

6

UK EXCHANGE RATE VOLATILITY OUT OF OR IN EMU

In principle, an exchange rate movement could be an appropriate response of the exchange rate to changing economic conditions or an unwarranted change. In practice, observed volatility may be a mixture of both. Measures of volatility are unable to distinguish between these 'warranted' and 'unwarranted' exchange rate movements.

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

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

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

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

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

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

6.3 In addition, any reduction in the volatility of nominal variables is also likely to be of little economic benefit if it is not reflected in comparable changes in the behaviour of real variables.¹ If the source of exchange rate volatility is fundamental shocks to the economy rather than extraneous movements then this volatility will manifest itself in the real exchange rate anyway, but not via the nominal rate.

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

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

Measures of volatility

6.5 There are several possible measures of the volatility of nominal exchange rates. These include statistical measures such as the standard deviation, coefficient of variation and econometric models such as GARCH and ARCH.² The focus here is on the coefficient of variation – defined as the standard deviation expressed as a per cent of the mean of the series over the same period.

The exchange rate index

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

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

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

²ARCH stands for auto-regressive conditional heteroscedasticity, GARCH for generalised auto-regressive conditional heteroscedasticity. Both approaches allow for the possibility that volatility may fluctuate over time.

Box 6.1: Volatility of sterling ERI and covariance

The reason for a possible increase in the sterling ERI after entry to EMU is found in the covariance of the bilateral exchange rates. The variance of a sum includes a covariance term:

$$\text{Var}(aX+bY) = a^2\text{Var}(X) + b^2\text{Var}(Y) + 2ab\text{Cov}(X,Y)$$

As a simple example, assume an ERI comprising only the sterling-US dollar and sterling-euro rates with weights 'a' and 'b' respectively. This gives:

$$\text{Var}(\text{ERI}) = a^2\text{Var}(\text{£/\$}) + b^2\text{Var}(\text{£/€}) + 2ab\text{Cov}(\text{£/\$,£/€})$$

The assumption that the distribution of shocks would be unaffected by entry to the euro would imply that the variance of the sterling-euro rate would be zero, the variance of the sterling-US dollar rate would be replaced by the variance of the US dollar-euro rate, and the covariance term would be zero. Even if the US dollar had a weight equal to that of the euro, the variance of the US dollar-euro rate would have to be at least twice that of the sterling-euro rate for increased volatility against the US dollar to offset the zero volatility against the euro – unless the covariance between sterling/euro and sterling-US dollar is negative. In this case, if sterling were to be replaced by the euro, the negative covariance would drop out of the equation, contributing to a rise in the overall variance.

A negative covariance term implies that when sterling strengthens against either the US dollar or the euro, it tends to weaken against the other. In some sense, sterling would be walking a stable middle path. This has been the case since the euro was created in 1999. Correlation is a positive function of covariance, and on average the correlation between the sterling-US dollar and sterling-euro rates measured over:

- 60 days was -0.15;
- one year was -0.37; and
- three years was -0.42.

