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Calculating the real exchange rate

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**Interpreting Economic Data
Calculating the Real Exchange Rate**

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Introduction

Economists and financial commentators often refer to the exchange rate when they discuss the economic situation. However, for each currency there are as many exchange rates as there are other currencies and it is difficult to judge which if any should be considered the most important. In this article we will show how it is possible to take data for individual exchange rates and construct an index which is economically meaningful. First we show how to average exchange rate data to construct a measure known as the *effective exchange rate*. This allows us to judge whether on average the pound has appreciated or depreciated relative to other world currencies. However, the effective exchange rate does not make allowances for differences in the price of goods between different countries. Therefore in the next section we show how we can make such an adjustment to obtain a measure known as the *real effective exchange rate*. In the final section this allows us to discuss the impact of the exchange rate on the level of international competitiveness and hence on the overall economy. All data in this article are taken from the IMF's International Financial Statistics database.

Measuring the Effective Exchange Rate

Consider the data given in Table 1. This shows the bilateral exchange rates for the pound in 1990 and 1991 relative to five other currencies: the French Franc (FF), the German Deutschmark (DM), the Italian Lira, the Japanese Yen and the US Dollar. The data given are averages over the years in question and taken together these countries account for over two-thirds of UK imports and exports. These data indicate some of the problems involved in assessing the behaviour of the foreign exchange market. First, it is hard to judge whether the overall exchange rate appreciated or depreciated during this period. We see that the value of sterling increased relative to the Franc, the DM and the Lira. However, it fell relative to the Yen and the Dollar. This is why it is important to construct an index for the value of overall value of the pound. When we try to do this

however, we run into a second problem – each exchange rate is measured as the number of units of foreign currency which can be purchased with one pound. Therefore, since each exchange rate is expressed in different units, a simple average of the figures is meaningless.

Table 1: Units of Foreign Currency per Pound Sterling (period averages)

Date	French Franc	Deutsch mark	Italian Lira	Japanese Yen	US Dollar
1990	9.72	2.88	2139	258	1.79
1991	9.98	2.94	2195	238	1.77

Source: International Monetary Fund – International Financial Statistics

In circumstances where the units of a particular variable are unimportant, or even a nuisance, it is often useful to express it as an index. To do this we set the value for a particular time period equal to 100 and then express the values for all other time periods relative to this. For example, let us set the FF/£ exchange rate for 1990 equal to 100, we can then express the value in 1991 as $100 \times 9.98 \div 9.72 = 102.7$. This calculation has the advantage that it enables us to assess immediately the extent to which the exchange rate has appreciated or depreciated. In this case we see that the value of sterling relative to the FF appreciated by 2.7% between 1990 and 1991.

Table 2: Exchange Rate Index Numbers

Date	French Franc	Deutsch mark	Italian Lira	Japanese Yen	US Dollar
1990	100.0	100.0	100.0	100.0	100.0
1991	102.7	101.8	102.6	92.2	99.1
Weights	0.1884	0.3365	0.1237	0.1047	0.2467

In Table 2 we have calculated index numbers for each the exchange rates in our sample. From this we see that sterling appreciated by 1.8% relative to the DM, by 2.6% relative to

the Lira, depreciated by 7.8% relative to the Yen and depreciated by 0.9% relative to the US Dollar. Thus sterling appreciated relative to three currencies and depreciated relative to the other two. The problem is therefore how we can make sense of these contradictory movements and calculate an overall figure for the value of sterling. The method we will use to take a *weighted average* of the index figures. Taking an average is meaningful in this case since the units of the data are now longer relevant given that they are expressed in index form. However, we do need to allow for the differences in importance of the different currencies by weighting the data. A useful analogy can be made here with the construction of a price index. When we construct a price index we weight the price of each good by its proportion in total consumer expenditure. In constructing a measure of the value of sterling we will similarly weight different currencies by the share of each country in total UK trade. Trade in this case is defined as the sum of imports from and exports to each country.

