The variability of exchange rates: measurement and effects

This note reports the results of two recent studies concerned with exchange rate variability. The first study considers a number of measures of variability of bilateral and effective exchange rates, comparing particularly the periods before and after the introduction of the exchange rate mechanism (ERM) of the EMS. It finds no general tendency towards reduced variability in effective rates after introduction of the ERM; bilateral variability within the ERM and non-ERM groups has tended to fall, but between these groups it has increased.

Recent research by the Federal Reserve Bank of New York has found that US and German trade have been adversely affected by exchange rate volatility. Applying the same methods to the equations for UK manufacturing trade volumes and unit values in the Bank's model no significant impact of short-term variability on trade is found for the United Kingdom.

Until the 1970s, advocates of floating exchange rates argued that a more flexible regime, by permitting adjustments to differing rates of inflation, would allow more autonomy in the conduct of domestic economic policies. In particular, flexible exchange rates were seen as a means of maintaining or enhancing economic growth, which might otherwise be disrupted either by policies intended to defend fixed parities or by the consequences of large but infrequent realignments which had become characteristic of the Bretton Woods system.

The general abandonment of fixed rates between major currencies from the early seventies was accompanied by much greater real exchange rate variability than the advocates of flexible rates might have hoped or expected. For long periods, nominal exchange rates have been subject to large swings which have often borne little apparent relationship to trends in relative inflation rates or other underlying factors affecting potential competitiveness. In the shorter term, foreign exchange markets have also been characterised by a higher degree of volatility than is easily explicable in terms of underlying economic factors.

It is useful to distinguish the costs of real exchange rate disequilibrium resulting from large and prolonged swings in nominal exchange rates from those associated with the uncertainty created by short-run volatility of rates. In a speech discussing the costs to international trade and investment of longer-term disequilibrium[1], the Deputy Governor suggested that short-run volatility, while an inconvenience to traders, was unlikely to impose important costs given the existence of forward markets and other institutional mechanisms for hedging against risk. Moreover, empirical work[2] had failed to find any significant impact of short-run variability on trade volumes and only a limited impact on prices. Some subsequent research by the Federal Reserve Bank of New York, however, reported a significant negative effect of volatility on US and German trade.[3]

Various definitions of exchange rate variability may be considered, including measures of nominal and real variability. In the first study reported here, which covers the period 1973–82, various measures of the variability of effective exchange rate indices for a number of currencies have been decomposed in order to assess the contribution of the constituent bilateral rates. Changes in the pattern of variability that have occurred since the establishment of the exchange rate mechanism (ERM) of the European Monetary System (EMS) are also discussed.

Measures of exchange rate variability[4]

Although there is a widespread presumption that variability in exchange rates inhibits international trade, there is no strong theoretical consensus as to the forms of variability that might be most relevant, and no strong empirical evidence on the effect that variability has had. Bank work on this subject has used a wide range of measures.[5]

Measures of variability

Many factors are likely to have affected volatility between 1973 and 1982, including two oil price shocks and more volatile interest rates associated with the new operating techniques of monetary policy adopted in the United States in 1979. Furthermore, the exchange

(1) 'The role of the exchange rate'. Speech by the Deputy Governor to the ninth annual conference of the International Herald Tribune on 15 November 1983; reprinted in the December 1983 *Bulletin*, pages 530–3.

(2) See, for example, 'Exchange rate volatility and world trade', IMF Occasional Paper No 28, and 'The impact of exchange rate variability on international trade flows' by G Justice, Bank of England Discussion Papers, Technical Series, No 4.

(3) 'Effects of exchange rate uncertainty on German and US trade' by M A Akhtar and R S Hilton, *FRBNY Quarterly Review*, Spring 1984.

(4) This section summarises a forthcoming Bank of England Discussion Paper by D G Barr.

