IMF WORKING PAPER

This is a working paper and the author would welcome any comments on the present text. Citations should refer to an unpublished manuscript, mentioning the author and the date of issuance by the International Monetary Fund. The views expressed are those of the author and do not necessarily represent those of the Fund.

WP/87/87

INTERNATIONAL MONETARY FUND

Research Department

A Revised Weighting Scheme for Indicators of Effective Exchange Rates

Prepared by Peter Wickham

Authorized for Distribution by Mohsin S. Khan

December 30, 1987

Abstract

The Fund in its operational work makes extensive use of indicators of nominal and real effective exchange rates. For the smaller industrialized countries and most developing countries the indicators have typically used weights based on aggregate trade flow data. Such weighting schemes have a number of shortcomings. This paper describes an alternative methodology for calculating the weights used in the indicators which attempts to improve their informational content.

JEL Classification Number:
431

* I am grateful for comments and suggestions from Malcolm Knight, Gerard Belanger, and from other colleagues in the Research, Exchange and Trade Relations, and Area Departments. Excellent research assistance was provided by Youkyong Kwon, Brooks Calvo, and David Hicks.

Contents

I. Introduction

With the onset of generalized floating in the early 1970s, increasing attention focused on the need for countries to monitor what was happening to key economic variables as a result of exchange rate changes between the domestic currency and various foreign currencies. The notion of the nominal effective exchange rate was developed by Hirsch and Higgins (1970), and was subsequently extended by Artus and Rhomberg (1973), Black (1976), and Rhomberg (1976). These authors emphasized that indices could be developed to monitor the impact of exchange rate changes on various variables, but attention was focused on the trade (or more generally the current account) balance and the impact of exchange rate-induced changes in relative prices on trade flows.

The Multilateral Exchange Rate Model (MERM) (Artus and Rhomberg (1973), Artus and McGuirk (1981), Masson (1987)), for example, is a large general equilibrium simulation model dealing with trade flows in five (six in the 1981 and 1987 versions) commodity groupings among eighteen industrialized countries, the oil-exporting countries, and the rest of the world. In order to isolate the relative price effects of exchange rate movements, the model makes a specific set of assumptions about demand management policies in each country or group of countries; in general, it is assumed that policies are such as to keep real output constant. The model provides notional estimates of the medium-term effects of a set of exchange rate changes on the trade balances of the industrialized countries, the oil-exporters, and the rest of the world. Simulations with the model provide the necessary information to derive weights for effective exchange rate indicators which focus on the trade balance implications of exchange rate changes. 1/

Attempts have also been made to apply a similar methodology to certain primary-product-producing developing countries (Belanger (1976); Feltenstein, Goldstein, and Schadler (1979)). Reflecting the fact that a currency can become overvalued if the domestic inflation rate exceeds that of its partner (competitor) countries, the latter paper gave explicit consideration to the "real" effective exchange rate--i.e., the nominal effective exchange rate adjusted for overall price or cost movements at home and in competitor countries. While the emphasis on real indices has continued, the data and resource requirements necessary to generate

---

1/ The change in a country's effective exchange rate in the MERM is defined as the notional unilateral change in the exchange rate which would produce the same change in the trade balance as that estimated to have taken place as a result of all exchange rate changes that actually occurred during the period.

MERM-type weights for both nominal and real effective exchange rate indices have meant that most developing countries and the smaller industrialized countries have had to rely on simpler approaches. 1/

The Fund in its operational work and the exercise of its responsibility for surveillance of exchange rates under the Articles of Agreement makes extensive use of indicators of real effective exchange rates. For a number of industrialized countries, there are indicators (other than those based on the MERM) which concentrate on the analysis of competitiveness in manufacturing trade. 2/ These indicators, which are published regularly in International Financial Statistics, use various price or cost indices including normalized unit labor costs, manufacturing value-added deflators, wholesale price indices, and export unit values to adjust the exchange rate data. The weights used are built up from disaggregated trade data for manufactures, taking into account direct trade relations as well as competition in third-markets.

For other member countries, the weights used in the indicators have typically reflected bilateral non-oil trade flows, although in some instances attempts have been made to make some allowance for third-market competition in manufactures and for certain non-merchandise current account flows. Overall price and cost developments at home and abroad are (by default) generally measured by the consumer price index.

The weighting schemes used in calculating the latter indicators of real effective exchange rates have a number of shortcomings. Where emphasis has been placed on competitiveness in manufacturing, modifications have been made to formulas used to compute the weights to make some allowance for competition in third-markets. Nevertheless, the weights have been computed using aggregate trade data rather than data for trade in manufactures. While manufactures may dominate total export earnings for some countries (e.g., Korea), this is not the case for other countries such as Argentina and Brazil. Similarly, inter-country differences in the structure of trade may be quite marked on the import side. Furthermore, to the extent that exchange rate movements influence earnings from or payments for primary products, it would be desirable to pay more explicit attention to this fact. The same holds true for other developing countries where weights based on simple bilateral non-oil trade flows are typically used to compute the indicators. Moreover, it is desirable to recognize in computing the weights that many developing countries, although not generally classified as major exporters of manufactures, have manufacturing sectors which are playing an increasingly important role in determining overall trade performance.

1/ See Rhomberg (1976) and Maciejewski (1983) for a detailed discussion.
2/ See McGuirk (1987).

This paper discusses a methodology for deriving weights that attempts to address the principal weaknesses of previously used schemes. This is done by using disaggregated trade flow data and by drawing a distinction between differentiated manufactured goods and primary products. Separate sets of weights have been calculated for nearly all Fund members covering manufactured exports, manufactured imports, primary product exports, and primary product imports. The four sets of weights available can be used to calculate indicators relevant to the particular trade flows covered or they can be aggregated in various ways to provide weights relevant to export earnings, trade in manufactures, total trade, etc..

Before outlining the structure of the paper, it is necessary to emphasize that the objective is to refine the weights for indicators relevant to assessing trade performance viewed from a medium-term perspective. Short-run effects of exchange rate changes reflect the presence of certain rigidities and differences in the response speeds of particular variables, whereas medium-term effects allow for certain lags to have worked themselves out. Magee (1973), for example, examines the "currency-contract" issue, dealing with the period immediately following a depreciation (or appreciation) in which contracts entered into prior to the exchange rate change fall due. Magee also considers the "pass-through" problem, referrring to the behavior of international prices on contracts following depreciation, but before significant volume effects are realized. These aspects of adjustment give rise to such phenomena as J-curves following exchange rate changes.

Models like the MERM and the simple elasticity models of trade used by Black (1976) and Branson and Katseli-Papaefstratiou (1981) are concerned with the effect of exchange rates in inducing price and quantity changes at a more advanced stage in the process of adjustment. For this reason, the currencies in which trading contracts are denominated (or settled) or the currencies in which commodities are typically priced are not directly relevant to the computation of the weights used for the indicators of real effective exchange rates considered in this paper. The notion of international "competitiveness" embodied in the indicators is thus a broad one, and not one restricted to international comparisons of the evolution of contract prices for traded goods. It should also be pointed out that the consumer price indices typically used in the real effective exchange rates should not be interpreted as proxies for traded goods prices in each country, but rather as (albeit imperfect) indicators of broad or underlying cost developments in each country. The interpretation, therefore, of a real effective appreciation (loss of international competitiveness) is that the the ability of the traded goods sectors to compete and/or to remain profitable will be adversely affected with consequent deleterious effects on trade performance over the medium term.

The structure of the paper is as follows: Section II discusses the distinction between differentiated and homogeneous goods in international trade. Section III explains the rationale behind the weighting schemes for manufactured goods, while Section IV considers the case of primary products. A description of the data bases used in the computation of the weights is the subject of section V. Section VI looks at procedures for aggregating the sets of weights and the behavior for selected Fund member countries of indicators based on the revised weighting schemes; in addition, consideration is given to the use that can be made of indicators based on the component weights (e.g., manufactured goods, exports, etc.).

II. Differentiated versus Homogeneous Goods in International Trade 1/

The approach taken toward computing the revised weights is based on the distinction frequently drawn between two broad classes of traded goods. The first consists of differentiated goods--"manufactures;" for these goods non-transitory price differentials between different markets and producers are often observed in the short to medium term. 2/ The second, "primary commodities," includes homogeneous products--such as copper, zinc, palm oil--which are not distinguished on the demand side by country of origin. Thus producers cannot sustain a price that is different from those of their competitors, and commodity arbitrage is potentially such as to ensure a common or "world" price of the commodity. 3/

For a homogeneous good (or primary commodity), the common or "world" price is determined by the interaction of world demand and world supply. In considering the effects of exchange rate movements between many currencies, a key element is how these movements are likely to affect the "world" price. The movements in exchange rates are likely to cause demand and supply responses in each country, which on aggregate alter the "world" price of the commodity. As will be elaborated

1/ A detailed discussion of the importance of trade structure in analyzing the impact of multilateral exchange rate changes is also presented in Goldstein (1986), pp. 29-39.

2/ These kind of goods have been referred to by McKinnon (1979) as Hicksian fix-price goods. The breakdown of the so-called "law of one price" for such traded goods is documented in Kravis and Lipsey (1978) and Isard (1977).

3/ This does not necessarily imply that arbitrage almost instantly ensures a common or "world" price for the commodity (although there are well organized auction markets where this is the case), but rather the flow of information between buyers and sellers is sufficient to bring about fairly rapid price convergence.

further below, the importance of changes in an individual country's exchange rate in affecting the world price is related in part to that country's share in production (exports) or consumption (imports) of the commodity. And it is the change in "world" price (induced by multilateral exchange rate movements), in conjunction with the simultaneous demand or supply response in individual importing or exporting countries, that determines how a country's import payments for or export receipts from the commodity will be affected over the medium term.

Manufactured goods, in contrast, are considered to be distinguished on the demand side by country of origin. That is to say, the merchandise of a given kind supplied by producers in one country is not a perfect substitute in a particular market for merchandise of the same kind supplied by another country. Price differentials can therefore exist in a market between similar types of manufactured goods because of differing elasticities of substitution in demand. Exchange rate changes (among other factors) are seen as leading to shifts in demand among similar, but differentiated, manufactured goods produced by various countries, thus affecting export and import-substituting trade performance. In a given market (or country), demand for a particular type of manufactured good can be met by domestic producers and by producers in foreign countries. Producers of import-substitutes face competition from exporters in other countries, while from an exporter's perspective competition in each market is provided both by other exporters to that market and by the domestic suppliers.

III. Weights for Imports and Exports of Manufactures

The weights for indices designed to indicate changes in import and export competitiveness in manufacturing are considered first.

On the import side, producers of import-substitutes compete in the domestic market against foreign suppliers in satisfying demand for particular types of manufactured goods. The importance attached by the importing country to a foreign supplier (competitor) is related in a straightforward manner to the latter's share (in terms of value) in imports of the particular manufactured good. In other words, for each type of manufactured good that a country imports, a set of weights for the foreign suppliers is computed based on bilateral import trade data.

Let :

MM(h,i,j) = the value of manufactures of type h imported by country i from country j.

$$WMM(h,i,j) = \frac{MM(h,i,j)}{\Sigma j\ MM(h,i,j)}$$

= the weight attached by country i to country j for good h.

