below full capacity, domestic prices will tend to rise by less than the initial nominal depreciation, leading to a sustained real devaluation. Indeed during the past fifteen years the UK has experienced large and persistent changes in its real exchange rate (Box 3.2).

**Box 3.2: Nominal and real exchange rate changes in the UK**

In the past fifteen years, there have been two striking episodes where the context in which a large movement in the nominal exchange rate has occurred has enabled a persistent change in the real exchange rate:

- the sharp decline in the nominal exchange rate in 1992 was not eroded by an increase in domestic inflation, since it occurred in the context of substantial excess supply in the UK market; and
- the sharp appreciation of the exchange rate in 1997 did not lead to an equivalent drop in the UK price level, since it occurred against the backdrop of strong demand for UK production.

In the first instance, recovery from the 1990-92 recession would probably have been much more subdued, and may have been delayed, if sterling had not depreciated. And in the second instance, inflationary pressures would probably have been much stronger had sterling not appreciated. The historical evidence on the link between the exchange rates and macroeconomic conditions in the UK is considered further in Section 4. Section 5 contains a more detailed appraisal of sterling’s appreciation in 1997.

**The exchange rate as a source of shocks**

3.40 The third part of Buiter’s critique is that the exchange rate is determined primarily by developments in the international capital market. While these flows may take the exchange rate in the same direction as required to achieve product market equilibrium, they do not necessarily do so. In his view, capital market developments subject the nominal exchange rate to large and persistent changes that may have little relation to imbalances in product markets. This reduces the effectiveness of a flexible exchange rate as a stabilising mechanism.

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\(^5\)This issue is addressed in Mundell (1961), which acknowledges that the size of an economy puts a lower limit on the size of an OCA. Mundell notes that a smaller economy is likely to have a higher proportion of imports in total consumption, and so more likely to see wages rise in response to a nominal exchange rate depreciation.
Indeed, in some circumstances capital market developments may lead to an exchange rate change that exacerbates rather than reduces imbalances in product markets.

3.41 In a currency union, the way in which asset market demands are transmitted is different. Those asset market flows that are motivated by the desire to either hedge currency risk, or to exploit the chance that the nominal exchange rate may change, no longer exist. However, even in the absence of floating exchange rates there is still the possibility that country specific risk premia\(^6\) may emerge in asset prices. But since cross-border demands for both financial and real assets will no longer be transmitted through the currency markets, they will impact directly on individual asset market prices. As they will no longer affect exchange rates within the monetary union, the spillover to price signals in product markets will no longer exist.

3.42 The argument that asset market flows may lead to exchange rate changes that are inconsistent with product market equilibrium is potentially a valid one. But it does not necessarily follow that asset market flows are, in practice, destabilising. Asset market flows are determined by investors’ wish to create and maintain portfolios that adequately balance risk and return. While investors are far from omniscient, they are not, as a group, wilfully irrational.\(^7\)

3.43 Investor rationality implies that asset markets should not misprice the exchange rate consistently, nor indeed any other asset price. Cross-currency asset flows are determined by investors’ evaluations of the relative value of assets in each currency area. These in turn are likely to reflect the underlying strengths and weaknesses of economic activity within each currency area.

3.44 In short, asset prices, including exchange rates, are unlikely to be strong when the economy is weak, and vice-versa. This argument provides theoretical grounds for questioning whether the exchange rate is as frequently or as powerfully a source of shocks as is sometimes claimed. Section 4 considers the empirical evidence on the issue.

Conclusions

3.45 Under both fixed and floating exchange rate regimes, a real exchange rate change may be required to enable the economy to adjust to a disturbance to the balance of aggregate supply and demand. This will generally be the case when the disturbance is asymmetric across countries. Optimal currency area theory analyses the conditions in which nominal exchange rate adjustment may be a more efficient way of achieving real exchange rate adjustment than by allowing inflation rates to differ for a period.

3.46 The chief advantage of a flexible exchange rate regime is that price adjustment in the foreign exchange market reacts rapidly to changes in the supply and demand for a country’s goods, services and assets. This may be especially desirable when the alternative, under a fixed exchange rate system, would entail lower inflation than in other countries, and potentially wage cuts. However, under both regimes the real effects on the economy will be the same; real relative prices are adjusting even if it is nominal exchange rates that are facilitating the adjustment.

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\(^6\) A risk premium is the difference between the expected rate of return on an investment and the risk-free return (e.g. on a government stock) over the same period. If there were any risk element at all (e.g. in investing in a particular country), both the price of the asset and the rate of return would be higher than that if no risk is involved.

\(^7\) In other words, their investment decisions will typically have a rational base, even if subsequent developments lead to some expectations being disappointed. Actual outcomes only consistently match expected outcomes when there is certainty. In an uncertain world, actual outcomes will more often than not either exceed or disappoint expectations. When this happens, it does not necessarily mean that the initial expectations were ill-founded, since expectations need to price in all possible outcomes, including those that fail to materialise.
In theory, flexible exchange rates may not always act to stabilise the economy, and some have argued that they tend more often to be destabilising. However, asset market demands are, in general, likely to reflect the underlying strengths and weaknesses of economic activity within each currency area. Consequently they will tend to push the exchange rate up when the economy is strong and cause a depreciation when the economy is weak. Such movements should boost the stabilising properties of flexible exchange rates. The next section considers the empirical evidence relating to this question.
4.1 This section considers various methods that have been used to analyse the extent to which movements in nominal exchange rates have helped to stabilise or destabilise the economy, with particular reference to the UK.

4.2 The problem that empirical studies of this issue face is how to distinguish between warranted and unwarranted movements of the exchange rate. This turns out to be less straightforward to do than it might appear. This section first presents and reviews some descriptive analyses of exchange rate movements over the past thirty years. It then goes on to review econometric studies that use more technically sophisticated econometric techniques to consider this question.

4.3 Sterling’s nominal exchange rate has fluctuated considerably over the past thirty years. Between 1975 and 1995 it depreciated by 29 per cent against the US dollar and 59 per cent against the deutschmark, and between 1995 and 2002 it depreciated by a further 5 per cent against the US dollar but appreciated by 38 per cent against the deutschmark (Chart 4.1). These movements, and those of sterling against the UK’s other trading partners are reflected in the sterling exchange rate index (ERI). When sterling moves in a different direction against the dollar than against the euro, the exchange rate index will be less volatile than the bilateral exchange rate, as has been the case, for example, since 1999.¹ During the 1970s, nominal and real exchange rate movements were weakly correlated, as inflation outcomes in the UK differed substantially from those in other major economies. More recently, the narrowing of inflation differentials has meant that the correlation between the nominal and real exchange rate has strengthened (Chart 4.2).

¹ The ERI is an example of an effective exchange rate index (see Box 1.1). Annex B illustrates how different weighting schemes affect the volatility of such measures.
Chart 4.1: Sterling-deutschmark (sterling-euro from 1 January 1999) and sterling-US dollar bilateral exchange rates and sterling ERI


Chart 4.2: UK nominal and real effective exchange rate

Source: HM Treasury.
Exchange rate movements and the business cycle

4.4 In order to stabilise economic activity, sterling’s real exchange rate should, other things equal, appreciate when demand is stronger in the UK than in its main trading partners, and depreciate when it is weaker.

4.5 In practice, the correlation between sterling’s exchange rate and its relative demand (measured by its relative output gap\(^1\)), has been weak (Charts 4.3 and 4.4). That said, with two notable exceptions, sterling’s movements do not seem to have been particularly destabilising. Indeed, over extended periods it has moved in a direction consistent with the UK’s relative cyclical position:

- between 1981 and 1986 the UK’s relative cyclical position was weak and sterling depreciated in both nominal and real terms;
- between 1986 and 1990 the real exchange rate appreciated when the UK relative cyclical position was strong. The nominal exchange rate was broadly stable over this period, with most of the real appreciation attributable to higher inflation in the UK than in our main trading partners;
- between 1992 and 1993 the real exchange rate depreciated when the UK relative cyclical position was weak. The nominal exchange rate depreciation after sterling left the ERM was an important component of the real depreciation; and
- between 1994 and 1996 and also between 1998 and 2002 the UK cyclical position was broadly the same as in other major countries and sterling’s exchange rate remained approximately stable in both real and nominal terms.

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\(^1\) The relative output gap for the UK is its output gap (the difference between its actual and potential output) minus the weighted average output gap of the US, Germany and Japan, using GDP weights.
4.6 The two episodes where the real exchange rate change appears to have been destabilising were:

- between 1978 and 1981, when the exchange rate appreciated sharply even though the UK cyclical position was relatively weak. During this period, there were strong upward pressures from the rapid improvement in the UK’s balance of payments on oil, and from the tight monetary policy stance; and

- between 1990 and 1992, when the real exchange rate remained approximately constant despite the UK’s relatively weak cyclical position. During this period, sterling’s nominal exchange rate was constrained by participation in the ERM.

4.7 The other striking feature of this analysis is that sterling’s strong appreciation between 1996 and 1998 appears unrelated to the cyclical position. With the relative output gap close to zero between 1995 and 1998, an appreciation of this scale does not appear to have been needed to stabilise the cyclical position. But nor did the appreciation cause the cyclical position to deteriorate.

4.8 On balance, this evidence does not offer much support to the view that nominal exchange rate movements tend to be a significant source of shocks to the economy. But the extent to which nominal exchange rate movements help to stabilise the economy appears to vary over time. Nominal depreciations in the early 1980s and after 1992, and the nominal appreciation between 1996 and 1998, were key components of the respective real exchange rate adjustments, while at other times real exchange rates have tended to be driven by differences between UK and foreign inflation.

4.9 In a similar analysis of exchange rate changes and the business cycle in the main industrial economies, the IMF (1998) reached similar conclusions:

“there does appear to be a positive correlation between currency movements and the business cycle in several prominent episodes. ... At other times, however, the correlation between exchange rates and the cycle is less apparent or even negative” (page 62).
Exchange rate changes and monetary policy

4.10 Cobham (2002) argues that exchange rate changes have not generally helped to stabilise the economy. He analyses whether movements in sterling were expected or welcomed by the UK monetary authorities, and concludes:

“... the exchange rate has not generally functioned as a useful automatic equilibrating mechanism or as a useful policy instrument; ... in nearly every phase there were movements of the exchange rate, or pressures on it, which for the authorities were unexpected and unwelcome. Thus the exchange rate has typically been a source of extraneous shocks” (page 70).

4.11 Cobham’s analysis is based on deviations of the real exchange rate from its long-run average, and does not include explicit consideration of the cyclical position of the economy. For the real exchange rate to act as a stabilising mechanism, it should be expected to depart from its equilibrium level when there is either excess supply or excess demand in the economy. Departures of the exchange rate from its long run average do not necessarily equate to destabilising movements, just as departures of the interest rate from a neutral policy stance are not necessarily destabilising. Without relating exchange rate movements to the underlying cyclical position, it is not possible to reach a meaningful conclusion as to whether particular movements are acting as an equilibrating mechanism.

4.12 Neither does the observation that exchange rate movements were unexpected and unwelcome to the authorities help to resolve the question as to whether the exchange rate is a source of extraneous shocks. While consistent with the proposition that the exchange rate is a source of shocks, it is also consistent with the alternative proposition that exchange rate movements are one of the channels through which shocks to the economy are transmitted. Either way, the fact that exchange rate movements are unexpected is consistent with the efficient markets hypothesis, which implies that exchange rate movements should be unpredictable (see Section 2). The finding that the authorities do not tend to welcome exchange rate movements is consistent with their existing policy stance having already been aligned with their previous reading of economic conditions.

4.13 Hence while Cobham’s analysis provides interesting insights into the history of UK monetary policy, the evidence it provides does not prove that the exchange rate has typically been a source of extraneous shocks.
Macroeconomic volatility under different exchange rate arrangements

4.14 Flood and Rose (1999) note that a number of researchers have attempted to assess whether countries with flexible exchange rates are more vulnerable to economic shocks than countries with fixed exchange rates. They summarise these studies as follows:

“there is remarkably little evidence of a systematic relationship between the exchange rate and measurable macroeconomic phenomena...Simply put...countries with fixed exchange rates have less volatile exchange rates than floating countries, but macro-economies that are equally volatile” (page 661).

4.15 This evidence could be interpreted as showing that having a flexible exchange rate does not expose countries to additional sources of shocks. But it could also be interpreted as showing that flexible exchange rates are no better at absorbing shocks than fixed regimes.