(5) Justice, *op cit*.

rate mechanism of the EMS was put in place in March 1979. Thus it is of interest to compare the period up to 1979 with that after these changes had taken place. For the seven currencies which belong to the ERM, only their rates against other members stand to be directly constrained by the mechanism; their rates against non-members have been floating. The eleven non-ERM currencies considered include some which have floated freely against ERM currencies and each other, and some with informal links to the ERM.

It is likely that greater costs are imposed by unexpected exchange rate movements than by those which to some extent can be foreseen. In practice, it is not possible to distinguish at all precisely between these two types of change. But the measures studied include not only the volatility of the exchange rate itself but also the volatility of changes in the rate, and of the rate relative to a trend; the trend or average change may be regarded as more readily foreseeable than short-run fluctuations. (However, the recent behaviour of the US dollar suggests that even longer-term trends can be unexpected.)

There is also a presumption that costs are imposed by fluctuations about some equilibrium rate and that this equilibrium rate may change over time, so that not all changes in exchange rates are costly. The only influence on the equilibrium rate that is specifically considered here is relative prices. The volatility of 'real' exchange rates, that is rates corrected for changes in prices (in this case retail prices), may come closer to measuring volatility around an equilibrium. The ERM is designed both to reduce the volatility of nominal exchange rates and (through policy co-ordination) changes in the equilibrium rates; comparisons of the volatility of nominal and real exchange rates may throw some light on these matters.

Bilateral rates

The variability of bilateral rates between five major currencies on these different measures is compared in the table. Strong general conclusions are hard to find. Changes in the exchange rate are, not surprisingly, generally less variable than the exchange rate itself, and this is more often true of nominal rates than of real rates. Real rates tend to be less variable than nominal rates in cases where one or both of the countries concerned has had high inflation over the period considered. This suggests that some movements in exchange rates have acted to offset the inflation differentials.

Among the individual bilateral rates, the variability of the deutschemark-French franc rate (the only rate in the table directly affected by the ERM) has fallen significantly on all measures between the two periods. It has been the least variable rate on most measures, not only while the ERM has been in place, but also in the earlier period (for part of which the two currencies were included in the European 'Snake'). There have also been some sharp falls in the variability of rates between currencies not included in the ERM (dollar, sterling, yen) at least where the level of the exchange rate is considered, while rates between currencies, one of which is included in the ERM and one of which is not included, have generally become more variable, in some cases very considerably more. Consideration of a wider selection of currencies (all those industrial countries for which effective exchange rates are constructed) confirms this general pattern of reduced variability within the groups of ERM and non-ERM currencies but of increased variability between these groups. The pattern is clearer for the level of exchange rates than for changes, and clearer for nominal exchange rates than for real exchange rates.

Effective rates

Given this pattern, it is not surprising that the effective rates of currencies which are members of the ERM (effective rates which will include bilateral rates *vis-à-vis* both other members and non-members) show no general tendency to reduced variability. Indeed, of the measures considered (nominal and real, exchange rate level and relative to trend) for the members of the ERM, half show increased and half reduced variability. The results are also mixed for the currencies not members of the ERM, although here some two thirds of the measures considered show a fall in variability. When the contributions of different bilateral rates to the changes in variability of effective rates are considered, for members of the ERM it is almost universally the case that variability of their rates against other members has fallen while the variability of their rates against non-members has risen. Among the currencies which are not members of the ERM, those of continental Europe show some similarities to ERM currencies (in their reduced variability *vis-à-vis* ERM currencies). Those outside Europe tend to show an increase in variability *vis-à-vis* ERM currencies (at least on the levels measure) but reduced variability *vis-à-vis* other non-ERM currencies.