By considering how important each particular type of manufactured good is in a country's total import bill for manufactures, the sets of weights for each type of manufactured good can be aggregated into a set of weights [WMM(i,j)] covering all imports of manufactures. 1/

$$WMM(i,j) = \Sigma h. \frac{MM(h,i,j)}{\Sigma h\ MM(h,i,j)} .WMM(h,i,j)$$

The aggregation procedure yields a set of weights that is exactly equivalent to one based on the share of each foreign supplier in a country's total imports of manufactures. This means that as far as the data requirements are concerned, the computation requires only information on a country's total imports of manufactures by country of origin. As will be seen below, this is not the case when undertaking the computation of export-competitiveness weights for manufactured goods.

As suggested in Section II, an exporter of a particular type of manufactured good is considered as facing competition in an export market both from domestic suppliers and from other foreign producers. Korea, for example, exports certain types of manufactured goods to the United States, France, Germany, etc.. In the U.S. market, Korea faces competition from U.S. manufacturers and also from exporters in France, Germany, Japan, Singapore, etc.. Similarly in the French market, French manufacturers provide competition as do exporters in the United States, Germany, Japan, Singapore, etc..

The weights attempt to take into account these kind of competitive relationships. That element of competition provided to an exporter by domestic producers in each market is referred to as the bilateral competitive element, while the competition provided by other exporters to that market is referred to as the third-market competitive element. The two elements are assumed to be of equal importance. Using the above example, this means that when considering Korean exports of a particular kind of manufacture to U.S. market, U.S. domestic suppliers are assigned a weight of 50 percent and exporters to the U.S market other than Korea itself are collectively assigned a weight of 50 percent. Among the other exporters to the U.S. market, the relative

1/ This simple method of aggregation clearly does not take into account the fact that certain manufacturing sectors may be more sensitive to import competition than others.

importance of competitive relationships is determined by individual exporters' shares in *U.S. imports* of the manufactured good. The equal weighting assumption is, of course, restrictive, but is occasioned by the fact that data on domestic output by type of manufacture (based on comprehensive input-output tables) are lacking for most countries. 1/

The formulas are as follows:

Let:

WXMB(i,j) = the weight attached to country j by country due to competition between exporters in country i and domestic suppliers in country j (the bilateral competitive element after aggregation across manufactures).

WXMT(i,j) = the weight attached to country j by country i due to competition from exporters in country j in country i's other export markets (the third-market competitive element after aggregation across manufacures).

The combined weight WXM(i,j) is simply:

$$WXM(i,j) = 0.5\ WXMB(i,j) + 0.5\ WXMT(i,j).$$

Let:

XM(h,i,j) = the exports of manufacturing good h from country i to country j.

The bilateral competitive element, WXMB (i, j), is:

$$WXMB(i,j) = \frac{\Sigma h\ XM(h,i,j)}{\Sigma j\ \Sigma h\ XM(h,i,j)}$$

It should be noted that the weight is thus the importance of country j *as a market for country i's total exports of manufactured goods.*

1/ The indicators for the major industrialized countries published in IFS do make use of available input-output tables to make adjustments for effective competition.

The expression for the third-market element is more complex:

$$WXMT(i,j) = \Sigma h. \frac{\Sigma k\ XM(h,i,k)}{\Sigma h\ \Sigma k\ XM(h,i,k)} . \Sigma k. \frac{XM(h,i,k)}{\Sigma k\ XM(h,i,k)} . \frac{XM(h,j,k)}{\Sigma j \neq i\ XM(h,j,k)}$$

$$\langle\text{------}1\text{------}\rangle \qquad \langle\text{-----}2\text{----}\rangle \qquad \langle\text{------}3\text{-----}\rangle$$

The expression can be divided into three parts. Part 3 gives the share (excluding the exports of country i) of a competing exporter j in market k for manufactured good h. Part 2 of the expression shows how important market k is to country i when all country i's markets for a particular manufactured good have been considered. Taken jointly (after the summation over k), Parts 2 and 3 of the expression thus show country j's role as a competitor across all markets (other than country j itself) to which country i exports good h. Thus, if country i is Korea, country j is Japan, and the export is electrical equipment, part three of the expression considers Korea's export markets for electrical equipment one by one, establishing the importance of Japan as a competitor in each market. Summing over k provides an indication of the importance of Japan as a competitor to country i when all of Korea's markets for electrical equipment have been considered. This procedure is carried out for each type of manufactured good.

The first part of the expression shows the share of each type of manufactured good in country i's total exports of manufactured goods. The summation over h performs the aggregation over all types of manufactured goods. In terms of the example used above, having established the importance of Japan as a competitor in electrical equipment, chemicals, textiles, etc., the summation provides an indication of the overall role of Japan as an export competitor in manufactures to Korea. To the extent that Korea exports to Japan, this is taken into account in the computation of the bilateral competitive weight.

In terms of the computations for any country i, the range of j covers all Fund members plus several additional currency areas (e.g., Hong Kong); k, which refers to markets, ranges over these countries and entities plus a sub-group of countries belonging to, or affiliated with, the Council for Mutual Economic Assistance (CMEA). 1/ The range of h (i.e., types of manufactures) covers 27 SITC two-digit groups within SITC 5 (chemicals), SITC 6 less SITC 68 (basic manufactures less non-ferrous metals), SITC 7 (machines and transport equipment), and SITC 8 (miscellaneous manufactures).

1/ For Fund member countries belonging to the CMEA, trade in manufactures within the CMEA is excluded from the computation. For example, Hungary's exports of manufactures to Poland (a Fund and CMEA member) and to the Soviet Union (CMEA member) are excluded from the computation of weights for manufactured exports.

IV. Weights for Imports and Exports of Primary Commodities

The approach taken toward computing weights for export and import competitiveness in primary commodities is somewhat different from that employed above. While manufactured goods are treated as differentiated products, primary commodities (products) are treated as homogeneous goods--the output of various suppliers is not distinguished on the demand side by country of origin. The approach is based on the framework suggested by Ridler and Yandle (1972). 1/ Ridler and Yandle present a simplified method for taking account of multilateral exchange rate changes as they may affect an individual country's export receipts from (or import payments for) a particular primary commodity. The essence of the method is to specify a simple partial equilibrium model of world trade in a commodity. The commodity is assumed to be a homogeneous good traded in a competitive world market. Exchange rate changes, which are assumed to be exogenous, shift the import demand and export supply schedules for the commodity, thus affecting its price and the export receipts (import payments) of individual exporters (importers). 2/

It can be shown, using such a simple model of trade, that the induced change in the world price of the commodity (faced by each exporter or importer) can be expressed as a function of a weighted average of the changes in the exchange rates of exporters' currencies and a weighted average of changes in the exchange rates of importers' currencies. 3/ The weight attached to an exporters' exchange rate is related to that country's share in world exports of the commodity, and the weight attached to an importer's exchange rate is related to that country's share in world imports. The relative importance attached to exporters' exchange rates as a group and to importers' exchange rates as a group depends on the size of the world supply and demand elasticities for the commodity.

1/ This framework was subsequently adapted by Belanger (1976) and Feltenstein, Goldstein, and Schadler (1979) in developing exchange rate models and effective exchange rate indices for certain primary-producing developing countries.

2/ Other factors which may shift the demand and supply curves are suppressed in the model so that the focus is exclusively on shifts in the curves induced by exchange rate changes (or exchange rate changes adjusted for inflation).

3/ The model is specified in the Appendix.

Specifically, the expression for the percentage change in world price P($) measured in terms of a numeraire currency such as the U.S. dollar can be written as:

$$\dot{P}(\$) = \left[\frac{\mu}{\mu - \tau}\right] \cdot \Sigma i \; \alpha(i) \; [\dot{E}(\$,i) + \dot{P}(i)] - \left[\frac{\tau}{\mu - \tau}\right] \cdot \Sigma j \; \beta(j) \; [\dot{E}(\$,j) + \dot{P}(j)]$$

where :

τ , μ = are the world price elasticity of demand and supply, respectively;

E($,i) = country i's exchange rate in U.S dollars per local currency unit;

P(i) = the overall price or cost index in country i;

$\alpha(i)$ = country i's share in world exports of the commodity;

$\beta(j)$ = country j's share in world imports of the commodity;

Making the strong assumption that the elasticities are equal in size, but of opposite sign, the expression above simplifies to:

$$\dot{P}(\$) = [0.5 \; \Sigma i \; \alpha(i)[\dot{E}(\$,i) + \dot{P}(i)] + 0.5 \; \Sigma j \; \beta(j)[\dot{E}(\$,j) + \dot{P}(j)]]$$

The relevant variables for determining changes in the world price of the commodity are the exchange rate-adjusted cost developments in the importing and exporting countries. This implies that an exporter or importer of primary products should consider exchange rate movements in both major exporting and importing countries when evaluating the likely consequences for trade performance. An important exporter of primary products--Argentina, for example--would take into account not only exchange-rate adjusted overall price or cost developments in other exporting countries like Australia and the United States, but also such developments in the major importing countries of Western Europe. The assumption about the elasticities means in effect that the demand and supply sides of the market are deemed equally important.

The expression is given in terms of real exchange rates vis-à-vis the U.S dollar. For real effective exchange rates (which are expressed in terms of a weighted average of real bilateral exchange rates), the weights given above must be modified slightly; these adjustments are elaborated on further below.

It is apparent that the assumptions underlying the weighting scheme are strict. Except in the case of sugar, there is no consideration of segmented markets, restrictions, quota schemes or other marketing agreements for particular commodities, or the fact that the elasticities are likely to be different between commodities and between the demand and supply sides of commodity markets. In the case of sugar, some allowance has been made for the segmented nature of the market: in fact, three markets are distinguished---the United States, the EC, and a residual "world" market. Attempting to make some allowance for differing elasticities would obviously require a large amount of additional information since the weighting scheme proposed involves over 100 commodities and consideration of all Fund members. It should be kept in mind, however, that the assumptions required to justify the use of a weighting scheme based on bilateral trade weights are substantially more restrictive. The proposed scheme, by taking into account the effect on prices of the changes in exchange rates of exporters and the importers, in fact relaxes some of the restrictive assumptions implicit in the use of bilateral trade weights for exporters and importers of primary commodities. In particular, one advantage of the present approach over the bilateral trade shares approach is that countries exporting primary products (but not to each other) nevertheless are recognized as competing against each other.

The formulas used to calculate the weights for import and export competitiveness are presented below.

Let:

XP(h, i) = total exports of primary product h by country i.

MP(h, i) = total imports of primary product h by country i.

$$xp(h, i) = \frac{XP(h,i)}{\Sigma i\ XP(h,i)}$$

= share of country i in world exports of primary product h.

$$mp(h,i) = \frac{MP(h,i)}{\Sigma i\ MP(h,i)}$$

= share of country i in world imports of primary product h.

The weight, WP(h,i,j), to be attached by i to j is:

$$WP(h,i\ j) = 0.5 \cdot [xp(h,j) / (1 - xp(h,i))] + 0.5 \cdot [mp(h,j) / (1 - mp(h,i))]$$

If country i is an exporter of primary product h (i.e., XP(h,i) > 0), then the term mp(h,i) will typically be zero. If country j is also an exporter, its weight will be determined by the first term in brackets on the right hand side of the expression. It will be country j's share of total exports of primary product h from sources other than country i. If country j is an importer, the weight will typically be country j's share in total imports of primary product h. Similar considerations apply when country i is an importer of primary product h (i.e., MP(h,i) > 0). It should be noted that if country i exports or imports a primary product h but its share of world exports or imports is negligible, the weights that it assigns to other countries collapse to simple world market shares of exports and imports for the commodity.

