Indices of Effective Exchange Rates

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IN ANALYZING THE EFFECTS of movements in the exchange rates of several currencies that occur either simultaneously, as in a negotiated currency realignment, or within a short time period, as in a readjustment of floating exchange rates, it is generally convenient to employ for each country an index that measures what is in some sense the average change of the country's exchange rate against all other currencies. In the calculation of such an index, a weight representing the comparative importance to the home economy of each foreign country is applied to the value, relative to a chosen base period, of the exchange rate between the foreign currency in question and the home currency. Such a weighted average of exchange rate relatives (i.e., index numbers expressing exchange rates relative to a base period level) is called an index of the effective exchange rate.[1]

Several types of such an index are regularly calculated, and some of them are published. The best known of these are listed in Table 1. These indices may differ, inter alia, with regard to (i) the base period of the index; (ii) the partner countries included; (iii) the calculation of proportionate changes in exchange rates; and (iv) the weights used in averaging these changes and the type of averaging formula employed. The base date is normally chosen so as to make the index show deviations from a set of rates to which general interest attaches, say, from par values in existence at the time when they were last generally observed. Each of the indices listed in Table 1 is based on a historical rate structure, but any structure could be used as a base.[2] The choices

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[1] See, for example, Fred Hirsch and Ilse Higgins, "An Indicator of Effective Exchange Rates," *Staff Papers*, Vol. 17 (November 1970), pp. 453–87.

[2] An index that shows deviations for a historical base period that precedes the date for which the index value is being calculated may be interpreted as indicating the proportionate change from the base period to the period in question. To

under (ii), (iii), and (iv) above, concerning the list of partner countries and the weighting and related elements of index construction, are of more fundamental significance than the selection of the base period and will be discussed separately in Section I. Section II presents a comparison of recent movements of several of the indices and a discussion of the reasons for differences among them. Section III sets forth the conclusions.

I. Considerations Relevant to the Construction of the Index

The weights to be given to changes in the home country's exchange rates vis-à-vis 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. The proper choice of weights depends, therefore, on the particular policy objective selected as the focal point of the index. For different objectives, indices employing different weighting schemes would be appropriate.

The effect of an exchange rate change that is most commonly considered as a policy objective is its influence on the balance of payments. However, other objectives are conceivable, for instance, the cost of imports in terms of national currency or the competitiveness of a country's exports in the world market as a whole. Indeed, under certain assumptions—in particular, that neither the imported quantities nor their prices in the countries of origin are affected by exchange rate changes—an index of prices of foreign currencies in terms of the home currency based on bilateral import weights (e.g., the import-weighted index published by the Morgan Guaranty Trust Company mentioned in Table 1) measures the effect of a set of exchange rate changes on the cost of imports in the home currency. Under corresponding assumptions, an export-weighted index of prices of the home currency in terms of each foreign currency measures the average change in the cost of the home country's exports to foreign customers. These two objectives are, however, clearly too limited and subordinate to furnish the guiding principle in the construction of an index of the effective exchange rate. Import-weighted and export-weighted indices are ordinarily used in combination with the intention of approximating an index constructed with a trade balance objective in mind. The following discussion is

avoid cumbersome expressions such as "deviations of exchange rates from their base-period levels," the simpler "exchange rate changes" will sometimes be used in the text when there is no risk of misunderstanding.

TABLE 1. SELECTED INDICES OF EFFECTIVE EXCHANGE RATES [1]

Issuing Organization or Name of Index	Country Coverage	Exchange Rate Change	Weights	Comment
Morgan Guaranty Trust Company				
Export index	15 countries (industrial countries plus Australia)	Foreign currency units per unit of home currency	Countries' shares in home country's exports	
Import index		Home currency units per unit of foreign currency	Countries' shares in home country's imports	
Combined index				Export index and import index averaged in accordance with shares of exports and imports in total trade
Reuters' currency index	10 industrial countries	Foreign currency units per unit of home currency	Partner countries' shares in home country's total trade (exports plus imports)	
U.S. Treasury I	22 member countries of the Organization for Economic Cooperation and Development (OECD) other than the United States	←Similar to Morgan Guaranty Trust Company's combined index→		
II	47 member countries of the International Monetary Fund (IMF) accounting for 90 per cent of total U.S. trade	←Similar to Morgan Guaranty Trust Company's combined index→		
U.S. Federal Reserve Board	11 industrial countries	U.S. dollars per unit of foreign currency	Countries' shares in world-wide trade of all included countries	
MERM [2]	21 countries	Home currency units per unit of foreign currency	Effect of change by 1 per cent in price of foreign currency on trade balance of home country	Weights derived from the MERM
U.K. Treasury	11 industrial countries	←Similar to the MERM→		Weights derived from the MERM
OECD	23 OECD countries, and rest of the world	←Similar to the MERM→		Weights calculated at the OECD

[1] Indices similar to some of those listed in this table are calculated by several other organizations, including the U.S. Department of Commerce, the Bank of Canada, the Deutsche Bundesbank, the Federal Reserve Bank of New York, and the U.S. Central Intelligence Agency.
[2] Multilateral exchange rate model, IMF (Research Department).

based on the merchandise trade balance, measured in the currency of the home country, as the underlying objective. The current account balance as a whole (or perhaps an even more comprehensive balance of payments measure) might, however, be a more pertinent objective, and what is said here in terms of the trade balance is envisaged as, in principle, capable of being extended to these other balance of payments measures.

In terms of the trade balance objective, the change in the effective exchange rate may be defined as the notional *uniform* proportionate change in the price of the home currency in terms of foreign currencies that would have the same effect on the home country's trade balance as the set of *actual* changes in these prices. To calculate this notional uniform exchange rate change, the actual change in the exchange rate vis-à-vis each foreign currency must be weighted by the effect on the home country's trade balance of an isolated change in the price of that currency in a given proportion, say, by 1 per cent.

These trade balance effects are not, in general, likely to be proportional to the bilateral trade flows between the home country and its partner countries—neither to exports, nor to imports, nor even to an average of the two. There are at least three major sources of divergence of bilateral trade weights from a set of ideal weights based on trade balance effects of exchange rate changes. The magnitude of these effects depends not only on the size of the trade flows between the two countries whose exchange rate has changed but also (i) on the extent of any competitive relations between them in third markets (that is, on the structure of trade of the two countries with all countries with which both are trading); (ii) on the price elasticities determining the response of these trade flows to exchange rate changes; and (iii) on the changes in prices of traded goods that are induced by exchange rate changes.

The point being made under (i) may be illustrated by the case of two countries with similar commodity composition of exports that, partly for this reason, trade very little with each other but export to the same third markets. A depreciation of the currency of one of them would tend to affect the trade balance of the other much more strongly than would be supposed on the basis of their insignificant trade with one another. In the light of this consideration, it has sometimes been suggested to use the global exports of foreign countries as weights (see, for instance, the Federal Reserve Board index referred to in Table 1). But this method runs into the opposite problem of leaving out of account the bilateral trading relationships, which are particularly important between certain neighboring countries, such as Canada and the United

States or Austria and the Federal Republic of Germany. Another method for letting third-market effects be reflected in an effective exchange rate index involves a double-weighting scheme: an index recently calculated for Austria consists of an export-weighted average of the import-weighted exchange rate indices of Austria's trading partners.[3] This method would seem to be preferable to the use of either bilateral trade weights or global export weights, but it takes no account of the points made under (ii) and (iii).