The weights we will use to construct the exchange rate index are given in the bottom row of Table 2. These are based on the weights used by the Bank of England to construct its effective exchange rate index. However, it is important that the weights used to construct the index add up to one and therefore we have adjusted the Bank's weights which are based on a rather larger group of currencies. The resulting figures are interesting in themselves in that they give a measure of the relative importance of the different countries in total UK trade. For example, we can see that, within this group of countries, Germany accounts for about one third of UK trade, the US about one quarter, France just under 20% with Italy and Japan sharing the remainder. Next we apply these weights to the index numbers for the currencies to construct the effective exchange rate index. In the case of 1990 this is trivial since the index number for each currency is equal to 100 and therefore the weighted average is also equal to 100. For 1991 however the calculation is not trivial, in this case we make the following calculation based on the index numbers and the weights:

$$E_{1991} = 0.1884 \times 102.7 + 0.3365 \times 101.8 + 0.1237 \times 102.6 + 0.1047 \times 92.2 + 0.2467 \times 99.1$$

$$= 100.4$$

The calculation for 1991 indicates that movements of the different exchange rates between 1990 and 1991 have largely offset each other. We see that the effective exchange rate appreciated by 0.4% during this period with the appreciation of the currency relative to the European countries being offset by the depreciation relative to the Yen and the Dollar.

So far we have calculated the effective exchange rate index for only two years. However, by using a spreadsheet it is easy to perform the same calculations for a large number of years. In Figure 1 we show the result of these calculations for the period 1970 to 2002. This shows a general tendency for the value of sterling to fall relative to other currencies during this period, although there have been periods in which sterling has appreciated and the depreciation does seem to have levelled off in the 1990s.

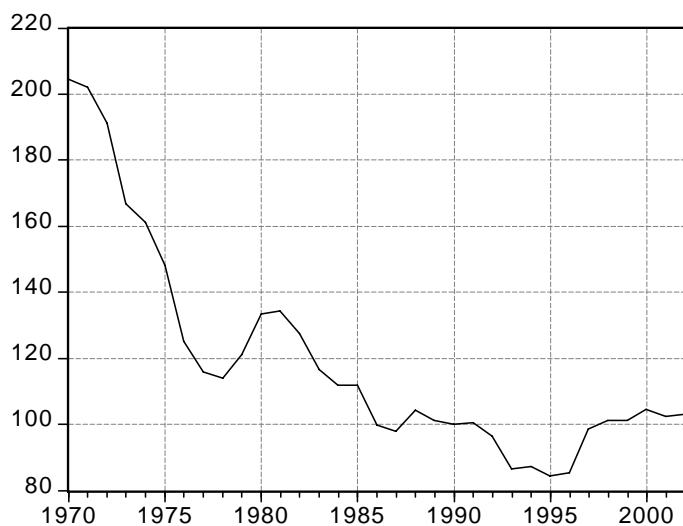


Figure 1: Nominal Effective Exchange Rate

Measuring the Real Effective Exchange Rate

In the previous section we showed how it was possible to construct an effective exchange rate index by taking index numbers of the data and then taking a weighted average of the resulting figures. These calculations give us a measure of the value of sterling relative to other currencies which rises when sterling appreciates in value and falls when sterling depreciates. It is tempting to use the effective exchange rate index as a measure of the competitiveness of the UK economy in international trade. However, the index we have constructed tells us only part of the story since it does not allow for changes in the price of the goods across different countries. Thus the index we have constructed is often referred to as the *nominal effective exchange rate* since it does not reflect changes in real competitiveness.

To correct for changes in goods prices we need to construct a measure of the real exchange rate. For example, suppose we wish to calculate the real exchange rate for sterling relative to the dollar for the year 1997. The index for the nominal exchange rate for 1997 can be calculated as 91.8. Using 1990 as the base year we obtain data for the UK and US price levels as 124.9 and 122.9 respectively. It follows that we can adjust for the effects of prices and write the real sterling-dollar exchange rate index as

$91.8 \times \frac{124.9}{122.9} = 93.3$. Next we repeat these calculations for each of the other currencies as

shown in Table 3. The price index used in each case is the consumer price index. Note that the price data shown are the consumer price indices for each country. The final stage of the calculation is to take a weighted average of these real exchange rate indices to obtain the real effective exchange rate shown in the final two rows of the table.