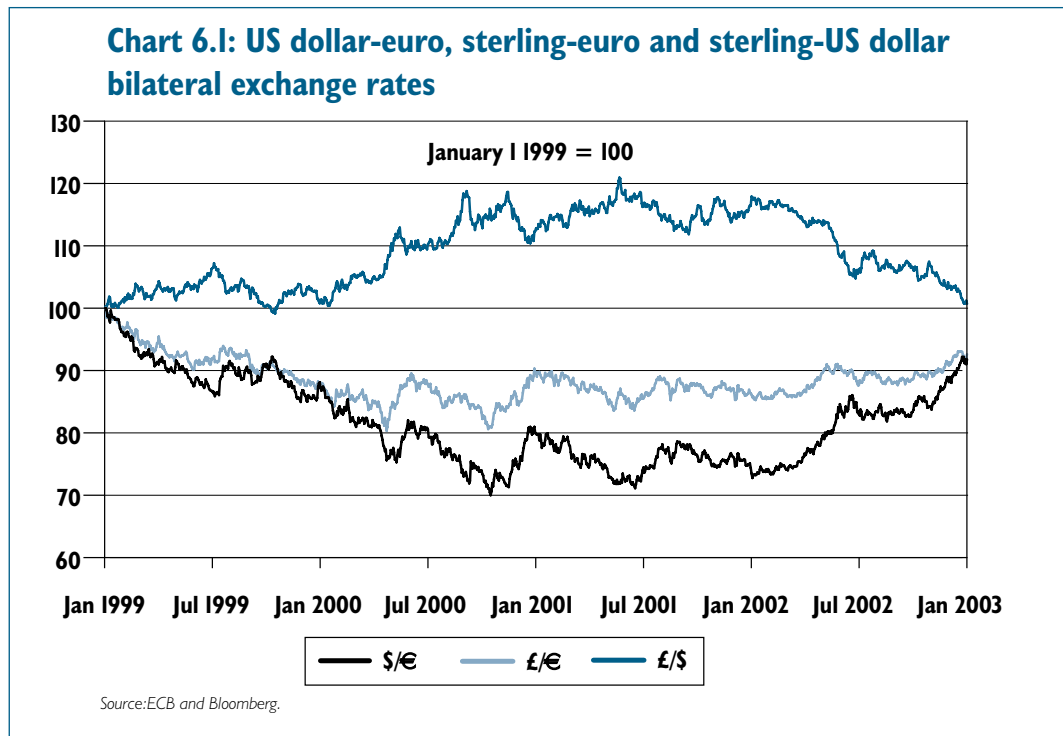
Therefore, replacing sterling with the euro would remove sterling's 'bridging' effect between the other two currencies. A later part of this section looks at the rolling correlation between the sterling-euro and sterling-US dollar bilateral rates to investigate whether the negative covariance relationship that has existed since 1999 is a special feature of this period or is a more general phenomenon.

The volatility of sterling compared to other currencies

Bilateral exchange rates since 1999

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

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



6.11 Aside from the initial weakening of the euro, three features stand out in Chart 6.1:

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

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

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

	Coefficient of variation		
	\$/€	£/€	£/\$
60 days	2.00	1.31	1.32
1 year	4.09	2.64	2.27
3 years	6.82	4.96	2.79

Source: Bloomberg and HM Treasury calculations.