Among the factors determining the response of a country's trade balance to a set of exchange rate changes, the relevant price elasticities of demand and supply, mentioned under (ii), are of primary importance. Price elasticities of demand for different classes of goods can be expected to differ substantially. For instance, the price elasticity for imported raw materials that are not produced domestically may be so low that an appreciation of the currencies of countries supplying the raw materials may tend to worsen the trade balance of the home country measured in its own currency. On the other hand, the response of demand to price changes of manufactured imports directly competing with similar domestic products may be very strong, so that an appreciation of the currencies of supplying countries would induce a sharp improvement in the home country's trade balance. The weights attached to exchange rate changes of the two types of supplying countries—exporters of essential raw materials and exporters of standard manufactured products—should therefore differ in magnitude from the bilateral shares of these countries in the home country's overall trade and in certain instances may even have to be of different sign. Similar considerations apply with respect to variations in the price elasticities of supply. Trade weights are restricted, by their derivation, to being positive as long as any trade takes place with the partner country in question. In the limiting case they can be zero, but they can never be negative.[4]

[3] Fritz Schebeck, Hannes Suppanz, and Gunther Tichy, "Preis- und Wechselkursindizes für den Export österreichischer Halb- und Fertigwaren," *Empirica* (No. 2, 1974), pp. 201–26.

[4] Very stringent and unrealistic assumptions with regard to price elasticities of demand and supply are implied by the use of bilateral trade weights for an index of the effective exchange rate intended to reflect trade balance effects of exchange rate changes. Such an index would accurately reflect these effects if, for instance, all price elasticities of supply of traded goods were infinite, all price elasticities of demand for a country's imports and exports (regardless of commodity, country of origin, and country of destination) were equal to one another, and all elasticities of demand for a country's exports with respect to prices of exports of other countries were zero.

The third major source of divergence between a trade-weighted index of the effective exchange rate and an index weighted by trade balance effects of exchange rate changes has to do with price changes that are induced by exchange rate changes. These induced price changes are related to the size of price elasticities of demand and supply and to the effect of changes in exchange rates on wages. They tend, at least partially, to offset the effects on the trade balance of the underlying exchange rate changes. These offsets may be quite important for small open economies dependent on large neighboring trading partners. Again, if a country sells its major export products at prices that are determined in the world market and denominated in a given foreign currency, and its supply of these products is highly inelastic with respect to price, as is often true for primary producing countries, export prices measured in foreign currency will not change, and prices in local currency will fully reflect the effect of an exchange rate change. In these circumstances, the country's share in the trade of other countries may severely overstate the importance of its exchange rate in determining the trade balances of these countries. This is one of the principal reasons for normally excluding primary producing countries from calculations of trade-weighted effective exchange rates for industrial countries. Weighting by trade shares implies the assumption that all price elasticities of demand for traded goods are equal; this assumption is somewhat less implausible if the calculation is confined to industrial countries.

The question arises whether movements of prices of traded goods that are not induced by exchange rate changes should also be reflected in an index of the effective exchange rate. To extend the definition of effective exchange rate in this direction would undoubtedly cause terminological confusion. It would be preferable to define additional indices showing, for example, movements in export competitiveness in the light of changes in both exchange rates and export prices expressed in national currencies. It is clear that the significance of the effective exchange rate index, standing by itself, is lessened under conditions of world-wide inflation at nationally different rates from what it would be under conditions of price stability (or of uniformity of national inflation rates). Even in the absence of world-wide inflation, balance of payments analysis is likely to focus on short-term and medium-term, rather than long-term, movements in the effective exchange rate: in the long run, rates of productivity growth, national price levels, and exchange rates tend to move in a mutually compensatory pattern, so that only limited interest attaches to a measure of long-term change in any one of these elements in isolation.

The foregoing discussion of certain elements characterizing the relation between exchange rate movements and a country's trade balance leads to the conclusion that the calculation of weights for an effective exchange rate index implied by the trade balance objective requires the use of a model that reflects the multilateral structure of trade, its commodity composition, the price elasticities of trade flows, and the effects of changes in exchange rates on prices and costs. Different models available for this purpose will exhibit these desirable features to a different degree of comprehensiveness and reliability. Nevertheless, even a crude trade model would yield more appropriate weights than the assumption that exchange rate effects are proportional to bilateral trade shares.

The weights used in the Fund's calculations of effective exchange rates are derived from the multilateral exchange rate model (MERM) maintained in the Fund's Research Department. The model and the method of deriving the weights are described elsewhere;[5] they are briefly summarized in Appendix I. Weights taken from this model are also used in computing the effective exchange rate index published by the U.K. Treasury (see Table 1)[6] and by the Bank for International Settlements.[7] A similar model constructed by the U.S. Central Intelligence Agency was used to provide weights for an effective exchange rate index published in the 1974 *Annual Report of the Council of Economic Advisers*.[8] Effective exchange rate calculations made by the Organization for Economic Cooperation and Development (OECD) also employ weights based on a similar trade model.[9]

II. Comparison of Selected Indices

Comparison of indices of the effective exchange rate calculated by various institutions is generally made difficult by differences not germane to the methodological issues discussed in this paper, such as the sample of countries, the base date, or the source of the exchange rate data. To

[5] Jacques R. Artus and Rudolf R. Rhomberg, "A Multilateral Exchange Rate Model," *Staff Papers*, Vol. 20 (November 1973), pp. 591–611, especially pp. 606–608.

[6] In the U. K. Central Statistical Office's *Financial Statistics;* the series is also published in that Office's *Economic Trends* and in the Bank of England's *Quarterly Bulletin*.

[7] Bank for International Settlements, *Forty-Fifth Annual Report* (Basle, June 1975), p. 27.

[8] See the *Economic Report of the President* (Washington, 1974), pp. 220–26.

[9] *OECD Economic Outlook,* various issues, table on effective exchange rate changes.

facilitate comparison, a number of typical indices have been recalculated with the same set of exchange rates (monthly averages of daily noon rates in New York), the same base date (May 1970), the same trade data used for calculating weights (total merchandise trade flows in 1972), and the same sample of countries.[10]

Seven indices have been calculated:

(i) *import-weighted index:* the arithmetic average of prices of partner currencies in terms of home currency, relative to the base period, weighted by partners' shares in total imports of the home country;

(ii) *bilateral export-weighted index:* the arithmetic average of prices of home currency in terms of partner currencies, relative to the base period, weighted by partners' shares in total exports of the home country;

(iii) *average bilateral trade-weighted index:* arithmetic average of (ii) and the reciprocal of (i), weighted by the ratios of exports and of imports to their sum;

(iv) *global export-weighted index:* the arithmetic average of prices of home currency in terms of foreign currencies, relative to the base period, weighted by foreign countries' shares in total exports to the world market excluding the market of the home country;

(v) *average export-weighted index:* unweighted arithmetic average of (ii) and (iv);

(vi) *average trade-weighted index:* unweighted arithmetic average of (v) and the reciprocal of (i);

(vii) *MERM-weighted index:* the geometric average[11] of prices of the home currency in terms of foreign currencies, relative to the base period, weighted by the effect calculated from the MERM on the home country's trade balance measured in home currency[12] of a change of

[10] The index is calculated for 15 countries: Australia, Austria, Belgium, Canada, Denmark, France, the Federal Republic of Germany, Italy, Japan, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom, and the United States. In its calculation, weight is also given to 6 other countries whose exports of manufactures in 1970 exceeded $1 billion, namely, the Republic of China, Finland, Hong Kong, Ireland, Spain, and Yugoslavia.