4.16 These interpretations are not mutually exclusive, particularly if the existing configuration of exchange rate regimes broadly satisfies the optimal currency area criteria. If this is the case, then countries with fixed exchange rate regimes should be able to absorb shocks without the need for nominal exchange rate adjustment, while countries with flexible rates should find it easier to allow some adjustment through the nominal exchange rate.

Econometric identification of the source of shocks

4.17 Another way to analyse exchange rate volatility is to use econometric techniques to identify how different shocks impact on the economy. Various studies have used the technique of structural vector autoregressions (SVAR) to do this. The SVAR technique uses statistical methods to analyse the relationship between a set of variables and the shocks that impinge on them. In the analyses considered below the set of variables generally includes measures of the exchange rate, output and inflation, and in some cases, the interest rate.

4.18 A number of studies have used this technique to investigate the extent to which exchange rate movements tend to be associated with movements in other economic variables either immediately or in the longer-term:

- a finding that large exchange rate changes tend to have big effects on output and prices, and that it tends to move in an inappropriate direction, (i.e. to appreciate when the currency was weak or depreciate when it was strong), would indicate that exchange rate movements tend to be destabilising;
- a finding that large exchange rate movements tend to have big effects on output and prices, and tend to move in an appropriate direction would be consistent with exchange rate movements having a strong stabilising role; and
- a finding that large exchange rate movements tend not to be associated with movements in other economic variables would be consistent with it acting as a shock absorber. This is because a shock absorber should take the impact of forces that would otherwise have other effects.

4.19 A number of approaches have been used to analyse the relation between the exchange rate and other variables. These are described in more detail below and in Annex A, which describes a model constructed by HM Treasury. This model investigates the interaction of UK output, prices, the short-term interest rate and the real exchange rate. It uses two different approaches to identify shocks that loosely follow the approaches of Clarida and Gali (1994) and Artis and Ehrmann (2000), which are explained in Box 4.1 and Box 4.2.
4.20 Despite the differences in approach, the various studies find that large exchange rate changes are not typically associated with changes in output or the price level. This finding is most consistent with the shock absorber explanation. It suggests that exchange rate changes tend to deflect some of the impact that demand shocks might otherwise have had.

Box 4.1: Clarida and Gali’s SVAR model

Clarida and Gali (1994) used the SVAR methodology to investigate the relationship between real exchange rates, relative output and relative price levels for a number of countries, including the UK. They identified three structural shocks as follows:

- relative supply shocks comprising all shocks that had a permanent effect on the level of output in the UK relative to output in the US;
- relative demand shocks comprising all remaining shocks that had a permanent effect on the level of the real exchange rate; and
- relative nominal shocks comprising all remaining shocks.

These definitions mean that all three structural shocks can have permanent effects on relative price levels, whereas only supply and demand shocks can permanently affect the real exchange rate, and only supply shocks can permanently affect relative output levels. These restrictions only apply to permanent effects. This means that all three structural shocks may have a temporary effect on output, prices or the real exchange rate. These ‘temporary’ effects may be quite long-lasting. They are temporary in the sense that they are not permanent, rather than in the sense that they only persist for a short period.

4.21 The SVAR technique can be used to analyse the extent to which the economy responds to particular shocks. This is done by considering the contribution of each shock to the errors made in forecasting each variable. Studies of the UK exchange rate have tended to attribute a high proportion of unexpected exchange rate movements to asymmetric demand shocks (Tables 4.1 and 4.2). The exception to this is Artis and Ehrmann, who define demand shocks differently from the other studies (see Box 4.2). The HM Treasury SVAR model can replicate both findings, by defining demand shocks in a similar fashion to Clarida and Gali (HM Treasury 1) or in a similar fashion to Artis and Ehrmann (HM Treasury 2). The Treasury SVAR model is described in Box 4.3 and in more detail in Annex A.

Annex A shows that the properties of the exchange rate shock in the HM Treasury 2 breakdown and the demand shock in the HM Treasury 1 breakdown are similar, despite the difference in their labels. See Labhard and Westaway (2002) for a more detailed investigation of this finding.
Box 4.2: Artis and Ehrmann’s SVAR model

Artis and Ehrmann (2000) use the SVAR approach to identify the source of shocks and their impact on four economies – Denmark, Sweden, Canada and the UK. Each of these economies has large neighbours with whom a monetary union has been mooted at some point. Their analysis measures the effect on output in these economies of monetary policy, inflation, the exchange rate and other exogenous shocks.

Artis and Ehrmann apply the SVAR methodology differently from the Clarida-Gali approach:

- they analyse more variables (output, price level, domestic interest and foreign interest rates and the nominal exchange rate);
- they model the nominal exchange rate rather than real exchange rate;
- they model UK output and price levels independently of output and prices in other countries, whereas Clarida and Gali modelled the difference between UK and US output and the difference between UK and US prices. As a result, Artis and Ehrmann’s model captures all shocks to UK output and prices, whereas Clarida and Gali only capture shocks that have a different effect on output and prices in the UK compared with other countries; and
- they define demand shocks as being all shocks, other than supply shocks, that have an immediate impact on GDP. This differs from the Clarida and Gali definition, which identifies demand shocks as all shocks, other than supply shocks, that have a permanent effect on the real exchange rate.

These differences imply:

- that some of their ‘nominal shocks’ have permanent effects on real exchange rates – and hence would be defined as ‘demand shocks’ if Clarida and Gali’s definitions were used; and
- that their nominal shocks also include effects of German supply and demand shocks (since these do not affect UK output in the long run nor UK output immediately, but should impact on the exchange rate).a

Artis and Ehrmann’s results are strikingly different from those in the Clarida-Gali tradition. In particular, they find that exchange rate unpredictability is predominantly due to nominal shocks rather than demand shocks (Tables 4.1 and 4.2).

Artis and Ehrmann’s decomposition identifies three nominal shocks: a domestic monetary policy shock, a foreign monetary policy shock, and an exchange rate shock. The exchange rate shock accounts for all exchange rate movements that are not associated with a UK supply shock, UK demand shock or policy shocks in the UK or Germany. Artis and Ehrmann find that pure exchange rate shocks account for around three-fifths of exchange rate volatility, at both short and longer term forecast horizons.

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a See Labhard and Westaway (2002) for a detailed exposition of this point.
Table 4.1: Contribution of shocks to forecasting errors for forecasts of sterling exchange rates in three months time.

<table>
<thead>
<tr>
<th>Study</th>
<th>Supply shock</th>
<th>Demand shock</th>
<th>Nominal shock</th>
<th>Exchange rate shock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clarida and Gali</td>
<td>1</td>
<td>97</td>
<td>2</td>
<td>n.a</td>
</tr>
<tr>
<td>Astley and Garratt</td>
<td>9</td>
<td>72</td>
<td>19</td>
<td>n.a</td>
</tr>
<tr>
<td>Funke</td>
<td>19</td>
<td>70</td>
<td>11</td>
<td>n.a</td>
</tr>
<tr>
<td>HM Treasury 1</td>
<td>2</td>
<td>95</td>
<td>3</td>
<td>n.a</td>
</tr>
<tr>
<td>Artis and Ehrmann</td>
<td>3</td>
<td>6</td>
<td>30</td>
<td>61</td>
</tr>
<tr>
<td>HM Treasury 2</td>
<td>2</td>
<td>11</td>
<td>0</td>
<td>88</td>
</tr>
</tbody>
</table>

Clarida and Gali (1994) model the real exchange rate against the US dollar; Astley and Garratt (1996) model the real rate against the deutschmark; Funke (2000) models the real rate against the euro; Artis and Ehrmann (2000) model the nominal rate against the deutschmark. HM Treasury models the real exchange rate against a basket of other currencies.

4.22 In principle, the contributions of each shock could be different at longer time horizons than at short horizons. But these studies find that the shocks that contribute to errors in forecasting exchange rates at the three-month horizon remain the dominant source of errors for five year ahead forecasts (Table 4.2).

Table 4.2: Contribution of shocks to forecasting errors for forecasts of sterling exchange rates in five years time.

<table>
<thead>
<tr>
<th>Study</th>
<th>Supply shock</th>
<th>Demand shock</th>
<th>Nominal shock</th>
<th>Exchange rate shock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clarida and Gali</td>
<td>4</td>
<td>95</td>
<td>2</td>
<td>n.a</td>
</tr>
<tr>
<td>Astley and Garratt</td>
<td>17</td>
<td>81</td>
<td>1</td>
<td>n.a</td>
</tr>
<tr>
<td>Funke</td>
<td>18</td>
<td>64</td>
<td>18</td>
<td>n.a</td>
</tr>
<tr>
<td>HM Treasury 1</td>
<td>9</td>
<td>88</td>
<td>3</td>
<td>n.a</td>
</tr>
<tr>
<td>Artis and Ehrmann</td>
<td>2</td>
<td>1</td>
<td>34</td>
<td>63</td>
</tr>
<tr>
<td>HM Treasury 2</td>
<td>9</td>
<td>5</td>
<td>3</td>
<td>83</td>
</tr>
</tbody>
</table>

See Table 4.1 for details of studies. Results for Artis and Ehrmann are for six year ahead forecasts.
4.23 Most studies find that supply shocks are the main contributor to the unpredictability of output in three month ahead forecasts (Table 4.3). The HM Treasury SVAR is an exception in this respect. This may be because Clarida and Gali, Astley and Garratt and Funke all model the difference in output between the UK and other countries, whereas the HM Treasury SVAR models the level of UK output. However, Artis and Ehrmann also model the level of UK output, but still find that a relatively high proportion of output variability can be accounted for by supply shocks.
Table 4.3: Contribution of shocks to forecasting errors for forecasts of GDP in three months time.

<table>
<thead>
<tr>
<th>Study</th>
<th>Supply shock</th>
<th>Demand shock</th>
<th>Nominal shock</th>
<th>Exchange rate shock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clarida and Gali</td>
<td>84</td>
<td>3</td>
<td>13</td>
<td>n.a</td>
</tr>
<tr>
<td>Funke</td>
<td>89</td>
<td>4</td>
<td>7</td>
<td>n.a</td>
</tr>
<tr>
<td>HM Treasury I</td>
<td>11</td>
<td>13</td>
<td>75</td>
<td>n.a</td>
</tr>
<tr>
<td>Artis and Ehrmann</td>
<td>70</td>
<td>30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>HM Treasury 2</td>
<td>11</td>
<td>89</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Clarida and Gali (1994) model UK GDP relative to US GDP; Funke (2000) models UK GDP relative to euro area GDP; Artis and Ehrmann (2000) and HM Treasury both model UK GDP. Details of HM Treasury models are in Annex A.

4.24 Differences between the models become less stark when forecasting over longer time horizons. There is a broad agreement between the studies that supply shocks are the main contributor to forecasting errors for GDP five years ahead (Table 4.4). However as noted above, the studies find that supply shocks account for little of the error in forecasting exchange rates. The implication is that the shocks that move exchange rates have in general, limited effects on future output.

Table 4.4: Contribution of shocks to forecasting errors for forecasts of GDP in five years’ time.

<table>
<thead>
<tr>
<th>Study</th>
<th>Supply shock</th>
<th>Demand shock</th>
<th>Nominal shock</th>
<th>Exchange rate shock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clarida and Gali</td>
<td>n.a</td>
<td>n.a</td>
<td>n.a</td>
<td>n.a</td>
</tr>
<tr>
<td>Funke</td>
<td>90</td>
<td>3</td>
<td>7</td>
<td>n.a</td>
</tr>
<tr>
<td>HM Treasury I</td>
<td>78</td>
<td>6</td>
<td>16</td>
<td>n.a</td>
</tr>
<tr>
<td>Artis and Ehrmann</td>
<td>86</td>
<td>5</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>HM Treasury 2</td>
<td>78</td>
<td>21</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

See Table 4.3 for details of studies. Results for Artis and Ehrmann are for six year ahead forecasts.

4.25 The finding that shocks that move the exchange rate do not have impacts on the wider economy is consistent with it being a shock absorber. But the difficulty is that these analyses do not provide definitive findings of what would have happened in the counter-factual case where the exchange rate had not moved. If the exchange rate is responding to real demand shocks, as implied by a number of studies, then in the absence of an exchange rate movement, these might be expected to have more of an impact on the UK price level.