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

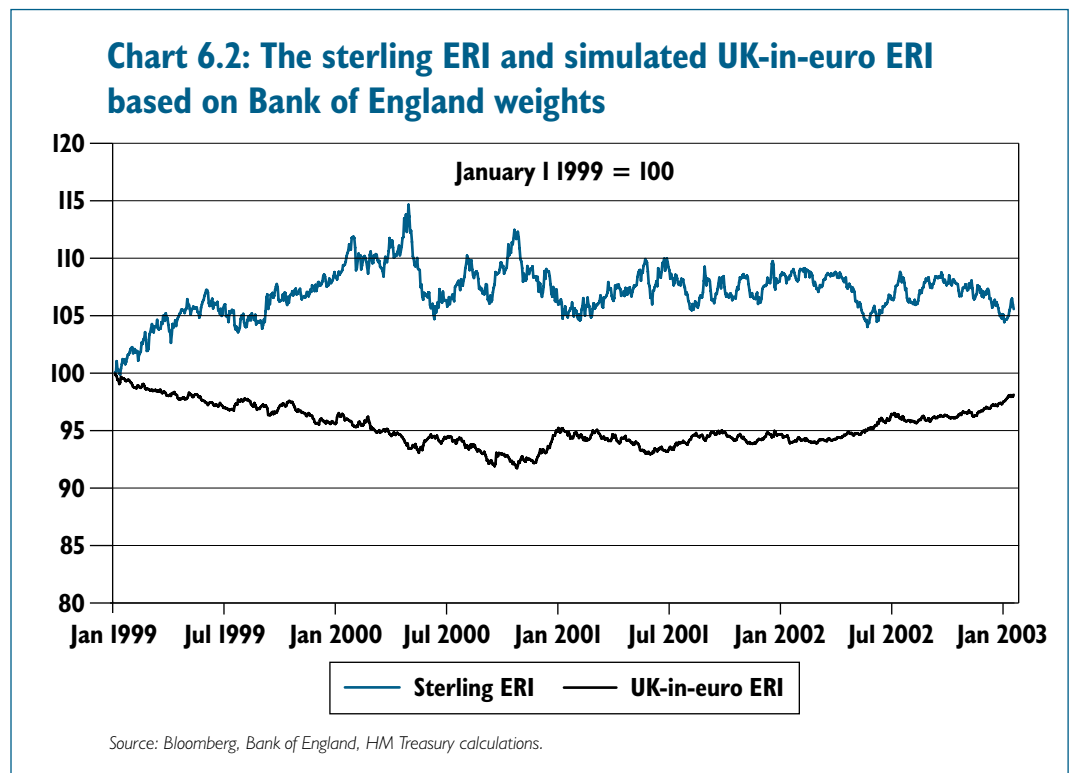
Calculating an ERI for the UK

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

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

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

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



³ These weights are the average of the ratio of UK to euro area GDP in the years 1999-2001.

⁴ Here the euro area includes Denmark.

6.18 Over the period since the launch of the euro, sterling ERI volatility, measured as the coefficient of variation, has been 1.96, while UK-in-euro ERI volatility would have been 1.81 per cent. However, when volatility is measured over shorter rolling periods the reductions in volatility are far more emphatic, as shown in Table 6.2.

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

	Coefficient of variation	
	Actual sterling ERI	Simulated UK-in-euro ERI
60 days	1.00	0.44
1 year	1.52	0.94
3 years	1.67	1.43

Source: Bloomberg, Bank of England and HM Treasury calculations.

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

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

6.21 Blake and Byrne (2002) use a similar methodology⁵ to estimate the impact on overall exchange rate volatility of EMU entry. The authors examine the observed relationship between the sterling-US dollar and sterling-deutschmark (euro) rates throughout the last 25 years. They note that in the period of floating rates, currencies have tended to simultaneously weaken against the US dollar and strengthen against the deutschmark/euro (and vice versa). If this relationship were to remain robust it would offer a clue as to how much the UK in the euro area would respond to movements in the US dollar.

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

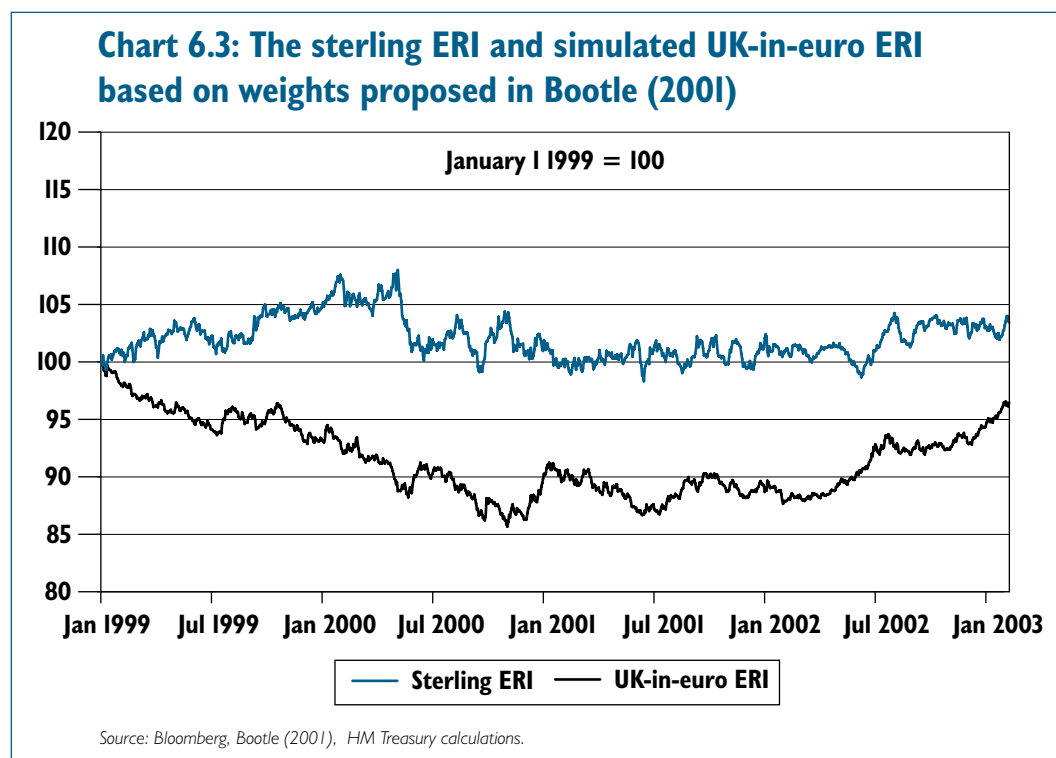
Using different weights to construct the ERI

