

Estimates of equilibrium exchange rates for sterling against the euro

EMU study by Professor Simon Wren-Lewis



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Estimates of equilibrium exchange rates for sterling against the euro

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to inform the assessment of the five economic tests*

The content and conclusions of this study are those of Professor Simon Wren-Lewis.

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

1 Short-term foreign exchange rate movements can often appear erratic, but economists generally believe that over the medium to long term there are basic forces (sometimes called ‘fundamentals’) which push a currency’s exchange rate towards an equilibrium exchange rate. Equilibrium exchange rates are defined in terms of the real exchange rate, which combines the nominal rate with measures of domestic and overseas prices. The equilibrium exchange rate (hereafter EER) can be thought of as a weak but steady attractor for the actual rate, gradually pulling the actual real exchange rate towards it.

2 This study examines the determinants of the EER, and surveys attempts to examine the implications for sterling in the medium term. It also provides some new estimates based on a model specifically designed to calculate an equilibrium exchange rate for the euro sterling rate, and examines how sensitive the EER is to alternative assumptions.

3 The concept of a medium-term EER is important in analysing possible entry into EMU. Under a flexible exchange rate system, deviations from the EER may be substantial and prolonged, but adjustment towards the equilibrium when it comes may be sudden, because the nominal exchange rate may move very quickly. Within EMU, the nominal euro sterling rate would be fixed. Consequently adjustment of the real exchange rate towards the equilibrium would have to take place through changes in prices, which may involve significant macroeconomic costs.

4 The strength of the US dollar and the weakness of the euro over the last few years raises the following issue. Should the focus be on an equilibrium effective rate for sterling (i.e. a rate against the rest of the world) or should it be restricted to an equilibrium euro sterling rate?

5 Only the euro sterling rate is fixed irrevocably if the UK joins EMU. If the UK entered the euro when sterling was overvalued against the euro, but the euro was undervalued against other countries, any subsequent correction in the euro rate against other countries as it adjusted to its EER would leave sterling overvalued against all currencies. It is therefore the euro sterling rate that is critical in relation to the UK’s possible entry into EMU.

6 There are four main methods that have been used to calculate EERs. The most straightforward of these is PPP (Purchasing Power Parity), which compares the prices of goods produced in two countries, and calculates the exchange rate that would equalise these prices. There are strong theoretical reasons for questioning how useful PPP is as an estimate of the medium-term EER, but it does have more validity as a measure of the long-run EER.

7 If PPP does not hold, the EER is likely to depend on a number of macroeconomic variables and relationships. The remaining methods of calculating EERs consider the real exchange rate as part of a complete macroeconomic system, which may be influenced by a number of macroeconomic forces:

- the first method examines a complete macroeconomic model, and its prediction for a medium-term equilibrium;
- the second focuses on one part of the macroeconomy – the determination of trade flows – and adds to this off-model projections for other key variables; and
- the third directly estimates a single exchange rate equation, and attempts to extract from this an estimate of the equilibrium rate.

8 These methods differ not so much in the theory they embody, but instead in the techniques they use to implement this theory. None of these approaches appear to dominate the others.

9 Taking a recent, well established example of each type of approach (including PPP) suggests a range for the euro sterling EER of 1.175-1.33 €/£. However, recent movements in both the exchange rate and current accounts throw some doubt on the estimates at the lower end of this range.

10 This study confirms these doubts by presenting a new estimate, using a new model of bilateral rates for the US, the UK, the euro area and Japan. The model follows the second approach identified above. In particular, it inputs exogenous assumptions about sustainable current accounts, and calculates the exchange rates required in medium-term equilibrium to achieve these current accounts.

11 On the assumption that the sustainable current account deficit is zero in the UK, 3.5 per cent of GDP in the US, and the euro area has a 1 per cent surplus, the model gives a medium-term EER for the euro sterling rate of 1.37 €/£.

12 While the model suggests a higher estimate for the euro sterling EER than some earlier studies using a similar approach, it still implies that the euro sterling rate has been substantially overvalued in recent years. However, the model does provide some ingredients for a potential explanation for this overvaluation.

13 Sensitivity analysis implies that capital inflows into the US, perhaps associated with productivity improvements, lead to significant upward pressure on the euro sterling rate. These flows are likely to have been larger in the past than they will be over the medium-term future. Combining this with short-term capital inflows into the UK associated with buoyant domestic demand, and relatively modest trade deficits as firms attempt to retain overseas markets, gives a possible explanation for the recent strength of sterling.

14 Of course, considerable uncertainties are attached to any estimates of equilibrium exchange rates, particularly concerning possible shifts in trade relationships and evaluation of the sustainable current accounts that may be associated with private sector net savings behaviour. It is conceivable, for example, that some of the factors generating the strength of sterling relative to the euro in the last few years may turn out to be much more persistent than expected, implying that the EER itself has appreciated. However, all the different methods of calculating the EER, including PPP, provide estimates well below the levels that sterling has reached in recent years. So the possibility that the EER could have appreciated to these levels appears remote.

INTRODUCTION^{1 2}

What is an equilibrium exchange rate?

1.1 Predicting short-term movements in exchange rates is very difficult, and many people attempt to make money from doing so. Although short-term foreign exchange rate movements can often appear erratic, economists generally believe that over the medium to long term there are basic forces (sometimes called ‘fundamentals’) which push a currency’s exchange rate in particular directions.

1.2 This study examines what those forces might be, and surveys attempts to examine the implications for sterling in the medium term. It also provides some new estimates based on a model specifically designed to calculate an equilibrium exchange rate (hereafter EER) for the euro sterling rate, and examines how sensitive the EER is to alternative assumptions.

1.3 It is difficult to pin down the concept of an EER more precisely without first asking why it is an interesting concept. A focus on an entry rate into monetary union is a way of specifying with greater clarity the relevant time horizon.

Equilibrium rates and entry into a currency union

1.4 A key to understanding equilibrium exchange rates is the concept of a *real exchange rate*. A real exchange rate combines the nominal rate with measures of domestic and overseas prices. If trade prices are used to convert nominal rates into real rates, then the real exchange rate is equivalent to a measure of international or bilateral competitiveness. Clearly the UK will continue to have a real exchange rate with other member countries after entry into Economic and Monetary Union (EMU). If the UK’s real exchange rate on entry differs from the EER, then the actual real exchange rate will move towards the equilibrium rate. As this adjustment will have to take place through changes in prices, it may involve significant macroeconomic costs. These costs could be avoided by suitable changes in the nominal exchange rate before entry.

1.5 Entering EMU at an inappropriate real exchange rate would not matter much if prices were highly flexible.³ Movements in domestic prices could easily correct any misalignment on entry. For example, if the UK entered EMU at an overvalued level of sterling, domestic prices would quickly and painlessly fall to bring the actual real exchange rate towards its equilibrium level. In these circumstances, flexible prices would mean that there would be no need to worry about the entry rate.

1.6 Although economists often work with models in which prices can move in this flexible fashion, in practice prices seem much more inflexible. The idea that prices might be inflexible lies at the heart of the Keynesian approach to understanding business cycles. With inflexible prices, the consequences of entering EMU at a nominal rate inconsistent with the equilibrium rate are much more serious.

¹ This study was completed by the autumn of 2002 and so is based on data available at that date. However, we would not normally expect a few quarters’ additional data to significantly influence any assessment of medium-term equilibrium exchange rates.

² I am grateful to Treasury officials for helpful comments on an earlier draft.

³ Flexible prices mean that the price level can move easily and quickly, without any noticeable effects on real magnitudes like output and unemployment.

1.7 To take a simple example, imagine the entry rate turns out to have been overvalued by 20 per cent.⁴ The economy would still move towards the equilibrium real rate, so domestic prices would have to fall to make this happen.⁵ Falling prices would almost certainly require deflation: lower output and higher unemployment. Suppose the rate of inflation in the rest of the euro area was 2.5 per cent per year. If it took eight years to converge to the equilibrium rate, it would require roughly zero UK inflation on average over this period. It would be as if the Bank of England's inflation target had been changed from 2.5 per cent to zero. The costs in terms of higher unemployment and lower output in achieving this reduction in inflation could be considerable.

1.8 The cost of an undervalued entry rate would be inflation above other EMU countries for a similar period. However, it is debatable whether the costs of going in at an undervalued exchange rate are as high as entry at an overvalued rate. A key consideration here is that at low inflation levels, the costs of a further reduction in inflation may be relatively high, particularly as it will require some prices or wages to actually fall. In addition, one of the normal costs of high inflation is the uncertainty it generates about future inflation. In the context of adjustment following entry at an undervalued rate, this uncertainty would not occur, because the long-run UK rate would be tied down by the European Central Bank's inflation target.

1.9 Inflexible prices are therefore at the heart of why the entry rate matters, but they also help define more precisely the relevant time horizon for any assessment of the equilibrium rate. An equilibrium rate which was only expected to manifest itself over a 20 or 30 year period would not be terribly interesting on its own, because over that long period adjustment through changes in inflation may be achieved at less cost.⁶ Instead the focus should be on the real exchange rate that is likely to occur over a medium-term time horizon of five to ten years.

1.10 While this time frame is considerably shorter than Keynes's famous description of the long run, it is long enough to be able to abstract from cyclical influences on the exchange rate. As suggested below, this also makes it possible to ignore any impact that monetary policy might have on the exchange rate in the short run when calculating an EER.

1.11 The EER can be thought of as a weak but steady attractor for the actual rate, gradually pulling the actual real exchange rate towards it. Under a flexible exchange rate system, deviations from the EER may be substantial and prolonged, but adjustment towards the equilibrium when it comes may be sudden, because the nominal exchange rate may move very quickly. When the nominal exchange rate is fixed or has been abolished, adjustment is likely to be steadier, but could involve substantial macroeconomic costs.

1.12 For an example of the costs that might be involved, it is necessary to look no further than the UK's brief period as part of the Exchange Rate Mechanism (ERM). The UK entered the ERM at a rate that was consistent with PPP-based estimates of an EER, but which more macroeconomic approaches suggested was significantly overvalued (Wren-Lewis *et al.*, 1991; Williamson, 1991; and Church, 1992). Opinion is still divided over whether the subsequent market pressure against sterling reflected this overvaluation, or was caused by other factors. (The new estimates presented in Section 4 also have implications for this period.) However, it seems highly likely that efforts to maintain ERM parity significantly aggravated the 1990-92 recession. Equally, if the UK had managed to maintain original parity within the ERM, it is likely the UK's recovery from recession would have been weaker and delayed (Hughes Hallett and Wren-Lewis, 1997).

⁴ In this study, the terms 'overvalued' and 'undervalued' are simply used as a shorthand for above or below the equilibrium exchange rate (see Annex A: Glossary of terms).

⁵ The assumption here is that there is a unique equilibrium real exchange rate, which is unaffected by nominal magnitudes and historical paths. Although this is a strong assumption, it is almost universal in economic theorising.

⁶ This is, of course, an issue of degree. If there were very large differences between medium and long run EERs, adjustment problems might still arise.

A rate against the euro or the world? **I.13** The strength of the US dollar and the weakness of the euro over the last few years raises the following issue. Should the focus be on an equilibrium *effective* rate for sterling (i.e. a rate against the rest of the world) or should it be restricted to an equilibrium euro sterling rate?

I.14 As UK trade (in both goods and assets) is more orientated to the United States and other US dollar related currencies than is trade in the current euro area, it is likely that any depreciation of the euro against the US dollar will tend to leave sterling somewhere between these two currencies. (For a model-based estimate of this effect, see Section 4.) A loss of competitiveness in relation to Europe can be compensated for by a gain in competitiveness relative to the US dollar. However, this state of affairs is only sustainable if the depreciation of the euro against the US dollar is permanent. Sections 3 and 4 discuss the prospects for the euro US dollar rate. That discussion suggests that the euro has been significantly undervalued against the US dollar over the last few years.

I.15 Only the euro sterling rate is fixed irrevocably if the UK joins EMU. If the UK entered the euro when sterling was overvalued against the euro, but the euro was undervalued against other countries, any subsequent correction in the euro rate against other countries as it adjusted to its EER would leave sterling overvalued against all currencies. As a result, any appreciation of the euro against the US dollar after the UK entered would erode UK competitiveness, forcing adjustment to come through domestic prices. It is therefore the euro sterling rate that is critical in relation to the UK's possible entry into EMU.

The structure of this study **I.16** Each main section of the study begins with a short summary. In addition, Annex A presents a glossary of a few of the main terms used in this study, some of which represent a useful shorthand but which may not be entirely standard.

I.17 The study begins in Section 2 by outlining different theories of what economic forces determine equilibrium exchange rates, and whether empirical evidence supports these theories. It first considers Purchasing Power Parity (PPP), and argues that this has a number of theoretical and empirical shortcomings, but that it is likely to be a better guide in the long run than the medium run. To move beyond PPP, the real exchange rate has to be seen as part of a complete macroeconomic system, which may be influenced by a number of macroeconomic forces. Section 2 outlines what some of the more important influences on the medium-term real exchange rate might be, and examines the relationship between the real exchange rate and the current account of the balance of payments. (Annex B contains more detailed discussion.) This section ends with a discussion of the relationship between actual and equilibrium real exchange rates, and how long persistent overvaluations or undervaluations might normally last.

I.18 Section 3 considers different methods of estimating equilibrium exchange rates. In the case of PPP, estimates attempt to directly compare the prices of a basket of similar goods in different countries. For more complex macroeconomic theories, the section outlines three broad methods of approach. The first examines a complete macroeconomic model, and its prediction for a medium-term equilibrium. The second focuses on one part of the macroeconomy – the determination of trade flows – and adds to this off-model projections for other key variables. The third directly estimates a single exchange rate equation, and attempts to extract from this an estimate of the equilibrium rate.

1.19 Each method is illustrated by examining one recent and influential study in that class. Collectively they suggest a range for the euro sterling EER between 1.175 €/£ and 1.33 €/£, and for the US dollar euro EER between 1.15 \$/€ and 1.25 \$/€. This implies that sterling has been substantially overvalued against the euro, and the euro undervalued against the US dollar, for a number of years. The section ends by considering what factors might have led these studies to underestimate the euro sterling EER, and possible evidence for underestimation.

1.20 One of the conclusions of Section 3 is that recent current account data may be inconsistent with some of these EER estimates. In short, both the UK current account deficit and the euro area surplus are not as large as might be expected if the sterling euro and US dollar euro rates were highly overvalued.

1.21 Section 4 examines this issue systematically by using a new model to estimate EERs for the US dollar, euro, sterling and yen. These results suggest that some of the earlier studies may have underestimated the strength of UK trade and interest flows, and as a result produced too low a figure for the euro sterling EER. In addition, they suggest that any strength in the US dollar against the euro caused by capital inflows into the US will also have led to a significant appreciation in sterling against the euro, because UK trade is relatively more orientated to the US. However, even when taking these factors into account, this new study suggests a figure for the euro sterling EER of around 1.37 €/£, well below rates observed in recent years. The study also suggests that, if substantial overvaluation continues, the UK current account deficit and euro area surplus are likely to rise.

1.22 Section 4 also examines the sensitivity of EER estimates to a number of uncertainties. The model can be made to produce a euro sterling EER close to recent actual rates by being very 'optimistic' on a number of fronts, such as the returns to UK assets held overseas, the behaviour of euro imports, and the size and persistence of inflows into the US. While none of these possibilities should be discounted, their combination seems far more improbable. However, this section does suggest that the recent strength in sterling may be at least partly explicable in terms of capital flows which have been fairly persistent, but which are unlikely to continue at the same level into the medium term.

1.23 The final section summarises the key points from each previous section to arrive at some general conclusions. There are four annexes. Annex A is a glossary of some of the key terms used in the study. Annex B is a more detailed discussion of some of the factors affecting medium-term EERs. Annex C outlines the modelling approach used in Section 4. Annex D describes in detail how estimates for trend current accounts, and hence EERs, were derived.

- While attractively simple, there are many theoretical reasons for doubting that the theory of purchasing power parity (PPP) is a good guide to medium-term equilibrium exchange rates (EERs). However, it may be more useful as a measure of the long-run EER. Empirical evidence suggests that there are a number of macroeconomic influences which may move the EER away from PPP levels over the medium term.
- Without PPP, it is necessary to take a macroeconomic approach to estimating a medium-term EER. Fortunately, the medium-term framework means that it is possible to ignore cyclical factors and the impact of monetary policy, with their associated short-term speculative capital flows. Unfortunately there may be many reasons for persistent medium-term capital flows that do influence the EER, and assessing the extent of these is very difficult.
- Although it would be expected that countries which were relatively cyclically buoyant would have overvalued exchange rates (relative to the EER), it is hazardous to try to assess the value of the EER on the basis of actual exchange rates and interest rates in any particular year.
- If the concept of a medium-term EER is to have any value, there should not normally be persistent overvaluations (or persistent undervaluations) relative to that estimate lasting over a decade. Persistent deviations from an EER that last for five or so years, however, are not sufficient to discredit an EER estimate.

2.1 The exchange rate is a price of one currency relative to another. Like many prices, it is determined in a market by the forces of supply and demand. Furthermore, the foreign exchange market involves many buyers and sellers making frequent trades, so prices should move quickly to clear the market. If we know what determines the supply and demand for a currency, we can in principle calculate what price will clear the market.

2.2 There are two main sources of demand for foreign currency: for buying and selling financial assets, and for trade in goods and services. The implications that each type of demand has for exchange rate determination are quite distinct. The analysis here begins with theories based on trade in goods and services, but returns to trade in financial assets later.

2.3 Although currency demands required for financial assets transactions dominate those for trade in goods and services on a day-to-day basis, over the longer term there are reasons for focusing on the trade side. Most people or institutions buy and sell financial assets to achieve a desired portfolio composition, or to profit from expected future movements in prices. A long-run equilibrium is defined as a state where prices are steady, and agents are happy with the composition of their portfolios. As a result, in this long-run equilibrium there will be no trade in financial assets, and therefore no demand for foreign currency on this account. However, trade in goods and services will still be taking place, so it is this trade that will determine the EER in the long run.²

¹ This section provides a highly selective account of models of the equilibrium exchange rate. For a more comprehensive discussion of empirical exchange rate models, see Frenkel and Rose (1995) for example.

² The key distinction here is between flows of goods and services, and stocks of financial assets.

