CHAPTER 4

THE IMPACT OF THE US DOLLAR ON REAL EFFECTIVE EXCHANGE RATE

4.0 Nominal and Real Effective Exchange Rates

If the exchange rate of the home country is expressed in terms of currencies of several other countries (for instance, the currencies of its major trading partners), it is then known as the multilateral or effective exchange rate. The term "effective" means a "weighted average". The effective exchange rates can also be expressed in both nominal and real terms. The nominal effective exchange rate (NEER) is computed as a weighted average of several important nominal exchange rates. Therefore, based on IMF's definition, the nominal effective exchange rate represents the ratio of an index of period average exchange rate of the home currency to a weighted geometric average of exchange rate for the selected currencies. Whereas, the real effective exchange rate (REER) takes account of movements in a weighted basket of its trading partners. Thus, it usually defined as a nominal effective exchange rate index that is adjusted for relative movements in national price or cost indicators of the home country and selected countries (IMF 2000).

Since the nominal effective exchange rate excludes any changes in the price levels of home and foreign countries, it does not really reflect the change in a country's competitive position relative to its partners (Bahmani-Oskooee 1995: 591). Thus, the appropriate measure of an exchange policy is one that incorporates changes in domestic and foreign prices into nominal exchange rate changes. The resulting measure is called the "real exchange rate". Thus, only devaluation or depreciation of real exchange rates can increase a country's international competitiveness" (Bahmani-Oskooee 2001: 103). Therefore, the real effective exchange rate indices have often been used to evaluate the

effect of exchange rates on domestic currency and trade balance and as indicators of price and cost competitiveness.

Based on Hinkle and Montiel (1999: 49-52), the effective exchange rates can be computed as either a geometric average or as arithmetic average. But most economists prefer to use the geometric average although the arithmetic average is much easier to compute. This is because the geometric average has certain properties of symmetry and consistency that an arithmetic average does not have. The nominal effective exchange rate can calculated using the formula below:

$$NEER = \prod_{i=1}^{n} E_{ir}^{\ w_i} \tag{4.1}$$

where 1) w_i is the appropriate weight for each trading partner *i*
2) E_{ir} – nominal bilateral exchange rate between the home country and the ith trading partner

The real effective exchange rates can be computed in two ways:

i. REER as a geometric weighted average of the bilateral real exchange rates of the home currency with each of its main trading partners or competitors. Thus the real effective exchange rates in domestic currency terms is given by the equation below:

$$REER = \prod_{i=1}^{n} e_{ir}^{\ w_i} \tag{4.2}$$

where e_{ir} represents the real bilateral exchange rate between the home country and the ith trading partner

The advantage of computing the real effective exchange rates as the weighted bilateral real exchange rates is that it can provide calculations of the bilateral real exchange rates indices for individual countries or subsets of countries. For

instance, in cases in which a country pegs its exchange rate to or targets it on that of another country, it is often useful to analyse the home country's REER in terms of:

a. Changes in the home country's bilateral real exchange rate with the peg currency caused by differences in inflation rates in the home and peg countries.

b. Changes in the home country's REER relative to the bilateral real exchange rate with the peg currency caused by inflation and exchange rate movements in third-country currencies.

ii. REER as a product of the nominal effective exchange rate and the ratio of a weighted index of foreign prices to the domestic prices as shown below:

$$REER = \frac{NEER * EP_f}{P_d} \qquad (4.3)$$

where EPf is the weighted average of foreign price index for the home country's trading partners

The advantage of using this method is that it allows us to analyse the effects of movements in nominal effective exchange rates in terms of changes in the exchange rate between the home currency and its peg.

4.1 Key Elements in the Calculation of the Effective Exchange Rates

Before we proceed, we should first consider some of the key elements for the construction of the effective exchange rates. These elements include the choice of trading partner currencies, the choice of weights and the base period as discussed below:

1. *The Choice of Currencies*

The choice of currencies would depend on Malaysia trading partners that account for most of its international trading activity and data availability. Since complete data for all of Malaysia's trading partners are not available, only 15 trading countries that account for at least 70 to 80 per cent of Malaysia's total trade have been selected for this study. These countries include Singapore, Thailand, Indonesia, Philippines, India, Japan, Australia, New Zealand, United States, Canada, United Kingdom, Netherlands, France, Italy, and Denmark.