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

⁵ This methodology builds on the earlier work of Haldane and Hall (1991).

Using a 47 per cent euro area trade share

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



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

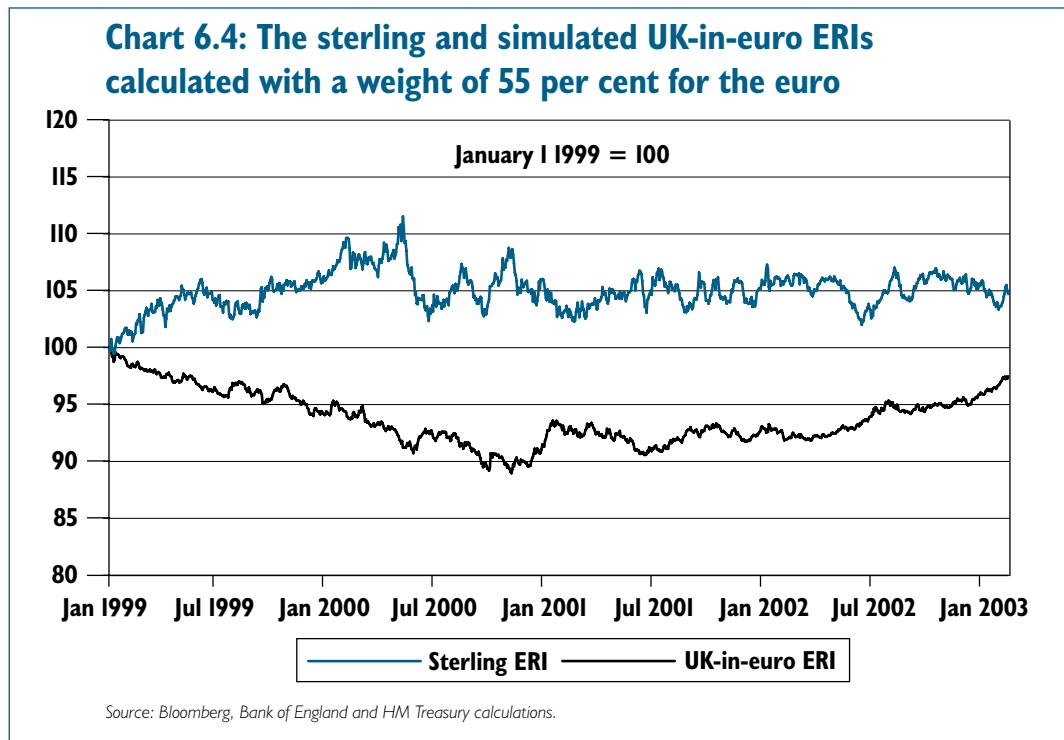
6.26 However, as explained earlier volatility measured over the entire period since 1999 does not paint a complete picture. When looking at 60-day volatility, on average the difference between Bootle's sterling and simulated UK-in-euro ERIs implies the simulated ERI is actually marginally less volatile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