PURCHASING POWER PARITY

Theory 2.4 Focusing on trade in goods and services to pin down the EER, the simplest theory is Purchasing Power Parity (PPP). This states that the exchange rate moves to equate the price of goods and services across countries. Like many important ideas in macroeconomics, it derives its attraction from highly simplified models of the world. 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. The idea easily generalises to the case of many goods, as long as these goods are produced everywhere and their location of production has no influence on consumer preferences. In this world, the EER is a constant,³ and moreover the nominal bilateral exchange rate consistent with the EER is simply the rate that equates a basket of goods in each country. This is the basis of the OECD estimates of PPP outlined in Section 3.⁴

2.5 This simple story illustrates many of the problems with PPP. Of course there are millions of types of traded goods, which are not all produced in every country and which are not perfect substitutes for each other. If the real exchange rate is defined in terms of producer prices, then any specialisation would lead to a breakdown in PPP.⁵ PPP, in terms of consumer prices, would also break down if consumers' preferences differed between countries (so they bought a different basket of goods). Barriers to trade, such as transport costs, prevent many goods being traded at all. (For goods that are traded, barriers to trade will also lead to a 'home bias' in consumption, causing a problem similar to that arising from different preferences.) The existence of non-traded goods may mean that the consumer price EER may change over time even if the producer price EER is constant (see the discussion of the Balassa-Samuelson effect below).⁶ For those goods that are traded, transport costs present a bounded region where prices can differ (see Obstfeld and Taylor, 1997, for example). In addition, if producers of any type of good have market power, then this will enable them to price to market, so the mark-up on costs becomes destination specific. This allows producers to cushion the impact of any change in nominal exchange rates on their price. (For an extensive discussion of reasons why PPP might not hold, see Williamson, 1994.)

2.6 It is important in discussing PPP to be clear about the time horizon involved. Suppose, for example, that it is accepted that for the reasons outlined above the forces of goods market arbitrage are weak in the medium run, so PPP will not hold. It may still be the case that other arbitrage forces may operate over *costs* in the longer run. Consider a depreciation in the nominal 'home' exchange rate generated by capital account outflows. The depreciation will make the price of home produced goods cheaper, generating a current account surplus to offset the capital account outflows. However, the depreciation also reduces the relative price

³ Suppose the price of UK goods increased by 10 per cent. Arbitrage would force a depreciation of exactly 10 per cent, leaving the real exchange rate unchanged.

⁴ This is not the only way of using PPP to estimate an EER. As the theory implies that, over some time frame, the EER will be constant, so it should be possible to recover its value from historical experience, using the regression estimation technique (see Section 3).

⁵ This is the basis of the widely used model of Obstfeld and Rogoff (1995), where each good is produced in only one country, but PPP in terms of consumer prices still holds.

⁶ One popular approach in the economics literature is to recognise the importance of non-traded goods, but to assume that the 'law of one price' continues to hold for all traded goods. In these models movements in the real exchange rate (using consumer prices) are governed by changes in the relative price of traded to non-traded goods (see the discussion of the Balassa-Samuelson effect below). However, these models are still close to PPP, because they assume perfect arbitrage in traded goods. Departures from PPP become more significant once allowance is made for different countries to produce different goods that are imperfect substitutes, where firms face downward sloping demand curves.

of home labour relative to overseas labour. Multinational companies will be tempted to relocate production in the home economy, thereby raising the demand for domestic currency. In this way demand moves towards the cheaper good because the location of production changes.⁷ However, this mechanism requires the movement of physical capital, and convex adjustment costs in changing capital mean that this process is likely to take considerable time. For this reason, PPP may be more appropriate to a long-run rather than a medium-term equilibrium.

2.7 As with many assumptions in macroeconomics, the issue is not whether there are reasons why PPP might not hold — there are many — but whether deviations from the PPP concept are important empirically.

Evidence 2.8 In recent years there has been an extensive literature on testing PPP, inspired in part by developments in cointegration analysis. There have been some excellent summaries of this work (e.g. MacDonald, 1995; Rogoff, 1997; Breuer, 1994). Much of the recent literature has examined whether the real exchange rate is stationary, which implies that it tends to revert to a unique mean. As PPP implies that the EER is constant, then a finding that the real exchange rate is non-stationary would be clear evidence against PPP. Many tests examine whether nominal exchange rates and prices cointegrate, with cointegration taken as confirming PPP. However, as Breuer (1994) points out, the coefficients on prices in the cointegrating vector are sometimes very different from unity, which makes this interpretation problematic.

2.9 It is important to note that this literature tests a weaker form of PPP, and not direct measures of PPP. While non-stationarity is clearly evidence against PPP, stationarity could still be consistent with a mean EER that was different from direct PPP estimates.

2.10 It is also important to note that even if the real exchange rate is stationary, it may take a considerable period of time for the exchange rate to reach this level. As such, stationarity may imply that PPP holds for the long-run EER, but not necessarily the medium-term EER. The key distinction here is whether deviations from PPP simply reflect Keynesian price rigidity, or more long lasting factors. Rogoff (1997) suggests that the degree of persistence of deviations from PPP seems to be too prolonged to be explained by nominal inertia alone. Breuer (1994) also notes that tests for PPP tend to be more successful if long samples are used.⁸

2.11 One, relatively benign, explanation for why PPP might not hold is the Balassa-Samuelson effect. This concerns the measurement of the real exchange rate, and stems from the existence of non-traded goods. The central idea here is that competition will force PPP to hold for traded goods, but not non-traded goods. If there are significant differences in productivity trends for non-traded goods between countries, then a measure of the real exchange rate that included non-traded goods (e.g. a consumer price based measure) could be non-stationary, even if PPP held for traded goods.

2.12 Can this effect explain any failure of empirical PPP tests? If real exchange rates are based on consumer prices, then measures designed to capture the Balassa-Samuelson effect appear to have explanatory power (see, for example, the Alberola *et al.* (1999) study discussed in the

⁷ A similar mechanism will operate in a world of the Dixit-Stiglitz type, where all production of each type of good is specialised in a single firm. In a long run in which there are no super-normal profits, the real exchange rate (in terms of producer prices) is tied down to technological parameters, including fixed costs.

⁸ A variant of tests for PPP are tests of the monetary model of exchange rates. As MacDonald (2000) notes, this is simply PPP plus a monetarist interpretation of price determination. Broadly this literature does not throw up any additional information about PPP that has not already been discussed, while measures of undervaluation or overvaluation based on this approach will be no more useful than PPP itself. Alternatively, PPP can be combined with UIP, and tests can be conducted of this joint model. (MacDonald (2000) describes this as CHEERs modelling: see Juselius (1995) for example.)

next section). However, correcting for the Balassa-Samuelson effect alone does not render the real exchange rate stationary. In addition, Engel (1993) shows that traded goods prices are generally more volatile than the ratio of traded to non-traded goods prices, which again suggests that the Balassa-Samuelson effect alone cannot explain deviations from PPP.

2.13 Indirect evidence against PPP also comes from aggregate trade equations typically used in empirical macroeconomic models. These suggest that movements in the real exchange rate have a significant but limited impact on net trade. If PPP held, then small movements in competitiveness should lead to large changes in exports and imports, but this appears not to be the case. This leads away from PPP towards structural macroeconomic models.⁹

MACROECONOMIC MODELS OF THE EER¹⁰

Theory 2.14 The theoretical criticisms of PPP discussed above inevitably lead to a view of the EER as one variable within a complete macroeconomic system. It would make little sense to ask what the equilibrium value of the real wage was without also asking about those factors influencing labour demand and supply, and the same point in principle applies to the real exchange rate. Does this mean that a theory of the EER must encompass all of macroeconomic theory? There are a plethora of open economy macroeconomic models — should this analysis cover them all?

2.15 Fortunately, the focus on a medium-term EER makes it possible to abstract from Keynesian effects caused by nominal inertia. Indeed many would define the concept of the ‘medium term’ as precisely the period it takes for the effects of nominal inertia to wear off, and this study follows that practice. Most economists would view Keynesian disequilibria as being relevant over a time span typical of a normal cycle, i.e. three to seven years.¹¹

2.16 One of the major advantages of abstracting from Keynesian effects is that it is possible to ignore monetary policy in assessing the EER. In the standard Keynesian view, monetary policy influences the real economy because of nominal inertia, but once that inertia dies away classical neutrality propositions hold. As a result, the relative interest rate setting behaviour of the Bank of England and the European Central Bank will not influence the EER, but instead will simply determine relative inflation rates (and hence nominal exchange rates) in the medium term.^{12 13 14}

⁹When focusing on the real exchange rate defined using consumer prices, then models that assume perfect arbitrage in traded goods and focus on traded/non-traded interactions can produce similar results to those based on imperfectly competitive goods markets. The key test between the two approaches is to look at the behaviour of the real exchange rate defined using producer or traded goods prices.

¹⁰The terminology here is not meant to imply that PPP ignores macroeconomic theory, but rather that once PPP is abandoned, it is necessary to consider the real exchange rate as part of a complete macroeconomic system. PPP allows a short cut, whereby the real exchange rate is independent of other macroeconomic decisions such as saving and investment. Others have called the framework described here the ‘external balance’ approach.

¹¹Although it might seem paradoxical to ignore Keynesian rigidities in calculating an EER when these rigidities are why the EER is important, it is in fact quite logical, because these rigidities are involved in the movement towards the EER under fixed exchange rates.

¹²In practice super-neutrality is unlikely to hold, but these effects should still be captured in the approach described below.

¹³The assumption that the EER is independent of monetary policy may seem strong, but it is almost axiomatic, on the assumption that money is neutral except for Keynesian price rigidities, and defining the medium term as the period by which all Keynesian price rigidities have disappeared.

¹⁴Abstracting from Keynesian effects in assessing the EER is not without risk. Perhaps the most widely cited reason why short-term Keynesian disequilibria might influence the medium term is not that prices are very slow to adjust, but that booms and recessions may have knock on effects which are highly persistent. Such ‘hysteresis effects’ are familiar from the discussion of unemployment in the 1980s. In the case of the EER, there is another hysteresis effect that operates through wealth, which is discussed below.

2.17 A large part of day-to-day transactions on the foreign exchange markets reflects reactions to, or anticipation of, differences in national monetary policies ('speculative' capital flows). If the EER is independent of monetary policy, then it is also possible to ignore the influence of these 'speculative' capital flows.

2.18 Speculation based on monetary policy is just one reason for capital flows; others include portfolio adjustment by financial institutions and foreign direct investment. As noted at the beginning of this section, in long-run equilibrium these flows will disappear. However, if interest is primarily in a medium-term time frame, then it is necessary to take into account potential capital flows that may persist over a considerable period of time.

2.19 Annex B outlines some of the factors that might lead to medium-term capital flows. They could reflect above or below average saving by the personal sector (both over time and among nations), foreign direct investment designed to exploit unusual profit opportunities, or deficits and surpluses run by fiscal authorities. In each case, highly persistent (but not permanent) capital flows are quite possible. For example, modern intertemporal consumption theory stresses how any disequilibrium in wealth may be unwound over a whole lifetime, or even longer if there are bequests. For firms, differences in real rates of return may be eliminated only very gradually, given the large adjustment costs associated with capital investment. Unfortunately, although the importance of these persistent capital flows over a medium-term time frame has been understood for some time (e.g. see Williamson, 1983), trying to assess what medium-term domestic net saving will be is perhaps the most difficult part of a structural EER analysis. It also goes to the heart of many of the difficulties in assessing the current position of sterling.

2.20 Besides medium-term capital flows, the EER will be influenced by any factor which leads to a change in a country's relative supply side performance over the medium term, or any medium-term change in the demand for its output relative to other countries. Annex B discusses some potential influences in more detail. In this context, different macroeconomic models are likely to emphasise different factors. A number of acronyms have been given to particular approaches in recent years: one of the best known is John Williamson's Fundamental Equilibrium Exchange Rate (FEER). However, the vast majority can be cast in the overall macroeconomic framework outlined in Annex B. Indeed, Wren-Lewis (1992) argues that approaches are more accurately distinguished by their method of estimation rather than their theoretical underpinning, and this seems consistent with more recent acronyms suggested by Clark and MacDonald (1999).

Evidence 2.21 The macroeconomic approach to determining the EER cannot be tested as easily as PPP, because it is more complex and diverse. There are many different macroeconomic models that represent specific versions of the framework outlined above. In addition, as noted in Section 3, there are also at least three different ways in which any particular model of the EERs can be estimated. Two of these involve constructing macroeconomic models (or partial models), and 'testing' such models by looking at their predictions for the real exchange rate is relatively rare.¹⁵ What can be said, however, is that these models generally allow PPP as a special case if competitiveness elasticities in trade equations are very large, but instead they typically find estimated elasticities to be fairly low.

¹⁵One exception is a recent, unpublished paper by Barisone *et al.* (2000), which generates EER estimates for the G7 using a partial equilibrium, FEER type model, and then examines whether these estimates cointegrate with actual EERs. The paper provides partial support for the FEER approach, and clearly rejects PPP. A rather more informal test of FEERs against PPP was provided by UK entry into the ERM. As noted above, our entry rate was close to the EER implied by PPP estimates, but a variety of macroeconomic approaches suggested a significantly lower EER for the DM/£ rate (Wren-Lewis *et al.*, 1991; Church, 1992; Williamson, 1991). Supporters of the macroeconomic approach might be tempted to view the UK's exit from the ERM as some sort of judgement between the two, but subsequent movements in sterling might support alternative explanations.

2.22 In one case, however, estimates based on the macroeconomic approach can be directly compared to PPP, and tested in a similar way. Reduced form approaches typically involve estimating an equation for the real exchange rate, using some of the factors outlined in Annex B as explanatory variables. If PPP held, then these additional variables should be insignificant. Of course it would be dangerous to cite one single study in this regard, because of the dangers of data mining (although this danger is less in studies based on cointegration). However, there are now a large number of studies which have found significant and robust influences from variables based on the macroeconomic framework, and in particular from net foreign assets, including some of those cited in Section 3. A particularly useful recent paper in this respect is by Lane and Milesi-Ferretti (2002), which examines the link between net foreign assets, the trade balance and the real exchange rate, taking into account international differences in rates of return.

2.23 If it is accepted that changes in net foreign assets can influence the EER, then it logically follows that there will be other influences as well, along the lines discussed in Annex B. Most of these additional influences are more difficult to capture than the link with net foreign assets, in part because of difficulties of measurement, so it is not surprising that here there is less consensus among reduced form studies. However, it seems reasonable to agree with MacDonald (2000) that, taken as a whole, these results comprise a considerable body of evidence in favour of a more macroeconomic approach.

EERS AND ACTUAL RATES: IMPLICATIONS OF THEORY

2.24 This section will address two related questions. The first is whether there is some way of relating actual exchange rates to EERs. The answer is in principle yes, using Uncovered Interest Parity (UIP), but it is subject to severe qualifications. The second question is how long actual exchange rates might deviate from the EER. This question is highly relevant when it comes to the euro sterling exchange rate.

Relating actual exchange rates to EERs

2.25 The discussion so far has distinguished between three different time frames: the short, medium and long run. The long-run EER involves stock and flow equilibrium, and implies an EER consistent with balance on the current account. It is here that PPP estimates are most relevant. However, for policy purposes, a concept of a medium-term EER may be more useful. In the medium term, the current account may not be in balance for a variety of reasons, and this will have consequences for the EER. The defining characteristic of the medium-term EER is that it abstracts from Keynesian disequilibria, as well as other short-term disturbances. This implies that the medium-term EER is independent of monetary policy but not fiscal policy.

2.26 One of the major reasons why short-term real exchange rates may differ from the medium-term EER, therefore, is because of actual and expected real interest rate differentials. It would typically be expected that these deviations from the medium-term EER are cyclical: an economy in recession would have lower real interest rates, and therefore an exchange rate that was undervalued relative to the EER. Note that in this case the terms undervaluation and overvaluation carry no implication that the exchange rate is in any sense 'wrong': indeed if the real exchange rate in a recession was not undervalued, one might question whether policy was appropriate.

2.27 A theory that is particularly powerful in linking the medium term and short run is UIP. In perfect capital markets and abstracting from risk, UIP states that the interest rate differential between two currencies must be equal to the expected change in the exchange rate between those currencies. Thus, if annual interest rates were 1 per cent higher in the UK than the euro area, asset holders would buy sterling until the expected annualised depreciation in sterling with respect to the euro was 1 per cent.

2.28 This simple equation might not hold if one currency was believed to be inherently riskier than another. However, if views about the relative risk associated with different currencies (risk premia) were relatively stable over time, then the relationship between changes in interest rate differentials and changes in expected appreciations or depreciations implied by UIP will still hold.

2.29 It is possible to combine UIP with estimates of an EER in an attempt to ‘explain’ the current level of the exchange rate. (For a good example, see Brigden *et al.*, 1997.) Some authors define the resulting estimate as a ‘short-run equilibrium rate’. The current exchange rate is equal to the EER at some point in the future, plus cumulated, expected, risk-adjusted interest rate differentials for the periods between then and now. Term structure information can be used to derive estimates of expectations about future interest rates.

2.30 Is it possible to run this kind of exercise ‘backwards’ to estimate an EER? To ask the same question in a different way: is it possible to use this kind of exercise with actual exchange rates as a ‘test’ of different EERs? In a qualitative sense the answer is often yes. It does tend to be the case that cyclically depressed economies tend to have exchange rates that are undervalued relative to the EER, and vice versa. However, going beyond this with actual numbers is much more hazardous. Market expectations about future interest rates are very difficult to establish with any certainty. In addition, the empirical backing for UIP theory is at best weak. While MacDonald and Nagayasu (1999) find some support, others are far more dismissive (e.g. Meese and Rogoff, 1988; Wadhvani, 1999). In practice, market participants regard estimates of EERs as highly uncertain, and may be reluctant to take bets on this basis for a pay-off that may only occur in five or more years’ time.

2.31 If UIP does not hold, then short-run exchange rate movements become more sensitive to short-term movements in the capital or current account. As noted at the outset, the exchange rate is determined by the supply and demand for currencies. Any short-term increase in the demand for a currency would raise its price. Under UIP, that additional demand is offset by additional supply, as speculators anticipate a future capital loss in holding the currency, because the additional demand is temporary (and assuming no change in interest rate differentials). Without UIP, there is nothing stopping the additional demand raising the price.

2.32 This observation is important, particularly in relation to recent developments, for the following reason. The analysis has identified a number of reasons for persistent capital flows that would imply a non-zero current account in the medium term. However, almost by definition, these flows will not be constant over time, but are likely to vary in size over their lifetime. In practice, EER estimates may be based on some average value of these flows, but there may be periods when the actual value of these flows may exceed this average, and in the absence of UIP this will influence actual exchange rates.¹⁶ Furthermore, there may be persistent movements in net national saving which are not thought to be prolonged enough to label medium-term, but which without UIP will lead the exchange rate away from the EER. An example might well be the recent strength in UK consumer demand and the associated increase in consumer debt.