Implications for UK and EMU

4.26 Both Funke (2000) and Artis and Ehrmann (2000) draw conclusions from their studies on whether it would be advisable for the UK to join EMU. Artis and Ehrmann argue that their results provide grounds both in favour of joining and against it. Monetary policy in the UK is found to have an impact on the real economy and so can be a useful stabiliser – this is evidence of costs to UK entry.

4.27 On the other hand, they argue that other findings (that exchange rate movements are largely driven by shocks to the exchange rate itself, are not responsive to supply and demand shocks, but do affect output and prices) suggest that the exchange rate has a limited stabilising role. Consequently, they argue that the loss of exchange rate flexibility in joining a monetary union would not be costly. Funke (2000) also interprets his findings as suggesting that the exchange rate has not played a shock absorber role.
4.28 But the conclusion that these studies demonstrate that the exchange rate is not a significant shock absorber is puzzling. Artis and Ehrmann argue that “if variable X perfectly stabilises shocks which could impinge on variable Y then the ex post data will reveal variations in X but none in Y but it would be a mistake to conclude that X was ineffective as a shock absorber!” (page 6). Yet having made this point, they appear to ignore it when they evaluate the role of the exchange rate.

4.29 This strand of analysis cannot conclusively resolve the question as to whether the exchange rate is or is not a shock absorber, since we can only observe what happens when the exchange rate actually moves. But the presumption that all other variables would be unaffected (and hence that the exchange rate is not responding to an otherwise unobserved shock) is a strong one. Without evidence that demonstrates that other variables would have been unaffected if the exchange rate had not moved, the conclusion that the exchange rate fails to act as a shock absorber is, at best, unproven.

Conclusions

4.30 The evidence considered in this section suggests that nominal exchange rate flexibility does not typically generate additional macroeconomic volatility. Econometric studies using the SVAR technique suggest that exchange rate movements do not, in general, destabilise the economy. This supports the conclusion drawn from more qualitative analysis of the relation between exchange rates and the relative cyclical position. On balance, there is little evidence to support the proposition that exchange rate flexibility provides an additional source of shocks.

4.31 Whether exchange rate flexibility is a significant stabilising mechanism or not is harder to resolve. The econometric evidence finds that large exchange rate movements do not typically affect other macroeconomic variables. This could be because they are helping to absorb an otherwise unobserved shock. But it could be that observed exchange rate movements are purely extraneous. Without observing what would have happened had the exchange rate not moved, it is not possible to resolve the question conclusively. But it seems unlikely that real exchange movements would not have real effects, and therefore likely that observed exchange rate changes have helped to absorb shocks that might otherwise have impacted on either output or prices.

4.32 The finding that countries with fixed exchange rate regimes do not experience higher macroeconomic volatility than countries with flexible exchange rates confirms the insight from OCA theory that fixed regimes are viable, provided that alternative mechanisms (for example, wage and price flexibility, flexible redeployment of resources to alternative uses and fiscal stabilisation) enable a rapid adjustment to economic shocks.
5

AN INTERPRETATION OF THE STRENGTH OF STERLING SINCE 1996

In recent years, sterling remained persistently above most estimates of its sustainable rate against the euro. Nonetheless, at a whole economy level, the effects on UK output and prices appeared limited. This section considers whether these outcomes provide grounds for thinking that the sustainable exchange rate has appreciated in recent years, or for thinking that a temporary appreciation relative to the longer-term sustainable rate may have been warranted.

The macroeconomic balance framework defines the sustainable exchange rate as the rate that should prevail when the economy satisfies two conditions, representing internal balance (aggregate demand matches aggregate potential supply) and external balance (the external current account flows can be sustainably financed). Neither condition need hold at a particular point in time, although when either condition fails, prices and quantities will tend to adjust to eliminate the imbalances over time. While these adjustment processes are operating, deviations of the actual exchange rate from its sustainable rate may be warranted. Both the magnitude and the duration of deviations of the actual rate from its sustainable level will depend on the extent and persistence of the factors causing the internal and external balance conditions to fail.

During the past few years, demand for UK goods and services has been relatively strong compared with demand for euro area goods and services, in part reflecting the relative strength of UK domestic demand. This differential in relative demand has warranted a degree of sterling real exchange rate appreciation against the euro, both to prevent the UK economy overheating and to bolster demand for euro area production.

With both the UK and the euro area monetary authorities pursuing broadly similar price stability objectives, real exchange rate movements between the two currency areas were mainly achieved by movements in the nominal exchange rate. By contrast, if the UK had been in EMU, any real exchange rate change between the UK and the current euro area countries would have needed to occur through differential price movements. It is likely that UK inflation would have been higher than it was.

Up until the end of 2002, some argued that sterling’s equilibrium real exchange rate had appreciated relative to the range of previous estimates. However, sterling’s depreciation during early 2003 is more supportive of the view that its strength in recent years may have been a temporary, albeit protracted, move away from longer-term equilibrium. It is important to emphasise that interpretation of recent movements is made more difficult by uncertainties about both the scale and persistence of market reactions to the particularly high degree of global political and economic uncertainty.

Nonetheless, this appreciation may have been warranted by a persistent decrease in net national saving, associated with relatively strong domestic demand growth in the UK compared with the euro area. These explanations are considered further in the convergence test – the first of the Government’s five economic tests for EMU entry.
5.2 That said, the strong exchange rate clearly affected the performance of certain sectors. The volume of exports of goods and services grew by 4.3 per cent a year between 1996 and 2002 compared with import growth of 7.1 per cent a year, and manufacturing output grew more slowly than services output and actually declined in 2001 and 2002. Nonetheless, overall macroeconomic performance held up well, despite the difficulties experienced by individual sectors. One interpretation of this is that a real exchange rate appreciation may have been needed in order to maintain macroeconomic balance, by attracting labour and other resources into the industries where they were most needed.

5.3 Understanding recent trends is an important part of assessing what might be the appropriate rate at which sterling should be fixed against the euro, were a decision taken to join EMU. The EMU study by Professor Simon Wren-Lewis Estimates of equilibrium exchange rates for sterling against the euro highlights that fixing at too high an exchange rate could mean that the early years of EMU membership would be characterised by low output growth in order to obtain the low inflation needed to secure a real depreciation within EMU. By contrast, entering at too low an exchange rate could mean that the early years of EMU membership would see relatively high UK inflation and a real exchange rate appreciation. These scenarios, together with possible policy responses, are illustrated in detail in the EMU study Modelling the transition to EMU. The EMU study Modelling shocks and adjustment mechanisms in EMU illustrates real exchange rate adjustment within EMU itself.
5.4 The analysis in this section uses recent exchange rate history to illustrate why actual exchange rates may deviate from their estimated sustainable rates for extended periods of time. The analysis focuses on sterling’s exchange rate against the euro. This is in large part because sterling has moved more sharply against the euro than against the US dollar in recent years. Indeed, sterling has tended to depreciate against the US dollar when it has appreciated against the euro, and to appreciate against the US dollar when it has depreciated against the euro, so that movements in the trade-weighted exchange rate have been more muted than sterling’s movements against the euro. Although the focus of this section is on the sterling-euro exchange rate, the principles discussed can be used to analyse exchange rate movements more generally.

5.5 Bilateral exchange rates are a relative price: the sterling-euro exchange rate is the price of sterling in terms of euro. As such, movements in the exchange rate reflect economic conditions in both currency areas.

5.6 The Government believes that exchange rate stability can only be achieved on the basis of sound economic fundamentals, in particular low and steady inflation, steady and sustainable growth and sound public finances. The exchange rate is, therefore, an outcome that reflects other economic policies, both in the UK and in other countries.

**Price stability and changes in the real exchange rate**

5.7 An important point to note is that both the UK and the European monetary authorities were pursuing price stability in their respective currency areas during the period considered in this analysis. As a result, there was limited scope for inflation differences to bring about any real exchange rate change between the UK and Europe that may have been needed. This meant that nominal exchange rate movements were the main channel for securing real exchange rate changes.

5.8 In other words, the foreign exchange rate market plays an important role in achieving real exchange adjustment when monetary authorities are committed to achieving price stability in their respective currency areas. This is especially the case when the required change in the real exchange rate is large. For example, in the absence of any nominal exchange rate change, a 10 per cent real appreciation in the sterling-euro real exchange rate would require either a 10 per cent increase in the UK price level or a 10 per cent fall in the euro area price level, or an appropriate combination of price level movements in the two areas. In any of these scenarios, monetary authorities would find it difficult to convince the public that they still had a strong and credible commitment to maintaining price stability.

**Deviations of the exchange rate from sustainable medium-term levels**

5.9 The sharp depreciation of sterling that followed its exit from the ERM in September 1992 appeared consistent with the view that the ERM parity of 2.95 DM/£ was unsustainably high (Wren-Lewis et al., 1991). Sterling remained below 2.50 DM/£ for most of the following four years.
But towards the end of 1996 sterling began to appreciate again. By July 1997, the exchange rate had risen back above the 2.95 DM/£ level, reaching a peak of over 3.30 DM/£ in May 2000, and averaging 1.62 €/£ (equivalent to 3.16 DM/£) between 2000 and 2002. This level was well above estimates of the sustainable exchange rate, many of which ranged between 1.2 and 1.4 €/£, equivalent to 2.35 and 2.74 DM/£, respectively.\footnote{Estimates based on past data have tended to provide lower figures for the equilibrium rate than other estimates, such as surveys of City economists, some of which have suggested that the sustainable rate could be as high as 1.55 €/£ (3.03 DM/£). But even these estimates imply that sterling was trading above its equilibrium rate between 1998 and 2002. Its subsequent depreciation during early 2003 has brought it within the range indicated by the survey evidence, although remaining, in mid March, above the 1.4 €/£ level.}

This prompts the question as to why sterling deviated from estimates of its sustainable rate for so long. Explanations can be divided into two categories:

- estimates of the sustainable medium-term exchange rate remained valid, but there were strong and persistent pressures that took the actual exchange rate away from its sustainable level for an extended period; and

- alternatively, the sustainable exchange rate may have been higher than previously estimated. For example, an analysis by the IMF concluded that “the persistence of the real exchange rate appreciation observed in the United Kingdom over the past few years ... suggests that the equilibrium real exchange rate may have appreciated” (IMF, 2002, page 68).

Estimates of the sustainable exchange rate provide an indication of the exchange rate that is expected to prevail when economic adjustment to shocks has run its course and any associated imbalances have been eliminated. For example, the estimates derived by Professor Simon Wren-Lewis in his EMU study \textit{Estimates of equilibrium exchange rates for sterling against the euro} are derived on the basis that there is no imbalance between aggregate demand and aggregate supply, and that net national saving (that is national saving less national investment) is at a sustainable level. Neither condition need apply at any particular moment, and the actual exchange rate may deviate from its estimated equilibrium rate until both conditions are satisfied.

In the macroeconomic balance framework, deviations of the actual exchange rate from its longer-term rate are warranted when either the internal balance or external balance conditions are not satisfied. Under current arrangements, UK and European interest rates are aimed at maintaining or restoring internal balance within their respective currency areas. Meanwhile, net national saving, which affects the external balance condition, reflects the interaction of private and public sector net saving, or in other words is partly determined by fiscal policy and partly by private sector behaviour.

Estimates of the sustainable exchange rate derived using the macroeconomic balance approach are often derived by making an assumption about the sustainable level of net national saving. But the time horizon over which this sustainable level should apply is not well defined. The factors that determine national saving may be highly persistent, and when this is the case then persistent deviations of the exchange rate from its longer-term sustainable rate may be warranted.

\footnote{See the EMU study by Professor Simon Wren-Lewis \textit{Estimates of equilibrium exchange rates for sterling against the euro}, and the estimates cited in Walton and Broadbent (2003).}
5.15 National saving is determined by factors such as the demographic composition of the population, the level of wealth, the level of expected income and hence expected wealth, the population’s attitude to risk and their rate of time preference (that is the extent to which their current spending behaviour is influenced by their expectations of future outcomes). National investment is determined by expected returns against expected costs of investment. These, in turn, are affected by a range of factors, including expectations about productivity, future demand and the risk attached both to particular projects and to the wider macroeconomic climate. Net national saving will depend on conditions both within the UK and abroad, since UK saving can be used to finance investment either in the UK or abroad, while UK investment may be financed by either UK or foreign saving.