Using a 55 per cent euro area trade share

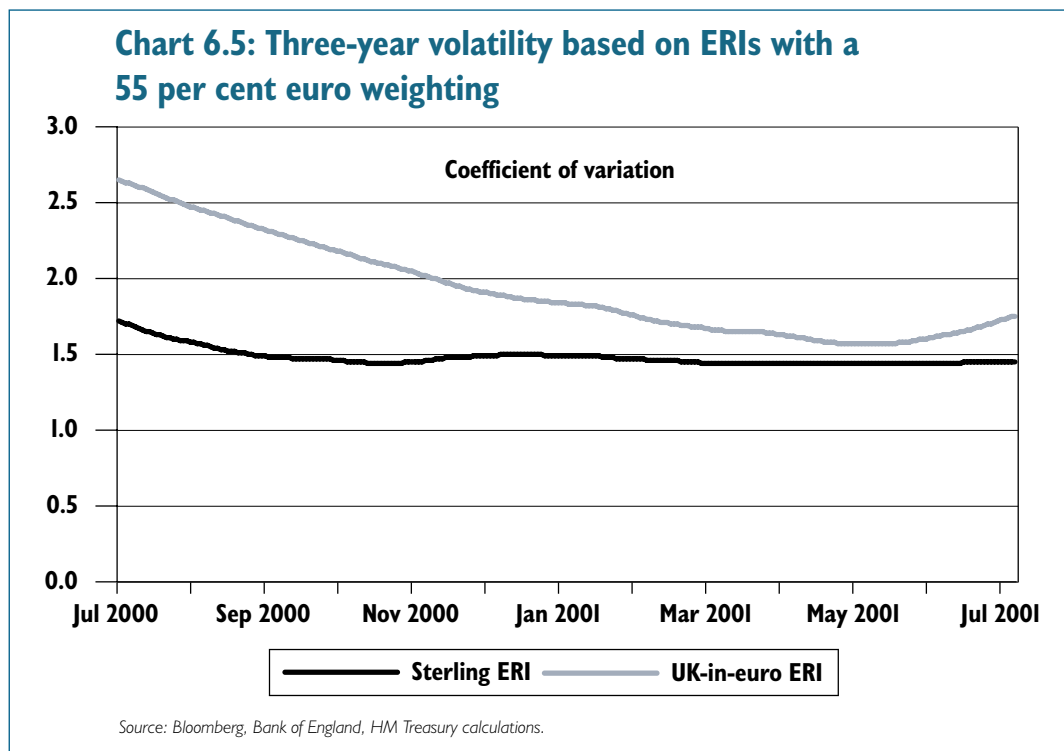
6.27 It is arguable whether either of the sets of weights used above is appropriate. On no measure of trade does the euro area account for over 65 per cent of UK trade. On the basis of UK current account figures (presented in Annex B), a plausible estimate of the share of UK trade related to the euro area would be around 55 per cent.⁶ Assuming the yen accounts for only 5 per cent, this leaves a substantial share of 40 per cent for the US dollar. So although the importance of the US dollar stretches well beyond the borders of the US, the euro area is more significant for UK trade.

⁶ Especially assuming that the exchange rates of Central and Eastern Europe are more closely linked to the euro than the US dollar.

6.28 Given that a weight of 55 per cent for the euro is between the two previous simulations, the results will also clearly lie between the previous results. The sterling and UK-in-euro ERIs recalculated using a 55 per cent trade weight for the euro area are shown in Chart 6.4.



6.29 The results from this simulation suggest membership of the euro would have reduced volatility over the 60-day horizon by about one third and over the one-year horizon by over one tenth (see Table 6.3).⁷ Over the three-year horizon the estimated volatility from the UK being in the euro is about 30 per cent higher than with retaining sterling. But volatility over the three-year horizon has been on a downward trend, before recently turning upwards again. This can be seen in Chart 6.5.



6.30 Table 6.3 summarises the implied impact of euro membership on volatility, using each of the different trade weights examined above. A negative sign indicates a decrease in the volatility of sterling ERI upon entry to EMU; a positive sign indicates an increase.

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

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

Source: Bank of England, *Bootle*, (2001) and HM Treasury calculations.