¹⁶ Even if UIP held the actual exchange rate may still change, but this would be accompanied by a change in domestic interest rates.

How long might actual rates deviate from EERs? **2.33** While it may not be possible to link medium-term EERs and actual exchange rates at all precisely, it is still the case that over a medium-term horizon, actual rates are obviously expected to converge towards the EER. The only uncertainty here is the time period involved. It seems fairly clear that an estimate of a medium-term EER that suggested a currency had always been overvalued for the past 20 years would not be plausible.¹⁷ However, it is more conceivable that a series of shocks might just keep the actual rate above the medium-term EER for a decade.

2.34 The key test here is the persistence in the sign of deviations from the EER, not the size of year-to-year deviations. Large differences between actual rates and the EER from year to year are quite possible, caused either by large movements in expected short-term interest differentials (under UIP), by erratic capital flows or trade flows (without UIP), or by speculative bubbles. However, in each case these deviations would not be expected to persist into the medium term. As noted above, nominal inertia allows the monetary authorities to influence real interest rates over the course of the business cycle, but not beyond it. Speculative bubbles, although potentially powerful in the short term, eventually burst.

2.35 As a result, estimates of medium-term EERs that implied persistent overvaluation or undervaluation for two or three years are quite likely. Estimates that implied persistent misalignments over a decade are conceivable, but less likely. Unfortunately the situation for sterling, the euro and the US dollar in 2002 appeared to lie somewhere between these two points, as is shown in the next section.

¹⁷This is not the case for long-term EER estimates, such as PPP perhaps, where persistent deviations of the same sign could well last for decades.

- There are broadly four different ways of estimating an EER: direct PPP, reduced form regression analysis, partial equilibrium studies and full model estimates. Each have their strengths and weaknesses, and so all may be of value.
- This section examines one authoritative example of each type of study that has been completed over the last five years. These give estimates for the euro sterling EER of between 1.175 €/£ and 1.33 €/£.
- These estimates are quite different from actual rates observed over the last five years. A persistent deviation of this kind away from PPP may not be that surprising, as there are grounds for viewing PPP as a more reliable long-run rather than medium-term EER. However, the discrepancy between actual rates and the other EER estimates is more puzzling.
- Some part of this implied overvaluation is likely to be due to interest rate differentials, reflecting relative cyclical positions. However, it is unlikely that this factor alone can explain the extent of overvaluation.
- Another explanation is that countries have been experiencing substantial and sustained capital inflows or outflows, which are unconnected with monetary policy. The key issue then is whether these flows will be sustained into the medium term. For both the UK and euro area this seems unlikely.
- There are firmer grounds for sustained medium-term inflows into the US, reflecting favourable technological changes. A key issue here is how much these might impact on the euro sterling EER.
- Another possible reason for doubting these EER estimates is that, as yet, the UK current account deficit is relatively modest, as is the euro area surplus. Section 4 investigates whether recent trade flows might imply an upward revision to the euro sterling EER.

3.1 The previous section established two main theoretical approaches to estimating an EER. Under PPP, arbitrage in goods moved the real exchange rate back to some constant level, independent of other macroeconomic variables. If these arbitrage forces are only effective over the long term, then estimating a medium-term EER needs to take a more macroeconomic approach, which allows the EER to be influenced by a number of factors, including factors leading to persistent capital flows.

METHODS OF ESTIMATING AN EER

3.2 Applying these theories to data to estimate EERs can be done in a number of different ways. They can be divided into four main approaches, although there are inevitably some rough edges to this classification. The methods can be summarised as follows:

- direct estimates of PPP by measuring prices of similar baskets of goods across countries;
- a 'reduced form' equation approach, generally involving the estimation of a single equation for the exchange rate as a function of key, medium-term determinants;

- a 'partial equilibrium' approach, which estimates a model for aggregate trade flows, but uses off-model estimates for medium-term capital flows and other key variables; and
- a complete model approach, where the EER is the output from a complete macroeconomic model.

3.3 If PPP holds in theory, then only one of the first two methods would be used. Estimating a reduced form equation for PPP would involve little on the right hand side besides a constant and perhaps some variable to capture the Balassa-Samuelson effect. However, taking the more macroeconomic theoretical approach, all but the first method could be informative.

3.4 Many of the issues that arise in comparing these different methods are general to any macroeconomic variable. Issues that are specific to estimating an EER relate to its medium-term nature, and to the partial equilibrium approach, which exploits a particular feature of the EER. Discussing the approaches in reverse order helps clarify these points.

The complete macroeconomic model approach

3.5 The complete macroeconomic model approach includes the real exchange rate as one variable within a complete system of equations. This system will produce predicted values for each variable, including the exchange rate. If the model is explicitly medium-term (i.e. it abstracts from cyclical factors by ignoring nominal inertia), then the solution for the real exchange rate is the EER. Williamson (1994) presents an attempt to use a variety of different models to compute FEERs, standardising a number of assumptions. Wren-Lewis *et al.* (1991) use both the partial equilibrium model set out in Barrell and Wren-Lewis (1989) and the National Institute's complete macroeconometric model of the UK to analyse UK entry into the ERM.

3.6 In practice, most existing structural econometric models are not restricted to the medium term, and so a potential problem arises in disentangling the medium run from the short run. If the only interest is in the EER some years ahead, then this will not matter too much, as any forecast that far ahead should by definition be a medium-term equilibrium projection. Even if it would be useful to know what the model implies for the EER today, there are possible techniques to use, such as starting the forecast in the past, projecting equilibrium values for exogenous variables, and switching off any explicit nominal inertia parameters.

The partial equilibrium approach

3.7 The partial equilibrium approach attempts to estimate part of this complete macroeconomic system, but to treat the rest as an exogenous input based on judgement. Most models treat some of their variables as exogenous, in the sense that there is no feedback from the model to the value of these exogenous inputs. National models treat the rest of the world in this way. The motivation is mainly simplicity and clarity, and the validity of such conditioning depends on how realistic it is to assume that there is no feedback to these exogenous variables.

3.8 In the case of partial equilibrium estimates, the key exogenous inputs are medium-term capital flows (i.e. private and public sector net savings behaviour) and the cyclically-adjusted level of output. What is modelled in some detail are medium-term trade flows (possibly using cointegration to strip out the dynamics). The model can then be used to predict the trade flows associated with cyclically-adjusted output and any given exchange rate: the EER is the rate that produces a current account that matches the assumption about medium-term capital flows. As the model is explicitly medium term and ignores short-term dynamics, the problems of extracting medium-term values that can arise for complete macroeconometric models do not occur.

3.9 This approach was popularised by John Williamson (Williamson, 1985), who christened it the FEER (Fundamental Equilibrium Exchange Rate). Williamson describes the FEER as the real exchange rate consistent with “internal and external balance”. In this study, this is interpreted as abstracting from Keynesian cyclical effects and other short-term transitory shocks both domestically and overseas, although this may not be precisely what Williamson meant by these terms. Other EER measures, although going by different labels (e.g. the DEER used by the IMF), can be thought of as partial equilibrium approaches of a similar type.

The reduced form regression equation approach

3.10 The reduced form regression equation approach relates the exchange rate to a number of key explanatory variables, usually in a single equation, and uses the predicted values from this equation as the basis for an estimate of the EER. In principle, the same issues that can occur for complete models about how to extract an equilibrium rate arise here too. One technique that can provide some help is cointegration, which looks for relationships between non-stationary variables. Even in this case, however, it is necessary to distinguish between the predicted value of the exchange rate based on actual values of explanatory variables (which Clark and MacDonald, 1999, christen the BEER) and the value based on the ‘permanent’ value of these variables (which they call the PEER).

3.11 If all the explanatory variables in the regression were equivalent to exogenous variables in a structural model, then the regression would be an estimated reduced form of this complete model (see Stein, 1999, for example). However, typically authors have included variables that are endogenous as regressors, which makes the task of establishing the equilibrium values of these variables more complex than for a complete macroeconomic model. The normal approach to this problem is to use some statistical technique to establish these equilibrium values.

3.12 This categorisation of approaches can become blurred. For example, some authors have used a small system of equations to estimate an EER, but if little structure is imposed on the equations (e.g. the VECM model of Clark and MacDonald, 1999), then this approach is closer to reduced form estimates than partial or full equilibrium models. In some recent partial equilibrium models, reduced form models have been used for the exogenous inputs.¹

3.13 The regression approach nests PPP in a very simple way. If the real exchange rate is regressed on a constant then, if PPP held, this constant would be an estimate of the EER. Even if PPP is abandoned, it is still possible to use purely statistical techniques to attempt to extract a time series for the EER. This could be done for a single time series, using a variety of possible trend extraction techniques, or for a system of equations in a vector autoregressive (VAR) model.

Comparing the different methods

3.14 Each approach has its advantages and disadvantages, and there seems to be no compelling reason to favour one over the others. The relative merits of reduced form versus structural econometric modelling have long been debated, and are well known. The fact that the exchange rate is the variable being modelled does not impact on these general arguments.

¹ Clarida and Gali (1994) use identification methods first outlined by Blanchard and Quah in a three variable system involving the real bilateral exchange rate, relative output and relative inflation. The focus of this and later studies along similar lines is to decompose movements in the real exchange rate into responses to different types of shocks (e.g. nominal, real demand and supply, where only the latter two influence the real exchange rate in the long run). MacDonald and Swagel (2000) use this technique to extract the influence of the business cycle on the real exchange rate (where the business cycle combines nominal and real demand shocks). The focus of these studies is on the historical decomposition of real exchange rate movements, rather than an attempt to estimate an EER for any particular point in time.

3.15 The partial equilibrium approach is more particular to EER estimation, and its advantages and disadvantages can be most easily appreciated by comparing it to the complete model approach. Treating medium-term output and the current account as exogenous is not generally valid, because there is likely to be some feedback from the EER to these variables, although Driver and Wren-Lewis (1999) suggest that in some cases this feedback may be small. The fact that the medium-term current account and output are determined off-model has some practical advantages. In the case of output, there are a large number of estimates of the natural rate around, so here the partial equilibrium approach could be seen as having a positive benefit, making it easy to examine the sensitivity of the EER to different estimates of the natural rate.

3.16 Estimates of the medium-term current account are scarcer. Perhaps in response to this, some recent studies have estimated reduced form models for the medium-term current account, which result in an interesting mixture of reduced form and structural analysis. In both Faruqee and Dabelle (1998) and Barisone *et al.* (2000), fiscal policy is one of the variables influencing the medium-term current account, as would be expected from the theoretical discussion in Annex B. However, although estimating this input into the trade model may make the partial equilibrium method appear less ad hoc, it does not avoid the endogeneity problems noted above.

3.17 Are there any features which the methods themselves are likely to impart to estimates of EERs? It is generally the case that the larger the model, the less transparent the results become, although sensitivity analysis can overcome this to some extent. Single equation reduced forms suffer from a rather different transparency problem. Although it can be made quite clear how each variable is influencing the EER, it is often less clear what the theoretical story behind this effect is (see Wadhvani, 1999, discussed below). There is always the danger of spurious regressions or correlations based on underlying variables that are missing from the analysis.

3.18 The additional complexity of full model or partial equilibrium estimates is also an advantage when it comes to testing the plausibility of estimates. As was noted in Section 2, the EER can be thought of as the exchange rate that ‘delivers’ a ‘sustainable’ medium-term current account. If the model suggests the actual exchange rate is persistently overvalued, then if the model and its inputs are correct, it follows that the cyclically-adjusted current account should also be in deficit compared to the assumed equilibrium value. This is used as a check on two of the studies considered below.

3.19 Is there any reason to expect any systematic differences between EER estimates from any source and direct PPP estimates? In the past, FEER-based estimates for the US dollar and sterling have generally implied a depreciation relative to PPP, with the opposite result for Japan. One anecdotal explanation in the case of the UK – at least historically – is that the UK tended to be weaker when it came to non-price competition (e.g. delivery lags), which are not allowed for under PPP.

3.20 A minor issue that applies to all estimates of the EER relates to the extent to which they are normative in nature. This issue arose with FEERs, and the IMF defined a DEER as essentially the FEER but based on an optimal fiscal policy trajectory. (As Annex B shows, fiscal policy assumptions are important in both influencing the demand for domestic output and in deriving off-model estimates of the medium-term current account.) The issue of what medium-term fiscal policy is assumed to be, in principle pertains to all three approaches. Equally, none of the three approaches (including the FEER) needs to assume optimal fiscal policy: it could instead use a forecast for medium-run policy. In practice the distinction is unlikely to matter much.²

² Westaway and Wren-Lewis (1990) argue that a natural extension of the rational expectations principle is to base forecasts of policy on optimal policies.

The sensitivity of estimates **3.21** How reliable are the estimates produced by these various methods? Unfortunately this is a question that is much easier to ask than answer. Reliability in stochastic models can be assessed *ex ante* or *ex post*. *Ex ante* analysis generally assumes that the model is correct, and uses the uncertainty implied by the model's equation(s) to provide confidence intervals for its predictions. When the model involves many equations, stochastic simulation techniques have to be used. *Ex post* analysis looks at the predictive performance of a model after it has been estimated (i.e. at the accuracy of its forecasts). In this case errors will also contain mistakes that result from model misspecification.

3.22 A difficulty that arises for estimated EERs is that what is being predicted is not actually observable: there is not and never will be data on equilibrium exchange rates. With a long enough sample, tests could be constructed using actual exchange rate data: for example, the difference between the actual rate and the predicted equilibrium rate should be stationary. However, no one has been forecasting EERs for long enough to conduct such tests.

3.23 Nor is the *ex ante* reliability of EER estimates normally assessed formally. However, more informal analysis suggests that model-based EERs are subject to considerable uncertainty. A number of authors who have used partial equilibrium models have conducted a sensitivity analysis of their results to changes in exogenous assumptions. Driver and Wren-Lewis (1999) argue that results are more sensitive to 'plausible' variations in current account assumptions than assumptions about trend output or natural rates. This stems from the relative insensitivity of aggregate trade to real exchange rates already noted. They also suggest that the other major source of uncertainty in estimated 'structural' EERs lies in the trade equations at the heart of this analysis. Not only do import and export equations traditionally have large standard errors compared to many other macroeconomic relationships, but they are notoriously subject to apparent structural breaks. (These results are confirmed in Section 4.)

3.24 In these circumstances, there are two natural reactions. The first is to look more favourably on PPP estimates, which, if they are based on direct estimates of the type produced by the OECD (see below), involve no *ex ante* uncertainty at all. This is a simple error. If we lose a glove in a badly lit street, we do not go looking for it in a well lit square! The second reaction is to ignore estimates of EERs altogether, and conclude that the concept is in practice too imprecise to be useful to policy. This reaction might be understandable if well researched estimates were all over the place relative to actual rates, but is much more questionable in the context of estimates which generally point in a similar direction. (This would be like the Monetary Policy Committee doing nothing even when their fan chart suggested that there was an 80 per cent chance that inflation was going to be above 3.5 per cent, on the grounds that there was still a 20 per cent chance that inflation might be within the target range.)

ILLUSTRATING THE APPROACHES: FOUR RECENT STUDIES

3.25 This section illustrates each of the methods outlined above by considering one recent, well conducted, example of each type that has produced an estimate of an EER for sterling. The methods are considered in the same order as outlined above. Of course many more studies have been published in the last five years or so, and one approach is to list them all to give a range of possible estimates. However, this comprehensive approach is in fact less informative, as no attempt is made to distinguish either the quality of the study, or how independent it is from other studies. The studies listed below have all received wide recognition, and are of a high academic quality. In the discussion in the next section some other studies that may have generated different estimates are also noted.

OECD PPP estimates **3.26** Direct estimates of PPP are derived by comparing the same ‘basket of goods’ in two countries, and calculating the exchange rate that would make the two baskets equal in value. The OECD (in conjunction with Eurostat) has over many years published estimates of PPP. The most widely quoted are those for a bundle of goods representative of GDP itself. Their latest estimates for 2001 are for a US dollar euro rate of 1.16 \$/€, and a euro sterling rate of 1.33 €/£. (A rate of 1.4 €/£ is widely quoted. This is based on the estimate for 2000 published in 2001. The latest estimate for 2000 is 1.37 €/£, implying both a downward revision for 2000, and a fall in 2001 compared to 2000.)³

3.27 O’Sullivan and Doyle (2001) present an interesting analysis of the breakdown of PPP figures by expenditure category. The euro sterling PPP figure would be rather lower if the focus was on expenditure categories which contained a relatively high proportion of traded goods: UK goods appear to be relatively cheap in predominantly non-traded sectors, like construction or consumption services. Given the discussion above of the importance of the traded goods sector in determining the EER, this might suggest that the aggregate GDP PPP is biased upwards as an estimate of the euro sterling EER.

Regression based studies: Alberola et al. (1999) **3.28** This study by four IMF economists applies a panel cointegration analysis to 12 currencies. The regressions use a CPI based measure of the real exchange rate as the dependent variable, and include two independent variables: the ratio of the CPI to wholesale price index (capturing any Balassa-Samuelsion effects), and a measure of net foreign assets (cumulated current accounts). The coefficients on the first variable are all close to one, which in effect simply converts the independent variable into one based on wholesale prices (their Table 3, page 19). Net foreign assets have the expected sign, implying that an increase in these assets leads to an appreciation.

3.29 To use these regressions to calculate effective equilibrium rates, the independent variables first have to be set at their ‘steady state’ values. The study then translates these effective rates into bilaterals, by in effect inverting the process that is used to calculate effective rates.

3.30 Their analysis suggests an equilibrium US dollar euro rate of 1.26 \$/€, and a euro sterling rate of 1.25 €/£, both for the end of 1998.

Partial equilibrium studies: Driver and Wren-Lewis (1998) **3.31** Driver and Wren-Lewis (1998) estimate EERs for the G7 for both 1995 and 2000. This analysis focuses on estimated trade equations for each country, and combines these with off-model projections for the medium-term current account to obtain medium-term EERs (based on a global study by Williamson and Mahar, in an annex to Driver and Wren-Lewis). The trade equations are estimated as part of the study, while estimates of ‘internal balance’ are based on analysis by the OECD. The estimation period for the trade equations in their model ends at around 1995.