2. *The Base Period*

Effective exchange rates are often expressed relative to a certain base period. The selected base period should be compatible with the purpose of the study and should be able to reflect the economic structure throughout the period of analysis. The base period should also be fairly recent in order to make a comparison of past and present values. Finally, it should be a period of normal or stable economic condition.

However, it should be noted that the effective exchange rates computed here is not based on a particular base period. The reason for this is that by using a base period, it may lead to misleading results as the selected basket of currencies may not be consistent with the current situation and be unable to account for changes in exchange rate regimes.

3. *The Choice of Weights*

"The weights to be given to changes in the home country's exchange rate with other foreign countries must reflect the relative importance of each of these changes in contributing to a specific result that is selected as deserving attention, that is, to an objective of economic analysis or policy" (Rhomberg 1976: 89).

Thus, the method of computing the effective exchange rates would depend on the purpose of this study. Since, this study focuses on the impact of the US dollar on Malaysian bilateral imports and exports, it would therefore be appropriate to compute both the import weighted effective exchange rates (which measures the effect of exchange rate changes on the cost of imports in the home country) and the export weighted effective exchange rates (which measures the average change in the cost of the home country's exports to foreign customers rates) in both nominal and real terms. Finally, to analyse the impact of the US dollar on overall trade balance, it would be best to compute the trade weighted effective exchange rate. "The trade flow weights for the effective exchange rate measure the direct impact on income of the foreign/ external sector. Thus, a country whose trade share is large is one whose economy's impact on the domestic markets is large, while a country with smaller trade share has less impact" (Ott 1987:8).

Another important factor that concerns the choice of weights is whether to use a fixed weight or changing weights. Fixed weights are often used because they are easy to compute. "But, trade flows change over time, so in principle the corresponding weights should change. The more rapid the evolution of trade patterns, the more likely it is that a fixed weight index will misinterpret the impact of exchange rate changes" (Chinn 2002:11). Hence, changing weights depending on Malaysia's actual trade performances would be more appropriate.

4.2 Bilateral Exchange Rates

The nominal and real bilateral exchange rates[11] can be measured in domestic-currency terms (units of domestic currency per unit of foreign currency, E_{dc}) or in foreign-currency terms (units of foreign exchange per unit of domestic currency, E_{fc}). The domestic- and foreign-currency measures are the inverses of each other as shown below by equation 4.4:

$$E_{dc} = 1/ E_{fc} \tag{4.4}$$

The term appreciation (depreciation) is used to refer to an increase (decrease) in the value of the home currency relative to foreign currency. Since the domestic- and foreign-currency measures are reciprocals of each other, an appreciation of the nominal or real bilateral exchange rates expressed in foreign-currency terms implies a depreciation of the exchange rates expressed in domestic-currency terms. Hence, an increase or upward movement in one corresponds with a decrease or a downward movement in the other. The real bilateral exchange rates (e_{dc}) is given by equation 4.5 below:

$$e_{dc} = E_{dc} * P_d / P_f \tag{4.5}$$

where (1) E_{dc} – represents the nominal bilateral exchange rate expressed in domestic-currency terms
(2) e_{dc} – represents the real bilateral exchange rate expressed in domestic-currency terms
(3) P_d and P_f - represents the price of goods in domestic and foreign country respectively.