Having determined the weights to be attached by country i to a country j either because country i exports or imports a product h, the weights must be aggregated over primary products. The primary product export weights, WXP(i,j), and the primary product import weights, WMP(i,j), are as follows:

$$WXP(i,j) = \Sigma h. \frac{XP(h,i)}{\Sigma h\ XP(h,i)} \cdot WP(h,i,j)$$

$$WMP(i,j) = \Sigma h. \frac{MP(h,i)}{\Sigma h\ MP(h,i)} \cdot WP(h,i,j)$$

The consequences of using the weighting scheme can be seen most clearly by looking at a particular case. Tin and palm oil are important export commodities for both Malaysia and Indonesia. Consequently, in the primary product export weights computed for Malaysia, Indonesia is assigned a relatively high weight, and vice versa. However, because the major industrialized countries are the principal importers of the two commodities, they also have important weights assigned to them in both Malaysia's and Indonesia's primary product export index.

V. Data Bases Used in the Computations

Data for trade in manufactured goods have been taken from the United Nations D-Series made available through the World Bank's Trade System. The data base assembled covers SITC groups 5 through 8, but excludes non-ferrous metals (SITC 68) since the latter are treated as primary commodities. Within this grouping of manufactures, the disaggregation is taken to the SITC two-digit level. This means, for example, that within SITC 7 (which is machinery and transport equipment) trade in non-electrical machinery, electrical machinery, and transport equipment are considered separately. For each manufactured good (defined at the SITC two-digit level) the data base contains the value of trade flows by country of destination and origin. In general, the data used in the computation of the weights for trade in manufactures are average trade flows for the 1980-82 period. Considerable lags exist in the reporting of such disaggregated data to the United Nations (particularly by developing countries) and this factor acts as a constraint on the period that can be covered by the data base.

The computation of the manufacturing import and export weights was done using a large export matrix. Thus, for example, the f.o.b. value of exports of electrical equipment from country A to country B gives the f.o.b. value of country B's imports of electrical equipment from country A. Additional use was made of the so-called symmetry proposition in filling up the export matrix to the maximum extent possible. A certain number of developing countries are non-reporters of their export trade in manufactures. These data were obtained using import data (with adjustments for freight and insurance) reported by partner countries. Clearly, if trade in manufactures takes place between two countries which are both nonreporters, such trade will not be covered by the export matrix so constructed. In a limited number of cases, the bias caused by the neglect of these trade flows has prompted a modification of the period used for the computation or the selection of an alternative set of weights.

Additional problems with the data base occur when certain geographical trade aggregates are reported rather than the trade flows for individual countries. This is the case, for example, with the South African Customs Union (Botswana, Lesotho, Namibia, South Africa, and Swaziland) so that data or trade flows in manufactures are reported for the Union as a whole but not for the individual countries. The data have been used in computing the weights for South Africa but not for the three smaller countries. Another example is the trade data available for several small and relatively n: ly independent countries in the Eastern Caribbean region. Certain partner countries (principally the United States and Canada) report data on their imports and exports of manufactures only for an aggregate that includes these particular countries and several other geographical entities in the region. This factor precludes calculating weights for competitiveness in manufacturing for these countries.

The data base for primary products includes trade in over 100 commodities and also covers the 1980-82 period. The data come principally from UN/FAO/GATT sources on files maintained by the World Bank's Commodity Division. For each commodity (e.g., wheat, palm oil, copper) the data base contains the total value of each country's imports and exports: the origin or destination respectively of such trade is not distinguished except in the case of sugar where three markets (the U.S., the EC, and a residual "world" market) are considered. Trade in energy products (crude petroleum, refined products, etc.) is excluded. The basic justification for this exclusion is the desire to focus on the international competitiveness of domestic factors of production (excluding rent), and it is in the non-oil traded goods sectors, rather than in the oil sector, that changes in factor rewards are likely to impinge on trade balance performance. The commodities were selected to ensure that trade in most important primary products is included. Nevertheless, coverage is not fully comprehensive of trade in primary products; thus total imports or exports of primary products computed for a country using this data base would not be identically equal to such totals computed by summing all SITC one-digit totals for non-energy primary products (i.e., SITC 0, 1, 2, and 4). Most countries, however, are considered to be covered adequately.

VI. Indicators Based on the Revised Weighting Schemes

For nearly all Fund member countries, separate sets of weights have been computed for manufactured imports, manufactured exports, primary product imports, and primary product exports. These component sets of weights can be used to compute separate indicators or they can be aggregated in various ways. Based on their respective shares of total trade in manufactured goods, the weights for manufactured imports and manufactured exports, for example, can be combined into a vector of weights for manufacturing competitiveness. Aggregate export competitiveness weights can be similarly obtained by appropriately combining the manufactured export and primary product export weights. "Total" competitiveness weights combine all four sets of component weights into one vector.

The following totals are needed to form "total" or aggregate trade weights:

$\Sigma h\ \Sigma j\ MM(h,i,j) = MM(i)$ = total imports of manufactured goods;

$\Sigma h\ \Sigma k\ XM(h,i,k) = XM(i)$ = total exports of manufactured goods;

$\Sigma h\ MP(h,i) = MP(i)$ = total imports of primary products;

$\Sigma h\ XP(h,i) = XP(i)$ = total exports of primary products;

Let:

WMM(i,j) = the weight given to country j for imports of manufactures by country i.

WXM(i,j) = the weight given to country j for exports of manufactures from country i.

WMP(i,j) = the weight given to country j for imports of primary products by country i.

WXP(i,j) = the weight given to country j for exports of primary products from country i.

$TT(i) = MM(i) + XM(i) + MP(i) + XP(i)$ = total trade of country i.

$\alpha(i) = MM(i)/TT(i)$

$\beta(i) = XM(i)/TT(i)$

$\pi(i) = MP(i)/TT(i)$

The aggregate weight AW(i,j) is:

$$AW(i,j) = \alpha(i).WMM(i,j) + \beta(i).WXM(i,j) + \pi(i).WMP(i,j) + (1-\alpha(i)-\beta(i)-\pi(i)).WXP(i,j)$$

Similar considerations apply when it is desired to focus on other aggregates, such as manufacturing trade or exports.

The weights for each country have been computed with no prior restrictions on the number or type of countries to be considered as potential competitors. The lack of prior restrictions means that the set of potential competitors is not arbitrarily restricted to the industrialized countries or to some other small predetermined sub-group of member countries. This means, however, that the number of countries included in the set of weights computed for each country is potentially very large. In truncating the number of countries included, partner countries with the smallest computed weights were eliminated under the proviso that coverage of trade not fall below a certain percentage. 1/

The formula used to compute the various real effective exchange rate indicators is as follows :

$$REER(i,t) = EXP[\Sigma j\ w(i,j)[\ln E(j,\$,t) - \ln P(j,\$,t)] - [\ln E(i,\$,t) - \ln P(i,t)]]$$

where :

REER(i,t) = the real effective exchange rate of country i

P(i,t) = the price or cost index in country i expressed in domestic currency

P(j,t) = the price or cost index in country j expressed in domestic currency

E(i,\$,t) = an index of country i's exchange rate expressed in units of domestic currency per U.S. dollar

E(j,\$,t) = an index of country j's exchange rate expressed in units of domestic currency per U.S. dollar

w(i,j) = the weight of country j in country i's real effective exchange rate indicator.

The nominal effective exchange rate uses the formula above but ignores the terms involving the price indexes.

The price data used in the real effective exchange rates calculated with the revised weights are generally consumer price indices. Consumer price indices have the advantage of being available in a relatively timely fashion and for a broad range of countries, attributes not shared, for example, by unit labor cost indices which are largely restricted to the manufacturing sectors of industrialized countries and to a limited number of the newly industrializing countries (NICs). Nevertheless, the reliability of consumer price indices as indicators of how underlying cost trends are evolving in different countries is affected by differential productivity growth and the extent of subsidization and price control.

1/ The trade coverage criterion was set after some experimentation at 80 percent for most countries.

In recent months the Fund has been canvassing member countries on their willingness to have real and nominal effective exchange rate indices based on the revised weighting schemes described in this paper published in International Financial Statistics (IFS). Affirmative replies have already been received from a number of countries. The attached charts show the behavior of nominal and real effective exchange rate indicators based on total trade for certain countries within this group (Charts 1-12). Also shown are the behavior of real effective exchange rate indicators covering the various components of total trade, such as manufacturing trade and exports of primary products (Charts 13-24).

As has been found elsewhere, the impact of differences in weighting schemes is much more pronounced for nominal effective exchange rates than for real effective exchange rates. Compared with nominal indices based on bilateral trade weights which typically assign a very high proportion of the weights to industrialized countries, a number of developing countries show greater nominal appreciations using the revised trade weights. This results primarily from the inclusion of other developing countries in the weights some of which (the high inflation countries) have been experiencing ongoing currency depreciation. Clearly real effective rates will be much less influenced than nominal effective rates because nominal exchange rate movements are often being offset to a large extent by the behavior of relative price levels. While differences in the behavior of real effective rates do emerge, interpretation of such differences must largely proceed on a case-by-case basis. The preliminary results of this paper reinforce the need to interpret the behavior of real effective exchange rates with caution. In particular, undue importance should not be ascribed to relatively small and possibly short-term movements in the indicators and that evaluation must take account of changes in the external environment and the stance of economic policies in the country concerned.

Chart 1

NIGERIA

REAL AND NOMINAL EFFECTIVE EXCHANGE RATES

(SEMI-LOG SCALE : 1980=100)