[11] The weighted geometric average of a number of elements is the product of the elements, each raised to a power represented by its weight; the weights are normalized so that their sum equals unity. Geometric averaging is used in the MERM-weighted index in order to preserve certain properties of consistency and symmetry because what is being averaged is a set of proportionate, rather than absolute, changes. The trade-weighted indices could also have been calculated as geometric, rather than arithmetic, averages, but this would have introduced an element unfamiliar to users of such indices and would not have notably affected the results.

[12] The trade balance, expressed in home currency, is deflated by the average change in export and import prices (expressed in home currency) that is induced by the exchange rate change. This form of deflation is intended to remove certain

1 per cent in the price of each foreign currency in terms of the home currency.

The formulas for the seven calculations are shown in Appendix I. In addition to the four versions of an effective exchange rate index using independent sets of weights—(i), (ii), (iv), and (vii)—three averages of trade-weighted indices are also computed. The calculation under (iii), showing the average of indices weighted by bilateral export weights and bilateral import weights, is sometimes proposed as an overall trade-related measure of movements in the effective exchange rate. In forming the average, one of the indices must first be inverted, since they tend to move in opposite directions: when exchange rate changes cause the cost of imports in terms of the home currency to rise, they also cause the cost of the home country's exports to residents of foreign countries to fall.[18]

The version under (v) shows an index whose movements are intermediate between those of the index with bilateral export weights and the index with global export weights. There can be no guarantee, of course, that this averaging adequately corrects the flaws of either index as a device for registering exchange rate influences on a country's exports. Finally, the calculation under (vi), which combines indices using import weights and the two types of export weights, represents an average trade-weighted index for purposes of comparison with the results of applying the MERM-weighting system, in which the structure of trade is more fully reflected and which also draws on information about price responses.

In order to comment on some of the causes of discrepancies among different indices, it will be convenient to refer to a specific example. For this purpose, quarterly values of the seven indices for the Netherlands are reproduced in Table 2, and three of the indices, namely, those using average bilateral trade weights (iii), global export weights (iv), and MERM weights (vii), are shown in Chart 1. Corresponding charts (Charts 2–15) for the other 14 countries are found in Appendix II.

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effects on the calculation of weights that could otherwise be important where exports and imports of the country whose effective rate is being calculated are not of similar size—effects that can be regarded as arbitrary because they depend crucially on the currency unit in which the exchange rate effects are measured. Such deflation, of course, does not eliminate terms-of-trade effects, which are an essential element in the overall trade balance effect of exchange rate changes.

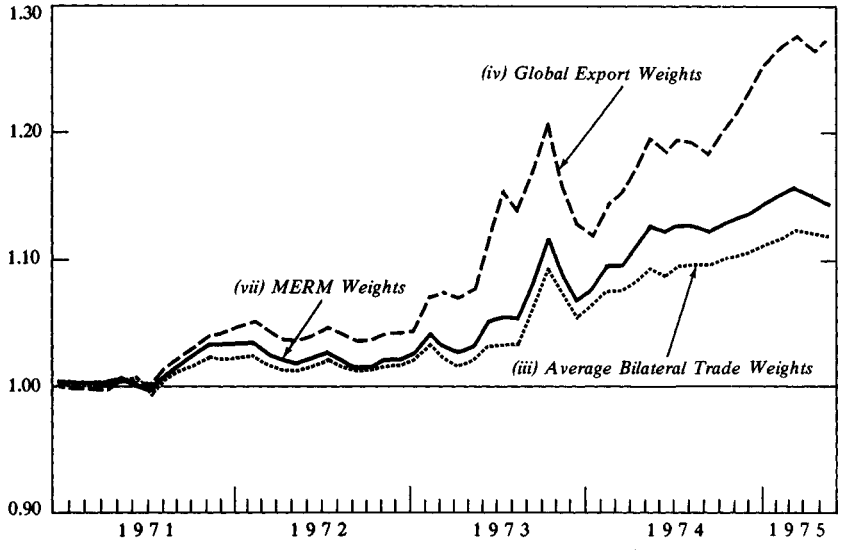
[13] Using the reciprocal of the import-weighted index (together with the export-weighted index) is preferable to using the percentage deviation of the import-weighted index with sign reversed (together with the corresponding deviation of the export-weighted index). For large exchange rate changes, the difference in the two methods of averaging can be substantial.

TABLE 2. NETHERLANDS: INDICES OF EFFECTIVE EXCHANGE RATE, FIRST QUARTER 1971–FIRST QUARTER 1975

(Quarterly averages; May 1970 = 1.00)

Year	Quarter	Reciprocal of Import-Weighted Index (i)	Bilateral Export-Weighted Index (ii)	Average Bilateral Trade-Weighted Index (iii)	Global Export-Weighted Index (iv)	Average Export-Weighted Index (v)	Average Trade-Weighted Index (vi)	MERM-Weighted Index (vii)
1971	I	1.001	1.001	1.001	0.999	1.000	1.001	1.002
	II	1.001	1.000	1.000	1.002	1.001	1.001	1.003
	III	1.004	1.002	1.003	1.014	1.008	1.006	1.008
	IV	1.022	1.021	1.021	1.038	1.030	1.026	1.032
1972	I	1.023	1.022	1.022	1.049	1.035	1.029	1.032
	II	1.014	1.012	1.013	1.039	1.025	1.020	1.022
	III	1.017	1.016	1.016	1.042	1.029	1.023	1.022
	IV	1.016	1.016	1.016	1.040	1.028	1.022	1.020
1973	I	1.025	1.026	1.025	1.064	1.045	1.035	1.033
	II	1.024	1.024	1.024	1.089	1.057	1.041	1.038
	III	1.039	1.045	1.042	1.154	1.099	1.069	1.064
	IV	1.071	1.076	1.073	1.165	1.120	1.095	1.091
1974	I	1.068	1.076	1.072	1.139	1.108	1.088	1.090
	II	1.082	1.095	1.089	1.185	1.140	1.111	1.197
	III	1.092	1.102	1.098	1.190	1.146	1.119	1.125
	IV	1.096	1.110	1.103	1.217	1.163	1.130	1.133
1975	I	1.108	1.126	1.117	1.267	1.197	1.152	1.152

CHART 1. NETHERLANDS: EFFECTIVE EXCHANGE RATE, 1971–MAY 1975
(*May 1970 = 1.00*)



The first point to note about Table 2 concerns the observation, already made earlier, that the import-weighted index moves in the opposite direction from all other indices, since it is a weighted average of the changes in the prices of foreign currencies in terms of the home currency, whereas the other indices are all weighted averages of the prices of the home currency in terms of foreign currencies. For this reason, the reciprocal value of this index has been used whenever it is combined with other indices to form an average, as in columns (iii) and (vi), and this reciprocal value is also shown in the table.

All the indices exhibit substantial conformity in their general upward and downward drifts. There are, however, significant divergences, especially in the last two years when deviations from base-date exchange rates tended to be larger. This observation applies to the indices for all countries examined. The general relationship among the indices for the Netherlands for the latter half of the period exhibits two features that are typical for many, although not all, of the 15 countries: (i) the MERM-weighted index lies between those using bilateral export weights and global export weights (this is true for 9 countries) as well as between

those using average bilateral trade weights and global export weights (also 9 countries); and (ii) the (reciprocal of the) import-weighted index and the global export-weighted index often appear as either the lowest or highest of the indices calculated (the former in 11 and the latter in 9 countries).

Divergent movements in the various indices are the result of differences in the weighting patterns. For instance, some of the countries whose nominal exchange rates against the Netherlands guilder had declined over the period examined, especially the United States and Canada, have much smaller shares in the bilateral trade (imports and exports) of the Netherlands than in the global exports of all countries included in the calculation (i.e., in the export to the world market excluding the market of the Netherlands); the opposite holds for some countries whose exchange rates have appreciated against the guilder, such as the Federal Republic of Germany (Table 3). As a result, the index based on global export weights shows the guilder as effectively more appreciated during most of the period examined than does the index based on bilateral import weights.