3.32 Driver and Wren-Lewis combine their estimates of EERs for Germany, France and Italy to obtain an approximation to a euro EER. They also convert their estimate of effective EERs into bilateral rates, using a similar method to Alberola *et al.* (1999). They suggest (for 2000) a US dollar euro rate of just under 1.25 \$/€. This is based on a sustainable current account deficit of 2 per cent of GDP for the US, a small deficit for Germany, but surpluses of around 2 per cent for France and Italy. (These latter surpluses are in part the counterpart to fiscal consolidation due to entry into EMU.)

³ Source: OECD: Main Economic Indicators. Direct PPP measurements tend to be conducted every three years and extrapolated for the years in between. Revisions are therefore likely when new direct measures are computed.

3.33 The sustainable current account for the UK is assumed to be a 0.2 per cent deficit. This produces an estimated EER for euro sterling of 1.2 € / £ for 2000. The study also provides an extensive sensitivity analysis, illustrating how the EER might change if the assumptions about output or the current account were different. For the UK, a move into surplus for the sustainable current account of 1 per cent of GDP would depreciate the FEER by about 4 per cent. Driver and Wren-Lewis also point out that this figure would decrease through time, as higher UK asset stocks would increase debt service (IPD) inflows, requiring a smaller trade surplus.

3.34 This study uses an approach which is conceptually similar to a model originally constructed in Barrell and Wren-Lewis (1989), which was used in Williamson (1994) and in Wren-Lewis *et al.* (1991). The latter focused on an EER for sterling at the time of ERM entry, and produced an estimate that was not far from the one calculated in Driver and Wren-Lewis. In addition, Williamson (1991) also independently calculated a FEER for sterling during ERM entry, which was similar to that in Wren-Lewis *et al.* (1991). Taken together, these studies show a consistent picture of an EER for sterling that is close to the level of the actual rate shortly after the UK's exit from the ERM, but well below the average rate over the last decade.

'Full model' approach: Church (1999) **3.35** Strictly this is a misclassification, in that Church imposes on the model an exogenous sustainable current account (a deficit of 0.2 per cent of GDP for the UK, taken from Driver and Wren-Lewis, 1998). However, in other respects, in particular trend output, he uses a complete model: the 1996 vintage of the HM Treasury model. Among recently published studies, it comes closest to the 'full model' method of estimation outlined above.

3.36 The analysis produces an estimate for the equilibrium effective rate through the 1990 to 1997 period. It suggests that sterling was about 18 per cent overvalued in the middle of 1997. As the model is restricted to the UK alone, no disaggregation across currencies is possible, so assuming a uniform overvaluation across all currencies implies an equilibrium rate against the DM of about 2.3 DM / £.⁴ This would equate to a euro sterling rate of 1.175 € / £.

3.37 The analysis also performs some sensitivity analysis with respect to the NAIRU (non-accelerating inflation rate of unemployment) and the current account. In particular, the model suggests that for every 0.1 per cent reduction in the sustainable current account, the EER would appreciate by about 0.5 per cent, which implies slightly greater sensitivity of the EER to the sustainable current account than in Driver and Wren-Lewis (1998).

3.38 The four studies are summarised in Table 3.1 below.

Table 3.1: Alternative EER estimates

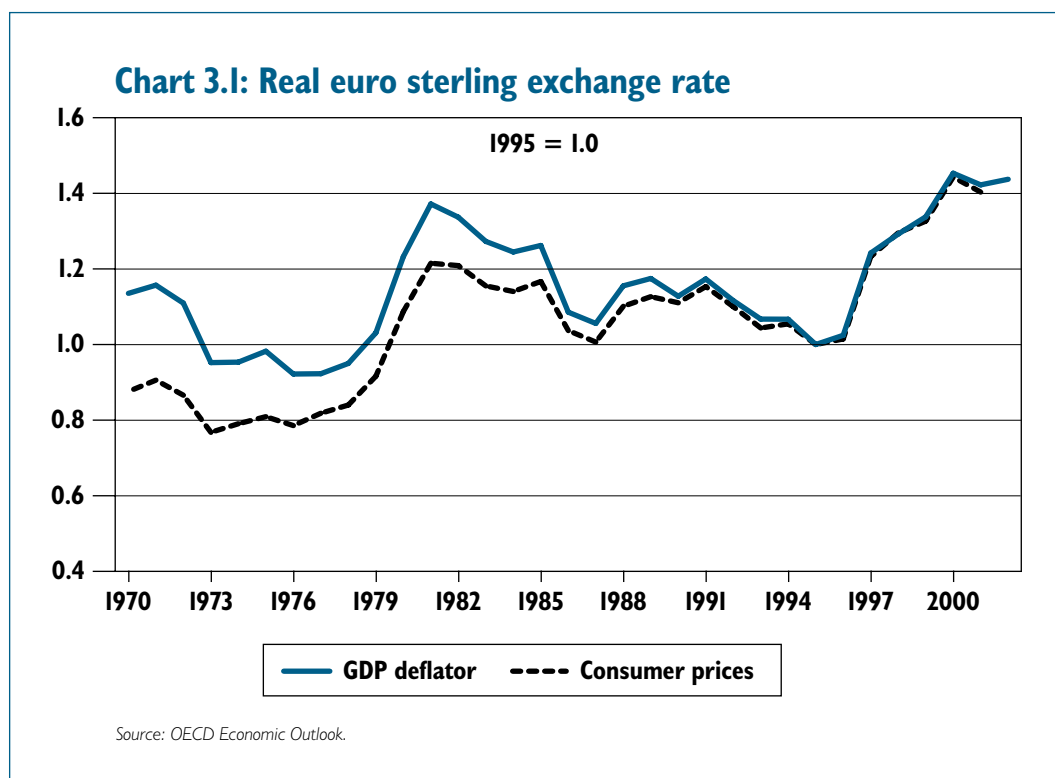
	€/£	\$/€
OECD (direct PPP)	1.33	1.16
Alberola <i>et al.</i> (reduced form)	1.25	1.26
Driver and Wren-Lewis (partial equilibrium)	1.20	1.25
Church (HM Treasury model)	1.175	–

3.39 There are two striking features of the numbers in Table 3.1. First, they are not too dissimilar, even though they use very different methods. The fact that the highest estimate for the euro sterling rate comes from PPP is not surprising: as noted above, partial equilibrium and full model based estimates at the time of entry into ERM were also below PPP estimates. Second, all the estimates are substantially below actual rates observed over the last few years. The next part of the analysis examines whether this fact alone should lead to suspicion of these EER estimates.

⁴ This may not be a very good assumption. Assuming that the euro is undervalued against the US dollar would imply an even lower euro sterling rate.

EER ESTIMATES AND RECENT DATA

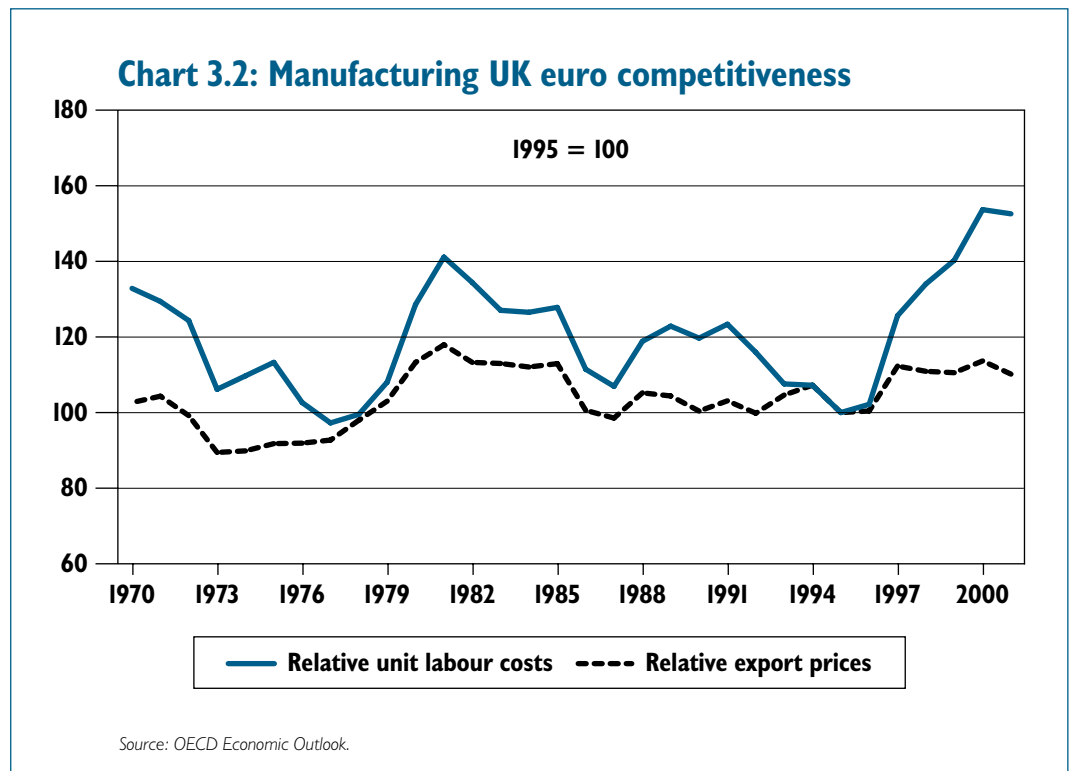
3.40 The EER is a real exchange rate. While all measures of the real exchange rate share in common an effective or bilateral nominal rate, they differ in the measure of prices used. Chart 3.1 plots two measures of the real euro sterling rate, using the GDP deflator and consumer prices.



3.41 The real appreciation before the UK joined the ERM, and the depreciation as the UK left, are clearly shown in this chart. Both are dwarfed in size by the extent of the appreciation in the last few years. The only comparable episode is the early 1980s, when sterling appreciated substantially, reflecting both the discovery of North Sea oil and tight UK monetary policy under the MTFS (Medium Term Financial Strategy). (Differences between the two series over the long run may simply reflect the way the series are constructed.)

3.42 Two natural reference points from which to measure the extent of the recent appreciation are levels in 1991, while the UK was in the ERM, and in 1993, after the UK left. To some, the former was close to PPP and the true EER, while to others the rate after leaving the ERM was closer to an EER. The UK's average real rate against the euro in 2001 had appreciated by 21 per cent compared to 1991, and 33 per cent compared to 1993 levels. (In both cases the GDP deflator measure is used, but figures using the CPI would be very similar.)

3.43 Both the GDP deflator and consumer price index contain the prices of many goods that are not traded. Chart 3.2 plots two measures of competitiveness. The first is the ratio of UK to euro area manufacturing export prices, both measured in US dollars. This shows a similar pattern to Chart 3.1, but the variation in the series is much smaller. This is because exporting firms tailor their prices to those of the competition, thereby reducing the volatility in the real exchange rate. The other series is for UK/euro unit labour costs. This series shows clearly the extent of the recent appreciation in sterling. Using this measure, the UK's competitiveness in 2001 had deteriorated by 24 per cent compared to 1991, and 42 per cent compared to 1993. In addition, on this measure the current UK position is significantly worse than in the early 1980s. A comparison of the price and cost measures shows clearly the extent to which UK manufacturers have squeezed profit margins in response to the recent appreciation of the euro sterling rate.



3.44 It is clear that there has been a very large appreciation in the real value of sterling over the last five years, producing levels of underlying competitiveness that could be worse than during the 1980-82 recession.

Do recent data suggest the models are misspecified?

3.45 Are these developments consistent with the estimates of the EER surveyed above? Taking each method of estimation in turn and accepting the arguments in Section 2 that PPP is a more useful guide to the long-run EER than a medium-term EER, then there is no problem here. The PPP estimates imply sterling is overvalued compared to its long-run equilibrium, but this overvaluation could persist for many years, as the forces operating to bring the rate back to PPP may take decades to operate. They may involve, for example, a decline in the amount of foreign direct investment (FDI) coming to the UK (and an increase in FDI by UK companies), because the UK is now an expensive place to manufacture.

3.46 The other studies are aimed at providing more medium-term measures of the EER. As noted in Section 2, persistent deviations away from equilibrium of the size implied by these estimates – although not unprecedented – are unusual. It naturally raises the concern that the EER produced by these studies may be wrong. However, it is too simple just to argue that the

studies are out of date. The EER is a medium-term concept, and it should not be sensitive to a few years' extra data. To examine possible misspecification, it is necessary to consider each type of study in turn.

3.47 The Alberola *et al.* (1999) study regresses the real exchange rate on a constant, net foreign assets, and a measure designed to capture the Balassa-Samuelson effect. As noted above, the latter essentially transforms a consumer price based measure of the real exchange rate into an output price based measure: as has been seen, both measures have shown the same marked appreciation over the last five years. Section 4 notes how the UK has moved from a net creditor to a net debtor over the last ten years or so: this would imply a depreciation in the EER, not an appreciation. Thus, their equation is incapable of generating the sharp recent appreciation in the EER for sterling. As it is estimated over the last two decades or so, it will inevitably produce an EER well below current exchange rates.

3.48 The only way a reduced form study of this type could produce an estimate of the EER close to current rates is to include some additional variable that explained such an appreciation. The widely quoted study by Wadhvani (1999) does just this. It focuses on the sterling Deutschmark rate, and uses an eclectic regression model to estimate an 'intermediate run' EER (ITMEER). He includes the two variables used in the Alberola *et al.* study (net foreign assets and the ratio of wholesale to consumer prices), but also adds the current account to GDP ratio and unemployment. Both these two variables help to explain a large part of sterling's recent appreciation. He also adds additional variables to capture short-term movements in the exchange rate. Using *current* (end 1998) values of these independent variables (i.e. using the terminology of Clark and MacDonald, a BEER rather than PEER), he suggests an equilibrium rate of 2.92 DM/£. At the euro conversion rate, this would give a euro sterling rate of about 1.5 € / £.

3.49 Wadhvani's description of his estimate as an 'intermediate run' rate is significant. He writes "there is little doubt that an exchange rate of DM 3, if sustained indefinitely, would inflict considerable pain on both UK manufacturing and agriculture. It is clear to me that the estimate of ITMEER should not necessarily be regarded as a level that is either socially desirable, or as one that would be obviously sustainable in any potential currency union." (Wadhvani, 1999, p. 423). His concern is rather to suggest that rates at this level are not inexplicable, and may persist over a two year forecast horizon.

3.50 The problem is how to interpret these results. If the current account and relative unemployment variables are capturing risk, then their influence on the exchange rate should die away in the medium term, as would the impact of interest rates themselves. If relative unemployment is capturing some supply side factor, or expectations of future trends in the current account, then its influence may persist into the medium term, but such an interpretation seems difficult to sustain. Wadhvani himself is very cautious about how long an impact this effect might have on sterling. Without identifying a convincing story of why the EER has changed, any reduced form regression approach will at best only produce half an answer.

3.51 Partial equilibrium and full model based studies are easier to interpret because they are more structural. Logically these models could be generating the wrong EER for two reasons: their model of trade is wrong, or their exogenous inputs are wrong. These two possibilities are now considered in turn.

The UK's sustainable current account deficit **3.52** Partial equilibrium exercises take as an exogenous input the value of medium-term capital inflows (often called structural inflows), which is the counterpart to a sustainable current account deficit, and is the sum of private sector net borrowing and the public sector deficit. As Driver and Wren-Lewis (1999) show, partial equilibrium EER estimates are highly sensitive to assumptions about the sustainable current account. The estimates in both Driver and Wren-Lewis (1998) and Church (1999) assume that the sustainable UK current account is approximately zero. If, instead, it is assumed that persistent capital inflows allowed a sustainable deficit, this would lead to an appreciation in the EER for the UK compared to the estimates in those studies.

3.53 Are there grounds for assuming a sustainable deficit for the UK? As far as the public sector is concerned, the UK's fiscal position does not look out of line with those of the euro area. On the other hand, one of the features of the UK economy in recent years has been the surprising strength of domestic demand, which does not appear to be simply cyclical.

3.54 There is the usual chicken and egg problem here: both investment and consumption are likely to be strong partly because of the appreciation in sterling. (The appreciation reduces the price of imported capital and consumption goods.) However, demand looks strong even after controlling for this effect. The problem for the UK is that it is very unclear what would justify persistent private sector net borrowing. Most of the conventional reasons for expecting medium-term imbalance outlined in Section 2 and Annex B clearly do not apply to the UK. For example, the UK does not have a particularly unusual demographic profile, so there is no reason to expect net borrowing on this account.

3.55 Business investment in the UK grew rapidly in 1996 and 1997, and has remained at a relatively high level since then, although it has shown some decline recently. Discussed below is the view that the US has seen a positive productivity shock, which would generate additional investment that would in part be financed from overseas or provided directly through FDI. Could the UK be experiencing a similar productivity shock to the US? The evidence for this seems to be weak: for example FDI outflows from the UK have risen by at least as much as FDI inflows, although figures are confused by merger and acquisition activity.

3.56 A detailed discussion of the recent behaviour of UK demand is beyond the scope of this study. However, it seems most likely that recent capital inflows, although persistent over a number of years, are unlikely to be sustained into the medium term. For example, even if current levels of UK consumer indebtedness are sustainable, further increases in debt would be required to generate continuing capital inflows. The analysis in the next section continues to assume that the sustainable UK current account is a zero balance, although it does look at alternative assumptions. However, putting UIP to one side, capital inflows that have occurred may well be partly responsible for the recent strength of sterling.

The euro area's sustainable current account deficit **3.57** The EER for the euro sterling rate does not just depend on the UK's sustainable deficit, but also the sustainable deficit for the euro area. There has recently been some discussion of a possible source of capital outflows from the euro that may account for the currency's weakness. Data show that the demand for euro currencies slowed significantly after the launch of the euro, and fell sharply in 2001. This decline in demand appears to originate from outside the euro area. According to the Bundesbank, in 1995 about one in three Deutschmarks circulated outside Germany – mainly in Eastern Europe and Turkey. It appears that a large proportion of these Deutschmarks have been converted into domestic currency and US dollars rather than euro. The reasons for this are unclear, but this would generate a significant excess supply of euro, which would – *ceteris paribus* – depreciate the exchange rate. However, once the adjustment in currency portfolios had been completed, the depreciation should be reversed. As with the UK, we have a potential explanation for recent movements in the currency, but which does not extend into the medium term.

The US's sustainable current account deficit

3.58 More promising ground is found by turning to the United States. The argument starts by assuming that there has recently been a large positive productivity shock in the US relative to the rest of the world, associated with IT products. This will generate capital inflows into the US (and into US dollars) for two reasons. First, investment opportunities in the US will increase, and this will attract funds from abroad. This is consistent with a marked increase in net FDI inflows into the US (see Bailey *et al.*, 2001). Second, US consumers will want to spend some of any future productivity gains now (because of consumption smoothing), resulting in a fall in domestic saving. Both effects raise the demand for US dollars.