5.16 These considerations suggest that it is important to look at the short-term as well as longer-term influences on the exchange rate. Such influences are often difficult to pinpoint, and may only become apparent after the event. Since the determinants of net national saving are not directly observed, but only indirectly observed through the effect that they have on the exchange rate itself, it is only possible to construct a suggestive rather than a definitive account of past exchange rate movements.

Relative demand strength in the UK and the euro area

5.17 Examination of the respective positions of the UK and the euro area economies in the late 1990s points to reasons why sterling might have needed to appreciate against the euro. By 1997, the UK economy was recovering well from the recession of 1990-92. That recession had left the UK economy with significant excess aggregate supply, requiring a stimulus to aggregate demand. This was achieved by a combination of fiscal and monetary easing and by exchange rate depreciation. By 1997, it had become clear that demand growth risked becoming excessive (Chart 5.2). Monetary and fiscal policy were both tightened in order to restrain domestic demand. The accompanying appreciation of the real sterling-euro exchange rate provided an additional restraint, but it also provided a stimulus to the euro area economies.

Chart 5.2: Domestic demand in the UK and euro area

Strong demand in the UK...
5.18 In the euro area, German reunification had provided a short-lived stimulus to demand at the start of the 1990s, that exacerbated tensions within the ERM. By the mid 1990s, many countries in the euro area were tightening their fiscal policies, with the Maastricht criteria for government deficits providing a strong incentive for countries to ensure that borrowing was brought back to sustainable levels. Other things equal, a tighter fiscal policy implies a lower real exchange rate. Domestic demand remained subdued in the euro area as a whole, although experiences varied across countries.

5.19 It is relatively easy to describe the symptoms of the relative strength of demand in the UK economy, and less easy to identify its underlying causes. Domestic demand in the UK has benefited from a self-sustaining recovery in consumer and investor confidence, which has seen employment and spending hold up well despite the various shocks that have hit the economy, including the Asian and Russian financial crises, a tripling in the oil price and a sharp correction in equity prices. The strength of confidence in the UK is also apparent in the rapid increase in house prices since 1997, which itself helped to reinforce consumer confidence. The rise in equity prices in the late 1990s was a further indication of an improvement in investor confidence, although since euro area equity prices also rose strongly, the extent to which this may have contributed to differential demand pressures is unclear. In contrast to the UK, some, but by no means all of the euro area economies have found it difficult to generate strong self-sustaining increases in domestic demand.

5.20 Other things equal, strong consumer spending and investment in the UK would translate into a decline in desired net national saving, which would tend to reduce UK demand for foreign currency, including the euro. Similarly, relatively weak domestic demand in the euro area would translate into an increase in desired net saving in the euro area, increasing demand for other currencies, including sterling. Net national saving must sum to zero across the world, with exchange rates moving to balance the supply of and demand for individual currencies.\(^2\)

5.21 A complication in this analysis is that exchange rate movements themselves modify desired saving and investment flows, by curbing demand for the appreciating currency and encouraging demand for the depreciating currency. Since saving and investment outcomes reflect the interaction of initial pressures acting on the exchange rate and the feedback from the exchange rate reaction on saving and investment decisions, it is difficult to ascertain the extent of the initial pressures themselves. That said, the relative strength of UK domestic demand compared with the euro area, together with the strength of sterling’s appreciation against the euro, suggests that shifts in desired net national saving in the two currency areas may have contributed to sterling’s appreciation. If this was indeed the case, then the duration of sterling’s appreciation would depend on the persistence of the trends in desired net national saving.

5.22 If sterling’s appreciation against the euro had been unwarranted, then the UK would have been pushed towards recession, and the euro area would have risked overheating. In fact, UK economic performance remained relatively strong and the euro area showed little sign of overheating. Hence, on this occasion, the exchange rate movement appears to have been largely warranted.

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\(^2\) Official statistics show that net national saving does not sum to zero across the world. This reflects difficulties in measuring all international transactions accurately.
5.23 Analysis by the Bank of England is consistent with the view that strong domestic demand may have contributed to sterling’s strength. The February 2002 Inflation Report noted that sterling’s strength could be attributed to the relative strength of domestic demand in the UK compared with the euro area, and stated that:

“Were a correction to private spending to materialise, there is a risk of an associated fall in the sterling exchange rate” (page 48).

5.24 The preceding argument attributes much of sterling’s appreciation to differences in the strength of domestic demand. Analysis of the external balance of payments suggests that strong foreign demand for UK financial and business services and for investment in the UK may also have contributed to sterling’s appreciation after 1995. Although the overall current account balance was negative, the annual average trade balance on financial and other business services improved by £11 billion between 1993-95 and 1999-2001, despite sterling’s appreciation (Chart 5.3). These trends were offset by the deterioration in the balance on goods trade, where the annual average balance deteriorated by £14 billion over the same period.

**Chart 5.3: UK balance of payments**

Source: Office for National Statistics.

**Financial market sentiment**

5.25 Even though sterling’s appreciation appears consistent with relative demand pressures between the UK and the euro area, both the size and the speed of its appreciation remain difficult to explain. Buiter and Grafe in their contribution to the EMU study *Submissions on EMU from leading academics* argue that:

“There are no conceivable developments in the fundamentals of the real economy that called for such huge swings in relative prices and costs. These episodes are evidence of the havoc financial asset markets can create when they go off on their periodic peregrinations into misplaced euphoria and unwarranted gloom.”
5.26 As noted in Section 2, the exchange rate is largely determined by expectations of the future, which may reasonably switch from euphoria to gloom. Asset market prices are particularly prone to such swings when there is heightened uncertainty about future outcomes. Uncertainty about the relative performance of economies in the longer term will weaken investors’ confidence that a particular exchange rate level is appropriate. In such circumstances, financial market sentiment may cause the exchange rate to drift further away from its sustainable level than may appear warranted. This effect may have exacerbated sterling’s appreciation since 1996.

5.27 The level of the exchange rate is an important element in the overall stance of monetary conditions, and hence exchange rate movements influence the interest rate decisions of the monetary authorities. For example, Mervyn King, the Deputy Governor of the Bank of England has said

“although there is little that the MPC can do to influence the exchange rate, it can take its movements into account when setting interest rates. That it most certainly does. Because of the strength of sterling, interest rates have almost certainly been lower than would otherwise have been the case.”

5.28 As a result the relationship between domestic demand, the exchange rate and interest rates is a complicated mix of underlying developments in supply and demand and, savers’ and investors’ expectation of future economic developments in different currency areas, including the expectations of how macroeconomic policy will respond.

Medium-term influences on the exchange rate

5.29 To recap, the preceding analysis has suggested that sterling’s strength in recent years may be attributed to the relative strength of demand for UK production compared with euro area production during this period. This raises two questions:

• Could these trends be purely temporary phenomena?

• If they are permanent, what are the implications for the sustainable exchange rate?

5.30 Medium to long-term explanations of the exchange rate rely on the prediction that sustained deviations of the exchange rate from its sustainable rate will generate trends that will eventually bring the exchange rate back to its equilibrium. But these theories are generally unable to predict how rapidly the exchange rate will reach its medium to long-term level. This is particularly the case when there is uncertainty about the size and persistence of the shifts in supply and demand that are acting to keep the exchange rate away from its longer-term equilibrium.

5.31 Sterling’s strength over the past few years illustrates these points. Few observers expected sterling to remain as strong for as long. Nonetheless, this continued strength contributed to a steady deterioration in the balance of trade in goods, which has increasingly acted as a counterweight to the upward pressures on sterling from other sources. This is consistent with the prediction that prolonged deviations from the medium-term exchange rate will generate trends that help to bring the exchange rate back to its sustainable level.

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Footnote:

5.32 These considerations provide a number of explanations for the depreciation of sterling in early 2003:

- the pressures that contributed to sterling’s appreciation may have themselves faded. For example, weaker domestic demand in the UK may have reversed some of the upward pressure on sterling seen in recent years;
- earlier pressures may still remain, but other pressures may be acting to push sterling down. So, for example, it could be the case that demand for UK business services remains strong, but demand for sterling relating to other transactions has weakened; and
- related to the previous point, it may be that the deterioration in the trade in goods balance, that is in part a consequence of sterling’s previous strength, has become sufficiently strong to outweigh upward pressures from other sources.

5.33 These explanations are not mutually inconsistent, and it may be that each provides part of the total explanation. As always, it is difficult to identify how important each element is, since the underlying influences on currency transactions are not directly observed with sufficient precision. These problems have been exacerbated by the recent high degree of global uncertainty, which has increased the volatility of financial asset markets including currency markets.

5.34 Up until the end of 2002, some argued that sterling’s equilibrium real exchange rate had appreciated relative to the range of previous estimates. However, sterling’s depreciation during early 2003 is more supportive of the view that its strength in recent years may have been a temporary, albeit protracted, move away from longer-term equilibrium. It is important to emphasise that interpretation of recent movements is made more difficult by uncertainties about both the scale and persistence of market reactions to the particularly high degree of global political and economic uncertainty.

5.35 Nonetheless, this appreciation may have been warranted by a persistent decrease in net national saving, associated with relatively strong domestic demand growth in the UK compared with the euro area. These explanations are considered further in the convergence test – the first of the Government’s five economic tests for EMU entry.
In principle, an exchange rate movement could be an appropriate response of the exchange rate to changing economic conditions or an unwarranted change. In practice, observed volatility may be a mixture of both. Measures of volatility are unable to distinguish between these ‘warranted’ and ‘unwarranted’ exchange rate movements.

If the UK were to join the euro then nominal exchange rate volatility with respect to the euro area would be eliminated.

In recent times, the euro has been more volatile against the US dollar than sterling has been against the US dollar. If these trends were typical, then the volatility of the UK exchange rate against the US dollar would be higher inside EMU than outside.

In theory, higher volatility against the US dollar might outweigh the effects of eliminating volatility against euro area countries.

But this analysis suggests that, in general, increased volatility against the US dollar will not outweigh the reduction in volatility against euro area currencies. This implies that the overall volatility of the exchange rate is likely to be lower inside EMU than outside.

6.1 The analysis in this section attempts to determine the effect on overall UK exchange rate volatility if the UK were to enter EMU. But the analysis comes with a caveat. As the previous sections have discussed, it is not necessarily the case that any reduction in volatility, either inside or outside of EMU, represents an economic cost or a benefit. If the observed volatility of the exchange rate is a result of the exchange rate generating an appropriate response to an economic shock, then a reduction in volatility is an economic cost. If this volatility is an extraneous source of shocks to the economy, then a reduction in volatility represents an economic benefit.

6.2 In practice, observed volatility may be a mixture of both. Effectively, measures of volatility conflate ‘warranted’ movements in the nominal exchange rate (that is, movements of the exchange rate that are an equilibrating response to a fundamental shock) with ‘unwarranted’ movements (extraneous movements that do not reflect any change in the underlying real economy).

6.3 In addition, any reduction in the volatility of nominal variables is also likely to be of little economic benefit if it is not reflected in comparable changes in the behaviour of real variables. If the source of exchange rate volatility is fundamental shocks to the economy rather than extraneous movements then this volatility will manifest itself in the real exchange rate anyway, but not via the nominal rate.

6.4 The handling of exchange rate volatility is also important in studies that attempt to assess the overall macroeconomic cost of entering EMU. Two such recent studies, Barrell and Dury (2000) and Minford (2001), arrive at conflicting conclusions largely as a result of their differing treatment of the exchange rate. There is an extended discussion of this issue in the EMU study Modelling shocks and adjustment mechanisms in EMU.

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1 The earlier discussion in Section 3 examines the possibility of the nominal exchange rate becoming ‘disconnected’ from the real economy.
Measures of volatility

6.5 There are several possible measures of the volatility of nominal exchange rates. These include statistical measures such as the standard deviation, coefficient of variation and econometric models such as GARCH and ARCH. The focus here is on the coefficient of variation – defined as the standard deviation expressed as a per cent of the mean of the series over the same period.

The exchange rate index

6.6 One way to look at the combined effects of offsetting movements in a currency’s differing bilateral rates is to calculate an exchange rate index (ERI). An ERI combines bilateral exchange rates for a country by weighting each bilateral rate according to its economic importance using criteria such as trade weights. This allows analysis of a currency’s movements in general, rather than against an individual currency.

6.7 However, many companies export to one or only a few markets, or do not export, or export in different proportions to the trade weights. Their individual ERIs will be different from the nation’s. In particular, for firms exporting to one market only, the volatility of the bilateral rate will be relevant. They will not benefit from offsetting movements in other exchange rates (or changes in the volatility of other rates). This may be less important if they can switch markets, but this usually involves costs.