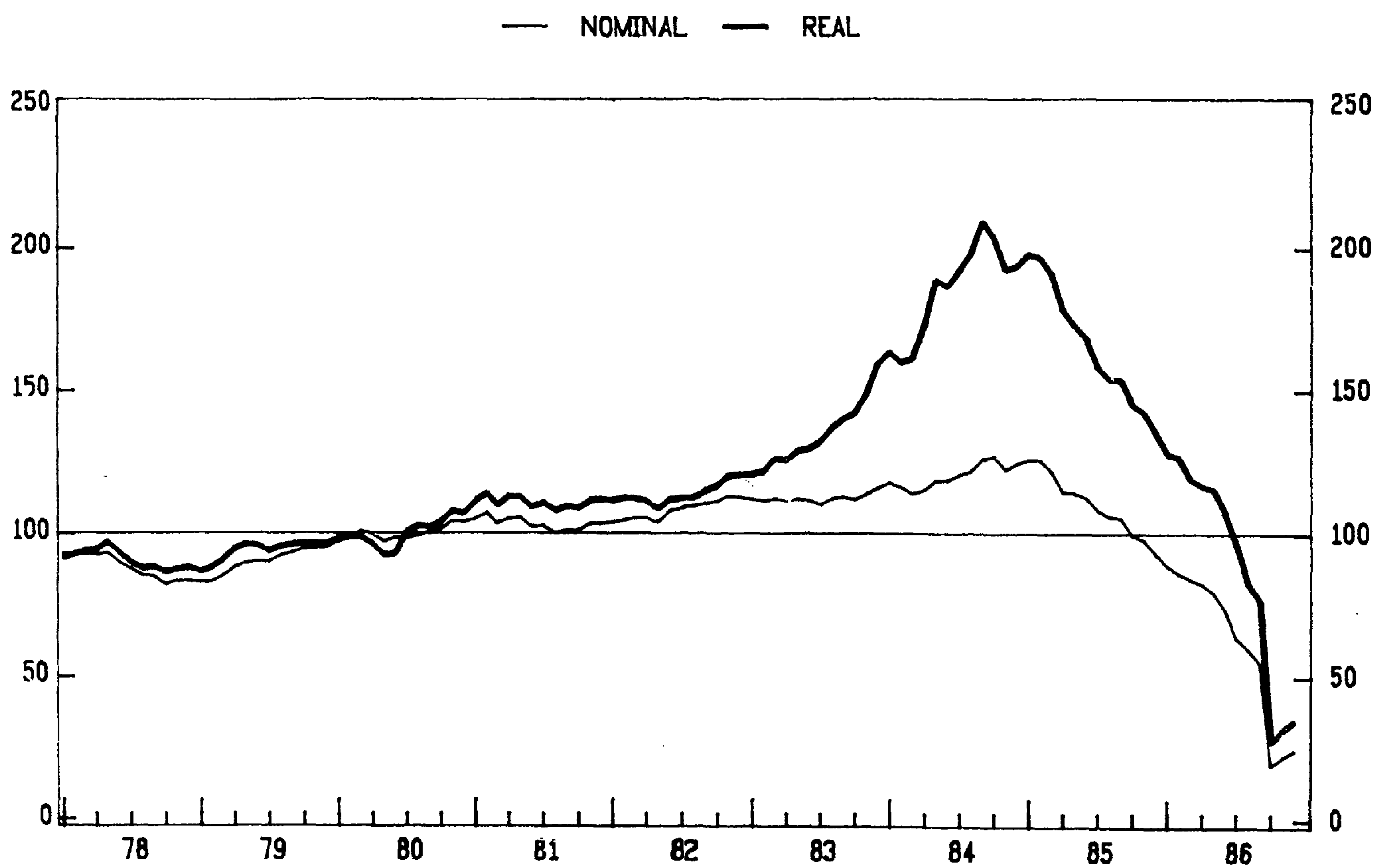


Chart 2

RWANDA

REAL AND NOMINAL EFFECTIVE EXCHANGE RATES

(SEMI-LOG SCALE : 1980=100)

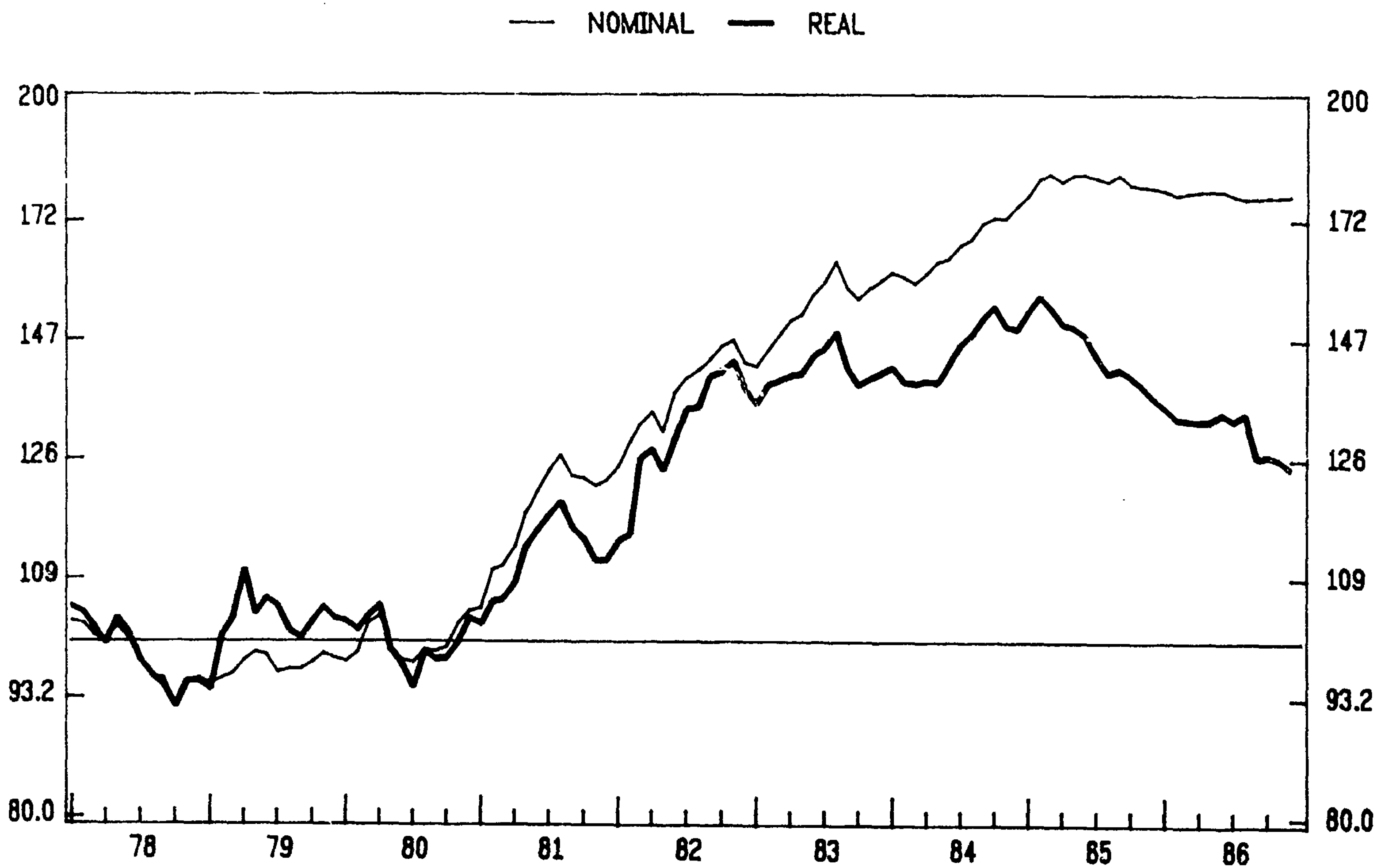


Chart 3

ZAMBIA

REAL AND NOMINAL EFFECTIVE EXCHANGE RATES

(SEMI-LOG SCALE : 1980=100)

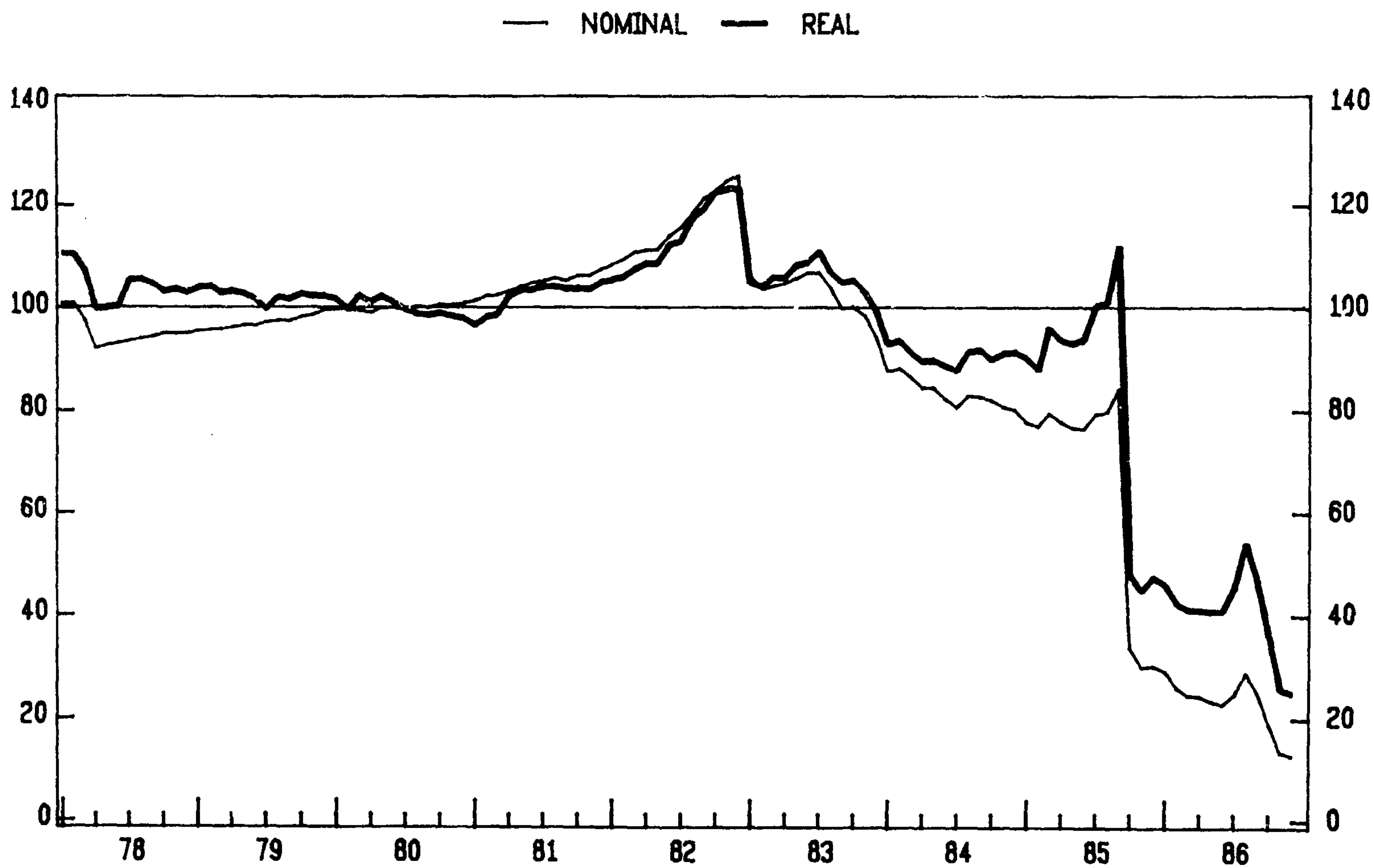


Chart 4

PHILIPPINES

REAL AND NOMINAL EFFECTIVE EXCHANGE RATES

(SEMI-LOG SCALE : 1980=100)