3.59 It is very difficult to estimate how long such effects would persist. Even if the technological shock itself was already over, adjustment costs for capital investment mean that its effects on investment and therefore capital inflows could remain significant for a decade or more. However, at some point the productivity gains are likely to spread to other countries, reversing these effects. A best guess is that this is a candidate for medium-term capital inflows (and a corresponding increase in the sustainable US deficit). However, this effect will die away eventually (and therefore not influence the long-run EER), and there must be a risk that this dissipation will be more rapid.

3.60 While this is clearly relevant to the euro US dollar rate, does it imply anything for the euro sterling rate? Any capital inflows into the US have to come from somewhere, but if they came 'equally' from the UK and the euro area then there would be no net effect on the EER for euro sterling on this account directly. However, because trade in the UK is more orientated to the US than in other European countries, some impact on this cross rate might have been expected. Any appreciation in the US dollar will have more effect on UK trade, so to maintain the same current account in the UK relative to Europe, sterling will need to appreciate relative to the euro. Section 4 quantifies this effect, and finds it to be important.

3.61 To sum up, there are some grounds for believing that a positive productivity shock in the US may have led to a larger sustainable US deficit than the one assumed in Driver and Wren-Lewis, and larger than the average deficit observed historically (and therefore perhaps implicit in reduced form studies like Alberola *et al.*). This could impact on the EER for the euro sterling rate.

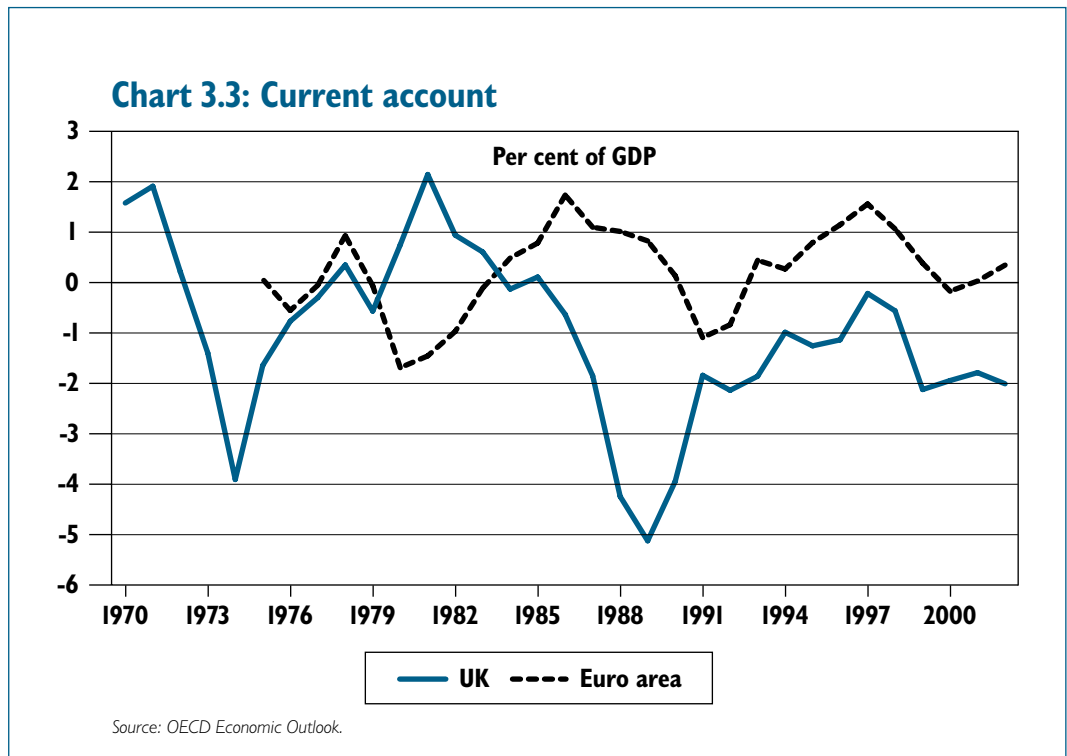
A structural shift in UK trade?

3.62 What about the second potential reason why the Driver and Wren-Lewis and Church studies might have underestimated the EER for the euro sterling rate: that they missed a favourable structural shift in UK trade? There is one obvious piece of supporting evidence here. Although sterling has been strong for a number of years, the current account deficit recorded recently has been relatively modest (see Chart 3.3 below). This cannot be explained by relative cyclical positions. Both studies would imply larger deficits. They suggest that a 1 per cent change in the sustainable current account to GDP ratio will lead to a 3-5 per cent change in the FEER. It is possible to reverse this, and say that, very roughly, a sustained overvaluation of, say, 20 per cent would lead to a cyclically adjusted current account deficit of at least 4 per cent of GDP.⁵

3.63 To put the point another way, suppose it is assumed that the UK's cyclically adjusted current account deficit at current exchange rates was, say, 2 per cent of GDP. Using a relationship between the EER and the current account of the kind implied by these studies (and assuming that in equilibrium that current account was balanced) would imply an EER of nearer 1.4 € / £ rather than 1.2 € / £. This is essentially the approach used in O'Sullivan and Doyle (2001).⁶

⁵ Of course, continuing deficits of this level would increase net national indebtedness, which would in itself lead over time to a depreciation in the EER.

⁶ These calculations will indicate an EER for the effective rate, not for the euro sterling rate. It is necessary therefore to make an additional allowance for any US dollar euro misalignment, as O'Sullivan and Doyle do.



3.64 So at first sight, the current (and forecast) UK deficit appears to be inconsistent with the EER estimate and parameters used in Church (1999) and Driver and Wren-Lewis (1998). There are two possible interpretations of this. The first is that there has been a gradual appreciation in the UK EER that these two studies did not pick up. The second is that UK trade has – at least on this occasion – not been as sensitive to exchange rate movements as these studies assumed. If this were a temporary phenomenon, it would imply that at current exchange rates the deficit will rise by more than forecasters are currently suggesting, essentially vindicating these two studies. If it was permanent, the EER implied by these studies might still be correct, but they overestimate the sensitivity of the current account to deviations from the EER.

3.65 This puzzle about current accounts is not confined to the UK. As Chart 3.3 above shows, the euro area surplus has hardly risen at all, despite the large gain in competitiveness that the euro area has received. Once again, this could be simply a result of lags, with no necessary implications for the EER, but it could represent a shift in trade, which would influence the EER.

3.66 To analyse both issues further a more detailed analysis of trade data is needed. This is undertaken in the next section.

- A new model determining bilateral rates for the euro, sterling, US dollar and yen is used to estimate EERs for 2002 and the previous ten years.
- The model suggests that, if mid-2002 exchange rates continued into the future, the UK current account deficit would rise, as would the euro area current account surplus.
- On the assumption that the sustainable UK deficit is zero, the model suggests an EER for the euro sterling rate of 1.37 €/£. A sustainable deficit of 3.5 per cent of GDP for the US, and a 1 per cent surplus for the euro area, imply a euro US dollar EER of 0.87 €/\$.
- These estimates are sensitive to assumptions about sustainable current accounts. In particular, an increase in the sustainable US deficit will imply a significant appreciation in sterling against the euro. The other major area of uncertainty for these estimates is the behaviour of certain trade flows, such as the volume of euro imports.
- While the model suggests a higher estimate for the euro sterling EER than some earlier studies using a similar approach, it still implies that the rate has been substantially overvalued in recent years. However, the model does provide some ingredients for a potential explanation for this overvaluation, based on short-term capital flows which are not speculative in nature, and which are unlikely to persist into the medium term.

4.1 This section presents new estimates of equilibrium exchange rates for the major currencies. These estimates come from a new model, which focuses on four economic areas: the US, the euro area, Japan and the UK. The model is in the partial equilibrium tradition discussed in the previous section: in particular, it inputs exogenous assumptions about sustainable current accounts, and calculates the exchange rates required in medium-term equilibrium to achieve these current accounts.

4.2 The model is used to address two questions raised in the previous section. First, by looking at recent trade data and comparing it with earlier experience, it is possible to ask whether there is evidence that the assessment in both Driver and Wren-Lewis (1998) and Church (1999) is too pessimistic. Is the relatively small UK current account deficit recorded in recent years an indication of an appreciation in the EER for sterling, or does it just reflect delays before a larger deficit occurs? Second, it is possible to examine the sensitivity of EER estimates to assumptions about medium-term capital flows, and in particular to investigate the extent to which any inflows into the US might influence the euro sterling EER.

4.3 This section is organised as follows:

- the model is briefly described – a full specification is outlined in Annex C;
- the model's predictions for a number of key elements of the current account are examined;
- the model's predictions for 'trend' current accounts are presented. These are the current accounts that would emerge at current or historic exchange rates, if the rest of the economy had been at its medium-term trend;

- this is then combined with assumptions about sustainable current accounts to derive estimates for bilateral EERs. The EER is the exchange rate that makes the trend current account equal to its sustainable level; and
- the final part examines how sensitive these estimates are, not only to assumptions about sustainable current accounts, but also other elements of the model including trend output and oil prices. There is also an illustration of what changes to the model would be required to produce an EER close to current exchange rates.

The structure of the model 4.4 The structure of the model is set out in Annex C. Although the model is clearly in the partial equilibrium mould, along with the Driver and Wren-Lewis (1998) study analysed above, it does involve one important innovation. Typically partial equilibrium models have estimated effective exchange rates for each country modelled, and these can then be transformed to recover bilateral exchange rates. This new model works with bilateral rates directly. As it models the euro area as a single bloc, it also avoids the need to aggregate individual euro area countries.

4.5 A major limitation of the model is that its equations are essentially calibrated rather than econometrically estimated. This is not quite as serious a limitation as it might first appear for two reasons. First, all the constants in the equations are estimated using static regressions to ensure that errors average zero over some time period. This period varies from equation to equation to avoid apparent structural breaks, but is normally at least 20 years and includes the latest data. Second, trade equations of the type that are at the heart of the model have been estimated many times in the literature, and this ensures that the model's parameters are consistent with econometric evidence at an informal level. Nevertheless, econometric estimation would be a useful further piece of evidence.

4.6 Each bloc of the model contains equations for the volume of trade, plus equations explaining total trade prices and the price of manufacturing trade. In each case trade is split between exports and imports. Together with an equation for net IPD (interest, profit and dividend) flows, this provides a complete model of the current account for each bloc, conditional on exogenous inputs for output, commodity prices, interest rates and asset stocks, and of course the exchange rate itself. The model is solved for an EER by finding the set of bilateral exchange rates that deliver current accounts equal to exogenous assumptions about their sustainable levels.

4.7 Interactions between blocs occur through two routes in the model. The first is through import volumes, which determine other countries' export volumes. The second is through export prices, which influence both the competitiveness of other countries' exports and domestic output as well as import prices.

4.8 There is also a residual rest of the world sector. At first sight it may appear as if there is a missing exchange rate in the system: the average rate for this residual sector. However, this rate appears implicitly through rest of the world export prices, which is an endogenous variable along with the model's explicit bilateral rates. The model allows rest of the world imports to respond to changes in this sector's competitive position.

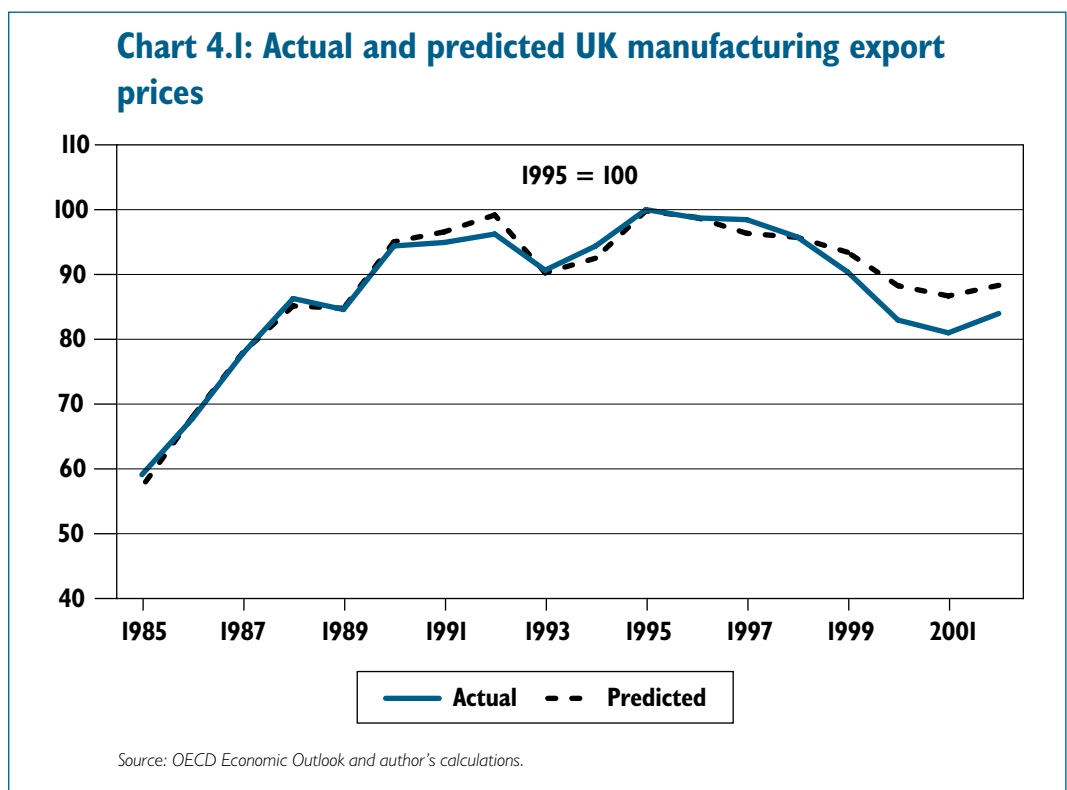
PUZZLES IN RECENT TRADE MOVEMENTS

4.9 A detailed account of the performance of each equation in the model and how it performs can be obtained from the author on request. Here a small number of relationships that turn out to be particularly important in the assessment are singled out.

UK export prices 4.10 It is traditional to model a country's export prices as a weighted average of domestic prices and overseas competitors' prices. Intuitively it might be expected that the weight on domestic prices would be higher for large, relatively closed economies than for the UK. (A model based on Cournot competition is one way to formalise this intuition.) However, even if a weight of only 0.4 is applied to UK domestic prices, then export prices over the last few years have been significantly lower than would have been anticipated. This suggests that exporters have had to squeeze margins significantly to stay in overseas markets.

4.11 This behaviour would be sensible if exporters expected the appreciation in sterling to be temporary. Given the sunk costs in entering markets, it would be better to sustain a temporary loss in profitability to stay in the market than incur the costs of re-entering the market later. The model also treats this phenomenon as temporary: in other words, in the medium term, export prices would be restored to the predicted line in Chart 4.1 below.

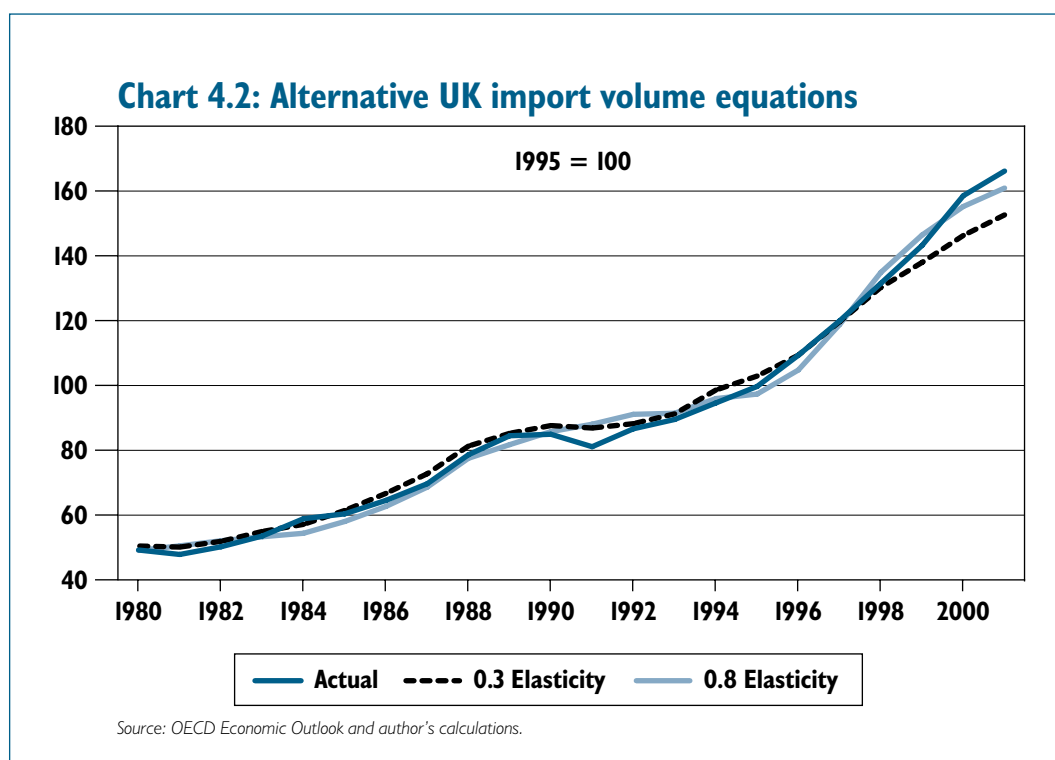
4.12 There is obviously a risk that this interpretation of recent behaviour is incorrect. It may be, for example, that exporters can sustain this apparent reduction in profitability indefinitely – in other words that UK export prices will be permanently lower. Lower export prices would have two opposite effects on the EER calculation: greater competitiveness would raise export volumes, but lower prices would also reduce the value of exports. The sensitivity of the model's estimates to this issue is examined at the end of this section.



UK import volumes 4.13 If there had been a structural improvement in UK trade performance, it might be expected to show up in either export or import volumes. In fact exports appear to have behaved in a fairly predictable pattern given historic behaviour, although the behaviour of export prices noted above has reduced the loss in market share implied by sterling's appreciation.