Table 3: Calculation of the Real Effective Exchange Rate

	Date	France	Germany	Italy	Japan	USA	UK
Exchange Rate Index	1997	98.4	98.5	130.4	76.7	91.8	
	1998	100.5	101.0	134.4	83.9	92.8	
Price Index	1997	115.2	120.5	135.5	109.0	122.9	124.9
	1998	116.0	121.7	138.2	109.7	124.8	129.1
Real Exchange Rate Index	1997	106.6	102.0	120.2	87.9	93.3	
	1998	111.9	107.2	125.6	98.7	96.0	
Real Effective Exchange Rate	1997	101.5					
	1998	106.7					

From Table 3 we see that between 1997 and 1998 sterling appreciated in real terms relative to all the other currencies in our sample. The question we need to ask however, is by how much. Using the same trade weights we used for the nominal effective exchange rate we obtain values for the real effective exchange rate of 101.5 for 1997 and 106.7 for 1998. It follows that the percentage appreciation over this period can be calculated as $100 \times \left(\frac{106.7 - 101.5}{101.5} \right) = 5.1\%$. A real appreciation of over 5% in one year amounts to a fairly substantial loss of competitiveness since it indicates that UK goods have become more expensive on world markets relative to foreign goods.

Again we need to repeat the calculation of the real exchange rate for a longer time period in order to assess how competitiveness has changed over time. Figure 2 shows the results for the period 1970 to 2002. In contrast with Figure 1 we see no evidence here of a depreciation in the real value of sterling over time. This is because the fall in the nominal exchange rate shown in Figure 1 mainly acted to offset the fact that UK inflation was rather higher than that of competitor economies during the 1970s and 1980s. As we might expect there is no evidence of a long term trend in the real exchange rate although there are periods in which there have been substantial movements. For example, from 1979

through to 1981, the real exchange rate appreciated significantly leading to a substantial loss of competitiveness for British industry. This was followed by a period in which the real exchange rate depreciated for a number of years before again appreciating in the later 1980s and early 1990s. Finally, we have seen a significant appreciation since 1996 which appears to have levelled off in the early part of the new century.

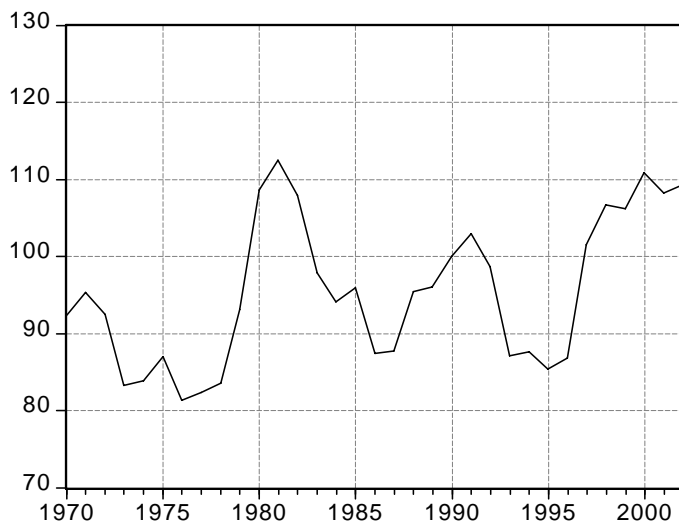


Figure 2: The Real Effective Exchange Rate

The Real Exchange Rate and the Business Cycle

How important is the real exchange rate? From Figure 2 we see that two of the major recessions of the this time period coincided with periods when the real exchange rate appreciated sharply. This was the case during the period 1979-1981 and the period 1989-1991. In both cases the loss of competitiveness associated with a real appreciation meant that UK firms found it hard to survive in world markets. This in turn led to negative growth and rising unemployment.