It should be noted that throughout this analysis, period averages of both the nominal and real exchange rates would be expressed in domestic-currency terms that is the domestic-currency price of a unit of foreign-currency. In this analysis, it is assumed here that there are n currencies that represent the bilateral exchange rates of Malaysia's

[11] Hinkle and Montiel (1999): 45.

trading partners with the US dollar as the numeraire currency. E_{ir} denotes the nominal bilateral exchange rate of the i_{th} trading partner in domestic-currency terms where

$$i = 1,2,\ldots\ldots\ldots\ldots\ldots\ldots n$$

Thus, the price of one US dollar in terms of domestic currency is expressed as one US dollar equivalent to RM 3.80 as shown below:

$$E_{ir} = E_{rus} = \frac{RM3.80}{US\$1}$$

If the price of one US dollar is equivalent to Singapore $1.724, the price of the Singapore dollar in terms of domestic currency can be calculated using the equation below:

$$E_{ir} = E_{rus} / E_{ius} \qquad (4.6)$$

where E_{ius} represents the foreign nominal bilateral exchange rate with US dollar as the numeraire currency.

Thus, the price of the Singapore dollar in terms of the Malaysian ringgit is expressed as one Singapore dollar equivalent to RM 2.204176 as can be seen below:

$$E_{ir} = \frac{3.800/1}{1.724/1}$$

$$= 2.204176$$

In some cases, some countries like Australia express their exchange rates in terms of foreign-currency. Thus, if one Australian dollar is equivalent 0.765 US dollars, the price of the Australian dollar in terms of the Malaysian ringgit is computed using the formula below:

$$E_{ir} = E_{rus} * E_{ius} \qquad (4.7)$$

Hence, the price of the Australian dollar in terms of the Malaysian ringgit is expressed as one Australian dollar equivalent to RM 2.907000 as below:

$$E_{ir} = (3.80/1) * (0.765/1)$$

$$= 2.907000$$

The real bilateral exchange rate in domestic-currency terms is denoted by e_{ir}. The real bilateral exchange rate can be calculated using equation 4.8

$$e_{ir,\,t} = E_{ir,\,t} * CPI_f / CPI_d \qquad (4.8)$$

The Consumer Price Indices (CPI) represents the price of goods in domestic and foreign country. The advantage of using CPIs is that they are "calculated using a basket of commodities that is broadly comparable across countries. They are relatively accurate, published frequently and available for a wide range of countries for an extensive time period" (Ha and Fan 2003:16).

4.3 Calculation of the Nominal and Real Effective Exchange Rates

4.3.1 *Sources of Data*

The data required to compute the effective exchange are as mentioned below:

(1) Bilateral import and export of Malaysian trade flows were obtained from Bank Negara's Quarterly Economic Bulletin (1975: Q1 – 2003: Q4).

(2) Period averages of the nominal bilateral exchange rates of the home currency and the foreign currencies with the US dollar as the numeraire currency were obtained from the IMF's International Financial Statistics Online website (1975: Q1 – 2003:Q4).

(3) Consumer price indices for all the countries included in this study were also obtained from the International Financial Statistics Online website (1975: Q1 – 2003: Q4).

4.3.2 ***Calculation of Weights***

In this study, three types of weights for Malaysia's trading partners are computed as explained below:

1) The export weight of Malaysia's trading partners is computed based on Malaysia's bilateral exports to foreign countries using equation (4.9):

$$w_{iX} = X_i / TX \tag{4.9}$$

where (1) w_{ix} is the export share of the i^{th} trading partner's country.
(2) X_i - represents Malaysia's exports to country *i*
(3) TX - represents Malaysia's total exports

2) The import weight of Malaysia's trading partners is computed based on Malaysia's bilateral imports from foreign countries using equation (4.10):

$$w_{iM} = M_i / TM \tag{4.10}$$

where (1) w_{iM} is the import share of the i^{th} trading partner's country.
(2) M_i - represents Malaysia's imports from country *i*
(3) TM - represents Malaysia's total imports

3) The total trade weight of Malaysia's trading partners is computed based on Malaysia's total external trade using equation (4.11):

$$w_{iT} = \frac{X_i + M_i}{\sum (TX + TM)} \tag{4.11}$$

where (1) w_{iT} is the total trade share of the i^{th} trading partner's country.
(2) $\sum (TX + TM)$ represents the sum of Malaysia's total exports and imports