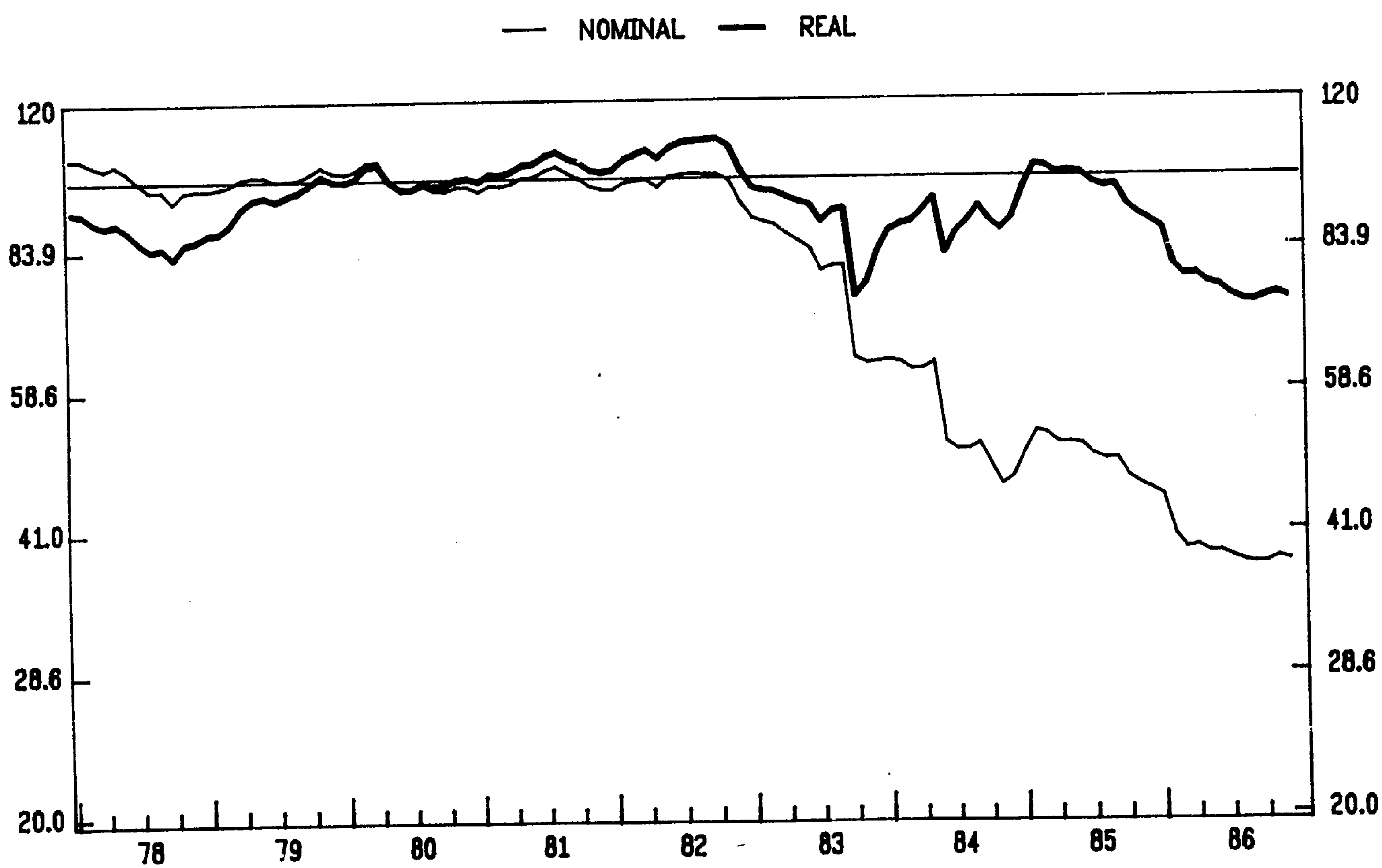


Chart 5

AUSTRALIA

REAL AND NOMINAL EFFECTIVE EXCHANGE RATES

(SEMI-LOG SCALE : 1980=100)

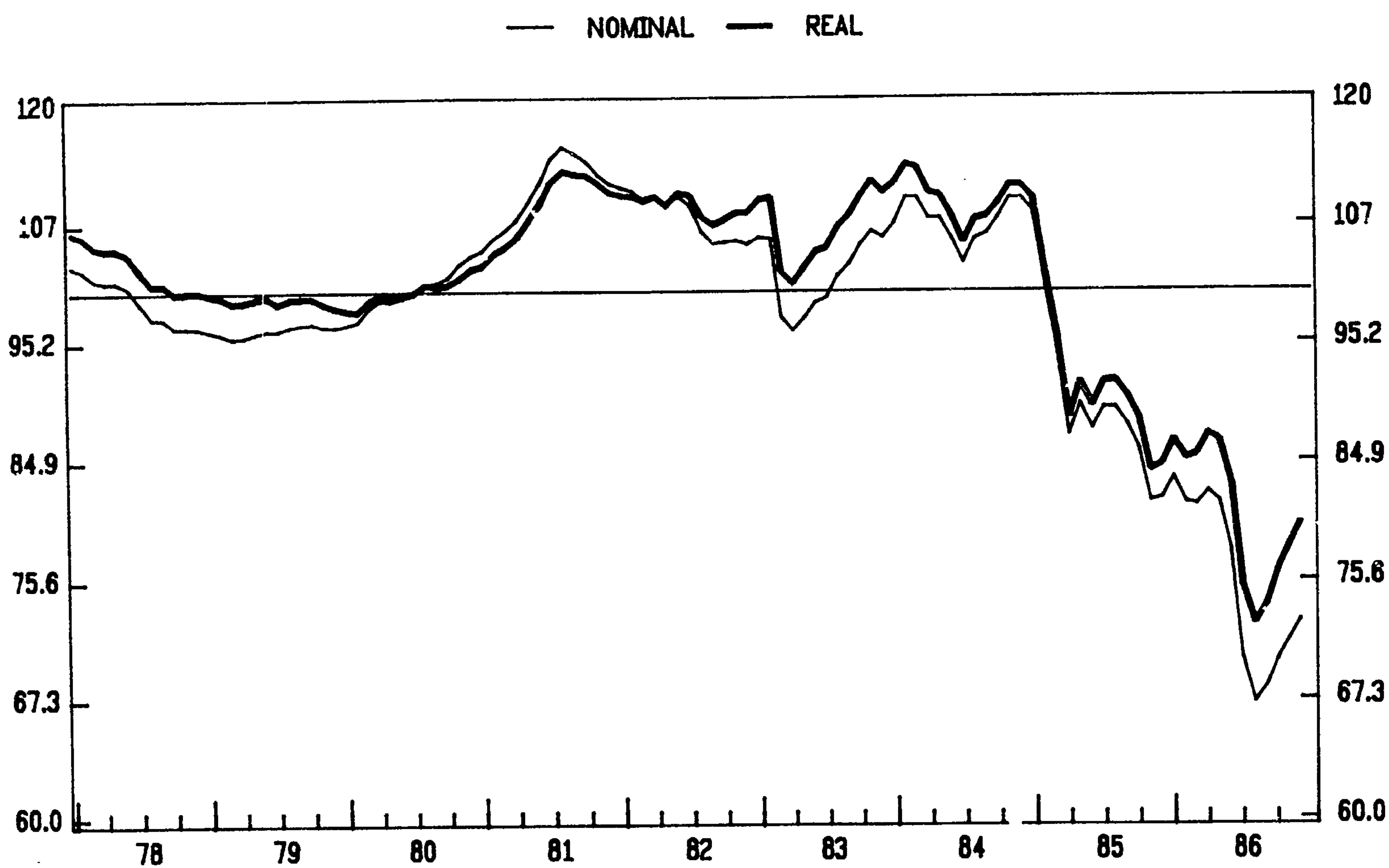


Chart 6

HUNGARY

REAL AND NOMINAL EFFECTIVE EXCHANGE RATES
(SEMI-LOG SCALE : 1980=100)

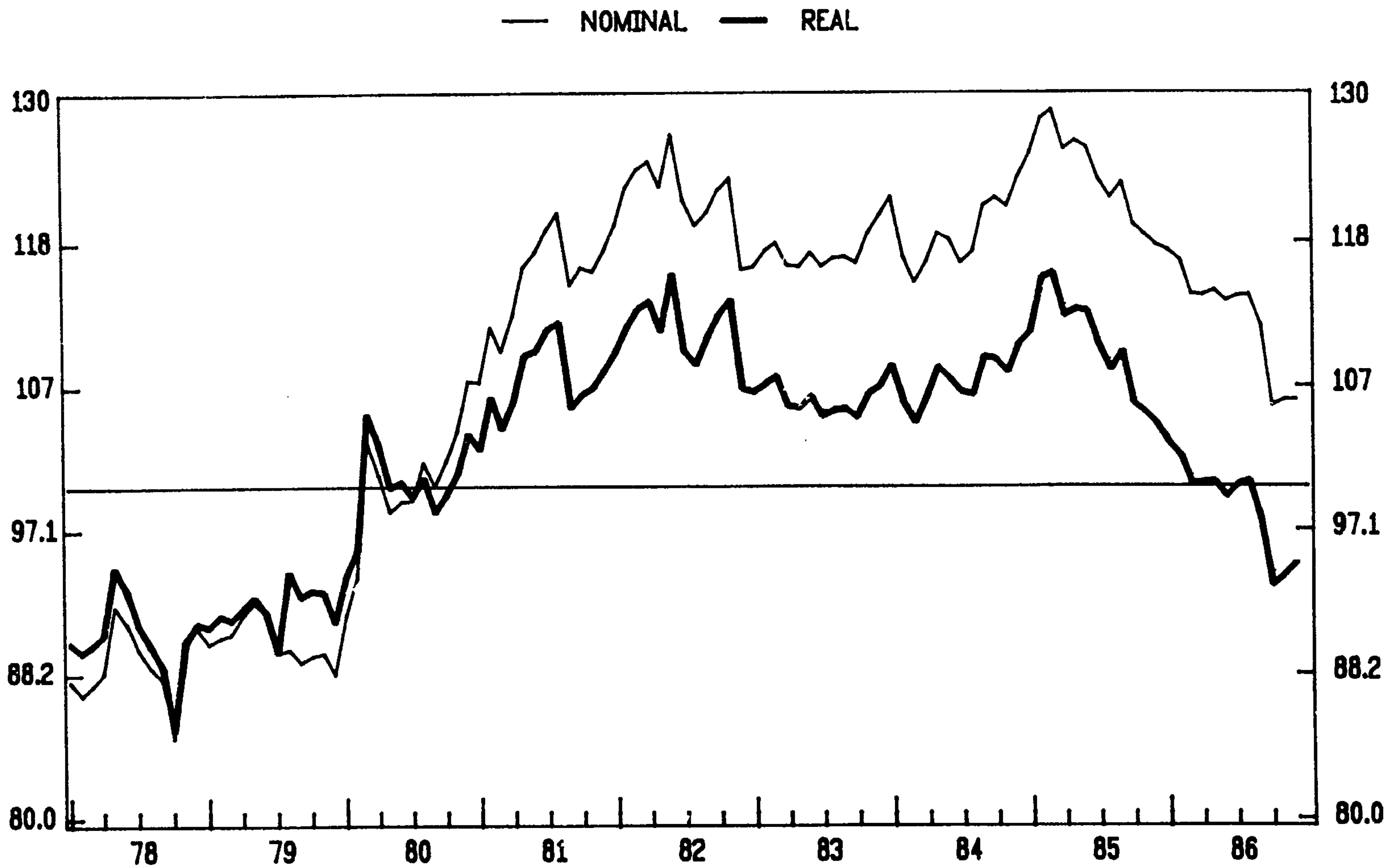


Chart 7

NEW ZEALAND

REAL AND NOMINAL EFFECTIVE EXCHANGE RATES

(SEMI-LOG SCALE : 1980=100)