6.8 Given that the volatility of the sterling-euro bilateral rate would fall to zero upon entry to EMU, it might be assumed that the volatility of the sterling ERI would be guaranteed to fall. In fact, this not need be the case, if entry into EMU were to lead to increased sterling volatility against other currencies (see Box 6.1 and Taylor, 2002).

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1ARCH stands for auto-regressive conditional heteroscedasticity, GARCH for generalised auto-regressive conditional heteroscedasticity. Both approaches allow for the possibility that volatility may fluctuate over time.
The volatility of sterling compared to other currencies

6.9 The first part of this analysis considers the volatility of the bilateral exchange rates of sterling, the US dollar and the euro, since the latter came into existence in 1999. The analysis then considers the volatility of major currencies over longer periods.

6.10 Chart 6.1 shows the nominal depreciation of the euro against both the US dollar and sterling since 1999. The weakening of the euro occurred over the first twenty months of its existence. For most of the period since then it has been relatively stable against both sterling and the US dollar, before recently strengthening against both.
Aside from the initial weakening of the euro, three features stand out in Chart 6.1:

- since early 2000 the sterling-euro rate has been the most stable;
- the US dollar-euro rate has been the most unstable; and
- the sterling-euro and sterling-US dollar rates often move in opposite directions over the period shown, i.e. sterling strengthens against one currency while weakening against the other.

The behaviour of each of the bilateral rates can be assessed by looking at their average volatility measured over varying lengths of time using the coefficient of variation (shown in Table 6.1). Using different time periods addresses the problem of a currency, for example, being volatile on a day to day basis, but relatively stable over longer periods of time (which may be more of a concern in international trade). For all three measures the US dollar-euro coefficient of variation is significantly larger than the sterling-US dollar rate.

**Table 6.1: Average volatility over the periods shown for the three bilateral exchange rates**

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<thead>
<tr>
<th></th>
<th>Coefficient of variation</th>
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<tr>
<td></td>
<td>$/€</td>
<td>£/€</td>
<td>£/$</td>
</tr>
<tr>
<td>60 days</td>
<td>2.00</td>
<td>1.31</td>
<td>1.32</td>
</tr>
<tr>
<td>1 year</td>
<td>4.09</td>
<td>2.64</td>
<td>2.27</td>
</tr>
<tr>
<td>3 years</td>
<td>6.82</td>
<td>4.96</td>
<td>2.79</td>
</tr>
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</table>

This suggests that although entry into the euro would eliminate the UK’s nominal exchange rate volatility against the euro, its volatility against the US dollar could increase markedly. Therefore, if the UK were to enter EMU the gains from eliminating sterling-euro volatility could be, at least partially, offset by the effect of increased volatility against the US dollar.
Calculating an ERI for the UK

6.14 Setting the UK’s exchange rate volatility against the euro to zero and replacing all the other sterling bilateral rates with euro bilateral rates produces the ‘UK-in-euro ERI’. This simulates how the UK’s ERI would have moved had the UK been in the euro area since 1999. Contrasting this with the actual sterling ERI shows whether the UK would have experienced lower exchange volatility had it been a member of the euro area.

6.15 The Bank of England’s official sterling ERI is used for this purpose. This contains weighted bilateral exchange rates between the UK and the euro area, the US, Sweden, Denmark, Norway, Switzerland, Japan, Australia, Canada, and New Zealand. The only modification made here is to combine the euro area and Denmark, which has an insignificant impact on the results.

6.16 An important assumption in this calculation is that the UK’s membership of the euro area would have influenced the euro-US dollar exchange rate over this period. So the ‘constructed’ euro-US dollar exchange rate used in the calculation of the UK-in-euro ERI is a combination of the actual euro-US dollar rate and the actual sterling-US dollar rate weighted by GDP at market prices in value terms. This gives sterling and the euro weights of 18.7 per cent and 81.3 per cent, respectively.3

6.17 Chart 6.2 compares the two ERIs for the UK. There are two noteworthy features. First, the actual sterling ERI strengthens through 1999 while the simulated UK-in-euro ERI weakens, which is the result of the general weakening of the euro over that period. Second, the simulated UK-in-euro ERI looks less volatile because there is no longer any exchange rate volatility with the euro area, which has a weight of 66.5 per cent in the sterling ERI.4

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3 These weights are the average of the ratio of UK to euro area GDP in the years 1999-2001.
4 Here the euro area includes Denmark.
6.18 Over the period since the launch of the euro, sterling ERI volatility, measured as the coefficient of variation, has been 1.96, while UK-in-euro ERI volatility would have been 1.81 per cent. However, when volatility is measured over shorter rolling periods the reductions in volatility are far more emphatic, as shown in Table 6.2.

Table 6.2: The average of ERI volatility measured over rolling 60 day, 1 year and 3 year periods

<table>
<thead>
<tr>
<th></th>
<th>Coefficient of variation</th>
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<tr>
<td></td>
<td>Actual sterling ERI</td>
</tr>
<tr>
<td>60 days</td>
<td>1.00</td>
</tr>
<tr>
<td>1 year</td>
<td>1.52</td>
</tr>
<tr>
<td>3 years</td>
<td>1.67</td>
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</table>


6.19 According to this simulation, the UK’s overall exchange rate volatility would have been significantly reduced had it joined the euro in 1999. This is particularly true for volatility measured over shorter periods.

6.20 This result is consistent with the work of Taylor (2002). This study tested the relationship between sterling and the US dollar to attempt to anticipate the expected fall in sterling’s ERI if the UK were to join EMU. The conclusion was that the UK would benefit from a reduction in high frequency volatility (short run volatility) of about two thirds from joining the euro. However, this finding was also based on using the official ERI weights, which Taylor notes, “may not give a reliable impression of the implications of joining EMU” (page 29).

6.21 Blake and Byrne (2002) use a similar methodology to estimate the impact on overall exchange rate volatility of EMU entry. The authors examine the observed relationship between the sterling-US dollar and sterling-deutschmark (euro) rates throughout the last 25 years. They note that in the period of floating rates, currencies have tended to simultaneously weaken against the US dollar and strengthen against the deutschmark/euro (and vice versa). If this relationship were to remain robust it would offer a clue as to how much the UK in the euro area would respond to movements in the US dollar.

6.22 The authors conclude that, given the current linkages in currencies’ movements, UK membership of the euro would lead to increased volatility against the US dollar. However, they go on to suggest that if these currency linkages are dependent on incomes flows, as suggested by Taylor (2002), then “UK membership of the euro could be a help with the reduction of overall currency volatility, and not just the volatility between the UK and the current Euro Area” (Blake and Byrne, 2002, page 45).

6.23 The preceding analysis of ERIs is partly dependent on the assumption made about the relative importance of each currency and its corresponding weight in the ERI calculation. The issue of how to determine the appropriate weights to use in the ERI is examined extensively in Annex B. The following analysis examines the effect of using the alternative weighting systems discussed there.

Using different weights to construct the ERI

6.24 Bootle (2001) uses different weights to construct the ERI, which he argues are more representative of UK trade patterns with other currency areas (see Annex B for more detail). His adjustments reduce the weight of the euro area from just over 66 per cent to less than 47 per cent, while increasing the weight of the US dollar from about 16 per cent to over 40 per cent. These changes mean that Bootle’s UK-in-euro ERI (shown in Chart 6.3) is more volatile than the UK-in-euro ERI shown in Chart 6.2. It also depreciates far more during 1999 and 2000. This is because the depreciation of the euro against the US dollar during this period is accorded a greater weight in Bootle’s index than in the official one.

Chart 6.3: The sterling ERI and simulated UK-in-euro ERI based on weights proposed in Bootle (2001)


6.25 Applying Bootle’s weights both reduces the volatility of sterling ERI (to 1.77) and increases the volatility of the UK-in-euro ERI (to 3.47) over the period since the start of EMU. Hence, using these weights implies that, had the UK adopted the euro in 1999, its overall exchange rate volatility since then would have been higher.

6.26 However, as explained earlier volatility measured over the entire period since 1999 does not paint a complete picture. When looking at 60-day volatility, on average the difference between Bootle’s sterling and simulated UK-in-euro ERIs implies the simulated ERI is actually marginally less volatile (around 1 per cent). But, over one-year and three-year periods it is, on average, 30 per cent and 48 per cent more volatile respectively.

6.27 It is arguable whether either of the sets of weights used above is appropriate. On no measure of trade does the euro area account for over 65 per cent of UK trade. On the basis of UK current account figures (presented in Annex B), a plausible estimate of the share of UK trade related to the euro area would be around 55 per cent. Assuming the yen accounts for only 5 per cent, this leaves a substantial share of 40 per cent for the US dollar. So although the importance of the US dollar stretches well beyond the borders of the US, the euro area is more significant for UK trade.

*Especially assuming that the exchange rates of Central and Eastern Europe are more closely linked to the euro than the US dollar.
6.28 Given that a weight of 55 per cent for the euro is between the two previous simulations, the results will also clearly lie between the previous results. The sterling and UK-in-euro ERIs recalculated using a 55 per cent trade weight for the euro area are shown in Chart 6.4.

![Chart 6.4: The sterling and simulated UK-in-euro ERIs calculated with a weight of 55 per cent for the euro](chart)


6.29 The results from this simulation suggest membership of the euro would have reduced volatility over the 60-day horizon by about one third and over the one-year horizon by over one tenth (see Table 6.3). Over the three-year horizon the estimated volatility from the UK being in the euro is about 30 per cent higher than with retaining sterling. But volatility over the three-year horizon has been on a downward trend, before recently turning upwards again. This can be seen in Chart 6.5.

![Chart 6.5: Three-year volatility based on ERIs with a 55 per cent euro weighting](chart)


7 These figures are the average of differences in volatility between the two ERIs.
Table 6.3 summarises the implied impact of euro membership on volatility, using each of the different trade weights examined above. A negative sign indicates a decrease in the volatility of sterling ERI upon entry to EMU; a positive sign indicates an increase.

Table 6.3: Impact of euro membership on volatility under different trade weights

<table>
<thead>
<tr>
<th></th>
<th>Sterling ERI</th>
<th>Coefficient of variation</th>
<th>Simulated UK-in-euro ERI</th>
<th>Impact of euro membership on volatility</th>
</tr>
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<tbody>
<tr>
<td>Bank of England weights</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 days</td>
<td>1.00</td>
<td>0.44</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>1 year</td>
<td>1.52</td>
<td>0.94</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>3 years</td>
<td>1.67</td>
<td>1.43</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Bootle (2001) weights</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 days</td>
<td>0.85</td>
<td>0.84</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>1 year</td>
<td>1.34</td>
<td>1.74</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>3 years</td>
<td>1.91</td>
<td>2.83</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>55 per cent trade weights</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 days</td>
<td>0.93</td>
<td>0.59</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>1 year</td>
<td>1.35</td>
<td>1.27</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>3 years</td>
<td>1.48</td>
<td>1.93</td>
<td>+</td>
<td></td>
</tr>
</tbody>
</table>


The EMU study EMU and trade by HM Treasury considers whether membership of the single currency would lead to a substantial increase in trade between the UK and the euro area, as some studies suggest. Such an effect would increase the weight of the euro area in the sterling ERI, implying that overall exchange rate volatility would be further reduced.

A longer time series

Since the launch of the euro, the US dollar-euro exchange rate has been more volatile than the US dollar-sterling rate. Furthermore, sterling has generally been stable, following a middle path between the US dollar and euro, giving a negative correlation between the sterling-euro and sterling-US dollar exchange rates. The question is whether this snapshot is representative of longer-term trends?

To answer this question it is necessary to use a proxy for the euro. One option is to create an index of the euro legacy currencies; an alternative is to simply use the deutschmark. Using an index of legacy currencies is consistent with the view that the euro should behave like a weighted average of its component currencies, while using the deutschmark acknowledges that euro area institutions are modelled to some extent on their German predecessors. For completeness this study presents both options.