Since the MERM uses information about the entire structure of trade, including both bilateral and third-market relations, it is not surprising that the MERM weights often lie between those based on bilateral trade shares and global export shares. This is not uniformly true, however, since information about the commodity composition of trade and the associated price elasticities of demand and supply, as well as about the effects of exchange rate changes on wages, are also taken into account

TABLE 3. NETHERLANDS: SELECTED WEIGHTS USED IN EFFECTIVE EXCHANGE RATE INDICES

Country	Bilateral Import Weights (i)	Bilateral Export Weights (ii)	Global Export Weights (iv)	MERM Weights (vii)
Belgium/Luxembourg	0.226	0.174	0.047	0.103
Canada	0.010	0.006	0.078	0.002
France	0.099	0.121	0.093	0.183
Germany, Fed. Rep. of	0.336	0.391	0.158	0.306
Japan	0.018	0.005	0.106	0.049
United Kingdom	0.064	0.085	0.087	0.041
United States	0.101	0.043	0.180	0.125
Australia	0.002	0.004	0.024	−0.005
Thirteen other countries combined	0.144	0.171	0.227	0.196
	1.000	1.000	1.000	1.000

in the derivation of the MERM weights. For instance, the MERM weights of the United Kingdom and, especially, Canada in the index for the Netherlands are smaller than any of the corresponding trade weights; indeed, Australia's MERM weight in the index of the Netherlands is negative, indicating that an appreciation of the Australian dollar tends to worsen, rather than to improve, the trade balance of the Netherlands and that it is, therefore, comparable in its effect on this balance to an appreciation, rather than a depreciation, of the guilder.

Differences in weighting pattern are sufficiently important to result in substantially different index values. The spread between the highest and lowest of the seven index values calculated for the Netherlands at the end of the period examined (May 1975) was about 15 per cent. For some countries these differences are even somewhat larger. For instance, for Austria it was 18 per cent on the same date, with the index using bilateral import weights showing an effective appreciation of 10 per cent and those based on global export weights and MERM weights indicating an appreciation of 30 per cent.

In deriving the MERM weights, a considerable amount of information about trade structure and price responses (elasticities) is used that is not taken into account in calculating trade-weighted indices. Nevertheless, the MERM-weighted index does not generally move outside the band marked by the other index calculations shown. From the charts it can be seen that the MERM-weighted index more often than not (in 9 of 15 cases) falls between the two trade-weighted indices charted. It assumes the largest or smallest of any of the calculated index values in only 5 of the 15 countries and even then it does not deviate very much from the trade-weighted index that is closest to it.[14]

The question was examined whether the results for the countries included in the study gave any clue as to which of the trade-weighted indices might represent the best approximation to the MERM-weighted index. No clear indication was found. For 6 of the 15 countries, the index based on MERM weights is approximated more closely by the bilateral trade-weighted index; for 6 countries the global export-weighted index approximates it more closely; for the remaining 3 countries the MERM index is about equidistant from these two trade-weighted indices. That is to say, the test applied here with respect to the comparative

[14] In this connection it should be remembered that MERM weights are determined more by relative price elasticities than by their (average) absolute magnitude. The reason for this is that the MERM weights reflect relative effects of exchange rate changes; assumptions that make these effects uniformly larger or smaller, such as the assumption of generally larger or smaller price elasticities, leave the weights largely unaffected.

value of the bilateral trade-weighted and the global export-weighted indices was inconclusive. In 9 of the 15 countries, the average of the indices using bilateral trade weights and global export weights—the index numbered (vi), which is not shown in the charts—approximates the MERM index more closely than either of the two trade-weighted indices, but in 6 countries this average gives a worse approximation than one of its two components.

It cannot be assumed, therefore, that one of the trade-weighted indices, or any average of them, is an acceptable substitute for the MERM-weighted index for purposes of trade balance analysis of industrial countries. For primary producing countries, MERM-type calculations are not now made. For these countries, use of bilateral trade weights or of global export weights (derived from total merchandise trade data and without regard to commodity detail) is, for reasons already given, even more questionable than for industrial countries. For these countries, calculation of meaningful indices of the effective exchange rate will depend on the development of suitable trade models that account for the effects of exchange rate changes on the prices of primary commodities. Groundwork for developing a suitable methodology was laid some time ago,[15] and a paper on effective exchange rate calculations for primary producing countries is included in this issue of *Staff Papers*.[16]

III. Conclusions

The proper choice of weights for an index of the effective exchange rate depends on its purpose. An index of the effective exchange rate intended to be used in connection with estimation or analysis of exchange rate effects on the trade balance has to use as weights some estimates, however imperfect, of the relative influence of changes in the prices of currencies of various foreign countries on the trade balance of the home country. The index using weights calculated from the Fund's MERM, in contrast to trade-weighted indices, is constructed in this manner and

[15] Duncan Ridler and Christopher A. Yandle, "A Simplified Method for Analyzing the Effects of Exchange Rate Changes on Exports of a Primary Commodity," *Staff Papers,* Vol. 19 (November 1972), pp. 559–78.

[16] The paper, written by Gérard Bélanger while he was a staff member in the African Department, is entitled "An Indicator of Effective Exchange Rates for Primary Producing Countries" and begins on p. 113 of this issue. The methodology developed in the paper is applied to two African countries; the proposed definition of the effective exchange rate index is the same as that used in the MERM calculations for the industrial countries and Australia.

is, therefore, preferable for analyzing effects of exchange rate movements on the trade balance. Indices using as weights exchange rate effects on the current account balance or some other balance of payments measure would be useful for making a more comprehensive analysis of countries' policies with respect to external balance and domestic stability, but unfortunately the corresponding models have not yet been developed. In their absence, the MERM-weighted index recommends itself for these analytical purposes as well. Averages of various trade-weighted indices, such as an average of indices using bilateral imports and bilateral exports as weights or an average of these and an index based on global export weights, are sometimes used as approximations of a general analytical measure of the effective exchange rate. This procedure is not generally advisable, although (as the charts show) in some particular instances the discrepancies between the various indices may not be large. The use of trade-weighted indices is especially inappropriate for primary producing countries; for these countries, a separate methodology is being developed for deriving weights to be used in effective exchange rate calculations.

APPENDICES

I. Formulas for Indices of the Effective Exchange Rate and Description of the Multilateral Exchange Rate Model

The formulas for the seven indices that are compared in this paper (see their description at the beginning of Section II) are as follows.

(i) $EM_i = \sum_j (M_{ji}/\sum_j M_{ji})R_{ji}$

(ii) $EXB_i = \sum_j (X_{ij}/\sum_j X_{ij})R_{ij}$

(iii) $EMXB_i = [M_{.i}(1/EM_i) + X_{i.}(EX_i)]/(M_{.i} + X_{i.})$

(iv) $EXW_i = \sum_{j\neq i} [(X_{j.} - X_{ji})/\sum_{j\neq i} (X_{j.} - X_{ji})]R_{ij}$

(v) $EXBXW_i = 0.5\ EXB_i + 0.5\ EXW_i$

(vi) $EMXBW_i = 0.5(1/EM_i) + 0.25\ EXB_i + 0.25\ EXW_i$

(vii) $EMERM_i = \prod_{j\neq i} R_{ij}^{w_{ij}}$

The symbols used, other than the mnemonic letter combinations indicating the names of the seven indices, are defined as follows:

$R_{ij} = (1/R_{ji})$ = price of one unit of currency i in terms of currency j, expressed as an index number relative to the base period; actual calculations use exchange rates vis-à-vis the U.S. dollar, $R\$_j$, relying on the relation $R_{ij} = R\$_j/R\$_i$;

M_{ji} = imports of country i from country j;

X_{ij} = exports of country i to country j;

$M_{.i}$ = total imports of country i;

$X_{i.}$ = total exports of country i to the world market;

$w_{ij} = W_{ij}/\sum_{j \neq i} W_{ij}$, where W_{ij} is the effect, calculated from the Fund's MERM, of a change of 1 per cent in the price of currency i in terms of currency j on the trade balance of country i measured in its own currency and deflated by the induced change in the average of its export and import prices in its own currency; a brief description of the MERM follows, and the weights are shown in Table 4.