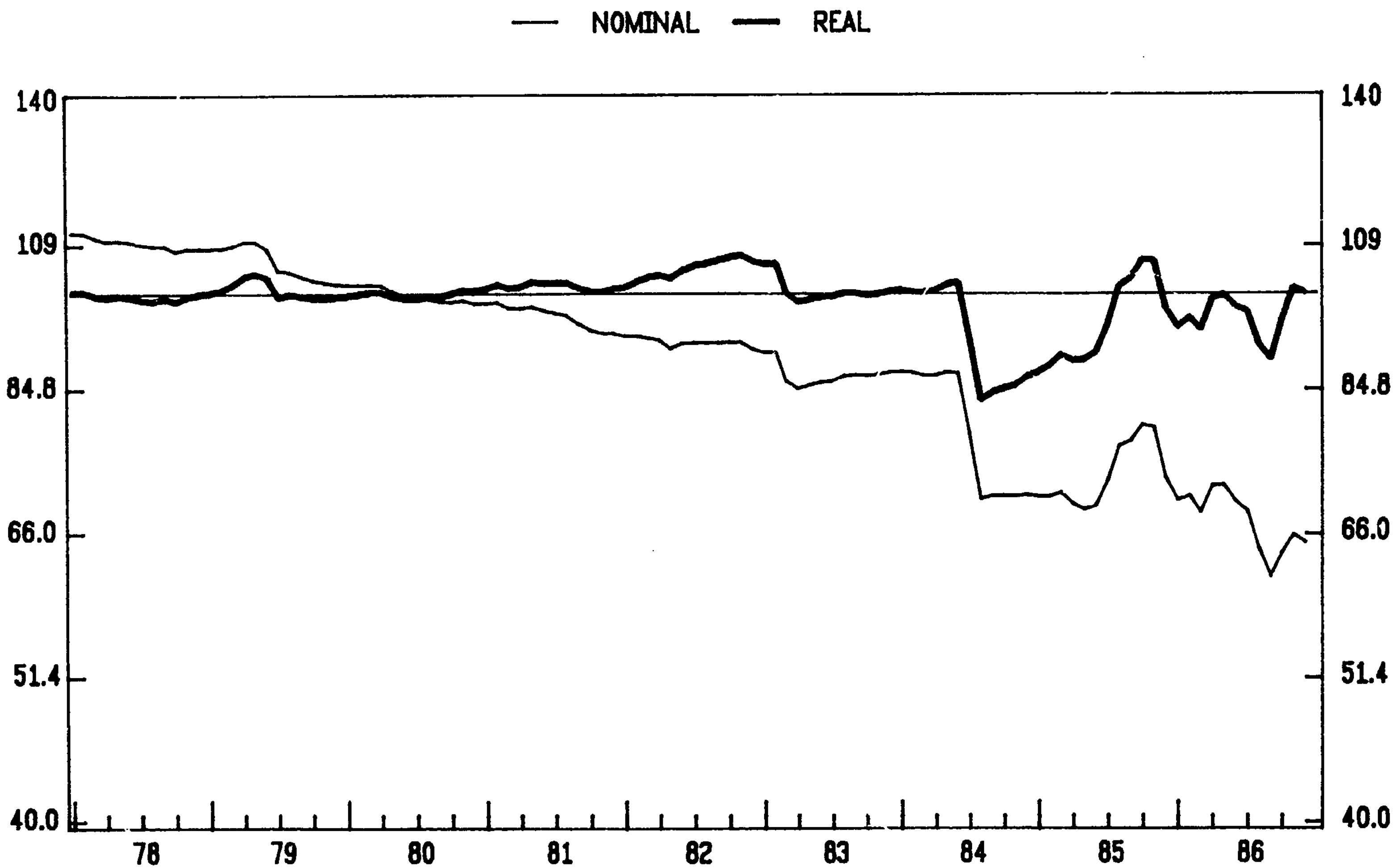


Chart 8

PORTUGAL

REAL AND NOMINAL EFFECTIVE EXCHANGE RATES

(SEMI-LOG SCALE : 1980=100)

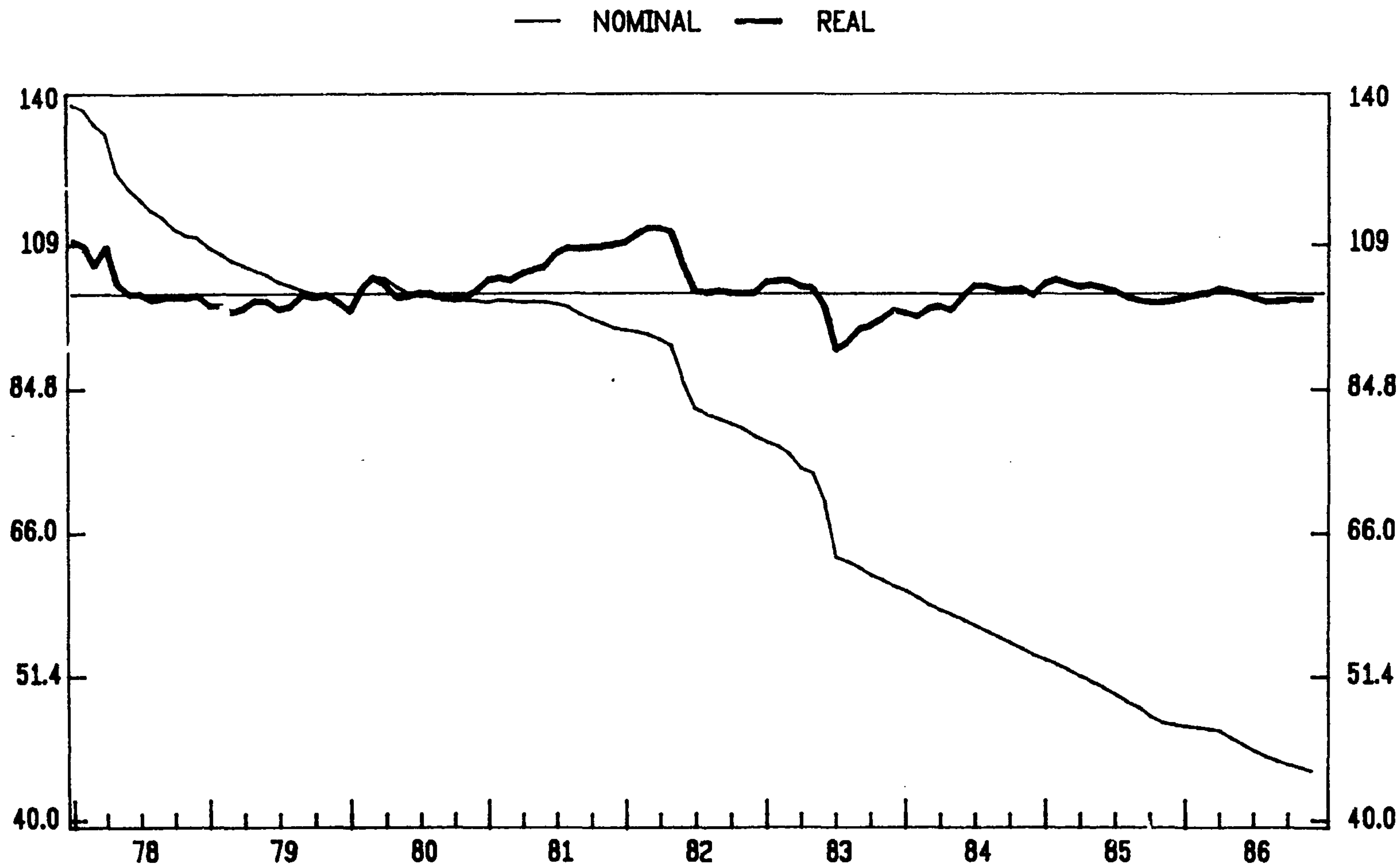


Chart 9

CHILE

REAL AND NOMINAL EFFECTIVE EXCHANGE RATES

(SEMI-LOG SCALE : 1980=100)

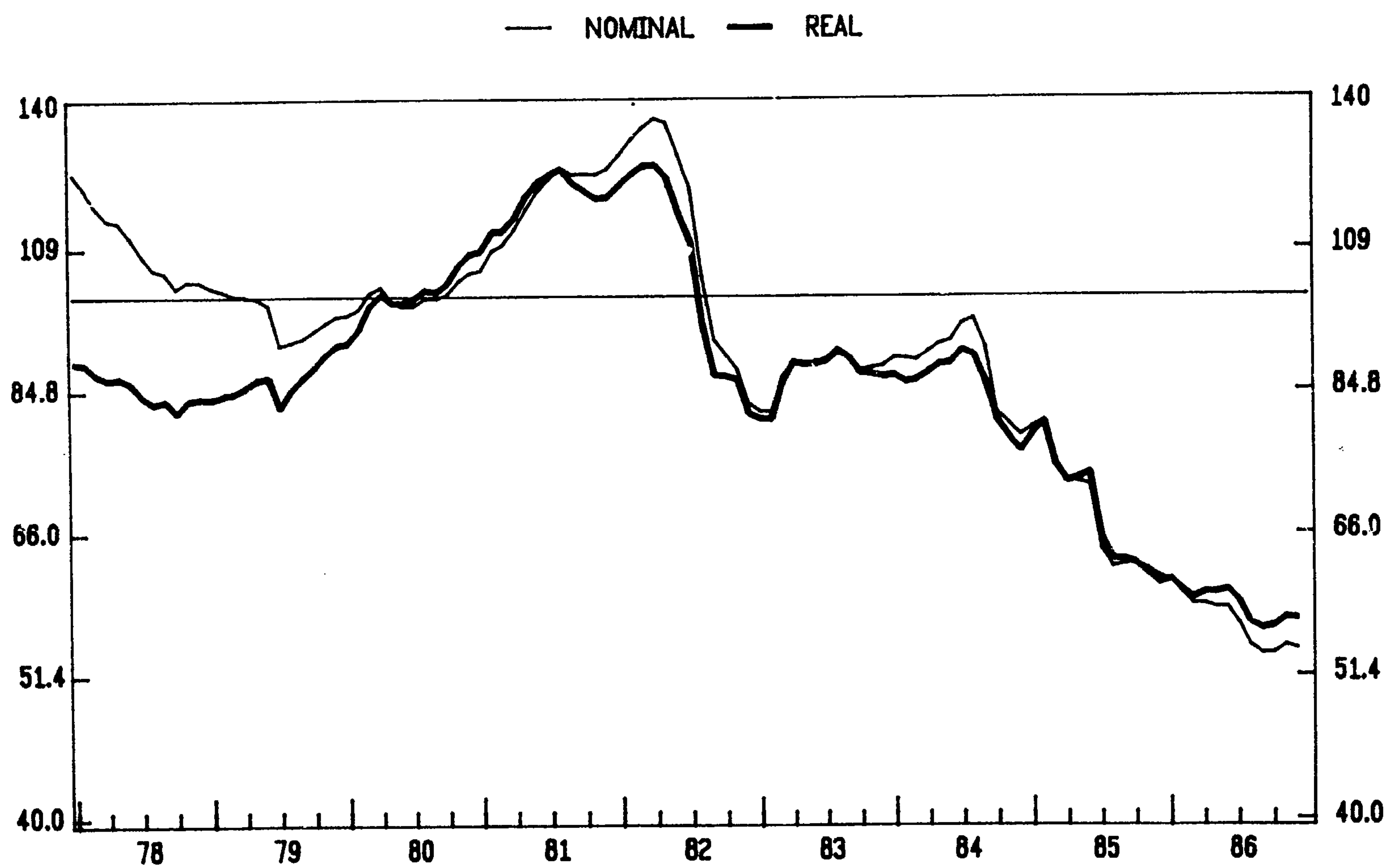


Chart 10

HONDURAS

REAL AND NOMINAL EFFECTIVE EXCHANGE RATES

(SEMI-LOG SCALE : 1980=100)