4.14 The position is less clear for UK imports. Until recently, the data appeared to suggest that the response of imports to changes in competitiveness was relatively small in the UK. If this is the case, then it is difficult to explain the strength of UK import growth. Chart 4.2 plots actual import volumes — against two alternative equations. In one, the competitiveness elasticity is 0.3, but the activity elasticity (parameter on GDP, logged) is nearly 1.9. (The equation is static, and the only additional term is a constant.) The chart shows a growing underestimation of imports over the last few years. The second equation has a competitiveness elasticity of 0.8. Imports still grow faster than predicted in the last few years, but the scale of underprediction is much less.

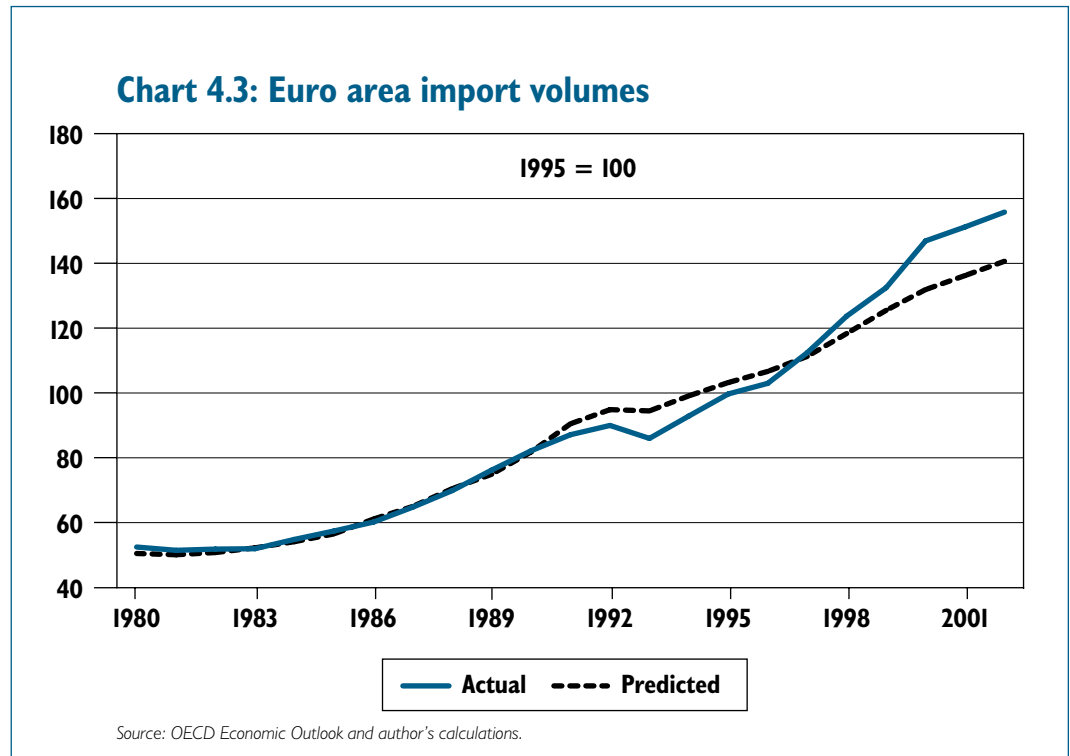
4.15 Could the underestimation of recent imports result from dynamic effects ignored by the equation? If imports were slow to respond to the recent appreciation, then a static equation would be expected to overpredict, not underpredict. As a result, the equation with the higher elasticity for the model has been chosen, although the sensitivity of the results to this judgement is also analysed.



Euro area import volumes **4.16** Section 3 noted how the euro area current account had not as yet benefited from the large depreciation in the euro. A major explanation for this lies in the behaviour of import volumes. Chart 4.3 below plots actual imports against the predicted value from a static equation with a competitiveness elasticity of 0.4 and an activity elasticity of nearly 1.9. It shows how euro area import growth in the last few years has been far greater than expected according to this equation.

4.17 In this case, lags in response could account for some of this import growth. In particular, if firms outside the euro area viewed the depreciation of the euro as temporary, they might attempt to maintain euro markets which were currently unprofitable but which might prove profitable at more normal euro exchange rates.

4.18 An alternative explanation for underprediction might be that the competitiveness elasticity in the equation was too high, but it is already on the low side. A third possibility is that there has been an unexplained shift upwards in import propensities in recent years, but there is no clear explanation for why this might have occurred. Once again an examination of how sensitive the calculations are to these alternatives is given in the final part of this section.

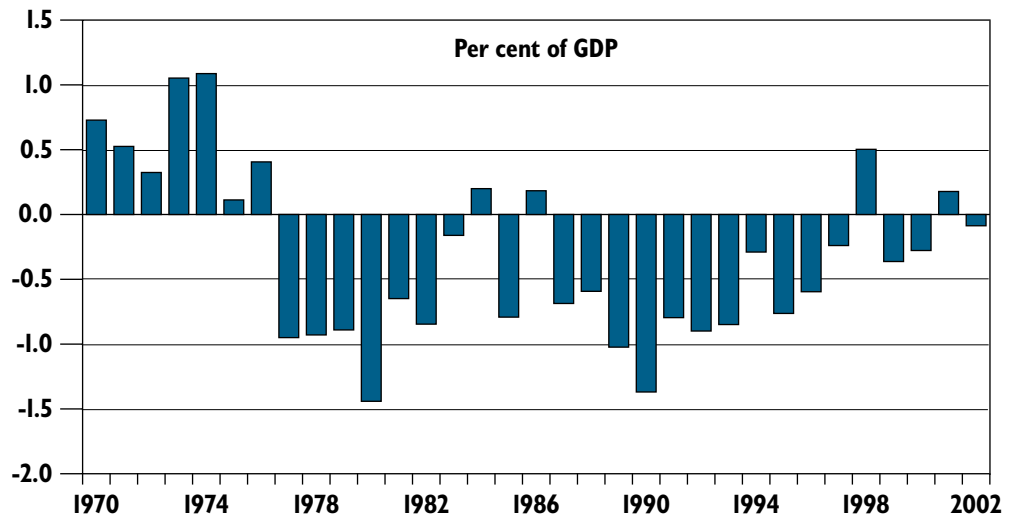


UK IPD flows **4.19** Chart 4.4 plots net interest, profit and dividend (IPD) flows into the UK. This shows that, while there were net outflows for most of the 1990s, in the last few years net flows have been roughly zero. (The measure shown here also includes transfers.)

4.20 These flows mainly reflect returns on assets of various types. Chart 4.5 plots IMF estimates of UK overseas assets and liabilities corresponding to these flows. Whereas in the 1980s the UK was a net creditor, by the end of the 1990s the UK had become a net debtor. Much of this is a simple response to exchange rate movements: an appreciation reduces the sterling value of overseas assets. The expectation, therefore, would be to see net IPD flows deteriorating in recent years, because the appreciation in sterling would also reduce the sterling value of interest receipts on these overseas assets. As Chart 4.4 shows, the opposite has occurred.

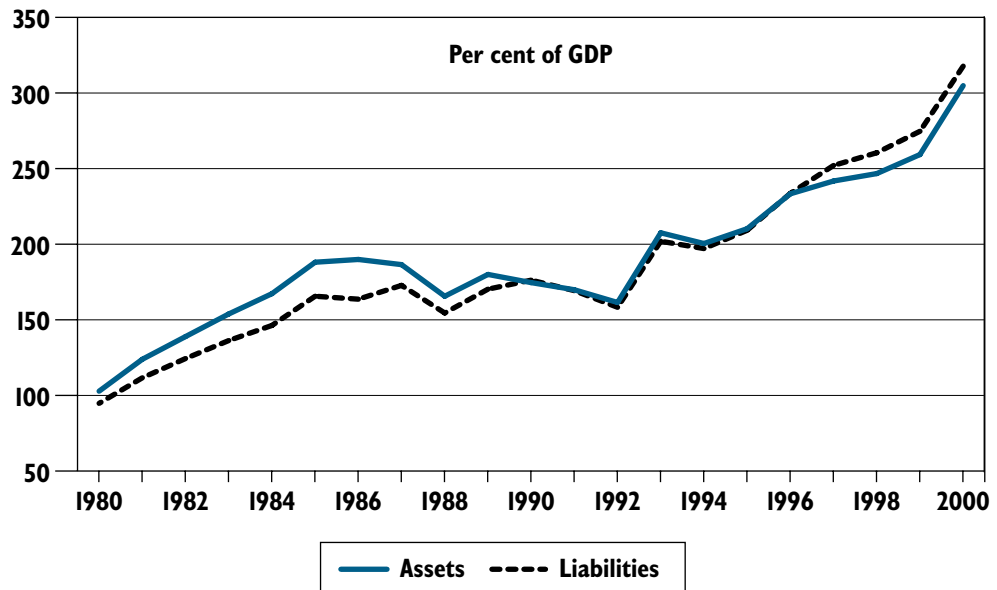
4.21 This is a major factor behind the relatively modest UK current account deficit recorded in recent years. (The other is the behaviour of euro imports discussed above.) A key judgement, therefore, is whether this improvement is temporary or permanent.

Chart 4.4: UK net IPD flows



Source: OECD Economic Outlook and author's calculations.

Chart 4.5: UK overseas assets and liabilities



Source: OECD Economic Outlook and author's calculations.

TREND CURRENT ACCOUNTS

4.22 Suppose that exchange rates are kept at historic levels, but output is put at its cyclically adjusted trend in each bloc, and also trade is put to its medium-term trend given these levels of demand. This means, for example, that any lags between exchange rate changes and their effect on trade flows are collapsed – there is no J curve. In these circumstances, what does the model suggest that current accounts would be?¹ In other words, what would be the underlying current accounts implied by historic exchange rate levels. These are termed ‘trend’ current accounts.

¹ No attempt is made to adjust asset stocks, which are kept at historic levels.

4.23 Table 4.1 gives the results, as a per cent of GDP, for three data periods, with actual levels at these dates in brackets. This looks at two-year averages to reduce any anomalies caused by sharp exchange rate movements. Annex D describes in more detail where these figures come from. Here some of the more interesting results from the perspective of the euro sterling rate are briefly discussed.

Table 4.1: Trend and actual current accounts (per cent of GDP)

	1990–91	1995–96	2000–01
Euro area	–1.0 (–0.5)	–0.6 (1.0)	3.6 (–0.1)
US	–1.8 (–0.7)	–1.3 (–1.5)	–5.3 (–4.3)
UK	–2.4 (–2.9)	1.7 (–1.2)	–3.4 (–1.9)
Japan	4.1 (1.7)	2.2 (1.7)	2.7 (2.3)

4.24 The first striking feature is that the trend deficit for the UK in 2000–01 is significantly larger than the actual deficit. The model suggests that, if recent exchange rates (specifically 1.09 €/£, 0.69 £/\$, 122 ¥/\$, 1.57 €/£) were to prevail, the UK deficit will rise. However, the discrepancy between actual and trend figures is even larger for the euro area. In fact both results stem largely from a common cause – the model’s prediction that euro area imports would be much lower than those actually recorded once the effects of the euro depreciation work through. (The UK deficit is also larger because of lower IPD flows, but lower import volumes partly offset this: see Annex D.)

4.25 The figures for 1995–96 are interesting because they provide an indication of the extent to which the analysis published in Driver and Wren-Lewis (1998) has proved to be robust. Although figures are not strictly comparable², these results are similar to theirs with one exception: the UK. The model suggests that the trend current account for the UK was a small surplus rather than the recorded deficit. Driver and Wren-Lewis had a slightly smaller deficit. This indicates that the model is more optimistic on UK trade than theirs, reflecting some of the points outlined above. The UK apart, however, Driver and Wren-Lewis’s claim that 1995 represented a period when the major economies were close to their medium-term trends appears to hold up well.

4.26 The results for 1990–91 are of some interest because this was when the UK entered the ERM. The trend deficit over this period confirms results in Wren-Lewis *et al.* (1991) and Williamson (1991) that the UK was overvalued. The implications of this are discussed below.

EQUILIBRIUM EXCHANGE RATE ESTIMATES

4.27 The assumptions about sustainable current accounts are set out in Table 4.2.

Table 4.2: Sustainable current accounts (per cent of GDP)

	1990–91	1995–96	2000–01	2002
Euro area	0.0	0.0	1.0	1.0
US	–2.0	–2.0	–3.5	–3.5
UK	0.0	0.0	0.0	0.0
Japan	2.0	2.0	2.5	2.5

² Driver and Wren-Lewis (1998) publish figures for 1995H1 rather than 1995–96, and they model Germany, France and Italy rather than the euro area.

4.28 The figures for 1995-96 are based on Mahar and Williamson's analysis in Driver and Wren-Lewis (1998). The deficit for the US is increased for the last few years to reflect inward investment following a positive productivity shock, with a corresponding move to surplus for the euro area and to a lesser extent Japan.³ There did not appear to be any strong case for a UK trend deficit, but sensitivity to this figure is examined below.

4.29 Table 4.3 shows the EERs required to achieve these sustainable current accounts.

Table 4.3: Bilateral equilibrium rates (actuals in brackets)

	1990-91	1995-96	2000	2002
€/\$	0.82 (0.76)	0.82 (0.77)	0.86 (1.10)	0.87
£/\$	0.64 (0.56)	0.64 (0.64)	0.63 (0.69)	0.63
Yen/\$	122 (139)	103 (101)	105 (114)	92
€/£	1.28 (1.33)	1.29 (1.20)	1.37 (1.59)	1.365

4.30 These results are a function of the gap between the sustainable current accounts in Table 4.2, and the trend current accounts in Table 4.1. A significant appreciation in the euro is required to reduce the trend surplus, while a large depreciation in sterling is needed to eliminate the trend deficit. In 1995, the euro area needs to eliminate a small deficit, while the US deficit needs to rise, which results in a depreciation in the euro US dollar rate. Sterling appreciates against the euro, eliminating the trend surplus.

4.31 Compared to the predictions of Driver and Wren-Lewis, this model suggests a higher value for the euro sterling rate for two reasons. The more important, which has already been signalled, is that the model takes a more optimistic view on UK trade. The second is that the assumption about sustainable current accounts is different. (If Driver and Wren-Lewis's assumptions about sustainable current accounts were plugged into the model, the EER for 2002 would be 1.325 €/£.) In other respects, however, the estimated EERs for 2000 are close to those in Driver and Wren-Lewis. Furthermore, the proposition in Driver and Wren-Lewis that exchange rates were close to their EERs in 1995 is replicated in this study.

4.32 The results for 1990-91 are of some historical interest. The euro (if it had existed) would have been overvalued against the US dollar – a depreciation is required to remove the trend deficit reported above. The yen is undervalued against the US dollar. Sterling is overvalued against the US dollar (14 per cent) and the euro (4 per cent). Although the latter is not large, using the conversion parity for the DM against the euro, this would imply an EER of about 2.5 DM/£, compared to the ERM central rate of 2.95 DM/£. The implication is that in 1990-91 the DM was undervalued against other euro currencies, which helps explain the subsequent collapse of the 'hard EMS'. However, sterling was also overvalued against the euro currencies as a whole, which helps explain why it was the first currency to come under attack.⁴

SENSITIVITY ANALYSIS

4.33 Before examining the sensitivity of the results to assumptions about sustainable current accounts and the specification of trade equations, it is worth noting some of the assumptions in the model that appear to be relatively unimportant. Assuming a country's trend output is higher means its EER depreciates to offset additional imports associated with

³ Suppose an unanticipated labour embodied technical progress shock implies US GDP will be 5 per cent higher, which in the long run requires a 5 per cent increase in the capital stock. With a capital output ratio of about 2.5, this implies additional investment of 12.5 per cent of GDP. If 60 per cent of that occurs in the first five years, and none of it comes from domestic saving, this implies capital inflows averaging 1.5 per cent of GDP over those five years. There may also be extra capital inflows to finance higher consumption in anticipation of higher future income.

⁴ Wren-Lewis *et al.* (1991) estimated a FEER for the UK of around 2.5 DM/£.

higher activity. However, this effect is not large. For example a 1 per cent increase in UK trend GDP would lead to a depreciation of about 1.3 per cent in the euro sterling EER. An increase in euro area trend GDP of 1 per cent would lead to a depreciation of about 2 per cent in the euro against both sterling and the US dollar. A 10 per cent increase in oil prices would, as we might expect, appreciate sterling against the euro, but the size of the effect is less than 1 per cent. These figures are small compared to the size of the current overvaluation.

4.34 Driver and Wren-Lewis (1999) argue that partial equilibrium studies are much more sensitive to assumptions about sustainable current accounts and trade equation misspecification, and this appears to be true for the model. Table 4.4 reports some sensitivity analysis for sustainable current accounts. The first column indicates alternative sustainable current account targets for each currency area.

Table 4.4: Sensitivity analysis on current account targets for 2002

	€/\$	£/\$	Yen/\$	€/£
Base (see above)	0.867	0.634	92.2	1.367
UK				
–1.5 per cent	0.864	0.612	92.2	1.412
–3.0 per cent	0.861	0.586	92.2	1.469
Euro				
2 per cent	0.893	0.638	92.3	1.399
balance	0.843	0.630	92.1	1.339
US				
–4.5 per cent	0.928	0.667	97.9	1.391
–2.5 per cent	0.811	0.602	87.1	1.347
US+euro				
E+1 per cent, U–1 per cent	0.967	0.679	98.9	1.425
Japan				
3.5 per cent	0.861	0.633	98.7	1.360

4.35 If the sustainable current account deficit for the UK was 3 per cent of GDP rather than zero, the EER for the euro sterling rate would appreciate to 1.47 €/£.⁵ This rate is also highly sensitive to assumptions about euro and US current account targets. Eliminate the euro surplus, and the euro sterling EER falls to 1.34 €/£.

4.36 An equally interesting variant is where the US sustainable current account deficit is increased by 1 per cent to –4.5 per cent of GDP. Both the euro and sterling depreciate against the US dollar, but there is also a significant appreciation in sterling against the euro. Thus the euro sterling rate is quite sensitive to changes in the US sustainable current account as well as changes in the euro or UK sustainable current accounts. This result provides an answer to a question posed in Section 3: could capital inflows into the US, associated with new investment opportunities following a favourable productivity shock, have an impact on the euro sterling cross rate? The model suggests a substantial effect. This is because an appreciation in the US dollar has a larger proportionate impact on UK trade than euro trade, requiring an appreciation in the euro sterling rate to prevent the UK moving into surplus.

4.37 This result has two additional implications. First, short-term capital inflows into the US which might have been larger still could explain a significant part of the recent appreciation in sterling relative to the euro. Second and more generally, the result indicates why ‘convergence’ between the UK and the euro area may not be enough if the position of the euro area and the US is very different.