Exchange rate variability

Variance of monthly measures(a)

		Pre-ERM (Jan. 1973–Mar. 79)		ERM period (Apr. 79–Dec. 82)	
		Nominal	Real	Nominal	Real
£/$	level	18.80	4.91	15.93	12.44
	change	0.70	0.72	1.05	1.29
£/DM	level	42.49	2.87	4.77	14.24
	change	0.90	0.92	1.11	1.23
$/DM	level	13.22	5.84	18.51	30.25
	change	1.32	1.36	1.14	1.18
£/FF	level	13.68	1.87	8.91	8.50
	change	0.74	0.74	1.09	1.22
$/FF	level	4.04	5.40	38.41	26.75
	change	1.10	1.10	1.19	1.23
DM/FF	level	12.57	2.77	4.99	1.84
	change	0.43	0.42	0.18	0.22
£/Yen	level	45.96	15.01	9.03	5.47
	change	0.80	0.94	1.58	1.67
$/Yen	level	21.15	24.97	5.48	11.03
	change	1.00	1.03	1.60	1.63
DM/Yen	level	5.63	11.73	15.53	15.00
	change	0.96	0.94	1.56	1.53
FF/Yen	level	19.05	14.41	28.23	10.45
	change	0.69	0.75	1.43	1.38

(a) Variances are based on the logarithms of end-of-month exchange rates. All variances have been multiplied by 1,000.

Sterling is something of a case apart. Here the clearest distinctions are not between changes in variability against ERM and non-ERM currencies, but rather between changes in nominal and real variability. For the effective exchange rate as a whole, both measures of nominal variability have fallen, while both measures of real variability have increased. (Indeed, real variability has risen against both ERM and non-ERM currencies and on both measures.) For the United Kingdom the first period was one of high and variable inflation in which the exchange rate tended to offset inflation differentials with other countries. In the second period a more persistently strong nominal exchange rate was one of the factors making for a reduction in inflation, which entailed large movements in the real exchange rate in the process.

Although the study as a whole suggests some fairly distinct patterns to the results, it does not enable strong conclusions to be drawn as to cause or effect. For example, it is not possible to say how far the reduced variability among ERM currencies is due to the operations of the ERM itself. The coincident fall in variability among the non-ERM currencies is not a reliable indication of the way in which the ERM rates would have behaved in the absence of the system. This result does nevertheless somewhat weaken the claim that the reduction in the variability of intra-ERM rates has been due to the creation of the system alone. On the basis of these results (including the increased variability between ERM and non-ERM currencies), it is likely that there has been a further partitioning of the major trading countries into two groups within which the incentives for trade with other group members may have increased at the expense of the incentive to trade outside the group. The results do not suggest that, over the period, the United Kingdom has been strongly aligned with one group or the other.

Exchange rate uncertainty and world trade

Since the collapse of the Bretton Woods system, there has been concern that the volatility associated with floating rates might depress the volume of world trade or tend to increase prices. On the whole, econometric studies which have concentrated on this aspect of trade behaviour have been unable to discern any systematic relationship between measured exchange rate variability and trade volumes. This may be because producers or traders have been able to insure against exchange rate risk through forward markets, or it may reflect the inadequacy of statistical measures of exchange rate variability as indicators of exchange rate risk.

In a recent article, however, Akhtar and Hilton[1] do appear to have found a significant influence of a proxy for exchange rate uncertainty on US and German trade. Their approach[2] is to include in conventionally specified equations for manufacturing trade volumes and prices, as an additional variable, the standard deviation over each quarter of daily observations of the appropriate effective exchange rate index.[3] Their findings support the hypothesis that exchange rate risk has reduced the volume of both German and US trade, either directly, or indirectly by raising trade prices.

Akhtar and Hilton's conclusions relate to the specific countries and time period[4] investigated, and they argue that 'further empirical research on the experience of a broad group of countries would be necessary to reach more general conclusions on the significance of exchange rate uncertainty'. In order to see whether their results would carry over to the United Kingdom, the equations currently employed in the Bank's short-term model to explain the volumes and prices of imports and exports of manufactured goods were extended to include a proxy for exchange rate uncertainty, defined as in Akhtar and Hilton's work and then re-estimated over the period 1976–83. Various lag structures were imposed on the variability term in an attempt to identify relationships which were economically sensible.