Impact of membership of a currency union on trade

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

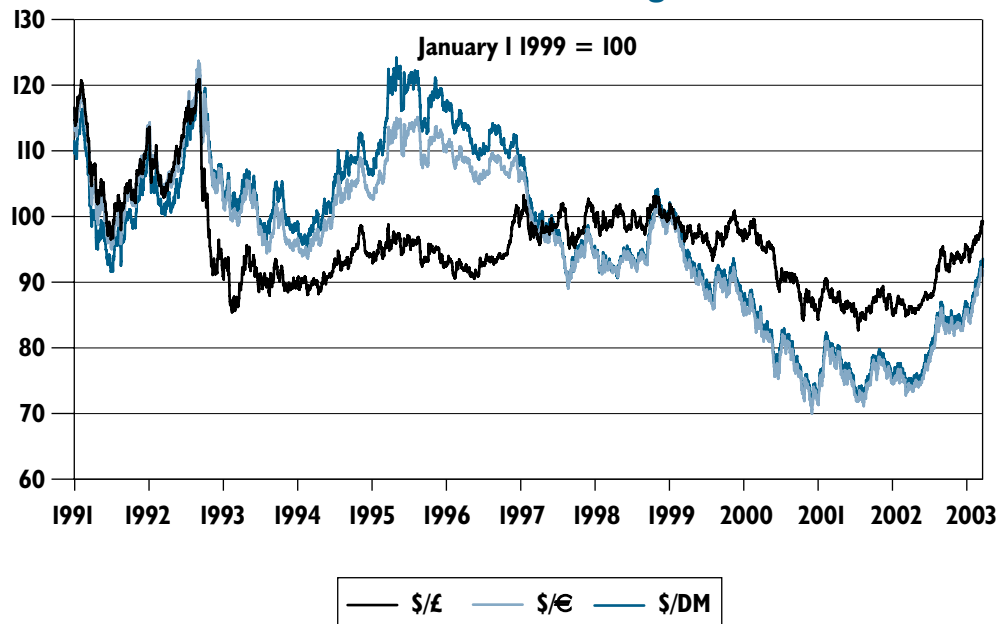
A longer time series

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

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

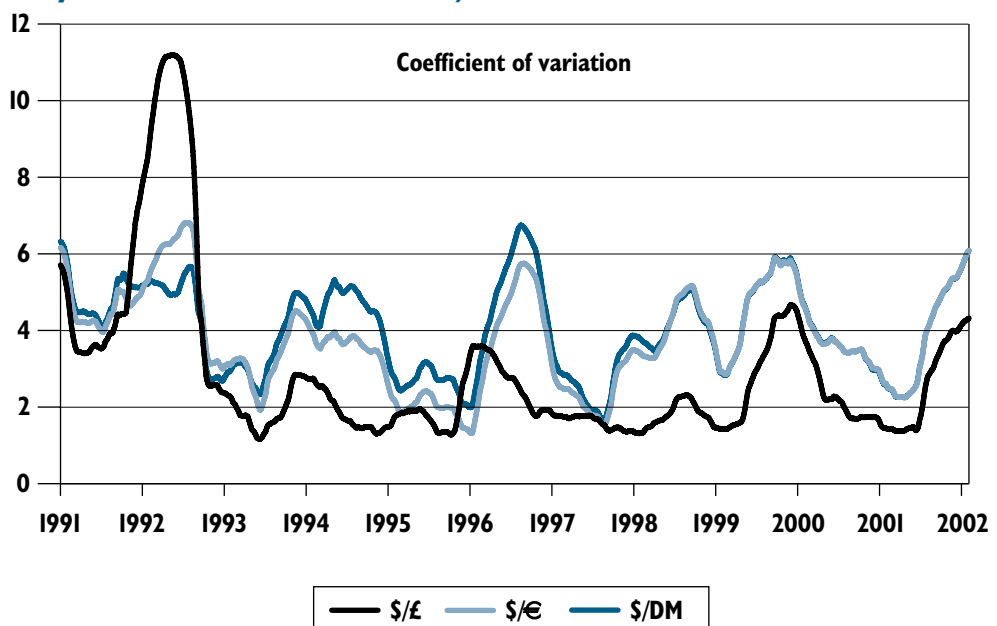
6.34 Chart 6.6 shows the bilateral exchange rates of the US dollar-sterling, US dollar-euro and US dollar-deutschmark since 1991. Chart 6.7 presents the related one-year measure of volatility.

Chart 6.6: The US dollar-sterling, US dollar-euro and US dollar-deutschmark bilateral exchange rates



Source: ECB and Bloomberg.