The US dollar-sterling is the most stable of the three bilateral exchange rates from 1993 onwards. The greater volatility seen in 1992 is the result of the UK leaving the ERM. Chart 6.7 indicates that the US dollar-deutschmark and US dollar-euro rates were more volatile than average following the start of EMU in 1999. Their volatility then declined over 2000 and 2001 before increasing again in 2002.
6.36 As was noted previously the negative correlation or covariance of the sterling-US dollar and sterling-euro rates seems to have contributed to sterling's relatively low volatility since 1999. However, Chart 6.8 shows that this negative correlation does not hold over all periods in this longer time series; for example around 1996 and 1997, and post-ERM in 1992, the correlation is positive. In these periods sterling was either depreciating or appreciating against both the deutschmark and the US dollar. During such periods membership of EMU would have entailed a much greater reduction in exchange rate volatility than emerges when the simulated volatility is derived using data since 1999.

Chart 6.8: Centred one year rolling correlation between the sterling-US dollar and sterling-euro exchange rates

Source: ECB and Bloomberg.

6.37 Chart 6.9 indicates the sterling ERI and UK-in-euro ERI derived from Bank of England ERI weights. The rolling one year volatility of these rates is shown in Chart 6.10.

6.38 The charts indicate that since 1999, sterling has experienced a period of stability compared with the previous years, at least over periods of a year or more. In 1992 sterling underwent a sharp depreciation on exit from the ERM and a rapid appreciation around 1997. These movements make the post-1999 appreciation against the euro look relatively small in comparison.

6.39 The reverse is true for the UK-in-euro ERI. Had the UK been in the euro in the 1990s, the large depreciation and even larger appreciation would not have occurred, so stability would have been improved. But, membership of the euro would also have meant experiencing the full effects of the euro depreciation against the US dollar in 1999 and 2000.
Overall, using Bank of England ERI weights, membership of the euro would have implied lower volatility measured over one year windows for the last decade. The effect on three-year volatility would have been even greater with similar volatility post-1999, but reduced volatility pre-1999.

Using a greater weight for the US dollar would reduce these differences by reducing the volatility of the sterling ERI and increasing that of the UK-in-euro ERI, but it would still show that during the 1990s, the volatility of the UK-in-euro ERI would, on average, have been lower if sterling had maintained a fixed exchange rate against the euro area currencies.
Conclusions

6.42 This section has examined the evidence of the possible effect on the overall volatility of the UK’s exchange rate in the event of UK entry to EMU. Measures of volatility need to be interpreted carefully. To the extent that exchange rate movements aid macroeconomic adjustment, some exchange rate volatility may be useful. But to the extent that exchange rate volatility disrupts the economy then it may be considered unwarranted. Summary measures of volatility are unable to distinguish whether observed volatility is warranted or not.

6.43 Since the launch of the euro, the sterling-euro and sterling-US dollar rates have often moved in opposite directions. During this period, the volatility of the US dollar-euro rate has also been substantially greater than the sterling-US dollar rate. This suggests that the elimination of sterling volatility against the euro could be offset to some degree by increased volatility of sterling against the US dollar.

6.44 That said, the analysis suggests that, in general, overall exchange rate volatility would tend to be lower if the UK were to join EMU. But this result varies in different contexts. The reduction in volatility is greatest in situations where, if sterling were independent, it would be moving against an unchanged euro-US dollar rate. In these circumstances, fixing the sterling-euro rate not only eliminates volatility against the euro, but also eliminates volatility against other currencies as well. By contrast, in circumstances of sharp adjustment in the euro-US dollar rate, the overall volatility of sterling might be higher within EMU than outside. While such circumstances have arisen in the past, and can be expected to arise in the future, the analysis suggests that more typical scenarios are ones in which the elimination of nominal exchange rate volatility against the euro area would outweigh any increase in sterling volatility against non-euro currencies.
7.1 This study has considered the question of whether nominal exchange rate flexibility aids macroeconomic adjustment, both in theory and in practice.

7.2 Optimal currency area theory highlights the conditions in which separate currencies may aid adjustment. It demonstrates that separate currencies may be beneficial in securing a real exchange rate change when other adjustment mechanisms, in particular wage and price adjustment, are sluggish. This is more likely to be the case when economies are not strongly integrated with each other, since this limits the extent to which price developments in one area get transmitted to another, and limits the extent to which resources such as labour and capital may flow between regions.

7.3 Irrespective of whether a country has its own currency or is part of a currency union, circumstances can arise in which its real exchange rate may need to change in order to maintain or restore macroeconomic balance. When nominal exchange rates are fixed, real exchange rate adjustment must necessarily come about through differential movements in inflation. That means that if the UK were in EMU, then UK inflation would tend to be higher or lower than the euro area average if a real exchange rate appreciation or depreciation were needed. Such changes have already occurred within the existing euro area, where inflation in the Netherlands has been relatively strong while inflation in Germany has been relatively weak.

7.4 Empirical analysis suggests that exchange rate movements have not been a significant source of shocks to the UK economy as a whole. Instead, exchange rate changes appear to have absorbed shocks that might otherwise have had a greater impact on UK output and prices. A striking example of this is sterling’s strong appreciation after 1996, which did not result in higher unemployment or a collapse in inflation, but nonetheless restrained the net export contribution to demand and probably alleviated some of the inflationary pressure that might otherwise have occurred.

7.5 Clearly, exchange rate movements impact more strongly on exporters and importers than on the economy as a whole, with large exchange rate changes posing particular difficulties. But the potential benefit of fixed exchange rates to the traded goods sector may be less than is sometimes claimed. As already noted, real exchange rates can still adjust when nominal rates are fixed, with adjustment coming through movements in relative price levels. Since it is the real exchange rate that influences the price competitiveness of exporters and importers in their respective markets, they will still find their price competitiveness will tend to rise and fall in response to the strength of economic activity in different markets. Since domestic prices tend to move more slowly than exchange rates, companies tend to have more time to adjust when nominal exchange rates are fixed, but they still remain subject to real exchange rate changes.

7.6 While nominal exchange rate volatility against other euro area countries would be eliminated if the UK were to join the euro, volatility against other currencies would still be present. In recent years the euro has been more volatile against the US dollar than sterling has been. If recent trends were to continue then this would offset some, but not all, of the reduction in nominal exchange rate volatility that would arise from fixing the sterling-euro exchange rate.
7.7 Overall, the analysis in this study suggests that movements in the exchange rate more often help to stabilise the economy than to destabilise it. Consequently, fixing the euro-sterling exchange rate would remove one of the adjustment mechanisms that is currently available to the economy. However, the analysis has also highlighted that this need not be costly, provided that other adjustment mechanisms, such as labour market flexibility and fiscal stabilisation operate effectively. These issues are considered further in the convergence and flexibility tests – the first and second of the Government’s five economic tests for EMU entry.


REFERENCES


This annex uses an SVAR model developed by HM Treasury to analyse the shocks that have affected UK economic outcomes over the past twenty years.

The model contains four variables:
- UK GDP;
- UK price level, as measured by the consumer expenditure deflator;
- UK real exchange rate, measured using the IMF measure of normalised relative unit labour costs; and
- UK interest rates.

Each of the four variables is regressed on past values of itself and of the other three variables. Results from these regressions are reported in Table A1.

### Table A1: Regression results for SVAR model of the UK economy

<table>
<thead>
<tr>
<th>Estimation period 1980 Q1 to 2001 Q4</th>
<th>Independent variables</th>
<th>Dependent variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output growth (-1)</td>
<td>0.3376</td>
<td>0.5346</td>
</tr>
<tr>
<td>Output growth (-2)</td>
<td>0.1151</td>
<td>-0.1308</td>
</tr>
<tr>
<td>Output growth (-3)</td>
<td>0.1281</td>
<td>-0.6700</td>
</tr>
<tr>
<td>Real exchange rate change (-1)</td>
<td>-0.0088</td>
<td>0.2715</td>
</tr>
<tr>
<td>Real exchange rate change (-2)</td>
<td>0.0100</td>
<td>-0.1011</td>
</tr>
<tr>
<td>Real exchange rate change (-3)</td>
<td>-0.0313</td>
<td>0.0275</td>
</tr>
<tr>
<td>Interest rate (-1)</td>
<td>-0.1875</td>
<td>3.3992</td>
</tr>
<tr>
<td>Interest rate (-2)</td>
<td>-0.4716</td>
<td>-2.8442</td>
</tr>
<tr>
<td>Interest rate (-3)</td>
<td>0.4911</td>
<td>0.8199</td>
</tr>
<tr>
<td>Inflation rate (-1)</td>
<td>-0.0038</td>
<td>0.1327</td>
</tr>
<tr>
<td>Inflation rate (-2)</td>
<td>0.0064</td>
<td>0.0591</td>
</tr>
<tr>
<td>Inflation rate (-3)</td>
<td>0.0065</td>
<td>0.0800</td>
</tr>
<tr>
<td>Constant</td>
<td>2.4488</td>
<td>3.2247</td>
</tr>
</tbody>
</table>

Source: HM Treasury.

The residuals from each regression represent ‘shocks’ to the system, in the sense that they are developments that could not be predicted from past observations of the variables in the system.

By applying appropriate restrictions, it is possible to convert the residuals into ‘structural’ shocks that have a clearer economic interpretation. There are a number of ways in which restrictions can be applied, each of which provides differing perspectives on the way that shocks tend to affect the variables in the model, both initially and in the longer term.

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SVAR stands for structural vector autoregression. The vector is the four variables estimated in the model, autoregression means that the vector is regressed on its own past values, and the structural element relies on identifying restrictions explained in the study.
In this annex, two different identification schemes are used. The first scheme loosely follows the approach used by Clarida and Gali (1994), and the second loosely follows that used by Artis and Ehrmann (2000). It turns out that, while the two schemes provide slightly different perspectives on how shocks affect the UK economy, they provide essentially the same insight into the relation between exchange rate changes and other economic variables.

Clarida-Gali style analysis: HM Treasury 1

The first way of analysing the model residuals follows Clarida and Gali (1994) by:

• constraining only one of the four shocks to have a permanent effect on the level of output, and denoting this as a supply shock; and
• constraining only one of the remaining three shocks to have a permanent effect on the level of the real exchange rate. This is labelled demand shock 1.

Demand shock 1 can be thought of as mainly reflecting demand shocks that have a different impact on the UK economy than on other countries. Such asymmetric demand shocks may require the real exchange rate to change, whereas common demand shocks typically do not. These shocks are not identical to those identified by Clarida and Gali, since their approach models relative output rather than UK output alone. Hence their supply shock captures asymmetric shocks but not symmetric supply shocks, and their demand shock captures asymmetric demand shocks. By contrast, the supply shocks in the model used here capture all permanent supply shocks impacting on the UK, both asymmetric and shared with other countries, while demand shock 1 resembles Clarida and Gali in capturing asymmetric demand shocks, but may also capture asymmetric supply shocks that affect output in the rest of the world but not in the UK. An extension of the model to include rest of the world output would enable these supply shocks to be separately identified.

The two remaining shocks cannot, by construction, have any permanent effect on either of the two real variables in the model (output and the real exchange rate), but may have a permanent effect on the price level. They may reflect real demand shocks that have a symmetric effect on the UK and other countries, or may reflect nominal shocks. They have been labelled demand shocks 2 and 3. These two shocks are separated by constraining one to include all interest rate policy reaction, while the other is not associated with an interest rate change.

This identification scheme implies the following:

• supply shocks may affect all four variables (output, the real exchange rate, interest rate and price level) immediately and may affect output, the real exchange rate and the price level in the long run; 1
• demand shock 1 may affect all four variables immediately, but only the real exchange rate and the price level in the long run;
• demand shock 2 may affect all four variables immediately, but only the price level in the long run; and
• demand shock 3 may affect output, the real exchange rate and prices immediately, but only the price level in the long run.

1 The structure of the model implies that there are no permanent effects on either inflation or the real interest rate, and accordingly no permanent effects on the nominal interest rate.
Annex A: Econometric Analysis of the Exchange Rate and Adjustment in the UK Economy

A11 Chart A1 illustrates how each of these shocks affects output, both initially and in the longer term. In each case a typical shock is applied, to allow a comparison of the relative magnitude of the impacts of each shock over different time horizons. This shows that demand shock 2 has most impact on output in the short run, while supply shocks tend to have a small effect initially, but to accumulate over time. By construction, the three demand shocks have no impact on output in the long run.

![Chart A1: Response of output to different shocks](image)

See text for details of how each shock is derived.
Source: HM Treasury.

A12 Chart A2 illustrates the impact of each shock on the real exchange rate. The fact that demand shocks 2 and 3 do not have a long run effect on the level of the real exchange rate is a direct consequence of the restrictions used to derive the shocks. But other features are not. In particular the finding that demand shock 1 tends to have a much larger initial impact on the real exchange rate than the other shocks is not an imposed feature.