4.3.3 ***Calculation of the Nominal and Real Export Weighted Effective Exchange Rate***

Based on Arshad, Mah and Cavanagh (1994), the following method of computation was used. Thus, the nominal export weighted effective exchange rates is constructed using the formula below:

$$NEER_{X,t} = \prod_{i=1}^{n} E_{ir}^{\,w_{iX}} \tag{4.12}$$

The real export weighted effective exchange rates is then constructed using equation (4.13):

$$REER_{X,t} = NEER_{X,t} / \exp \sum_{i=1}^{n} w_{iX} \ln (CPI_f / CPI_d) \tag{4.13}$$

where $\exp \sum_{i=1}^{n} w_i \ln (CPI_f / CPI_d)$ represent the ratio of a weighted index of foreign prices to the domestic prices.

4.3.4 ***Calculation of the Real and Export Import Weighted Effective Exchange Rate***

Similarly, the nominal import weighted effective exchange rates is constructed using equation 4.14:

$$NEER_{M,t} = \prod_{i=1}^{n} E_{ir}^{\,w_{iM}} \tag{4.14}$$

The real import weighted effective exchange rates is constructed using formula below:

$$REER_{M,t} = NEER_{M,t} / \exp \sum_{i=1}^{n} w_{iM} \ln (CPI_f / CPI_d) \tag{4.15}$$

4.3.5 ***Calculation of the Nominal and Real Trade Weighted Effective Exchange Rate***

The nominal trade weighted effective exchange rates is constructed using equation 4.16:

$$NEER_{T,t} = \prod_{i=1}^{n} E_{ir}^{\,w_{iT}} \qquad (4.16)$$

The real trade weighted effective exchange rates is computed using the formula below:

$$REER_{T,t} = NEER_{T,t} / \exp \sum_{i=1}^{n} w_{iT} \ln (CPI_f / CPI_d) \qquad (4.17)$$

4.4 **The Impact of The US Dollar on Malaysian Real Effective Exchange Rates**

Since the bilateral exchange rates used in this analysis are expressed as the price of foreign currency in terms of the domestic currency, an increase in the effective exchange rates computed in chapter would reflect a depreciation of the ringgit (either on the export or import side) with respect to its trading partners. Similarly, a decrease in the effective exchange rates would reflect an appreciation of the ringgit (either on the export or import side) against its trading partners.

An appreciation or depreciation of the real effective exchange rates may be due to inflation rates in the home country or in its trading partners. If domestic inflation is higher than that of its trading partners, then the real effective exchange rate may appreciate leading to a loss of price competitiveness and vice versa. In this section, we will look into the changes in the real effective exchange rates relative to changes in the RM/US$ bilateral exchange rates and analyse whether the RM/US$ bilateral exchange rates has a significant impact on Malaysia's real effective exchange rates. The effective

exchange rates computed in this chapter are as attached in Appendix A. Figure 4.1 and 4.2 show the changes in the real effective exchanges rates computed in this chapter relative to changes in the RM/US$ nominal and real bilateral exchange rates[12].

1. The mid-1970s

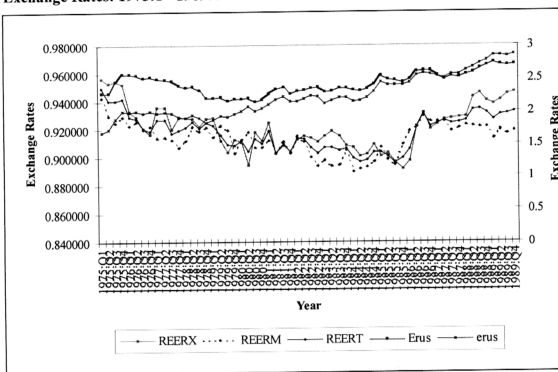
In the late 1970s, the ringgit generally appreciated against its trading partners on both the export and import side to varying extents. From the first quarter of 1975 to the fourth quarter of 1976, the real effective exchange rates showed an appreciating trend except on the import side in 1975:4, 1976:2, 1976:4 and on the export and total trade in 1975:3 and 1975:4 respectively. But from 1977:1 until 1978:4, the movements in the real effective exchange rates showed a depreciating trend. From 1977:1 until 1977:2, the ringgit depreciated against the other currencies except on the import side in 1977:1. In 1977:3, the ringgit appreciated against its trading partners but depreciated again in 1977:4 to 1978:2 except on the import side in 1977:4 and on the export side in 1978:2. From the third quarter of 1978 until 1979:4, the ringgit generally appreciated against its trading partners except in 1978:4 and 1979:4 when the ringgit depreciated in terms of exports.