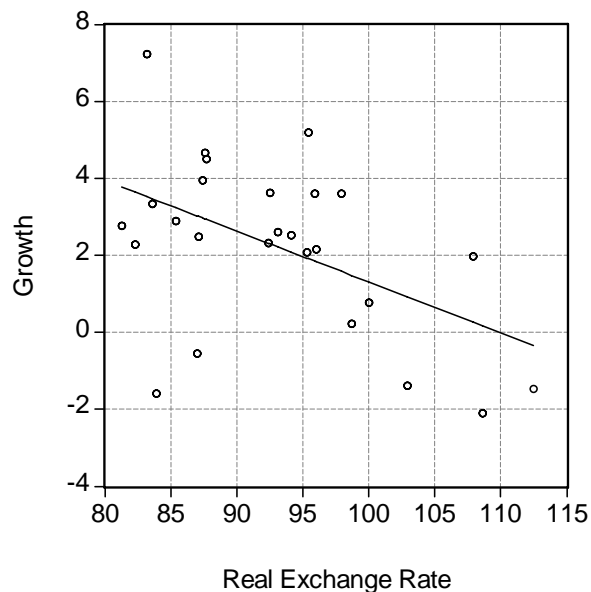


Figure 3: Growth and the Real Exchange Rate 1970-1995

We can look at the relationship between growth and the real exchange rate more systematically by plotting them together on a scatter diagram as shown in Figure 3. This shows a clear negative relationship between the two variables. The regression line shown in the diagram indicates that a 1 percentage point increase in the real exchange rate leads to a fall in growth of about 0.13%. However, in order to obtain a reasonably clear negative relationship between the variables we have had to restrict the sample by leaving out the observations from 1996 to 2002. If we include these then we find that the relationship is much weaker. Despite the fact that the real exchange rate has appreciated substantially during this period there is little evidence that this has had a significant effect on the growth rate. This indicates that something has happened to change the relationship between growth and the real exchange rate during the late 1990s which cannot be explained by the simple model shown in Figure 3.

Conclusions

In this article we have shown how it is possible to construct an index of the effective exchange rate by weighting individual indices for the exchange rate by the shares of each country in trade with the UK. We then showed how it was possible to construct an index of the real exchange rate by adjusting each bilateral exchange rate for price movements. This index provides a more accurate measure of the level of international competitiveness since it reflects the relative price of goods between different countries. Finally, we discussed the role of the real exchange rate movements in explaining the UK growth rate. In two cases we saw that recessions in the UK economy coincided with appreciations of the real exchange rate. However, the appreciation of the real value of sterling during the late 1990s does not seem to have resulted in a fall in the UK growth rate.

Questions and Thoughts for Further Discussion

- Using the data in the Table below and the weights given in the article, calculate values for the nominal effective exchange rate over the period 1995 to 1998.

	French Franc	Deutschmark	Italian Lira	Japanese Yen	US Dollar
1995	7.88	2.26	2570.5	148.4	1.58
1996	7.99	2.35	2410.1	169.9	1.56
1997	9.56	2.84	2789.7	198.2	1.64
1998	9.77	2.91	2875.2	216.8	1.66

The figures in the Table show units of national currency per pound sterling.

- It is often argued that the exchange rate appreciates when the monetary authorities increase the interest rate. Discuss reasons why this might be the case.
- Using the data in the Table below calculate a real exchange rate index for the Japanese Yen relative to the Pound Sterling and comment on your results.

	Yen/£ Exchange Rate	Japanese Price Index	UK Price Index
1990	258.5	100.0	100.0
1991	238.3	103.2	105.9
1992	223.7	105.0	109.8
1993	167.0	106.4	111.5
1994	156.6	107.1	114.3
1995	148.4	107.0	118.2
1996	169.9	107.1	121.1
1997	198.2	109.0	124.9
1998	216.8	109.7	129.1
1999	184.3	109.3	131.1
2000	163.4	108.6	135.0
2001	175.0	107.8	137.4
2002	188.2	106.8	139.7