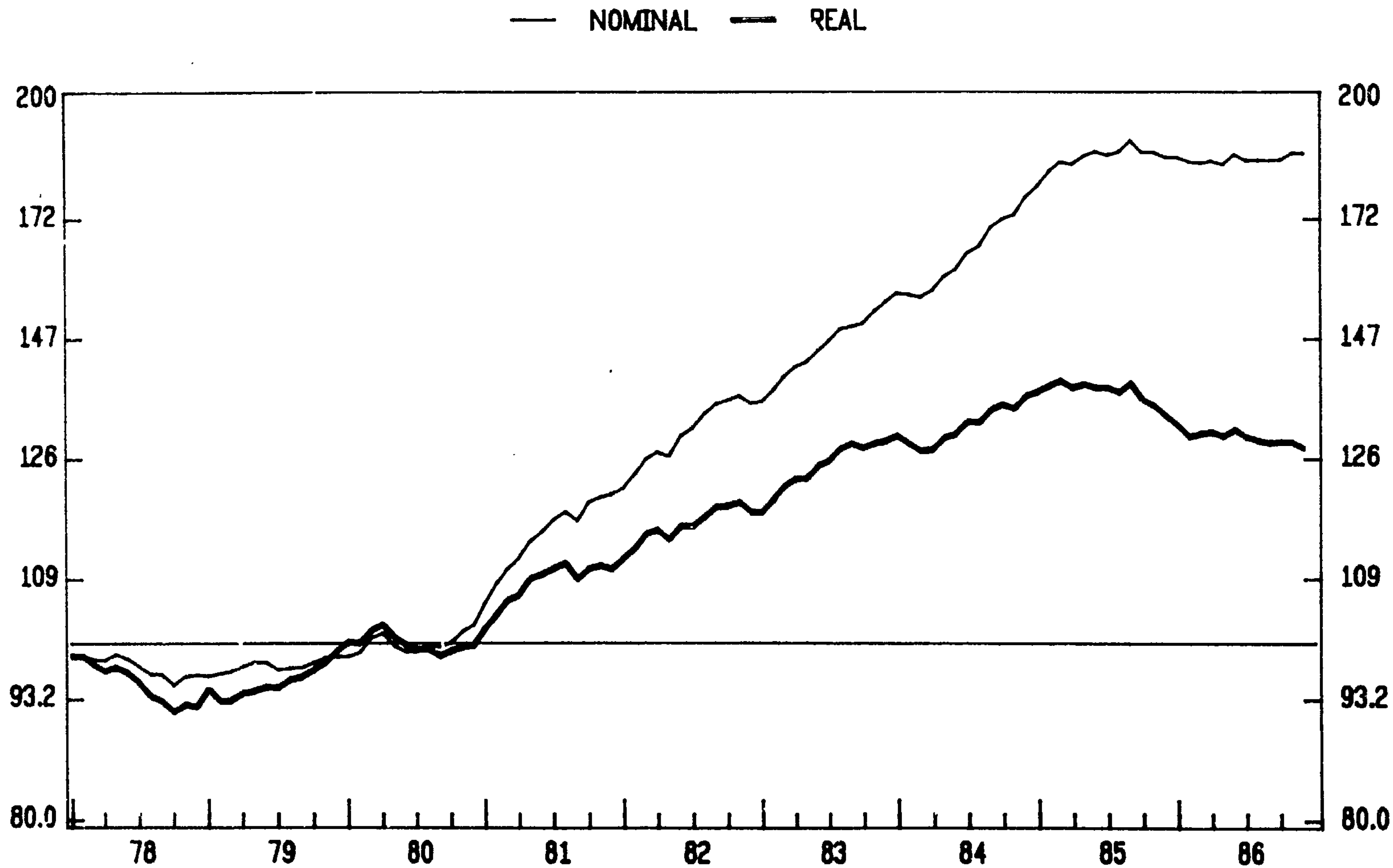


Chart 11

GERMANY
REAL AND NOMINAL EFFECTIVE EXCHANGE RATES
(SEMI-LOG SCALE : 1980=100)

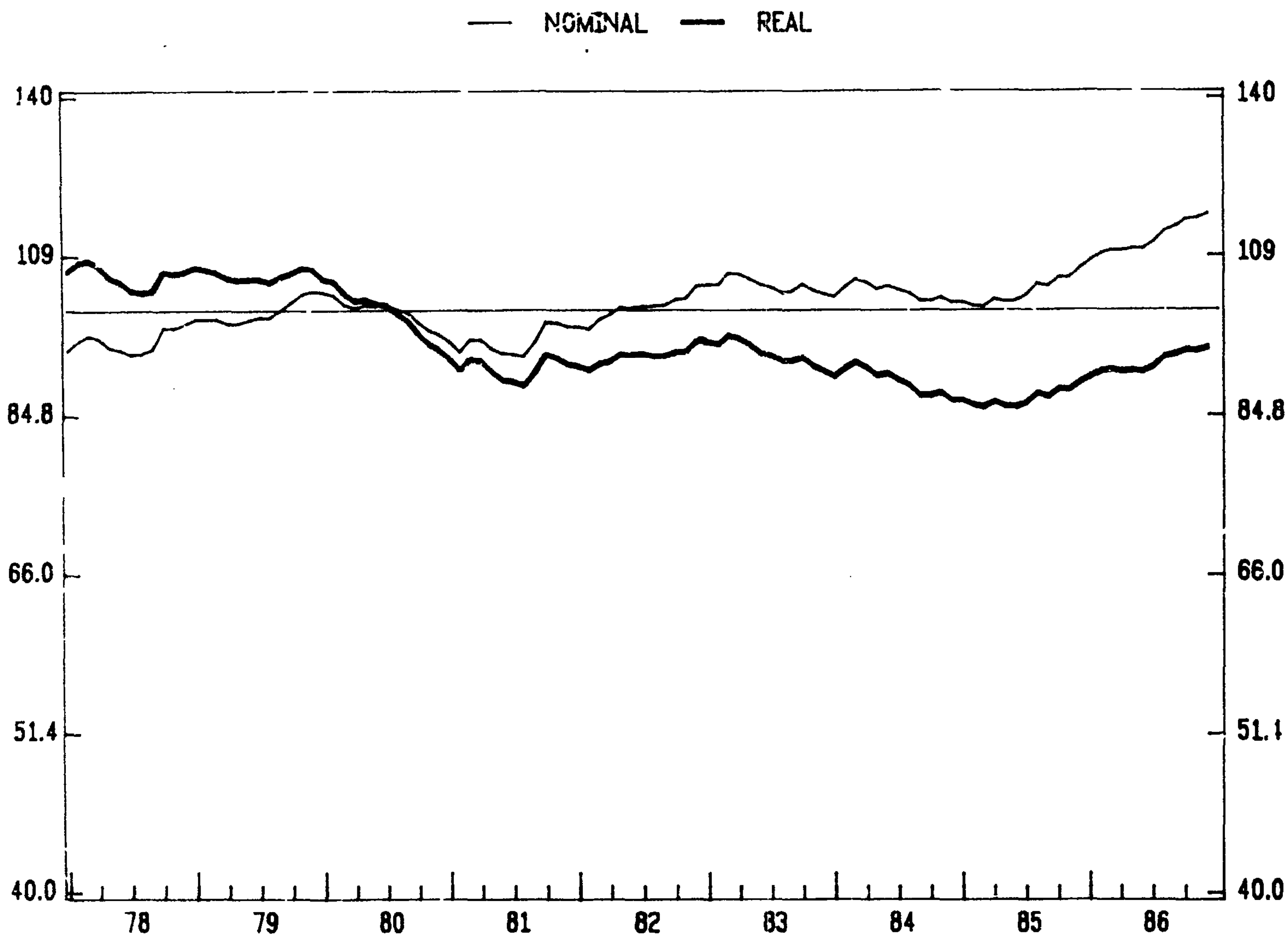


Chart 12

FRANCE
REAL AND NOMINAL EFFECTIVE EXCHANGE RATES
(SEMI-LOG SCALE : 1980=100)

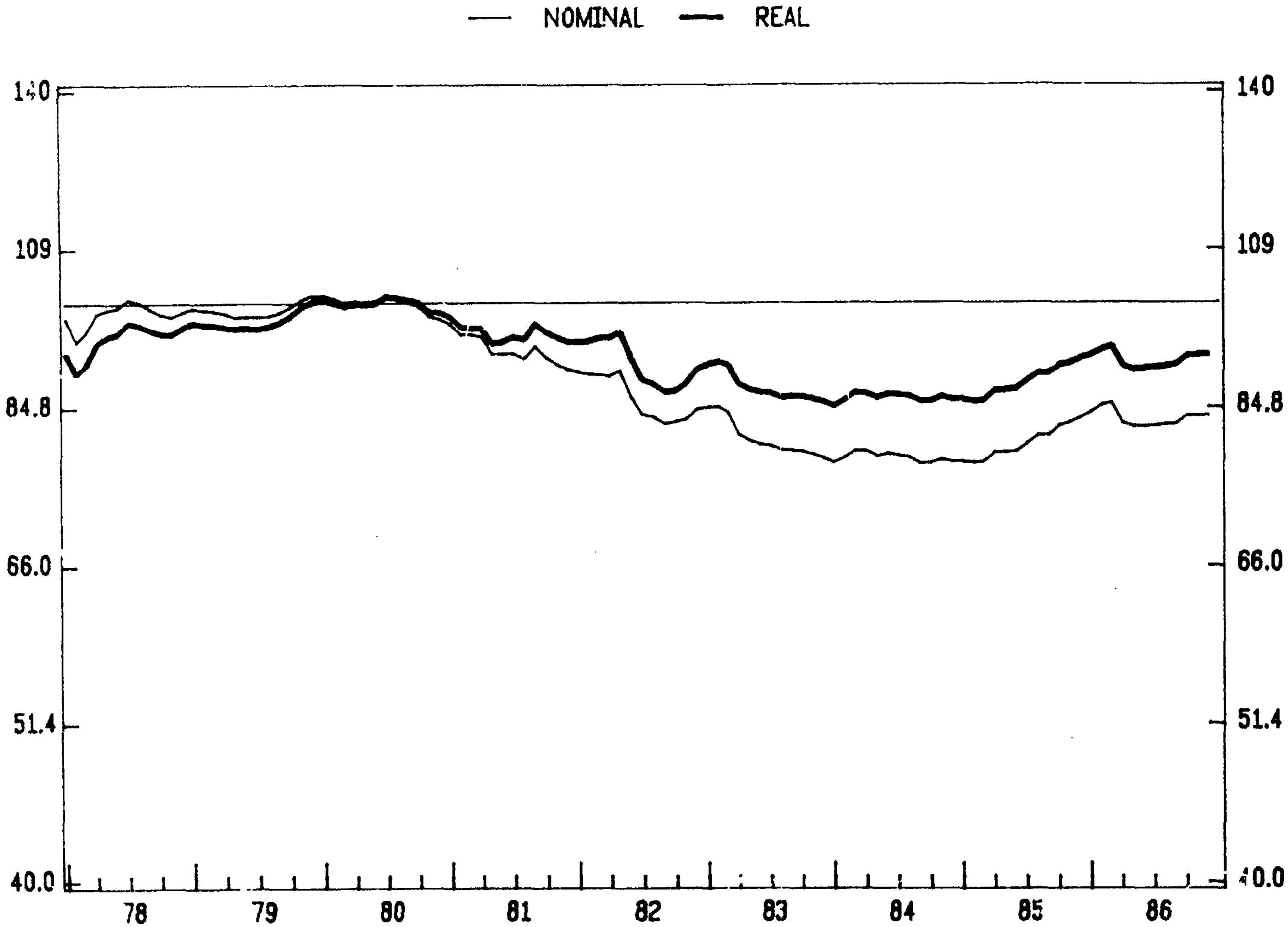
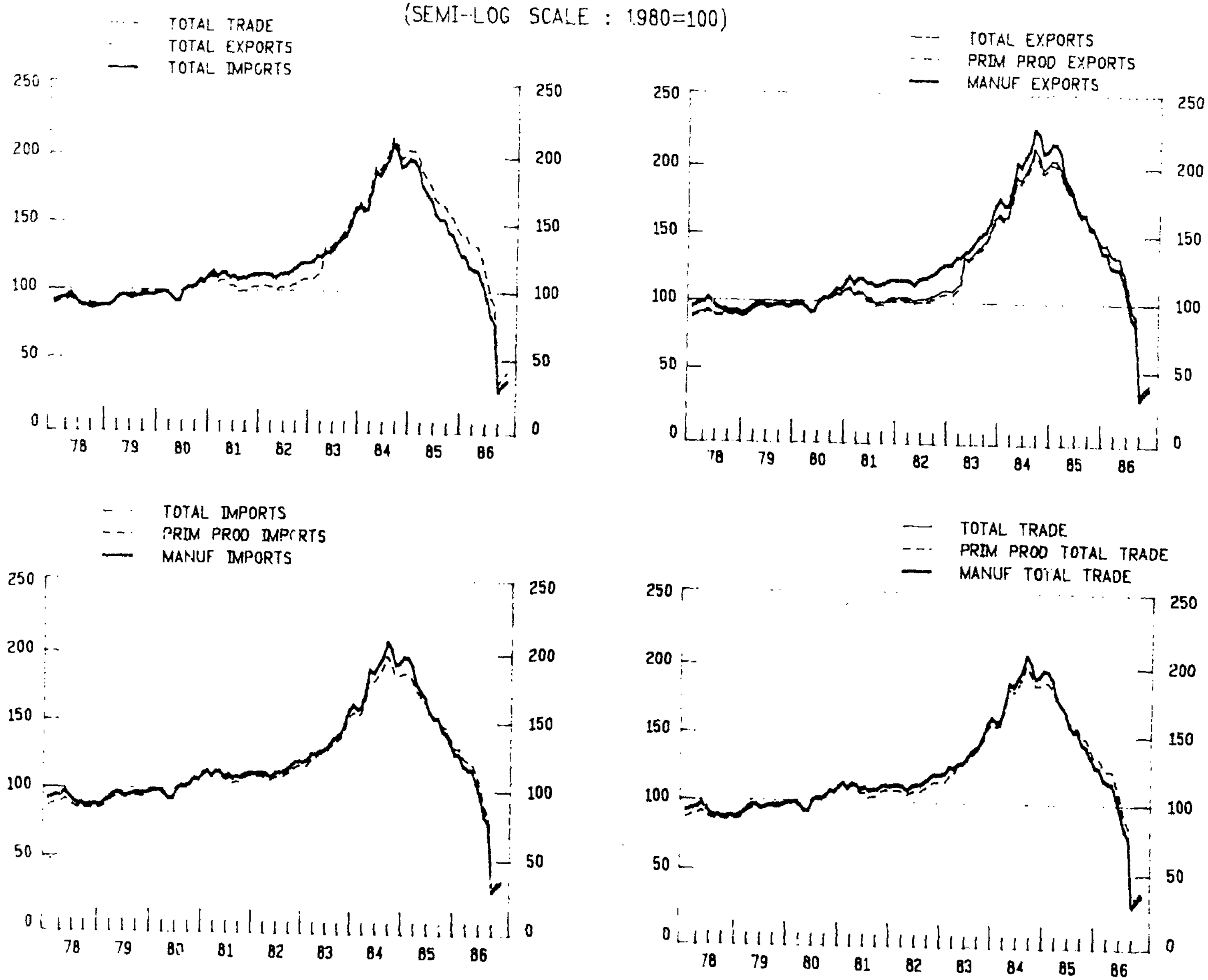