Since mid-1970s, the RM/US$ nominal bilateral exchange rates also appreciated quite significantly except in early 1975 and the first, second and the fourth quarter of 1979. The RM/US$ real bilateral exchange rates also initially depreciated in 1975 from the second quarter until the fourth quarter. This may have been due to high inflation rates in the United States. But generally, the nominal RM/US$ bilateral exchange rates appreciated in the late 1970s as can be observed

[12] The real RM/US$ bilateral exchange rates were computed using data obtained from the International Financial Statistics and are as attached in Appendix A.

in Figure 4.1 and thus, it could be said that the RM/US$ bilateral exchange rates appears to have a slight impact on Malaysia's real effective exchange.

Figure 4.1. Real Effective Exchange Rates and Nominal and Real RM/US Bilateral Exchange Rates: 1975:1 - 1989:4



Source: Nominal RM/US$ bilateral exchange rates were obtained from International Financial Statistics website.

2. *The 1980s*

In 1980 and 1981, the ringgit's response towards its trading partners were quite mixed. The ringgit depreciated in terms of imports and total trade in the first quarter of 1980 but appreciated in terms of exports and total trade in the second and fourth quarter. Whereas in 1981, the ringgit depreciated against its trading partners in the first quarter but appreciated in the second. The similar tend occurred in the third and fourth quarter for that year. In 1982 and 1983, although the ringgit depreciated against its trading partners in the first quarter, it generally appreciated against its

trade partners in the following three quarters except on the export side in the second quarter.

The ringgit continued to appreciate in the first two quarters of 1984 except on the import side in the second quarter. But from the third quarter of 1984 until the first quarter of 1985, the ringgit depreciated against its trading partners except in terms of exports in 1985:1. In the following two quarters of 1985, the ringgit appreciated briefly against its trading partners. But from 1985: 4, the ringgit began to depreciate against its trading partners until the third quarter of 1988 although the ringgit appreciated slightly against its trading partners in 1986:4 and in terms of imports in 1987:3 and 1988:3. From 1988:4 until 1989:1, the ringgit appreciated against its trading partners but it resumed a depreciating trend from the second quarter of 1989.

Hence, despite the early 1980s, the RM/US$ bilateral exchange rates seem to have influenced Malaysia's real effective exchange rates especially in the late 1980s. For instance, after the 1985 Plaza accord, the US dollar depreciated against other major currencies. As a result, the ringgit also depreciated against its major trading partners.

3. *The 1990s*

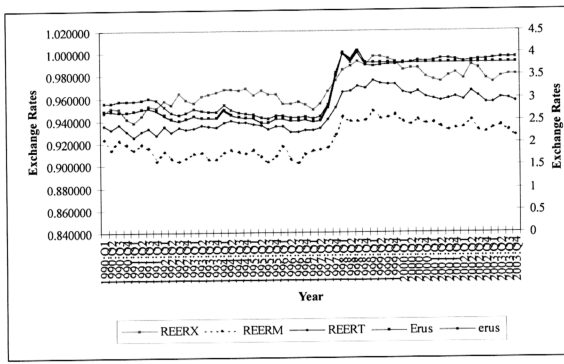
In 1990, the Malaysian real effective exchange rates depreciated from the first quarter until third quarter except in terms of imports and total trade in 1990:2 and in terms of exports in 1990:3. From 1990:4 until 1991:1, the ringgit appreciated against its trading partners. But in the second and third quarter, the ringgit showed a depreciating trend except in 1991:3 on the import side. In the fourth quarter of 1991 until 1992:2, the ringgit reflected an appreciating trend although it depreciated

briefly in 1992:1. In 1992:3, the ringgit depreciated in terms of exports and total trade but appreciated again in the fourth quarter.