THE MULTILATERAL EXCHANGE RATE MODEL

The MERM developed in the Fund's Research Department is a general equilibrium model of trade among 21 countries (listed in footnote 10) and two groups of countries, namely, major oil exporting countries and the rest of the world. The model focuses on the effects of exchange rate changes on trade flows classified into four groups of traded goods (using the Standard International Trade Classification) and a class of nontraded goods. Each of these goods is assumed to be differentiated in use according to the country of production.[17] A good produced by a particular country is named a product. Hence, the model distinguishes 115 (23×5) different products, each supplied by only one country. Various constraints are imposed on the utility functions, so that the numerous price elasticities of demand can be derived from a fairly limited number of *basic* parameters: trade shares, import and export price elasticities, and expenditure elasticities. In each country, a matrix of supply elasticities quantitatively represents the possibility of transferring resources from the production of one good to the production of another in response to price incentives. Shifts in the supply schedules reflect changes in the prices of imported products used as inputs in the production process as well as changes in wages and indirect taxes induced by the effect of exchange rate changes on the cost of living. The model is closed by assuming that the level of the total real output of each country is a target that is determined exogenously. The total nominal spending is assumed to be adjusted by the authorities with the help of monetary and fiscal policies by whatever amount is necessary to reach the total output target. The model is employed to derive for each country the changes in nominal spending and the trade balance that corresponds to the chosen (proportionate) changes in the levels of output and the foreign exchange rates for all countries. In many applications, the total real output of each country is kept constant to permit isolation of the effects of a change in exchange rates.

[17] The representation of demand is based on the theoretical framework developed by Paul S. Armington in "A Theory of Demand for Products Distinguished by Place of Production," *Staff Papers*, Vol. 16 (March 1969), pp. 159–78.

TABLE 4. WEIGHTS DERIVED FROM THE MULTILATERAL EXCHANGE RATE MODEL [1]

	Austria	Belgium	Canada	Denmark	France	Fed. Rep. of Germany	Italy	Japan	Nether-lands	Norway	Sweden
Austria	0.0000	0.0137	0.0356	0.0247	0.0951	0.1010	0.0867	0.0836	0.0179	0.0115	0.0474
Belgium	0.0122	0.0000	0.0084	0.0121	0.1876	0.3091	0.0599	0.0556	0.1216	−0.0050	0.0030
Canada	0.0023	0.0073	0.0000	0.0127	0.0265	0.0344	0.0186	0.0825	0.0082	0.0022	0.0093
Denmark	0.0194	0.0234	0.0310	0.0000	0.0860	0.1401	0.0651	0.0603	0.0245	0.0505	0.0998
France	0.0111	0.0647	0.0287	0.0125	0.0000	0.2448	0.1157	0.0750	0.0257	0.0065	0.0230
Germany, Fed. Rep. of	0.0365	0.0648	0.0281	0.0163	0.1901	0.0000	0.0720	0.0800	0.0404	0.0086	0.0349
Italy	0.0028	0.0315	0.0236	0.0082	0.1736	0.2557	0.0000	0.0771	0.0233	0.0059	0.0180
Japan	0.0073	0.0156	0.0476	0.0106	0.0649	0.1104	0.0420	0.0000	−0.0076	0.0085	0.0212
Netherlands	0.0095	0.1031	0.0020	0.0165	0.1830	0.3059	0.0870	0.0490	0.0000	0.0144	0.0052
Norway	0.0119	0.0270	0.0127	0.0434	0.1084	0.2049	0.0487	0.1006	0.0241	0.0000	0.0421
Sweden	0.0180	0.0266	0.0491	0.0447	0.1062	0.0976	0.0485	0.0876	0.0125	0.0465	0.0000
Switzerland	0.0294	0.0226	0.0321	0.0128	0.1321	0.1336	0.0436	0.1398	0.0111	0.0113	0.0285
United Kingdom	0.0137	0.0355	0.0240	0.0078	0.1160	0.1314	0.0566	0.1150	0.0272	0.0086	0.0258
United States	0.0076	0.0231	0.1847	0.0106	0.1083	0.1361	0.0604	0.2408	0.0226	0.0059	0.0265
Australia	0.0040	0.0100	0.0689	0.0092	0.0717	0.0513	0.0313	0.1932	0.0144	0.0060	0.0132

	Switzerland	United Kingdom	United States	Australia	Rep. of China	Finland	Hong Kong	Ireland	Spain	Yugoslavia
Austria	0.0903	0.0721	0.2473	0.0168	0.0045	0.0177	0.0017	0.0042	0.0149	0.0135
Belgium	0.0257	0.0197	0.1716	−0.0050	0.0010	0.0029	0.0012	−0.0010	0.0145	0.0048
Canada	0.0053	0.0314	0.7333	0.0046	0.0077	0.0023	0.0012	0.0021	0.0049	0.0029
Denmark	0.0344	0.1463	0.1497	0.0175	0.0031	0.0130	0.0042	0.0085	0.0161	0.0073
France	0.0342	0.0523	0.2497	0.0093	0.0033	0.0085	0.0014	0.0030	0.0227	0.0079
Germany, Fed. Rep. of	0.0556	0.0527	0.2558	0.0117	0.0031	0.0136	0.0026	0.0042	0.0165	0.0127
Italy	0.0298	0.0413	0.2590	0.0068	0.0050	0.0064	0.0016	0.0031	0.0230	0.0042
Japan	0.0161	0.0525	0.5713	−0.0122	0.0088	0.0089	0.0117	0.0026	0.0122	0.0075
Netherlands	0.0247	0.0413	0.1248	−0.0053	0.0015	0.0136	0.0056	−0.0004	0.0140	0.0046
Norway	0.0184	0.0859	0.1996	0.0082	0.0061	0.0294	0.0049	0.0041	0.0127	0.0070
Sweden	0.0060	0.0752	0.2826	0.0217	0.0053	0.0378	0.0033	0.0053	0.0178	0.0077
Switzerland	0.0000	0.0400	0.2792	0.0240	0.0059	0.0072	0.0102	0.0031	0.0248	0.0087
United Kingdom	0.0393	0.0000	0.3277	0.0212	0.0052	0.0061	0.0057	0.0097	0.0163	0.0071
United States	0.0187	0.0669	0.0000	0.0313	0.0114	0.0090	0.0062	0.0045	0.0182	0.0072
Australia	0.0080	0.0681	0.3844	0.0000	0.0212	0.0072	0.0164	0.0040	0.0088	0.0084

[1] The effective exchange rate index of any country in the stub is calculated by applying the weights shown in the row for this country to the exchange rate relatives of the corresponding countries in the heading.