1Technically, the typical shock is equivalent to the standard error of the derived structural shocks over the whole sample period (1980 to 2001).
Chart A2: Response of the real exchange rate to different shocks

Chart A3: Response of the price level to different shocks
A13 The price level moves in response to all four shocks, in both the short and long run (Chart A3). The largest short run influences are associated with demand shock 3. Demand shock 1, which is associated with large exchange rate movements typically has less effect on the price level than the other shocks.

A14 Interest rates tend to move most in response to supply shocks and demand shock 2 (Chart A4). As with prices, this suggests that they do not tend to be particularly responsive to exchange rate changes, since the latter are primarily associated with demand shock 1.

A15 An alternative way of analysing these results is to consider the question of how much each of the shocks contributes to the unpredictability of the four variables in the model. This is done by calculating the contribution each shock makes to the variance of the forecast errors for each variable over different time horizons (Chart A5). This illustrates clearly that real exchange rate unpredictability is overwhelmingly associated with demand shock 1. This result is very similar to that found by Clarida and Gali, even though they model the difference between UK and foreign output rather than UK output alone.

A16 Demand shock 1 contributes little to the unpredictability of output, the price level or interest rates. In other words, the shock that typically causes large exchange rate movements tends to have rather moderate effects on other macroeconomic variables.

A17 This analysis suggests that the exchange rate is not a significant source of shocks to the economy. It is also consistent with the proposition that the exchange rate may be a significant shock absorber, with movements in the nominal and real exchange rate acting to absorb the impact of real demand shocks on other variables.

**Artis-Ehrmann style analysis: HM Treasury 2**

A18 The second way of analysing the model residuals follows Artis and Ehrmann (2000) by:

- constraining only one of the four shocks to have a permanent effect on the level of output, and denoting this as a supply shock; and

- constraining only one of the remaining three shocks to have an immediate effect on output. This is labelled demand shock A1. Its properties are that it accounts for all unexpected changes in output that are not associated with supply shocks.

A19 The two remaining shocks are defined differently from Artis and Ehrmann. They are separated by constraining one to include all exchange rate movements. This is labelled an exchange rate shock. As a result of these restrictions, the fourth shock can have no immediate impact on output or the real exchange rate, but may have an immediate impact on interest rates and the price level. It turns out that it has very little effect on interest rates, and consequently may be viewed as a price level shock.
Annex A: Econometric Analysis of the Exchange Rate and Adjustment in the UK Economy

Chart A4: Interest rate response to different shocks

- See text for details of how each shock is derived.
- Source: HM Treasury.

Chart A5: Contribution of each shock to forecast uncertainty

- See text for details of how each shock is derived.
- Source: HM Treasury.
This identification scheme implies the following:

- supply shocks are identical to the Clarida-Gali scheme considered earlier. Hence they may affect all four variables (output, the real exchange rate, interest rates and the price level) immediately and may affect output, the real exchange rate and the price level in the long run;¹
- demand shocks may affect all four variables immediately, but only the real exchange rate and the price level in the long run;
- exchange rate shocks may affect the real exchange rate, the price level and interest rates immediately, but have no immediate impact on output. In the long run they only affect the real exchange rate and the price level; and
- price level shocks can only affect the price level and interest rates immediately, and only affect the real exchange rate and the price level in the long run.

Unlike the Clarida-Gali scheme considered earlier, all four shocks have permanent effects on the real exchange rate (Chart A6). However, the response of the exchange rate shock captures most of the variation in the exchange rate, both initially and in the longer term. In this respect it closely resembles demand shock 1 analysed earlier. By contrast, demand shock A1 tends to be associated with a more modest movement in the real exchange rate. These findings are similar to those of Artis and Ehrmann.

¹ The structure of the model implies that there are no permanent effects on either inflation or the real interest rate, and accordingly no permanent effects on the nominal interest rate.
ANNEX A: ECONOMETRIC ANALYSIS OF THE EXCHANGE RATE AND ADJUSTMENT IN THE UK ECONOMY

Chart A6: Response of the real exchange rate to different shocks

Chart A7: Contribution of each shock to forecast uncertainty

See text for details of how each shock is derived.
Source: HM Treasury.
A22 Analysis of the contribution of these shocks to forecast uncertainty confirms that exchange rate shocks account for almost all of the unpredictability in forecasting the exchange rate (chart A7). It also shows that exchange rate shocks contribute very little to the uncertainty in predicting output, the price level or interest rates.

A23 Comparison of Charts A5 and A7 shows that the exchange rate shock derived using the Artis and Ehrmann scheme has very similar properties to demand shock 1 derived using the Clarida and Gali approach. In both cases the shock accounts for a high proportion of exchange rate volatility, but a low proportion of the volatility of other variables. Although their respective properties are not identical, they are sufficiently close to suggest that the exchange rate shock in the second scheme could be considered to be demand shock 1 from the first scheme under a different name.5 Labhard and Westaway (2002) obtain a similar result.

A24 That the two approaches should provide broadly similar results is reassuring and arguably unsurprising. The different approaches provide different perspectives on the same model of the UK economy, and it would be more perplexing if they yielded very different results.

A25 Both approaches indicate that the shock that causes the real exchange rate to move has limited effects on other macroeconomic variables. This runs counter to the claim that exchange rate movements have been a significant source of shocks to the economy, and is consistent with it acting as a shock absorber.

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5 Indeed comparison of Charts A5 and A7 suggests: demand shock 1 in the first scheme broadly resembles the exchange rate shock in the second scheme; demand shock 3 resembles the price level shock; and demand shock 2 resembles, although less closely, demand shock A1. The supply shock is identical in both schemes, by construction.
Section 6 of this study considers the likely effect on the UK’s overall exchange rate volatility if the UK were to join EMU. In order to answer this question, a section of the analysis examines the impact of EMU membership on a UK-in-euro ERI. This UK-in-euro ERI is calculated by combining the bilateral rates for the UK with weights reflecting the importance of each rate for UK trade. This annex considers the issue of how to determine these weights.

The EMU study by HM Treasury on EMU and Trade shows that the euro area is the UK’s most important trading partner. Nonetheless, the importance of the euro relative to the US dollar may be overestimated by the official exchange rate index. Four factors are important:

- the definition of trade. Specifically, whether income flows from foreign investments should be considered;
- the existence of currency blocs. Countries can be assigned to a US dollar, euro or yen currency bloc on the basis of economic or other ties;
- differential regional growth. Relatively slow growth in the euro area means that the euro bloc may decline in importance for UK trade; and
- the existence of dollar-standard commodities. Trade in certain goods and services can also be attributed to the dollar bloc because they are typically traded in US dollars.

Two recent studies have considered whether income flows should be taken into account in the construction of the ERI:

- Bootle (2001) argues that analyses of the importance of different currency areas should take account of investment income flows as well as flows generated by trade in goods and services. Exchange rate movements affect the sterling value of UK income from abroad and the foreign currency value of investment income paid abroad. Therefore, exchange rate movements affect the profitability of foreign investment. This plays a role in determining the level of foreign investment, and therefore economic activity; and
- Huhne and Canning (2002), by contrast, suggest that income flows are irrelevant when the question under consideration is the effect of exchange rate movements on trade. Furthermore, not all UK income flows are related to activities that improve economic efficiency. Taylor (2002) notes that UK-based banks intermediating between non-residents give rise to income credits and debits in the UK current account that have no real effect.

On balance, it is important to pay attention to income flows when looking at the UK’s international exposure, but not so much when looking specifically at trade.

Measures of the ERI often split the world into three currency blocs, with individual currencies assigned to a US dollar bloc, euro bloc or yen bloc, depending on the strength of their link with these leading currencies. For example, Latin American currencies have close links with the US dollar, reflecting the region’s strong trade links with the US.
Annex B: Determining the Trade Weights to use in ERI Calculations

B6 Bootle (2001) argues that the US dollar bloc could also reasonably include much of Asia, the Middle East and some of Eastern Europe. The euro bloc is then made up of the EU, EFTA\(^{1}\) economies and some African countries with colonial links. Using this broad definition of the two blocs, and looking at the current account as a whole, Bootle estimates that 55 per cent of UK transactions are with the euro bloc. This is slightly lower than the whole of Europe’s share in the UK current account (see Tables B1 and B2 below). More importantly, this significantly increases the size of the US dollar bloc, which Bootle now estimates to account for about 40 per cent of UK transactions. The remaining 5 per cent of UK transactions are ascribed to a yen bloc.

B7 This definition of the US dollar bloc includes most of Central and Eastern Europe (CEE). For Russia this may be reasonable, given the reliance of its economy on the oil industry. But for countries such as the Czech Republic, Poland, Turkey and others, ties with Europe are much closer: they are geographically much closer to Europe; there is ongoing integration with existing EU members; and many of these countries are about to join the EU. Overall, it seems more reasonable to regard CEE (excluding Russia) as euro bloc members. According to Bootle’s figures, this collection of economies accounts for about 4 per cent of UK current account transactions.

B8 Tables B1 and B2 provide a geographical breakdown of credits (exports) and debits (imports) for the UK current account averaged over the period 1999 to 2001. It is immediately apparent that the euro area, and the EU more generally, is the dominant region with respect to the UK’s international trade. The EU accounts for over half of all UK trade in goods and services, while the euro area accounts for slightly less than half. For the current account as a whole, the EU is marginally less important but still represents about half of all current account debits and credits. This far exceeds the shares of the US and Asia, which both account for less than a fifth of all UK current account transactions.

Table B1: UK current account credits by region, per cent of category total (1999-2001 average)

<table>
<thead>
<tr>
<th>Region</th>
<th>Total</th>
<th>Goods and services</th>
<th>Goods</th>
<th>Services</th>
<th>Income</th>
<th>Transfers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euro area</td>
<td>45.3</td>
<td>49.1</td>
<td>54.5</td>
<td>36.0</td>
<td>41.1</td>
<td>13.9</td>
</tr>
<tr>
<td>add ECB and EU institutions</td>
<td>47.1</td>
<td>49.2</td>
<td>54.5</td>
<td>36.4</td>
<td>41.4</td>
<td>60.2</td>
</tr>
<tr>
<td>add rest of EU</td>
<td>50.1</td>
<td>52.7</td>
<td>58.0</td>
<td>39.8</td>
<td>43.7</td>
<td>61.2</td>
</tr>
<tr>
<td>add rest of Europe</td>
<td>57.8</td>
<td>60.0</td>
<td>65.0</td>
<td>48.0</td>
<td>52.5</td>
<td>63.0</td>
</tr>
<tr>
<td>US</td>
<td>19.1</td>
<td>17.6</td>
<td>15.3</td>
<td>23.3</td>
<td>22.3</td>
<td>18.1</td>
</tr>
<tr>
<td>Asia</td>
<td>13.3</td>
<td>13.6</td>
<td>12.3</td>
<td>16.6</td>
<td>13.1</td>
<td>10.6</td>
</tr>
<tr>
<td>Other</td>
<td>9.6</td>
<td>8.9</td>
<td>7.7</td>
<td>11.7</td>
<td>11.3</td>
<td>7.9</td>
</tr>
<tr>
<td>£million, 2001</td>
<td>426,826</td>
<td>267,771</td>
<td>190,050</td>
<td>77,721</td>
<td>142,660</td>
<td>16,395</td>
</tr>
</tbody>
</table>

Source: Office for National Statistics.