From the first quarter of 1993 until the second quarter of 1994, the ringgit fairly depreciated against its trade partners except in 1993:1 on the export side and also in 1993:3 in terms of imports and total trade. The real effective exchange rates appreciated once again from the third quarter of 1994 until the third quarter of 1995 except in terms of exports and total trade in 1994:4 and on the import side in 1995:1. From 1995:4 to 1998:3, the ringgit generally showed a depreciating trend. Similarly, although the ringgit appreciated against its trade partners in the second and third quarter of 1996 (in terms of both imports and total trade) and 1997:1 (in terms of exports), Malaysia's real effective exchange rates depreciated significantly against its trading partners due to the 1997-98 Asian financial crises from the second quarter of 1997 until the third quarter of 1998. From the fourth quarter of 1998 until the end of 1999, the ringgit appreciated once more against its trade partners except on the import side.

From Figure 4.2, it can be plainly observed that the real effective exchange rates moves quite closely with the RM/US$ nominal exchange rates. Thus, this could imply that the RM/US$ bilateral exchange rates may influence the changes in Malaysia's real effective exchange rates with respect to its trading partners.

Figure 4.2. Real Effective Exchange Rates and Nominal and Real RM/US Bilateral Exchange Rates: 1990:1 - 2003:4



Source: The NominalRM/US$ bilateral exchange rates were obtained from International Financial Statistics website.

4. 2000 onwards

In 2000, the real effective exchange rates appreciated against its trade partners except in the third quarter. The ringgit continued on an appreciating trend until the third quarter of 2001. However, it began to depreciate against its trading partners from the third quarter until the fourth quarter 2001. But from 2002:1 until 2003:1 the ringgit appreciated against its trade partners except in 2002:2. In the following quarter, the ringgit depreciated briefly but it appreciated again in the third quarter of 2003. But since the implementation of the pegged exchange rate with US dollar, it can be observed that the movements of the real effective exchange had become more stable.

Thus, from this analysis, it can be concluded that the Malaysian real effective exchange rates is influenced by the RM/US$ bilateral exchange rates except in the early 1980s. Therefore, changes in the RM/US$ bilateral exchange rates would have some significant impact on the Malaysian trade due to changes in the effective exchange rates.

4.5 International Monetary Fund's Information Notice System[13]

The International Monetary Fund's Information Notice System (INS) came into existence in 1983 to facilitate surveillance over the exchange rate policy of Fund members, as dictated in the IMF's Articles of Agreement. Under the INS, the real and nominal effective exchange rates are computed for almost all Fund members. The effective exchange rates computed under the INS are published in the Fund's International Financial Statistics (IFS). The Fund's members are divided into three categories as stated below:

- **Category I**: consists of 14 industrial countries for which normalized unit labour cost (ULC) based effective exchange rates indices are computed.
- **Category II**: consists of all industrial countries except Luxembourg and developing countries classified as major exporters of manufactures. For the 36 countries in this category, the CPI-based real effective exchange rate indices are computed using weights that reflect the bilateral trade with the other 35 countries.
- **Category III**: consists of 107 countries regarded as predominantly producers and exporters of primary commodities. For 73 countries in this category, the CPI-based real effective exchange rate indices are computed using weights that

[13] Adapted from Zanello and Desruelle (1997).

reflect bilateral trade with the countries in category II. For the remaining 34 countries, only nominal effective exchange rates had been constructed due lack of adequate data.