⁵ When there is a change made to the sustainable current account for just one bloc, the model assumes that there is a corresponding change in the sustainable current account for the rest of the world.

4.38 Table 4.4 also shows a simulation that combines the euro and US variants: here the additional capital inflows to the US can be seen as largely coming from the euro area, rather than the rest of the world. The final variant increases the Japanese target surplus. This has only a minor effect on the euro sterling rate.

4.39 The previous part of this section examined some elements of recent trade performance that remained puzzling given the specification of the model. In the case of potential misspecification it is difficult to quantify uncertainty, but Table 4.5 provides some feel for the issues that matter most. For example, take the question of the unusually low level of UK manufacturing export prices. In 2000-01, prices were about 6.5 per cent lower than the model predicted, and in the main case this residual is eliminated. Assume instead that prices will be permanently lower, adjusting prices down by about 4 per cent. This has relatively little effect on the EER, essentially because there are offsetting effects on volumes and prices.

4.40 Unfortunately the model's results are less robust to uncertainty about UK import volumes. It was noted above that an historically high figure for the UK's competitiveness elasticity had been assumed, so as to capture the growth in imports following sterling's appreciation. Suppose instead that a much lower elasticity of 0.2 had been used. This would leave about an 8 per cent underprediction of imports in 2000-01, compared to about 2.5 per cent for the actual model. As this error is treated as temporary, medium-term UK imports would be much lower, with a corresponding appreciation of nearly 4 per cent in the euro sterling EER.

4.41 The sensitivity to euro imports is greater still. Recall that euro imports in 2000-01 were much higher than the model predicted (over 10 per cent), although some of this may be explained by lags in adjustment. This residual could be reduced slightly by halving the competitiveness elasticity, but this has little impact. If instead an unexplained upward shift in euro imports is assumed, reducing the residual to only about 2 per cent, the euro sterling EER would appreciate to 1.48 € / £.

4.42 For reasons already discussed above, misspecification in US trade equations can also impact on the euro sterling EER. In 2000-01, US exports were about 13 per cent above predicted levels, although this residual is expected to fall substantially in 2002 and could be partly explained by a lagged response to the US dollar's appreciation. However, shifting up medium-term US exports by about 8 per cent would improve the US current account, and hence lead to a marked depreciation in the euro EER relative to the US dollar, and a modest appreciation in the sterling EER against the euro.

Table 4.5: Sensitivity analysis to trade equations

	€/\$	£/\$	Yen/\$	€/£
Base case (2002)	0.867	0.634	92.2	1.367
UK manufacturing export prices constant shift	0.870	0.633	92.2	1.374
UK imports 0.2 elasticity	0.865	0.611	92.3	1.417
Euro imports 0.2 elasticity	0.870	0.634	92.2	1.372
Euro imports constant shift	0.938	0.633	92.4	1.483
US export volume constant shift	0.927	0.668	97.7	1.388

4.43 This sensitivity analysis can be used to provide one possible answer to the following question: what would need to be done to the model to generate an EER close to 1.6 € / £? There is obviously no unique answer to this question: the issue is rather whether any combination of adjustments is plausible. The first step might be to combine the positive adjustment to euro imports above, with an increase in UK IPD payments worth 1 per cent of GDP. (Analysis above noted how recent UK IPD flows had been unusually strong: this

adjustment would assume all of this favourable movement was permanent.) These two adjustments would have the combined effect of moving the trend euro area current account to a small deficit, and reducing the UK's trend deficit to around 2 per cent of GDP. The net effect would be to raise the euro sterling EER to around 1.52 € / £ (and the euro US dollar rate to 0.94 € / \$). The next step would be to assume that this UK deficit was in fact sustainable: this would increase the EER to about 1.58 € / £. A final step might be to increase the sustainable US current account deficit by 1 per cent of GDP to 4.5 per cent of GDP: this would produce 1.62 € / £ and a euro US dollar rate of exactly unity.

4.44 It has already been suggested that none of these changes are likely. There is no obvious reason for this shift in euro import behaviour, or for any permanent improvement in returns to UK overseas assets. There is as yet nothing to justify persistent UK deficits of this size, and persistent US deficits of 4.5 per cent of GDP would appear to put the US economy in a very poor position in ten years' time. While individually unlikely, their combination is even less probable.

4.45 However, while this may not look like a probable medium-term scenario, it might well help provide a tentative explanation for the recent strength of sterling against the euro. Take capital inflows into the US for example. While a favourable productivity shock might justify inflows worth about 1 per cent of GDP over a medium-term horizon, these inflows could well be significantly larger in the short term. While convex adjustment costs for capital would imply additional investment over a prolonged period, that investment is likely to initially peak before gradually declining. In the case of the UK, consumer indebtedness has increased substantially over the last five to ten years, and this would, *ceteris paribus*, imply significant capital inflows into the UK. While it may be reasonable to assume that this increase in indebtedness is unlikely to continue much further, the inflows that have already occurred will have strengthened sterling.⁶

⁶ Strictly, the theoretical framework only suggests that capital flows should be excluded due to cyclical factors, including speculation about monetary policy. The remaining flows could be fairly volatile. The reason why fairly smooth series for sustainable current accounts are assumed (as in Table 4.2) is the difficulty in empirically separating speculative from other capital flows.

5.1 The equilibrium exchange rate is the rate to which the real exchange rate will tend over the medium term, whether the UK is inside or outside the euro. If the entry rate of sterling into the euro is overvalued, then this move towards the equilibrium rate would require UK inflation below the average euro rate, which in turn could involve significant costs in terms of unemployment and bankruptcies. The costs of joining at an undervalued rate would be a period of above average inflation. For this reason, estimates of the equilibrium euro sterling rate matter.

5.2 This study has looked at four recent studies, each of which take a different approach to estimating equilibrium rates. They put the medium-term value for euro sterling at between 1.175 €/£ and 1.33 €/£. However, the studies at the lower end of this range may be outdated, as recent trends in UK trade appear to have been rather more favourable than they assumed. This study has presented a new estimate, using a new model of bilateral rates for the US, the UK, the euro area and Japan, which gives a medium-term equilibrium rate of 1.37 €/£.

5.3 Estimates of equilibrium exchange rates are subject to a number of uncertainties, particularly concerning possible shifts in trade relationships and evaluating the sustainable current accounts that may be associated with private sector net savings behaviour. However, this model suggests that some quite improbable judgements would be required to justify an equilibrium rate of around 1.6 €/£. In addition, while there are good reasons for doubting the reliability of PPP based estimates for the medium-term, they have greater claim over the longer term, and it is difficult to rationalise a medium-term equilibrium rate of 1.6 €/£ with a PPP estimate of 1.33 €/£.

5.4 This analysis does, however, suggest a possible explanation for the recent overvaluation of sterling. The model suggests that capital inflows into the US, perhaps associated with productivity improvements, will lead to significant upward pressure on the euro sterling rate. These flows are likely to have been larger in the past than they will be over the medium-term future. Combining this with short-term capital inflows into the UK associated with buoyant domestic demand, and relatively modest trade deficits as firms attempt to retain overseas markets, gives a possible explanation for the recent strength in sterling.

5.5 It is conceivable that some of the factors generating the strength of sterling relative to the euro in the last few years may turn out to be much more persistent than expected, implying that the EER itself has appreciated. However, the fact that all the different methods of calculating the EER, including PPP, suggest substantial overvaluation implies that relying on this possibility would be extremely risky.

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A

ANNEX A: GLOSSARY OF TERMS

Although some of these definitions are fairly standard, others are more specific to this study, and have been used to increase its clarity.

Medium term A time frame over which cyclical influences on macroeconomic variables will have disappeared.

Equilibrium Exchange Rate A real exchange rate, to which the actual exchange rate tends over the medium term.

Over/Under valuation These terms are used in this report as a shorthand for the relationship between an actual exchange rate and its equilibrium value. It does not carry any implications about desirability or market misperception. For example, if demand in a country is relatively strong internationally, it would make sense for interest rates to be relatively high in that country, which under efficient markets would imply an 'overvaluation' which was quite helpful in dampening demand.

Misalignment As above, a shorthand for the actual exchange rate differing from the EER.

Sustainable current account The current account that is likely to emerge over the medium term, or equivalently medium-term levels of net national saving.

Trend current account The medium-term current account that would emerge if exchange rates were at their actual level rather than at their equilibrium values. The EER can then be thought of as the exchange rate that will produce a trend current account equal to its sustainable level.

FEER Fundamental Equilibrium Exchange Rate. A particular method of calculating an EER, associated with John Williamson.

PPP Purchasing Power Parity. An alternative method of estimating an EER, which can involve comparing the prices of a similar basket of goods in different countries.

Balassa – Samuelson effect One reason why PPP might not hold, because of the existence of non-traded goods.

UIP Uncovered Interest Parity. A theory linking actual exchange rates to interest rate differentials and the EER.

B1 Before examining what factors might influence the EER within this medium-term framework, it is important to avoid a possible confusion. This approach is often described as establishing the EER that delivers a particular current account of the balance of payments (the ‘external balance approach’). However, it could be equally described as examining an EER that ensures that the demand for domestic goods equals their supply. Within this framework these statements are both valid, because the medium-term current account depends on net saving (i.e. consumption and investment relative to income), and net saving also helps determine the demand for domestic goods. However, both statements can be misleading because they focus on one part of a macroeconomic system, whereas the EER is part of a complete macroeconomic system, and so potentially any permanent exogenous shock to this system could influence the EER. To put this point another way, it is important to think in terms of general rather than partial equilibrium. The model outlined below clarifies this point.

INFLUENCES ON THE EER

B2 What in particular might influence the EER in this framework? The following simple and very general model provides some answers, which are summarised in the bullet points below.¹ The national income identity can be written as:

$$Y(K(..)) = C(..) + G + \Delta K + X(Y_w, e) - M(Y, e) \quad [1]$$

where Y is domestic output net of depreciation, K is the capital stock, C is consumers’ expenditure, G is government spending, X are exports that depend on world demand Y_w and the real exchange rate e , and M are imports that depend on domestic output and the real exchange rate. (It is possible to model imports as depending on domestic demand rather than output, but this makes no difference to the issues discussed here.) All variables are in real terms, deflated by the aggregate price of domestic production.

B3 It is assumed for simplicity that all government spending is spent on domestic goods, and that labour supply is fixed. The determination of consumer and capital demand is left unspecified, and one influence could be the real exchange rate itself.² The export and import equations capture the demand curve for UK goods, and their dependence on the real exchange rate (with a finite elasticity) reflects the view that most traded goods are differentiated manufacturing goods sold in imperfectly competitive markets (see Section 2). Equating the demand and supply of domestic goods in this way reflects our abstraction from Keynesian disequilibria, and turns this identity into a behavioural equation. From this equation, it is easy to see why the real exchange rate can be described as equating aggregate demand and supply.

¹ This model focuses on imperfectly competitive traded goods markets, rather than on traded/non-traded sector interactions, for reasons outlined in footnote 9 in Section 2.

² Driver and Wren-Lewis (1999) discuss various reasons why either consumption or labour supply may be influenced by the real exchange rate.

B4 The private sector budget constraint can be added:

$$\Delta(F + B + K) = Y - T - C(\cdot) + r(F + B) \quad [2]$$

where F are overseas financial assets (which for simplicity, but unrealistically, are assumed to be denominated in domestic currency), B is government debt, T is taxes, and r is the return on all assets. (The return to capital is already in total income Y.)

B5 In addition the government's budget constraint is simply:

$$\Delta B = G - T + rB \quad [3]$$

B6 Combining all three equations gives:

$$\Delta F = X(e, Y_w) - M(Y, e) + rF \quad [4]$$

which is the balance of payments identity. Using this, it is possible to describe the EER as the exchange rate that delivered a particular current account, but of course this is exactly the same as the exchange rate that equates demand and supply in [1]. In both cases, the EER is one variable in a complete macroeconomic system, and as such it can in principle be influenced by any other part of that system.

B7 One difference between focusing on [1] or [4] appears to be the Marshall-Lerner condition. A familiar idea is that an exchange rate depreciation will only improve the current account if this condition holds. The condition arises because a depreciation will tend to raise the domestic currency value of imports, offsetting the increase in the volume of net exports. Although this condition appears to be absent from [1], it is there implicitly, because a rise in the price of overseas goods will, *ceteris paribus*, reduce real incomes, and hence consumption.

B8 The equation system also clearly distinguishes between a medium-run equilibrium, which is the solution to this set of equations where the asset stock variables can be changing, and a long-run equilibrium, where asset stocks are constant.

B9 The equations above already suggest a number of possible influences on the medium-term EER:

- an increase in world demand (Y_w), that is not matched by any increase in domestic supply, will tend to raise the demand for domestic output, and so from [1] or [4] an appreciation will occur to offset this;
- equally, an increase in domestic supply that does not occur overseas will lead to a depreciation in the EER;
- the stock of overseas assets, (F), will also influence the EER. A country that is a net creditor can afford to run a trade deficit equal to net interest receipts and still maintain a balanced current account, while a net debtor will require a trade surplus to do the same. Thus, the larger the net stock of foreign assets, the more the EER appreciates. The stock of net overseas financial assets often appears in reduced form studies of EERs, as Section 3 illustrates; and,
- fiscal policy will also influence the EER. Assuming that taxes are endogenous, then fiscal policy can operate either through changes in spending (G), or through changes to borrowing (B).

B10 It is possible to consider each of these influences in turn. Although the impact of changes in domestic and overseas supply appears straightforward, it should be noted that this effect might become problematic when moving from the medium to the long term. Implicit in the use of a demand curve approach to modelling aggregate net trade is an assumption that the set of goods produced at home and overseas remains unchanged. While this may be a reasonable assumption in the medium term, it becomes questionable in the long run because over this period the location of production may change. (This point was referred to in the discussion of PPP, and is made forcibly in Krugman, 1989.) If additional supply involves new varieties of goods, or even new types of good, rather than a greater quantity of existing goods, then no real depreciation will be required to sell them (see Wren-Lewis *et al.*, 1996, for example). Within this context, foreign direct investment into a country may expand the range of goods produced, leading to an apparent shift in trade performance.

B11 It is possible to describe the effect of changes in net overseas assets working through equation [4]. Higher overseas assets, by raising additional debt interest receipts, will increase the current account surplus, and so the exchange rate will need to appreciate to offset this for any given level of the current account. Equally, focusing on [1], note that higher wealth will generate an additional demand for domestic goods through higher consumption, again leading to an appreciation.

B12 One problem with including overseas assets as a determinate of the EER is that it is an endogenous variable within the macroeconomy in the long run. Any particular specification for aggregate consumption will in general imply a path for total wealth, and net overseas assets will adjust to achieve this.³ However one possible rationale for conditioning the EER on assets stocks is the following hysteresis type effect. A period of Keynesian disequilibrium, for example, might involve a series of temporary current account deficits, which will reduce consumers' wealth. Intertemporal models of consumption generally imply that consumers will smooth the adjustment to this disequilibrium over decades rather than years, i.e. for a period well beyond the Keynesian short run. This hysteresis problem is discussed further in Wren-Lewis (1992) and Artis and Taylor (1995).

B13 An increase in government debt (B), for a given value of spending (G), will require higher taxes, thereby depressing domestic demand and leading to a depreciation. An increase in government spending (G) financed through taxes has an ambiguous effect: higher spending raises domestic demand, but higher taxes have the opposite effect. (See Giovannini, 1988, but also Wren-Lewis *et al.*, 1996, who argue that an appreciation is more likely.)

B14 The model also makes it clear that, allowing a downward sloping demand curve for UK goods, means PPP will not hold. Indeed, PPP can be thought of as a special case of this model, where the elasticity of exports with respect to the real exchange rate approaches infinity. As noted above, empirical estimates of this elasticity suggest much lower values.

B15 The model above may be dynamic in many respects, such as in the determination of consumption through an intertemporal model, for example. It may seem odd describing the period-by-period solution for the real exchange rate as an equilibrium rate. This of course reflects the distinction between the medium and long term: the medium-term EER is a flow equilibrium, but not a stock equilibrium. From this perspective, it is clear that the medium-term EER may change over time. This will be true if the medium-term current account is non-zero, for example. If UIP is added to these equations, then because the capital stock is likely to depend on interest rates, this movement in the EER will feed back into the determination of the level of the EER.

³ An exception is if consumers are infinitely lived, in which case their wealth stock is historically (hysteretically) determined.

B16 To many the idea that the medium-term EER may move over time makes the whole idea of trying to assess the EER, and relate the actual exchange rate to it, problematic. It appears to be trying to ‘hit a moving target’. However, theory suggests that, if the medium-term EER does move over time, it should move relatively slowly and in a predictable fashion.

B17 Some macroeconomic approaches to estimating the EER have attempted to exploit the importance of trade relationships in this system, while taking short cuts with other parts of the macroeconomy. Probably the best known of these approaches is John Williamson’s FEER, which estimates output and the current account ‘off model’, plugging these estimates as exogenous variables into an estimated model of net trade flows to derive the EER. However, it may be preferable to describe this and other approaches as differing in their method of estimation of the EER, rather than being different theories of the EER, because in general they are not based on completely different views of the world (Wren-Lewis, 1992). This method of estimation is discussed in more detail in Section 3. Stein’s NATREX approach (see Stein, 1994; and Stein, 1999) is quite consistent with the theoretical discussion above, and has the merit of making the distinction between a medium and long-run equilibrium outlined here quite explicit.

THE MEDIUM-TERM CURRENT ACCOUNT

B18 In the medium run, there is no reason to believe that asset stocks will be constant. As a result, the medium-term EER will be influenced by these flows in financial assets, unless the conditions for PPP hold. As a result, the medium-run EER may well differ from the long-run EER.

B19 Are these medium-term asset flows likely to be important in influencing the EER? Unfortunately the answer seems to be yes, for the following simple reason. Most empirical estimates suggest that trade flows are relatively insensitive to movements in the real exchange rate. As a result, large movements in the EER are required to produce small changes in the current account, so estimates of the EER are highly sensitive to different assumptions about the medium-term current account (see Driver and Wren-Lewis, 1999).

B20 What factors are likely to generate medium-term asset flows? Williamson and Mahar – in their contribution to Driver and Wren-Lewis, 1998 – emphasise three sets of factors:

- saving generated by intertemporal consumption decisions;
- direct investment caused by differences in real rates of return; and
- fiscal policy.