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1 EFTA is the European Free Trade Association. EFTA economies are Iceland, Liechtenstein, Norway and Switzerland.
Table B2: UK current account debits by region, per cent of category total (1999-2001 average)

<table>
<thead>
<tr>
<th>Region</th>
<th>Total</th>
<th>Goods and services</th>
<th>Goods</th>
<th>Services</th>
<th>Income</th>
<th>Transfers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euro area</td>
<td>42.9</td>
<td>48.8</td>
<td>48.8</td>
<td>48.6</td>
<td>34.5</td>
<td>14.5</td>
</tr>
<tr>
<td>add ECB and EU institutions</td>
<td>45.6</td>
<td>48.8</td>
<td>48.8</td>
<td>48.6</td>
<td>35.4</td>
<td>61.1</td>
</tr>
<tr>
<td>add rest of EU</td>
<td>48.3</td>
<td>51.9</td>
<td>52.2</td>
<td>50.9</td>
<td>37.5</td>
<td>61.9</td>
</tr>
<tr>
<td>add rest of Europe</td>
<td>58.9</td>
<td>60.7</td>
<td>60.9</td>
<td>60.0</td>
<td>53.4</td>
<td>66.1</td>
</tr>
<tr>
<td>US</td>
<td>16.3</td>
<td>14.5</td>
<td>13.0</td>
<td>19.5</td>
<td>22.1</td>
<td>7.2</td>
</tr>
<tr>
<td>Asia</td>
<td>16.8</td>
<td>17.0</td>
<td>19.0</td>
<td>10.5</td>
<td>17.4</td>
<td>10.4</td>
</tr>
<tr>
<td>Other</td>
<td>8.2</td>
<td>7.9</td>
<td>7.4</td>
<td>9.6</td>
<td>7.3</td>
<td>16.6</td>
</tr>
<tr>
<td>£million, 2001</td>
<td>443,197</td>
<td>290,080</td>
<td>223,659</td>
<td>66,421</td>
<td>130,046</td>
<td>23,071</td>
</tr>
</tbody>
</table>

Source: Office for National Statistics.

There are good reasons to think the relative importance of the euro bloc will decline over time. Developing economies tend to grow faster than developed economies, and most are in the US dollar bloc. In addition, and notwithstanding recent developments, potential growth in the US itself is still thought to be higher than in Europe.

There are, though, factors working in the opposite direction. Growth in the developing CEE countries is also likely to be relatively high, so pushing up their share of UK trade. Also, ongoing and future integration of CEE with the current EU should further boost UK trade with these developing countries. In addition, if the UK were to join the euro area, this would provide an additional stimulus to UK trade with the euro area, as discussed in the EMU study *EMU and Trade*. More generally, the wealth of the EU and its proximity to the UK means the euro bloc will remain a very important region for UK trade, even if this importance falls back in the future.

An example of this continuing importance is given in Bootle (2001). Using the more pessimistic of three scenarios, where EU GDP per capita grows at 2.5 per cent per annum compared to 3 per cent per annum for the rest of the world, Bootle projects that the existing EU will still account for about 33 per cent of UK current account credits in 2050. This is based on total current account credits, not trade, and ignores the likely enlargement of the EU or more general economic integration with CEE. Therefore, it is probably fair to assume the importance of the EU for UK trade will be higher than this figure suggests.

Beyond the country bloc aspects, trade in certain goods is US dollar related. Oil and gas are the obvious examples. The same argument may also apply to IT and pharmaceutical goods as well as financial and insurance services. On this basis, Bootle (2001) makes further adjustments to his estimates of the size of the euro and US dollar blocs. Assuming that 50 per cent of all UK trade in nine product categories\(^1\) and seven service categories\(^2\) is US dollar related boosts the size of the dollar bloc from 40 per cent of UK current account transactions to about 47 per cent. Equally, the euro bloc share is reduced from about 55 per cent to about 47 per cent. On this view, the two blocs are now roughly equal in size.

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\(^1\) Inedible crude materials, excluding fuels; Mineral fuels and related materials; Office machines and computers; Telecoms/sound recording apparatus; Professional/scientific instruments; Other transport equipment; Power generating machinery and equipment; Other commodity and transactions; and Medicinal and pharmaceutical products.

\(^2\) Transport; Communication; Insurance; Financial; Computing and information; Royalties; and other business.
B13 The assumption that 50 per cent of all UK trade in nine product categories and seven service categories is US dollar related can be assessed through UK Customs data. Table B3 presents currency of invoicing data by commodity at the SITC 4 one-digit level. While an even greater degree of disaggregation is ideally required, as is data on services, this still shows that the US dollar’s share in UK trade was about 50 per cent in only two major categories – crude materials and mineral fuels and lubricants – and two other less important categories. More typically, the US dollar was used as the currency of invoicing for between around 20 and 40 per cent of UK trade in the commodities shown.

**Table B3: UK trade, invoicing currency by commodity, per cent by value (excludes ‘other’ currencies, which constitute the remainder)**

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Sterling</th>
<th>euro + DM</th>
<th>US Dollar</th>
<th>Value (£m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food/live animals</td>
<td>56</td>
<td>13</td>
<td>18</td>
<td>20239</td>
</tr>
<tr>
<td>Beverages and tobacco</td>
<td>70</td>
<td>6</td>
<td>18</td>
<td>7450</td>
</tr>
<tr>
<td>Crude materials</td>
<td>32</td>
<td>14</td>
<td>48</td>
<td>8851</td>
</tr>
<tr>
<td>Mineral fuels and lubricants</td>
<td>38</td>
<td>6</td>
<td>53</td>
<td>25671</td>
</tr>
<tr>
<td>Animal and vegetable oils/fats</td>
<td>15</td>
<td>5</td>
<td>64</td>
<td>707</td>
</tr>
<tr>
<td>Chemicals</td>
<td>38</td>
<td>16</td>
<td>37</td>
<td>51 130</td>
</tr>
<tr>
<td>Semi manufactures</td>
<td>46</td>
<td>11</td>
<td>39</td>
<td>53 943</td>
</tr>
<tr>
<td>Machinery, transport, misc. manufactures</td>
<td>44</td>
<td>17</td>
<td>29</td>
<td>246011</td>
</tr>
<tr>
<td>Other commodities</td>
<td>49</td>
<td>0</td>
<td>44</td>
<td>2221</td>
</tr>
</tbody>
</table>

Source: HM Customs and Excise 2001 and HMT calculations.

Currency of invoicing

B14 This discussion of US dollar denominated commodities raises more general issues concerning the currency used to invoice all trade deals. The currency of invoicing is only important in the short term while currencies fluctuate around their equilibrium levels, and when firms are more likely to be already locked into currency transactions. In the medium to long term firms can shift the currency they invoice in if volatility is a persistent problem.

B15 In choosing to trade, a firm must make a choice regarding which currency to invoice in. Given the nature of trade, regardless of the currency the firm decides to use, there will have to be some form of foreign exchange conversion along the way. For example, if a UK firm decides to invoice in sterling, importers from overseas will have to convert their currency into sterling. If however, UK firms decide to invoice in foreign currency then, assuming they desire ultimately to hold sterling, they must convert after the sale.

B16 Conversion of foreign currency is not a costless exercise. Not only is there an administrative charge on the actual conversion, but holding a foreign currency for any period of time also creates risks for firms. Hedging is a common method of avoiding risk, although it is not always possible for firms with limited access to capital markets, and hedging itself imposes costs on the firm.

B17 HM Customs and Excise produce data on the currencies used to invoice UK goods trade. It is important to recognise however, that the coverage of this data is very limited. The sample covers only 1 1/2 per cent of all UK goods transactions, and less than 1 per cent of goods transactions with the EU, and so the figures are likely to vary greatly from year to year. Nevertheless, with this caveat in mind, the figures provide some pointers on invoicing behaviour.

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1 Standard International Trade Classification.
Turning to the data, table B4 unsurprisingly shows that sterling accounts for the greatest share of UK trade invoices, with US dollars the second most important. Nevertheless, the US dollar is not used in 66 per cent of all UK trade. That said, the US dollar is the most used currency for UK trade with non-EU countries, while the euro is rarely used for this type of trade. For UK trade with the EU, though, both sterling and the euro are more important than the US dollar.

Of course, these figures will partly reflect the euro’s position as a new currency, and its importance is likely to increase over time. A recent survey by the Engineering Employers’ Federation5 suggested that the euro is now more widely used in UK international trade, overturning the US dollar’s dominance in previous surveys.

### Table B4: Currency of invoicing for 2001 (per cent)

<table>
<thead>
<tr>
<th>Currency</th>
<th>EU</th>
<th>Non-EU</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>sterling</td>
<td>45</td>
<td>40</td>
<td>42</td>
</tr>
<tr>
<td>US dollars</td>
<td>18</td>
<td>52</td>
<td>34</td>
</tr>
<tr>
<td>euro + deutschmark</td>
<td>27</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>other</td>
<td>10</td>
<td>5</td>
<td>8</td>
</tr>
</tbody>
</table>

Source: HM Customs and Excise.

When interpreting the data it is important to bear in mind that these figures make no distinction between pricing in a currency and invoicing in a currency. This is best illustrated using an example.

Consider the situation of a UK exporter and euro area importer where the exporter rigidly prices in US dollars, which means they demand payment of a specified amount of US dollars. The bilateral exchange rates of interest here are the sterling-US dollar and euro-US dollar rates. If the US dollar appreciates against the other two currencies, the exporter gains and the importer loses, and vice-versa if the US dollar depreciates against the other two currencies. If the US dollar moves in opposite directions against sterling and the euro, then either both parties gain or both parties lose. Given these various possibilities, it seems unlikely that all traders would enforce rigid pricing in a third currency.

It seems more likely that there will be some flexibility when goods are invoiced in a third currency, particularly if the firms involved have an ongoing relationship. If one firm gains while the other loses from US dollar movements, then they can to some extent agree to offset the gains against the losses. An ongoing relationship makes this more likely because the firms will be aware that at some point in the future the situation could be reversed. Certainly, a flexible approach can prevent the scenario of both firms losing when the US dollar moves in opposite directions against their domestic currencies.

Under this flexible approach to the payment of invoices, the key exchange rate of interest is the bilateral sterling-euro rate. While the goods may be invoiced in US dollars, flexible pricing would mean that the sterling-US dollar and euro-US dollar rates are less relevant. At the extreme where an exporter only cares about revenue in domestic currency terms, regardless of whether the US dollar is used for invoicing, the bilateral rate that matters will be the sterling-euro rate. The same arguments can be applied where trade is invoiced in any third currency. The fact that the US dollar is used in invoicing a substantial proportion of UK transactions does not necessarily imply that it is much more important than less frequently used currencies.

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5Manufacturing and the euro – any change? Available at <www.eef.org.uk/Downloads/9896DF_Euro%20Survey%20Results%2020021.pdf>
ANNEX B: DETERMINING THE TRADE WEIGHTS TO USE IN ERI CALCULATIONS

Summing up B24 It seems clear that the US dollar’s importance exceeds the US share of UK trade or current account transactions. This is because the world can plausibly be thought to contain three currency blocs related to the euro, US dollar and yen. The main points are that:

- the euro bloc perhaps contains all of Europe (excluding Russia) and parts of Africa. The US dollar bloc is the rest of the world, excluding Japan;

- the importance of the euro bloc is likely to diminish somewhat because the majority of high potential growth regions of the world are outside of Europe.

- Against this, the EU is likely to enlarge to take in some high potential growth CEE countries and UK trade with the euro bloc countries could receive a further stimulus if the UK were to join EMU; and

- trade in US dollar-denominated commodities raises the US dollar’s importance further still, though less than some commentators have suggested. Equally, even where UK trade in invoiced in US dollars, this does not necessarily mean that the exchange rate vis-à-vis the US dollar is the main concern.

B25 Table B5 below shows the detailed breakdown of the different trade weights used in Section 5.

### Table B5: Weights used in the ERIs in Section 5

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Euro area + Denmark</td>
<td>66.53</td>
<td>45.40</td>
<td>55.00</td>
</tr>
<tr>
<td>Sweden</td>
<td>3.45</td>
<td>1.90</td>
<td>4.64</td>
</tr>
<tr>
<td>US</td>
<td>16.49</td>
<td>40.85</td>
<td>22.17</td>
</tr>
<tr>
<td>Japan</td>
<td>7.00</td>
<td>4.10</td>
<td>9.41</td>
</tr>
<tr>
<td>Norway</td>
<td>1.19</td>
<td>1.20</td>
<td>1.60</td>
</tr>
<tr>
<td>Switzerland</td>
<td>3.27</td>
<td>3.10</td>
<td>4.40</td>
</tr>
<tr>
<td>Australia</td>
<td>0.48</td>
<td>1.40</td>
<td>0.66</td>
</tr>
<tr>
<td>Canada</td>
<td>1.38</td>
<td>1.70</td>
<td>1.86</td>
</tr>
<tr>
<td>New Zealand</td>
<td>0.21</td>
<td>0.35</td>
<td>0.28</td>
</tr>
<tr>
<td>Total*</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>


* Final column does not sum to 100 due to rounding error.

B26 The official ERI weights are based on guidance from the IMF. For further information on the calculation of ERIs see the Bank of England Quarterly Bulletin, February 1995 (available at www.bankofengland.co.uk).