The results were mixed. No significant direct effect was found on trade volumes (a result which accords well with much previous econometric work in the area), and the relevant coefficients in the import price equation tended to be negative rather than positive, implying that an increase in exchange rate variability would lower rather than raise prices.[5] On the other hand, a relationship which appeared economically sensible, although not statistically significant, was identified in the export prices equation.[6]

Quite what this mixture of results implies is uncertain. Part of the problem undoubtedly arises from the small number of (quarterly) observations available, which makes it difficult to identify a stable relationship. But over and above this statistical problem, the inconclusive findings probably reflect, to a certain (but unmeasurable) extent, the effect of market organisation and pricing rules. Markets for manufactured goods in world trade tend to be dominated by a relatively small number of producers selling differentiated products so that, unlike markets for many basic commodities, the 'law of one price' does not hold; suppliers then have some leeway in setting prices in any one market, subject to competition from near-substitutes. An exporter can either set prices in the currency of the buyer (and so reduce uncertainty regarding demand for the product at the expense of increasing uncertainty of his own domestic-currency

(1) Akhtar and Hilton, *op cit.*

(2) Justice, *op cit.* discusses the theoretical difficulties involved in this kind of approach.

(3) Alternative measures of exchange rate variability did not alter the broad pattern of results obtained to any marked extent.

(4) The authors note that their results are sensitive to substantial changes in the observation period: in particular, excluding the period since 1979 produced results in which exchange rate variability did not appear to be a significant variable in most cases.

(5) Justice, *op cit.* has argued that the expected sign on the coefficient in the price equation is ambiguous if markets for manufactured goods are less than perfectly competitive, as tends to be so.

(6) A similar result was found by Justice, *op cit.*

profit margins), or he can set prices in his own currency (so that profit margins are known, but the volume of sales is more uncertain).

In neither case can it be unambiguously stated that an increase in exchange rate variability would tend to increase prices noticeably. If prices are set in the exporter's currency, the increased uncertainty regarding demand will tend to impose costs on the supplier resulting from adjustments to stock levels, overtime working and so on which would tend to push prices up. On the other hand, foreign buyers, faced with a price which is uncertain in their own currency, might demand prices that are lower on average than those of domestic suppliers to compensate for increased risk. The outcome, in general, is indeterminate, and in each particular case will depend upon the relative strengths of the parties concerned. Where goods are priced in the buyer's currency, the strain of exchange rate variability will fall principally on the exporters' profit margins, as a result either of increased use of forward cover or of additional borrowing to even out irregular flows of income. Such an effect is likely to be small, however, as the cost of these services is generally low in relation to total costs.

Since a positive effect of exchange rate variability is found only in the export prices equation, this might suggest that UK exporters tend to set prices in foreign currencies. But this is at odds with what is known about invoicing behaviour, which tends to suggest that a large proportion of UK exports is invoiced in sterling.[1] Against this background, it is perhaps not surprising that only a very weak effect of exchange rate uncertainty was found in the export prices equation.

The general lack of findings for the United Kingdom contrasts with the strong effects reported by Akhtar and Hilton for German and US trade, but the difference can be reconciled in the following manner. Comparing Germany with the United States, Akhtar and Hilton find that German trade flows are more sensitive to exchange rate volatility, but also to price and exchange rate effects generally. Their results also suggest that the sensitivity of both German and US trade flows to competitiveness is much greater than that typically found in studies of UK trade. If competitiveness has a smaller effect on UK trade than that of Germany and the United States, it is perhaps not surprising that volatility of the exchange rate should also have less effect.

(1) See for example, a survey *The financing procedures of British foreign trade* by S Carse, J Williamson and G E Wood, Cambridge University Press, 1980. This estimated that in 1976 some 85% of exports and some 30% of imports, by number of transactions, were invoiced in sterling: by value the corresponding percentages were 75% and 30%. Furthermore, some 60% of imports were invoiced in the seller's currency.