II. Effective Exchange Rate Indices for 15 Countries, January 1971–May 1975

Charts 2–15, presented in this appendix, show the movements of three indices of the effective exchange rate described under (iii), (iv), and (vii) in the text and in Appendix I. (Chart 1, in the text, presents these indices for the Netherlands.)

A computer printout of a table showing monthly values of all seven indices discussed in this paper for each of the 15 countries is available on application to the author, International Monetary Fund, Washington, D.C. 20431 U.S.A.

CHART 2. AUSTRALIA: EFFECTIVE EXCHANGE RATE, 1971–MAY 1975

(*May 1970 = 1.00*)

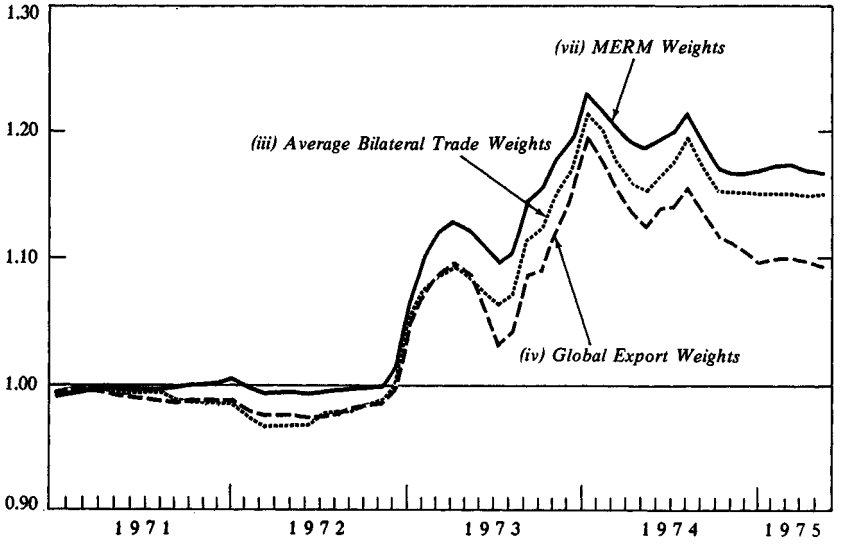


CHART 3. AUSTRIA: EFFECTIVE EXCHANGE RATE, 1971–MAY 1975

(*May 1970 = 1.00*)

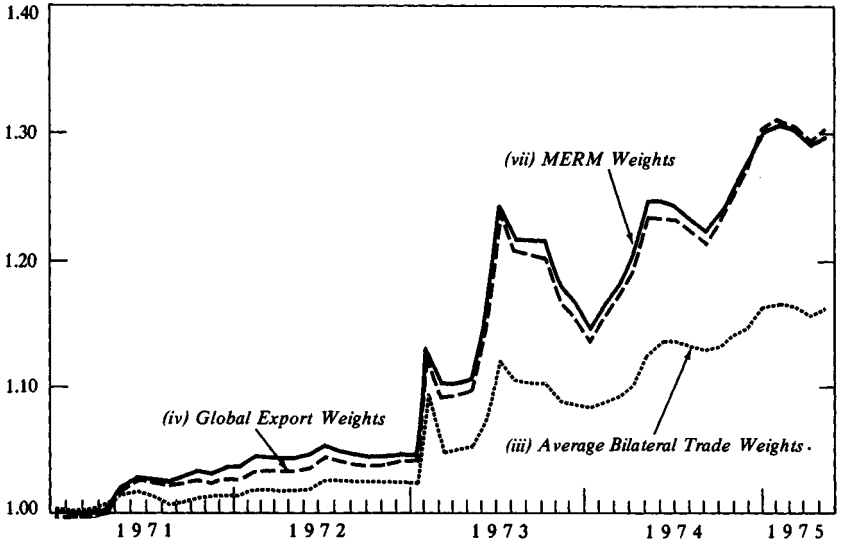


CHART 4. BELGIUM: EFFECTIVE EXCHANGE RATE, 1971–MAY 1975

(*May 1970 = 1.00*)

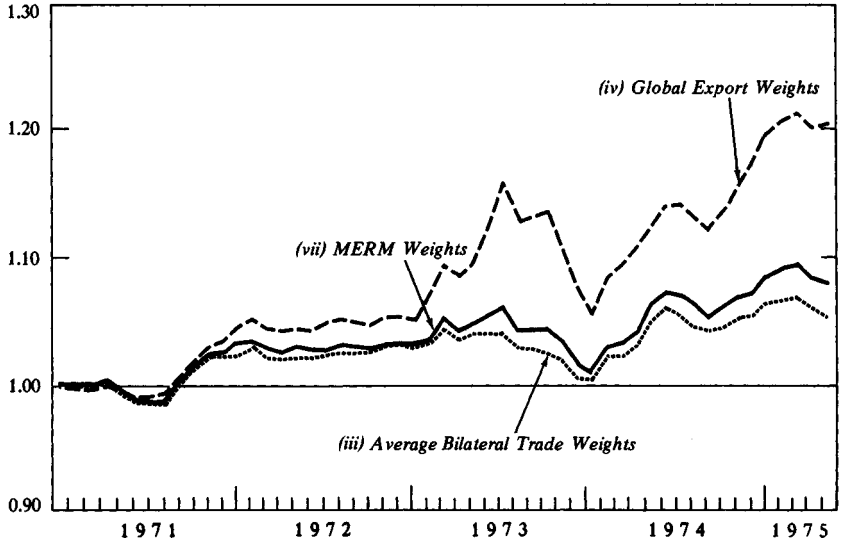


CHART 5. CANADA: EFFECTIVE EXCHANGE RATE, 1971–MAY 1975

(*May 1970 = 1.00*)

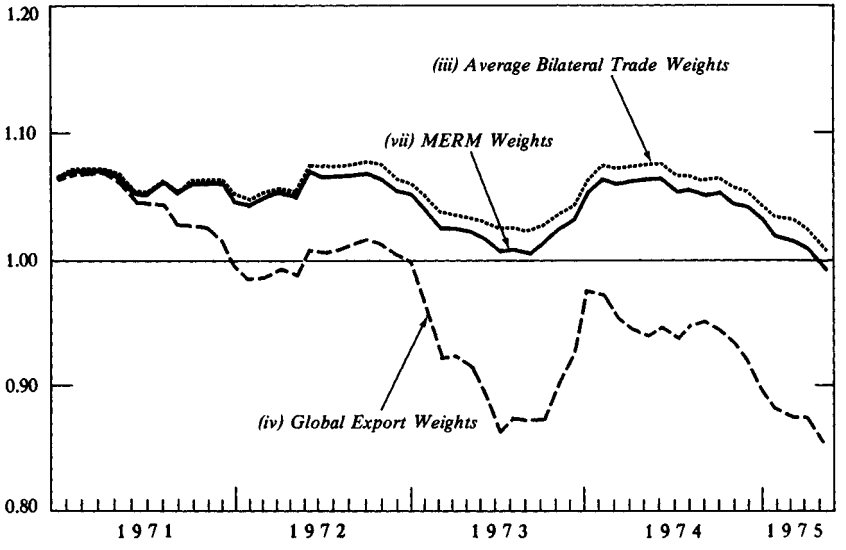


CHART 6. DENMARK: EFFECTIVE EXCHANGE RATE, 1971–MAY 1975

(*May 1970 = 1.00*)