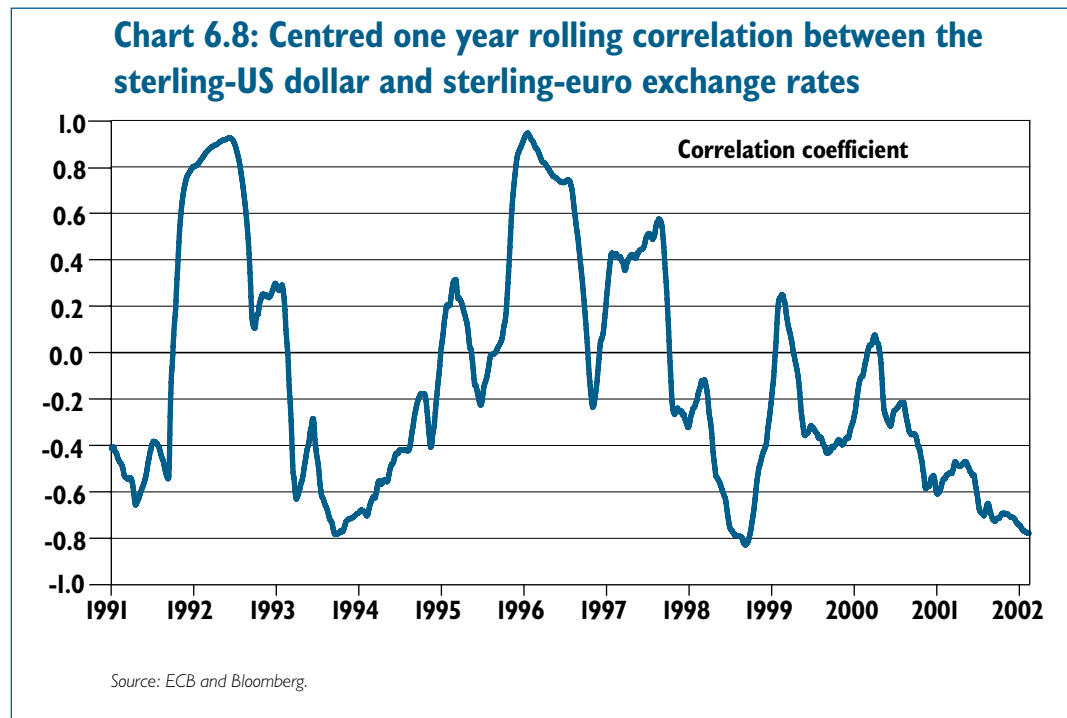
Chart 6.7: One year bilateral volatility (rolling centred one year coefficient of variation)



Source: ECB and Bloomberg.

6.35 The US dollar-sterling is the most stable of the three bilateral exchange rates from 1993 onwards. The greater volatility seen in 1992 is the result of the UK leaving the ERM. Chart 6.7 indicates that the US dollar-deutschmark and US dollar-euro rates were more volatile than average following the start of EMU in 1999. Their volatility then declined over 2000 and 2001 before increasing again in 2002.

6.36 As was noted previously the negative correlation or covariance of the sterling-US dollar and sterling-euro rates seems to have contributed to sterling's relatively low volatility since 1999. However, Chart 6.8 shows that this negative correlation does not hold over all periods in this longer time series; for example around 1996 and 1997, and post-ERM in 1992, the correlation is positive. In these periods sterling was either depreciating or appreciating against both the deutschmark and the US dollar. During such periods membership of EMU would have entailed a much greater reduction in exchange rate volatility than emerges when the simulated volatility is derived using data since 1999.