Malaysia falls into category II where CPI-based effective exchange rates had been constructed since 1975 using bilateral trade weights. Thus, it would be appropriate compare the indices calculated in this chapter with the ones computed by the IFS. The CPI-based REER indicators are computed as a weighted geometric average of the level of consumer prices in the home country relative to that in its trade partners. The CPI-based REER indicator of country *i* is given by the equation below:

$$E_i = \prod_{j \neq i} \left(\frac{P_i R_i}{P_j R_j} \right)^{W_{ij}} \tag{4.18}$$

where *j* is an index that runs over country *i*'s trade partners, W_{ij} is the competitiveness weight[14] put by country *i* on country *j*, P_i and P_j are consumer price indices in countries *i* and *j*, and R_i and R_j represent the nominal exchange rates of countries *i* and *j*'s currencies in US dollars. It should be noted that an increase in the effective exchange rates computed under INS reflect an appreciation whereas a decrease reflect a depreciation. This is because the effective exchange rates are computed in terms of foreign currency that is in terms of US dollars.

[14] The weighting scheme used in the computation of the CPI-based REER indices are based on trade in manufactures, non-oil primary commodities and for some countries based on tourism services.

4.6 A Comparison of the Computed Effective Exchange Rates with IFS's Effective Exchange Rates

In order to compare the effective exchange rates computed in this chapter with ones published in the IFS, we must adjust the computed effective exchange so that a decrease in the adjusted effective exchange rates would reflect a depreciation whereas an increase in the adjusted effective exchange rates would reflect an appreciation. Thus, the adjusted real effective exchange rates is given by the formula below[15]:

$$\text{Adjusted REER} = [100 - \text{Computed REER}] \qquad (4.19)$$

By comparing the real effective exchange rates computed in this chapter with the ones computed by IFS, it can be observed that in the mid-1970s, the adjusted real effective exchange[16] rates diverged significantly from the ones computed by the IFS. But in the 1980s, the adjusted real effective exchange rates moved quite closely with the indices computed by the IFS. Similarly, in the 1990s and from 2000 onwards, the adjusted effective exchange rates showed a similar trend with the ones computed by IFS. Thus, as can be observed from Figure 4.3, the adjusted real effective exchange rates and the real effective exchange rates computed by IFS show a similar trend apart from the late 1970s. The adjusted real effective exchange rates are represented as AREERM (import-weighted), AREEERX (export-weighted) and AREERT (trade-weighted).

[15] Adapted from Balachandran K.G (1994)

[16] The adjusted real effective exchange rates are given in Appendix B.

Figure 4.3. A Comparison Between the Adjusted Real Effective Exchange Rates and Real Effective Exchange Rates Computed by IFS

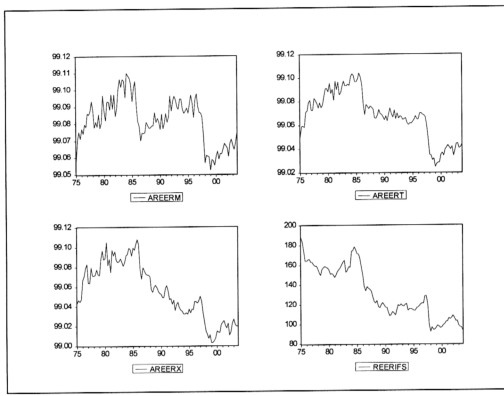


Table 4.1. Correlation Matrix between Adjusted REER and IFS Computed REER Indices.

	AREERM	AREERT	AREERX	REERIFS
AREERM	1.000000	0.840049	0.664439	0.539893
AREERT	0.840049	1.000000	0.961691	0.793222
AREERX	0.664439	0.961691	1.000000	0.835397
REERIFS	0.539893	0.793222	0.835397	1.000000

By estimating the correlation matrix (Table 4.1) for the adjusted real effective exchange rates and IFS rates, it has been found that the export weighted real effective exchange rates correlates best with the real effective exchange rates computed by IFS followed by the trade weighted real effective exchange rates as also shown by Figure 4.3.