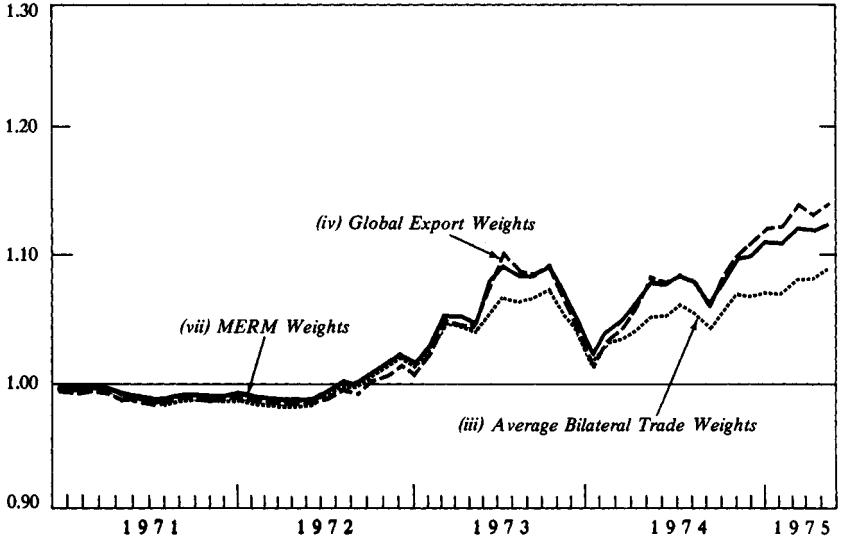


CHART 7. FRANCE: EFFECTIVE EXCHANGE RATE, 1971–MAY 1975

(*May 1970 = 1.00*)

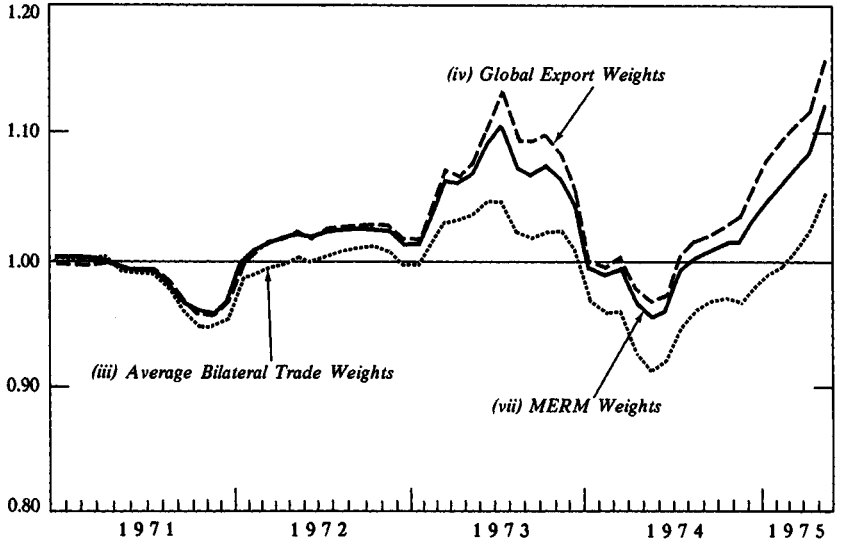


CHART 8. FEDERAL REPUBLIC OF GERMANY: EFFECTIVE EXCHANGE RATE, 1971–MAY 1975

(*May 1970 = 1.00*)

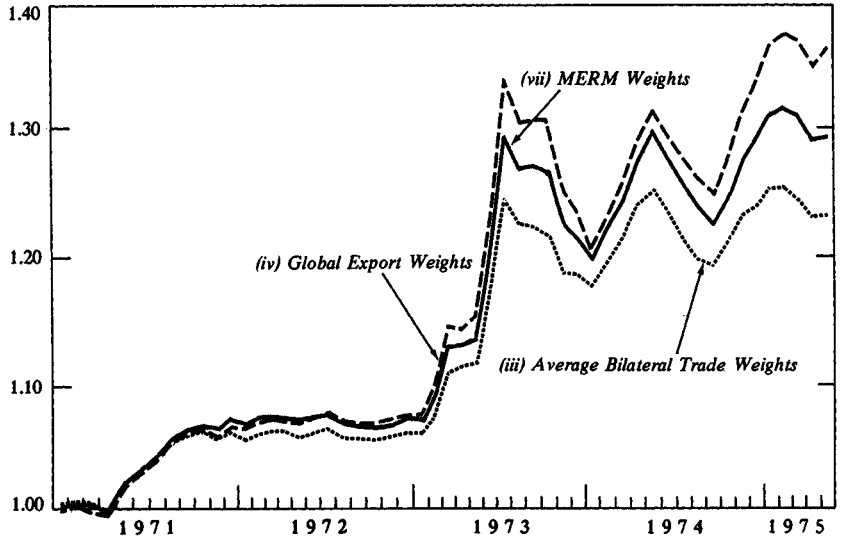


CHART 9. ITALY: EFFECTIVE EXCHANGE RATE, 1971–MAY 1975

(May 1970 = 1.00)

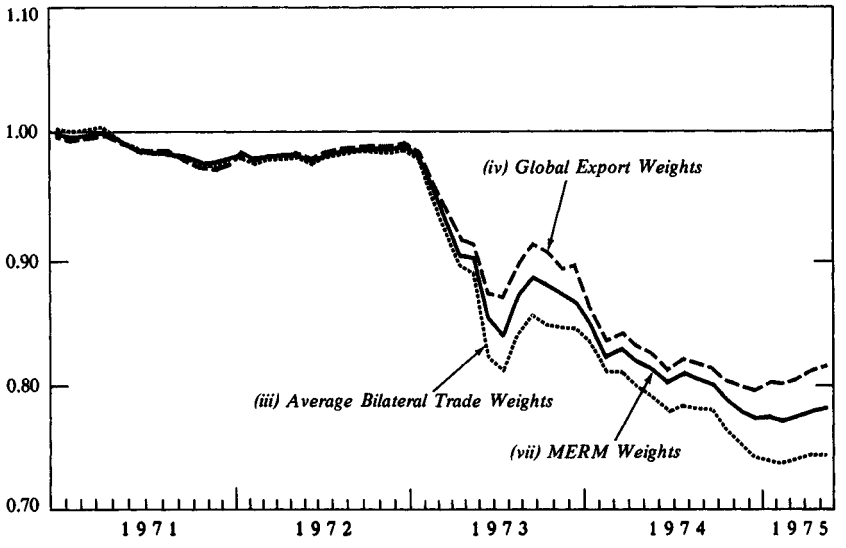


CHART 10. JAPAN: EFFECTIVE EXCHANGE RATE, 1971–MAY 1975

(May 1970 = 1.00)

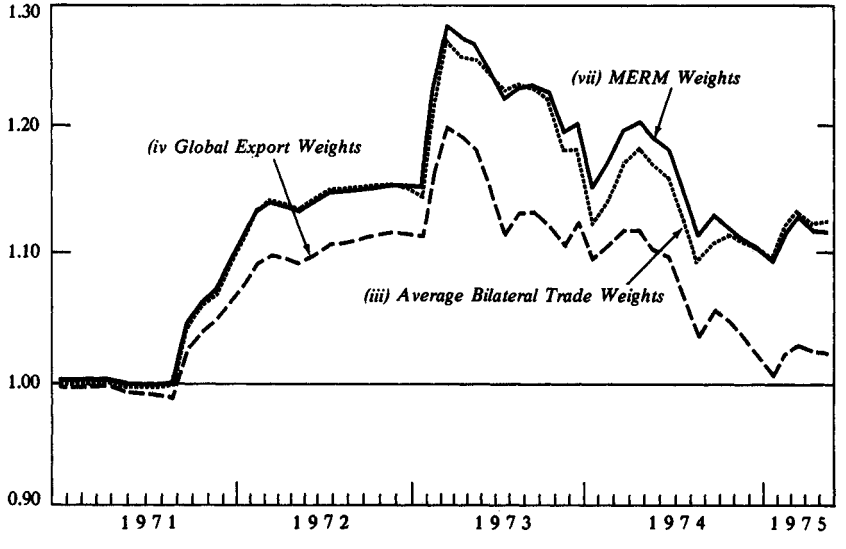


CHART 11. NORWAY: EFFECTIVE EXCHANGE RATE, 1971–MAY 1975

(*May 1970 = 1.00*)