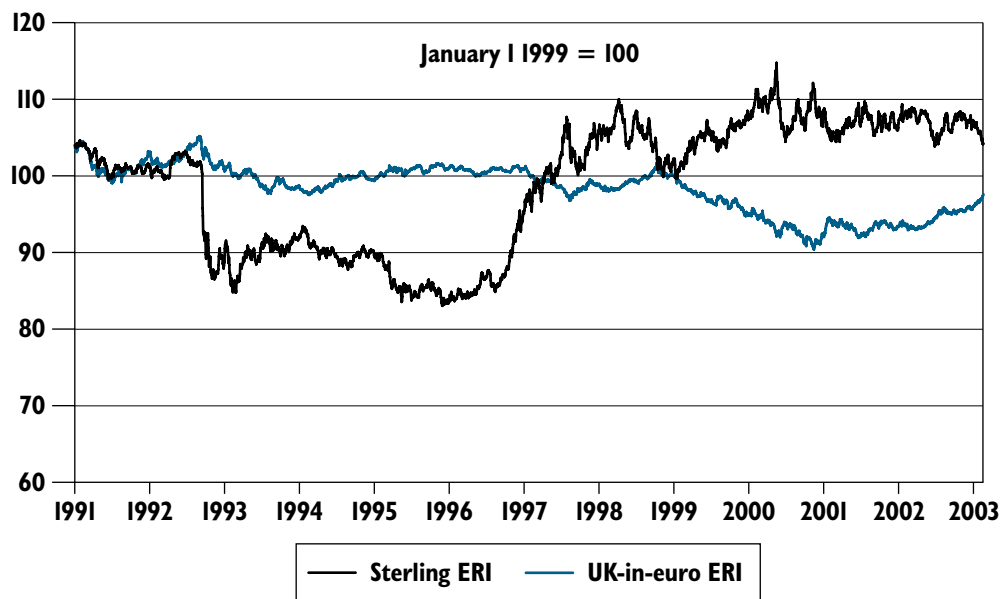


ERIs over a longer time period **6.37** Chart 6.9 indicates the sterling ERI and UK-in-euro ERI derived from Bank of England ERI weights. The rolling one year volatility of these rates is shown in Chart 6.10.

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

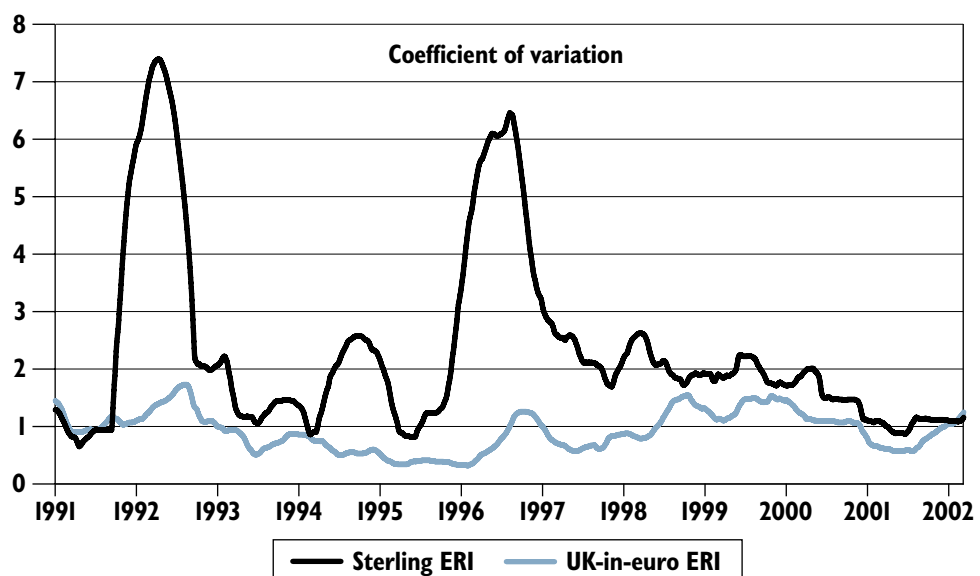
6.39 The reverse is true for the UK-in-euro ERI. Had the UK been in the euro in the 1990s, the large depreciation and even larger appreciation would not have occurred, so stability would have been improved. But, membership of the euro would also have meant experiencing the full effects of the euro depreciation against the US dollar in 1999 and 2000.

Chart 6.9: The sterling ERI and UK-in-euro ERI



Source: ECB and Bloomberg.

Chart 6.10: Centred one year rolling coefficient of variation



Source: ECB and Bloomberg.

6.40 Overall, using Bank of England ERI weights, membership of the euro would have implied lower volatility measured over one year windows for the last decade. The effect on three-year volatility would have been even greater with similar volatility post-1999, but reduced volatility pre-1999.

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

Conclusions

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

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

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