B21 A now standard part of most theoretical macroeconomic models is a consumption relationship based on the intertemporal consumer. This consumer takes a lifetime view of their resources (human and financial capital), and will accordingly spread the benefits of any windfall gain throughout their life.⁴ This means that adjustment paths are likely to be very drawn out. A clear example of when this would have macroeconomic consequences is if an economy discovers a natural resource like oil, but it takes a few years before that resource is extracted. Consumers would anticipate higher future income, and finance higher consumption in the short term by additional borrowing. In the years before the resource was extracted, therefore, the economy would run a current account deficit, implying an appreciation in the EER over this period. (Arguably this occurred in the UK at the end of the

⁴ Although, for various reasons, this spending may be tilted towards the present.

1970s.) Overseas agents are happy to finance this deficit, because the borrower's future income will rise. Demographic differences between countries would also be likely to lead to persistent current account imbalances for life cycle reasons, and this is often cited as the reason why the US appears to run a structural current account deficit and Japan an equivalent surplus.

B22 The discovery of natural resources in an economy is also likely to generate a current account deficit because of direct investment by overseas companies designed to exploit that resource. This is an example of where an increase in expected rates of return in the economy relative to overseas leads to inward investment and a current account deficit. Changes in the location of production brought about by foreign direct investment may be quite drawn out over time (because adjustment costs are likely to be high and increasing with the scale of investment), implying medium-term current account deficits.

B23 An example of this type that may be relevant to recent movements in the euro US dollar exchange rate is where one country experiences a productivity shock caused by country specific technological development. This shock could lead to capital inflows to finance both higher investment and consumption, where the latter reflects anticipation of higher future income. In the long run an increase in supply could generate a depreciation, for reasons examined above, but it seems more likely that the additional supply would involve new varieties of goods, which would have no long-run impact on the real exchange rate.

B24 The importance of fiscal policy in influencing the EER has already been noted. A higher debt stock will lead to a depreciation, because the higher taxes required to service the extra debt will reduce consumers' demand for domestic goods. However, the deficits required to raise the debt stock will have additional effects. Saving that might have gone to overseas assets will be diverted into government debt, implying that the current account will move into deficit. The exchange rate will appreciate, reflecting this deficit and the additional demand for domestic goods that higher spending or lower taxes brings about. Driver and Wren-Lewis (1998) use a model simulation to show that the dynamic response to a budget deficit may be quite complex.

B25 In all these cases a medium-term current account deficit is associated with higher levels of domestic demand. The higher domestic demand may be linked with increased borrowing by consumers, firms or the government, or additional investment coming from overseas. It should be clear that these deficits are not necessarily a problem from the point of view of policy, and any associated value of the exchange rate is not overvalued in a medium-term sense. However, within the context of entry to a fixed nominal exchange rate regime, an important issue is how quickly these medium-term current account deficits would unwind.

THE FIVE AREA BILATERAL EQUILIBRIUM EXCHANGE RATE (FABEER) MODEL

C1 This annex outlines the basic approach that the model uses. More detailed code is available on request, as are data sources.

Notation C2 Let x_i denote variable X for country/bloc i. Two 'atypical' blocs are the Rest of the World (i=r) and the US (i=u). Suppose there are n blocs, including r and u.

Exchange rate determination C3 Suppose, for simplicity, that export prices for country i = domestic prices for i. For each country define p_i as an index of domestic prices in US dollars. The trade balance for country i in nominal US dollars is given by:

$$p_i x_i(p_i, \text{all } p_j, j \neq i) - p m_i(\text{all } p_j, j \neq i) m_i(p_i, \text{all } p_j, j \neq i) \quad [5]$$

where $x_i(\dots)$ are real exports (measured in base year US dollars), $p m_i(\dots)$ the import deflator and $m_i(\dots)$ real imports for i. (All other arguments in these functions are ignored for simplicity, and the standard homogeneity assumptions are taken as given.) The sum of each of these expressions across all i (including i=r) must equal zero, or whatever the world current account balance is (which is taken as exogenous). As a result, one of these expressions can be dropped (specifically i=r), which will then be determined by residual. No information is lost by doing this, although it also avoids issues of cross equation restrictions, which may or may not be a good thing.

C4 Suppose that for each bloc there is some exogenous projection for the current account/GDP ratio = cay_i , and also assume IPD is zero (so trade balance=current balance). It is then possible to write n-1 equations of the form

$$cay_i = \{x_i(p_i, \text{all } p_j, j \neq i) - p m_i(\text{all } p_j, j \neq i) m_i(p_i, \text{all } p_j, j \neq i)\} / y_i \quad [6]$$

where y_i is real GDP (also exogenous) .

C5 For each country define pdc_i as domestic prices *in domestic currency terms*, which is also assumed to be exogenous. (The exogeneity of pdc is innocuous, as the model is essentially defined in real terms.) Thus:

$$p_i = ex_0 pdc_i / ex_i \quad [7]$$

where ex_i is the US dollar exchange rate (currency per US dollar), and ex_0 this value in the base year, for all i *except* u.

C6 [6] represent n-1 independent equations determining n-1 unknowns ex_i . This includes an equation for cay_u which can be thought of as an equation 'determining' ex_u , although of course all equations determine all unknowns simultaneously.¹ The model therefore determines all bilateral US dollar rates, with no need to work backwards from effective rates to bilaterals (as Driver and Wren-Lewis, for example, or reduced form studies like Alberola *et al.*, need to do).

C7 One problem may appear to be that ex_r does not in practice exist. However simply omitting [7] for i=r, means [6] still determines p_r . Data for p_r may exist, but a measure of export prices could be used instead — see below.

¹ Using iterative solution techniques here may be tricky, because p_i does not appear on the left-hand side of any of these equations.

The trade model for each country C8 For each country except $i=r$, it is necessary to elaborate on the model of trade determination.

C9 To do this, drop the assumption above about export prices, and introduce three new variables: px , the export price deflator; qx , the ‘manufacturing’ export price; and qm , the manufacturing import price; all defined in US dollars for each i . It is assumed that each deflator is a function of the manufacturing price and a country-specific weighted commodity price index:

$$px = qx^a cx^{(1-a)} \quad [8]$$

$$pm = qm^b cm^{(1-b)} \quad [9]$$

where cx and cm are the commodity price bundles, a and b are parameters derived from data on the composition of trade, and the i subscript is dropped as these equations are common across all i , $i < r$. (These equations will in practice need constants and possibly trends, reflecting measurement errors and trade in services.)

C10 For both qx and qm , assume that prices are a weighted average of domestic prices and other countries’ export prices i.e.:

$$qx_i = p_i^c \left(\sum_{j \neq i} wx_{ij} qx_j \right)^{1-c} \quad [10]$$

$$qm_i = p_i^d \left(\sum_{j \neq i} wm_{ij} qx_j \right)^{1-d} \quad [11]$$

where c and d are again parameters (to be calibrated), and wx and wm are weights summing to one (which can be derived from direction of trade statistics).

C11 Finally, there is the specification of the two volume equations. For imports:

$$m = m(y, qm / p) \quad [12]$$

C12 The function $m(\cdot)$ is calibrated, but its constant estimated. There are three problematic issues here. The first is using y as the activity measure. It could be replaced by TFE (i.e. $y+m$), or by a weighted demand variable. The second is the log-linear specification, which is not consistent with a log-linear model for the demand for domestic output (see Anderton *et al.*, 1992). The third is that qm/p is not an ideal measure of competitiveness, as p contains many non-traded goods, and traded goods that are not subject to strong competitiveness effects (like commodities). One possibility here is to define an additional domestic price variable (e.g. a price of domestic manufactures), and add a linking equation between this and the GDP deflator p . The disadvantage of this is that domestic manufacturing prices are likely to depend on overseas prices to some extent, so the system becomes complex in terms of simultaneity.

C13 For exports:

$$x_i / \left(\sum_{j \neq i} wd_{ij} m_j \right) = f[qx_i / \left(\sum_{j \neq i} wc_{ij} qx_j \right)] \quad [13]$$

C14 The function $f(\cdot)$ is calibrated, but its constant estimated. Here wd and wc are weights (based on direction of trade statistics) reflecting the direction of exports and third party competition respectively. The equations say that the share of exports in a weighted demand variable is a function of export price competitiveness.

Exchange rate determination revisited, and the RoW bloc

C15 Specifying the trade equations allows us to delineate how countries interact more precisely. There are two forms of interaction:

- changes in imports in one country influence exports in another; and
- changes in export prices in one country will influence other countries by both changing import prices and through export competitiveness.

C16 Output prices only influence other countries via these two effects. As a result, it is not necessary to define output prices for the rest of the world (RoW). Instead the endogenous 'exchange rate' variable for this bloc will be qx : manufacturing export prices.

C17 What about RoW imports? These could be treated as exogenous, but this might be misleading: if RoW qx increases significantly, then the RoW real exchange rate is appreciating and some increase in RoW imports would be expected. Substituting [11] in [12] gives:

$$m_r = m_r(p_r^d(\sum_{j \neq i} w m_{rj} q x_j)^{1-d} / p_r) \quad [14]$$

It is possible to then invert (10) to substitute out for p_r , giving

$$m_r = m_r((\sum_{j \neq i} w m_{rj} q x_j) / \frac{q x_r^{1/c}}{(\sum_{j \neq i} w x_{rj} q x_j)^{(1-c)/c}})^{1-d} \quad [15]$$

C18 This rather complicated expression allows changes in RoW export prices to influence RoW imports. It is programmed in change from base form, to come into operation when exchange rates are endogenised.

IPD flows

C19 The IMF publish data on the stock of overseas assets held by domestic residents, and domestic assets held by overseas residents. It is possible to calculate an implicit rate of return by combining this information with recorded IPD flows. Modelling IPD flows involves two major problems. First, the composition of assets by type is diverse, and so modelling the return is likely to be very difficult. A nominal deposit will attract the (short) nominal interest rate. There will be an inflation loss on these assets, but this is not recorded in IPD. An indexed deposit will suffer no inflation loss and will return a real interest rate recorded in IPD. Shares will receive dividends, which appear in IPD, plus some capital gain that is not recorded there. Direct investment returns a profit stream. *Ex ante*, arbitrage should ensure that the total return on all these assets should be equal after allowing for risk premia. However, IPD does not measure the total return (i.e. it excludes capital gains), and *ex post* there will be unexpected gains and losses.

C20 The second major problem involves modelling changes in the assets stock. Historical estimates of EERs have normally been conditional on actual stocks (the EER is a flow equilibrium, not a stock equilibrium concept), so at first sight no modelling may appear necessary. However overseas assets will be held in different currencies, and it is important to allow deviations in the EER from actual rates to influence asset stocks. Again UIP (Uncovered Interest Rate Parity) should ensure that expected capital gains are offset by interest rate differentials, but IPD flows only record the latter and there will be unexpected gains and losses.

C21 Tackling the first problem for a simple model involves making heroic assumptions that do least damage to the EER estimates. A key aspect of EER estimates is that they abstract from cyclical effects. As the economic cycle is likely to influence interest rates as much as output, it would be inconsistent to use actual interest rates in modelling IPD, although this has been the approach normally adopted in the literature. Instead, it is possible to construct a synthetic 'smoothed world ipd return' time series, and then relate IPD returns for each country to this rate, using a simple linear relationship:

$$ipd\ return_{it} = a + b\ world\ ipd\ return_t \quad [16]$$

C22 This takes account of any permanent differences in individual countries' rates of return (which appear to occur – see Lane and Milesi-Ferretti, 2002), and knockout any cyclical effects. However, any persistent but temporary idiosyncratic movements in returns will be lost.

C23 It is also important for the US dollar value of assets to move in simulations with changes in the exchange rate. It is possible to define a simple 'deviation from base' equation:

$$a_i = \hat{a}_i \sum_j w_{ij} p_j / \hat{p}_j \quad [17]$$

where a hat denotes the base value, and w are a set of weights reflecting the proportion of currency j assets in total assets for country i .

C24 Previous FEER studies have implicitly treated these weights w as equal to the weights in the effective exchange rate index, although in some studies a percentage of US overseas assets are assumed to be in US dollars. Equation [17] offers greater flexibility.

D

ANNEX D: DERIVING THE TREND CURRENT ACCOUNT

D1 The trend current account estimates presented in Section 4 can be decomposed into a number of different elements. First, it is possible to analyse the consequences of removing erratic (unexplained) elements in trade and IPD (interest, profit and dividend). Second, the consequences of putting output to trend can be seen. In both these cases each country is treated in isolation, taking actual data for other countries rather than the model's predictions. The third, and final, stage is to allow for country interactions.

TREND TRADE, IPD AND OUTPUT IN EACH BLOC

D2 For each bloc, it is possible to show for three sub-periods the amount by which the current account is moved away from its actual value by removing erratic elements in trade and IPD, and returning output to trend. The 'predicted' current account is the sum of all three elements.

UK D3 Putting trade to its medium-term value conditional on actual output, the exchange rate and overseas variables moves the trade balance towards surplus in 2000-01, largely as a result of lower import volumes (see Section 4). This is more than offset by a downward adjustment to IPD flows (also discussed in Section 4). The adjustment to trade is much larger in 1995-96, reflecting higher export volumes, and lower import volumes and prices.

D4 The OECD has estimated output was near trend in the UK in 2000, so there are no adjustments on this account. The model's equations imply that output was below trend by about 0.8 per cent in 1995-96 (which also roughly matches recent OECD estimates), which reduces the surplus. Output is about 2 per cent below trend in 1990-91 (most of which was in 1991), so returning GDP to trend raises the deficit by nearly 1 per cent of GDP.

Table D1: UK current account: predicted and actual

	1990-91	1995-96	2000-01
Trade	0.7	2.5	0.6
IPD	0.6	0.3	-0.8
Output	-0.9	-0.3	0.0
Total	0.4	2.5	-0.2
Actual	-2.9	-1.2	-1.9
Predicted	-2.5	1.3	-2.1

Euro area D5 The very large upward adjustment to the euro surplus in 2001-02 is due to euro import volumes, discussed in Section 4. The negative adjustments in the earlier periods mainly reflect exports rather than imports.

D6 The OECD suggest output was close to potential in 2000. Low growth in 2001 implies that in 2000-01 output was on average about 0.5 per cent below potential. The same applies in 1995-96. However, output was cyclically high in 1990-91.

Table D2: Euro area current account: predicted and actual

	1990–91	1995–96	2000–01
Trade	-1.9	-1.3	3.9
IPD	0.2	0.0	0.2
Output	0.7	-0.3	-0.3
Total	-1.0	-1.6	3.8
Actual	-0.5	1.0	-0.1
Predicted	-1.5	-0.6	3.7

United States D7 The downward adjustment to trade in 2000-01 is due to export volumes, which are higher than the model's equation predicts. The OECD has an output gap of nearly 2 per cent for the US in 2000. Using actual capital and labour force data, and assuming TFP (total factor productivity) growth of 1.5 per cent per year, this implies output was about 1.7 per cent below potential in 1995-96, and over 2 per cent below potential in 1990-91. Putting output to trend therefore improves the current account in 2000-01, but worsens it in earlier years.

Table D3: US current account: predicted and actual

	1990–91	1995–96	2000–01
Trade	-0.1	0.4	-1.2
IPD	-0.4	0.1	0.2
Output	-0.4	-0.3	0.1
Total	-0.9	0.2	-0.9
Actual	-0.6	-1.5	-4.3
Predicted	-1.5	-1.3	-5.2

Japan D8 The move to surplus in trade in 2000-01 reflects both exports and imports. It is assumed that Japanese output was 1 per cent below potential in 2000, and averaging 2 per cent below potential in 2000-01. It is further assumed that there was 1 per cent growth in underlying TFP from 1990 onwards. The corresponding output gap in 1995-96 was -2.7 per cent, and nearly -8 per cent in 1990-91. As a result, imports are raised slightly in 2000-01, but this does little to dent the increase in surplus noted above. In 1995-96 lower output raises the surplus slightly, but this effect is much bigger in 1990-91.

Table D4: Japan current account: predicted and actual

	1990–91	1995–96	2000–01
Trade	1.2	0.1	0.8
IPD	0.1	0.1	0.1
Output	0.9	0.2	-0.2
Total	2.2	0.4	0.7
Actual	1.7	1.7	2.3
Predicted	3.9	2.1	3.0

TREND CURRENT ACCOUNT

D9 The final stage allows for country interactions while still keeping exchange rates fixed. The rest of the world is also kept fixed, which implicitly assumes that it is at trend. Interaction at this stage works through two routes: through export prices and import volumes. The latter is in practice more important. In 2001-02 the most notable departure from the data is for the euro area, where predicted import volumes are over 9 per cent below actuals (with the depreciation perhaps taking its time feeding through into the data), and this depresses exports elsewhere, particularly in the UK. In 1995-96 changes are relatively modest, although

euro imports are nearly 5 per cent higher than actuals. In 1990-91 US imports are above actuals by nearly 9 per cent, but Japanese imports are below actuals by nearly 16 per cent: these influence each other, but have relatively less impact in Europe.

D10 The tables below first report the actual current account as a per cent of GDP, then the estimate computed above treating all other blocs as fixed, and then finally the result of running the complete model.

Table D5: UK predicted current account

	1990-91	1995-96	2000-01
Actual	-2.9	-1.2	-1.9
Own only (see above)	-2.5	1.3	-2.1
Trend	-2.4	1.7	-3.4

D11 The main difference for the UK is in 2000-01, where there is a large increase in the trend deficit. This is entirely due to the lower value of euro imports, discussed above. This leads to a decline in UK export markets of over 4 per cent, with a similar decline in exports. In 1995-96 higher euro imports adds to UK exports, raising the trend surplus.

Table D6: Euro area predicted current account

	1990-91	1995-96	2000-01
Actual	-0.5	1.0	-0.1
Own only (see above)	-1.5	-0.6	3.7
Trend	-1.0	-0.6	3.6

D12 The euro area is hardly influenced at all by developments in the other three countries, except in 1990-91 when higher US imports help the current account.

Table D7: US predicted current account

	1990-91	1995-96	2000-01
Actual	-0.6	-1.5	-4.3
Own only (see above)	-1.5	-1.3	-5.2
Trend	-1.8	-1.3	-5.3

D13 The reduction in euro imports in 2000-01 has a much smaller effect on US exports than in the UK: export volumes are about 1.5 per cent lower, but this only reduces values by about 0.1 per cent of GDP, making the deficit marginally worse. The increase in the deficit in 1990-91 is due to lower Japanese imports.

Table D8: Japan predicted current account

	1990-91	1995-96	2000-01
Actual	1.7	1.7	2.3
Own only (see above)	3.9	2.1	3.0
Trend	4.1	2.2	2.7

D14 Once again, US imports help Japanese exports in 1990-91.