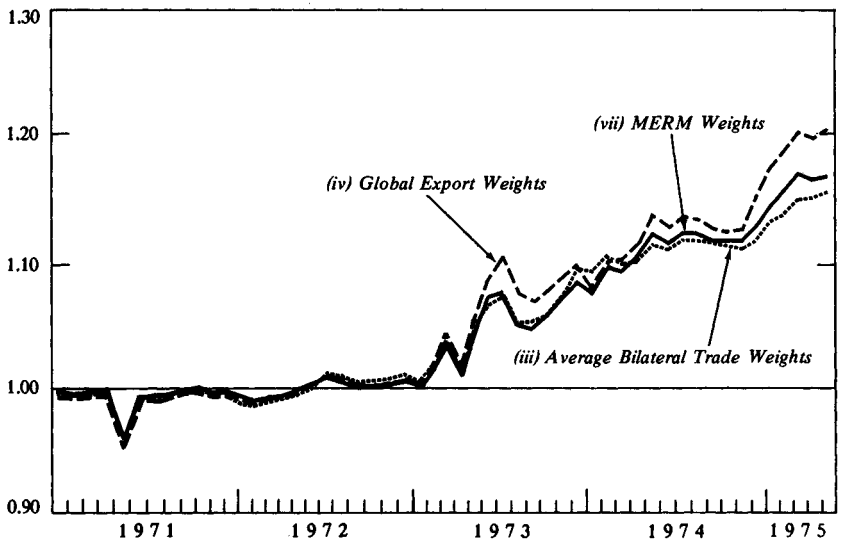


CHART 12. SWEDEN: EFFECTIVE EXCHANGE RATE, 1971–MAY 1975

(*May 1970 = 1.00*)

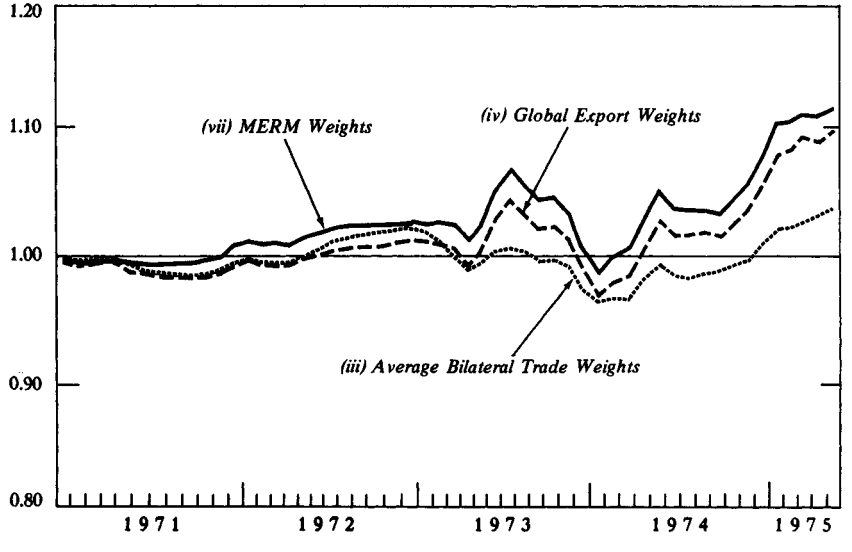


CHART 13. SWITZERLAND: EFFECTIVE EXCHANGE RATE, 1971–MAY 1975

(*May 1970 = 1.00*)

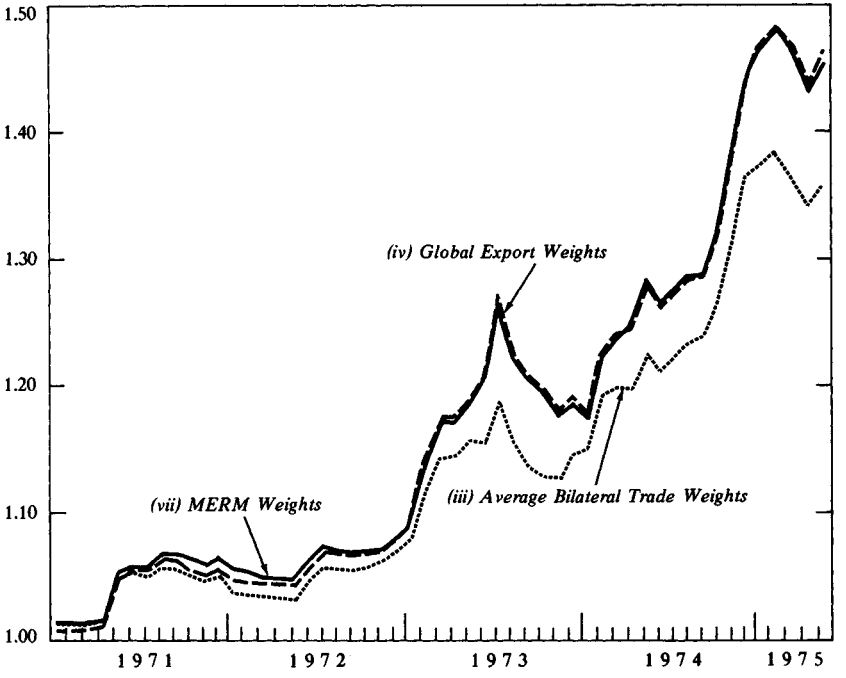


CHART 14. UNITED KINGDOM: EFFECTIVE EXCHANGE RATE, 1971–MAY 1975

(*May 1970 = 1.00*)

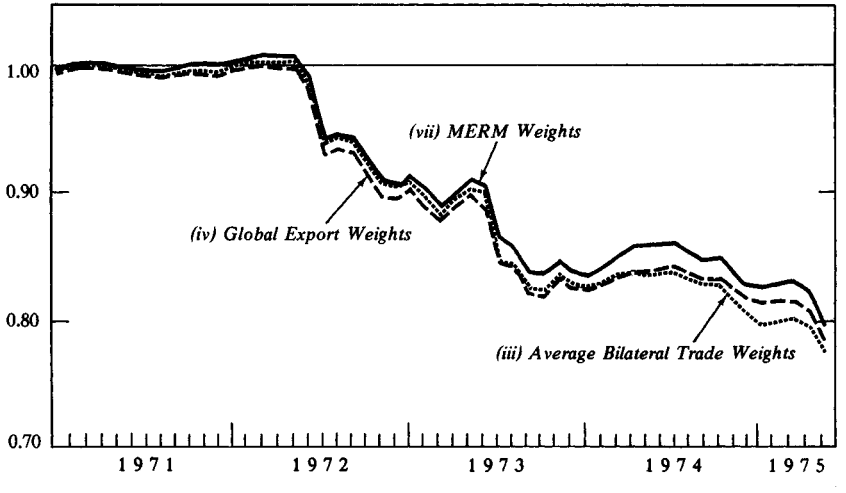


CHART 15. UNITED STATES: EFFECTIVE EXCHANGE RATE, 1971–MAY 1975

(*May 1970 = 1.00*)