Chart 13

NIGERIA

REAL EFFECTIVE EXCHANGE RATES

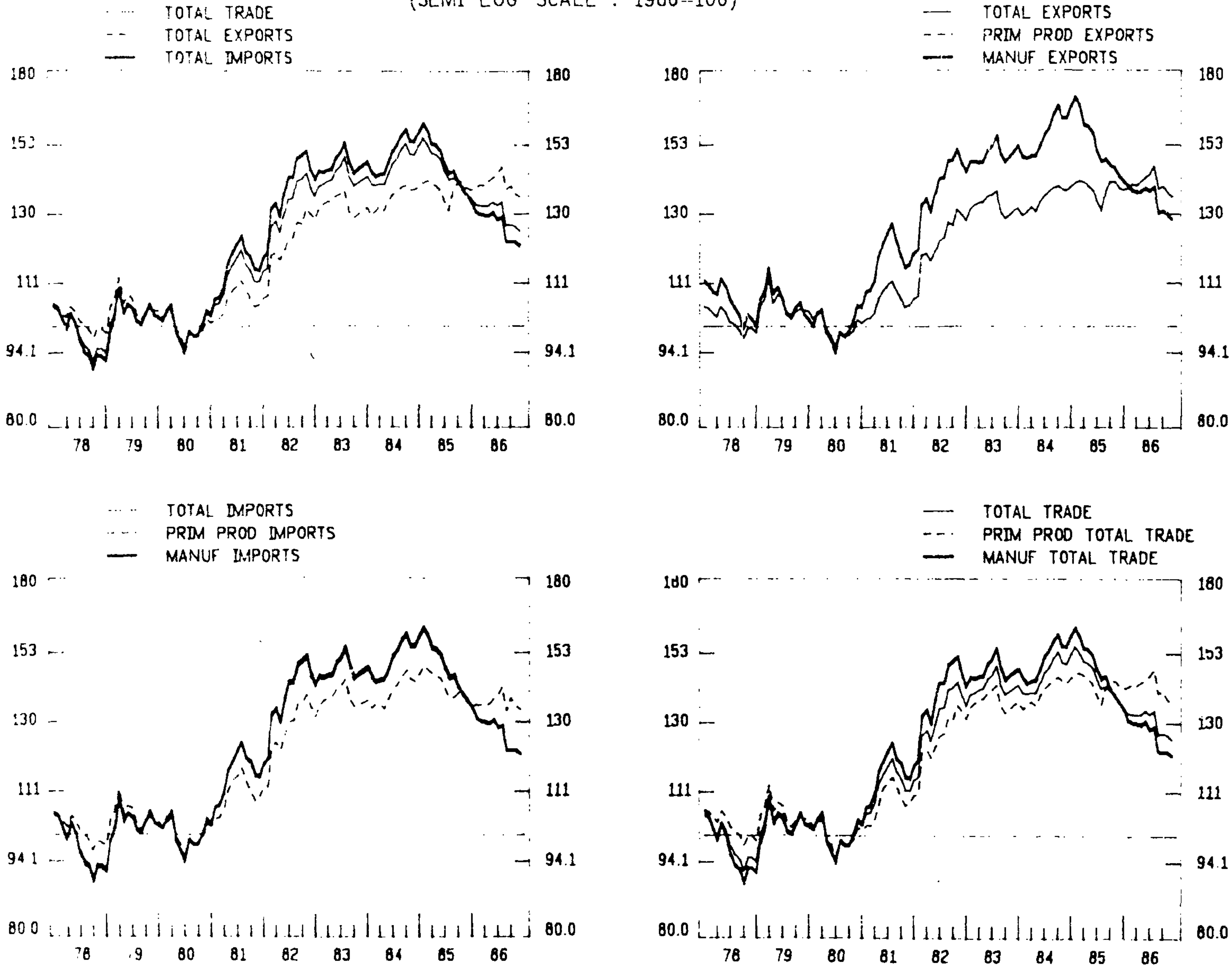
(SEMI-LOG SCALE : 1980=100)



RWANDA

REAL EFFECTIVE EXCHANGE RATES

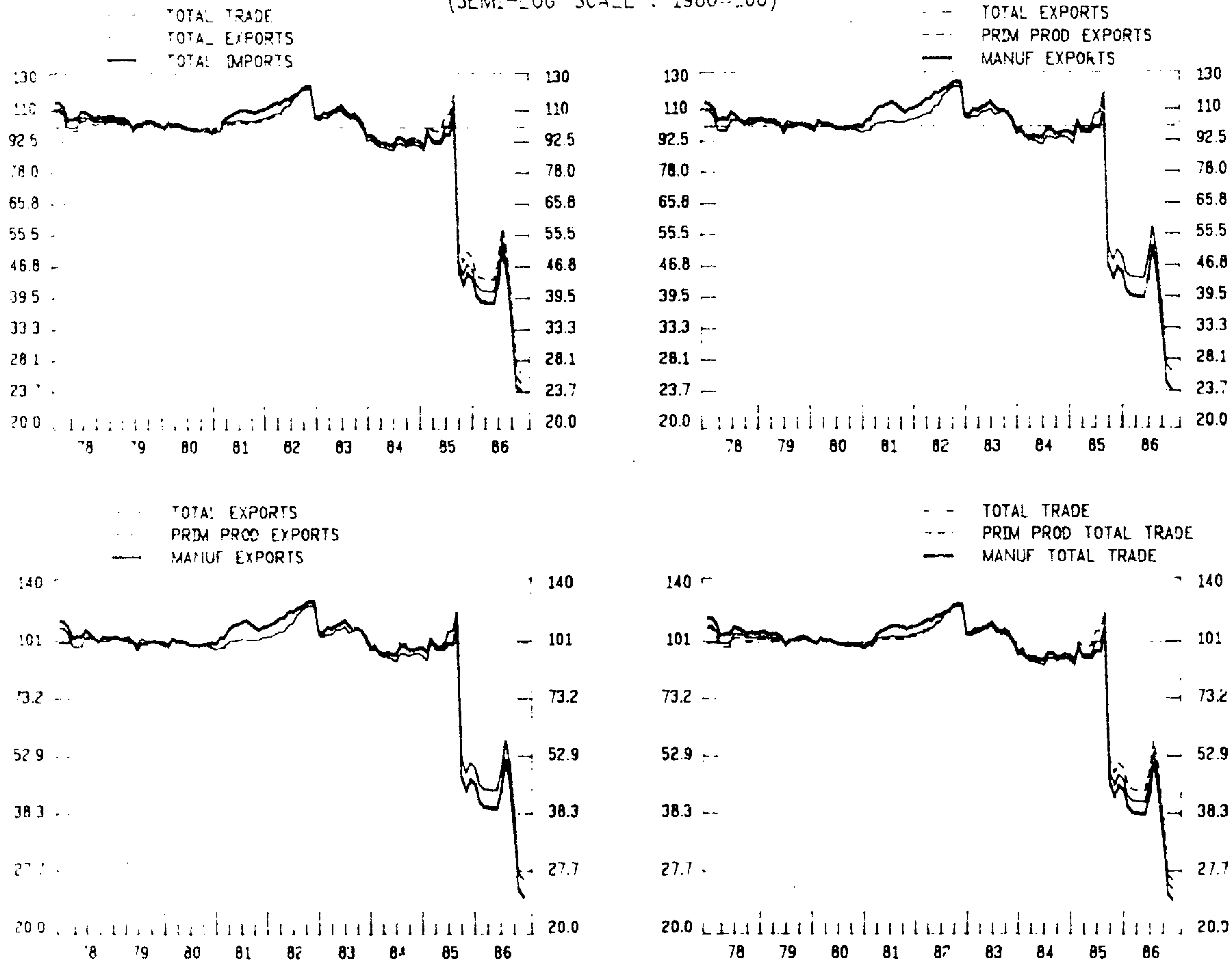
(SEMI-LOG SCALE : 1980=100)



ZAMBIA

REAL EFFECTIVE EXCHANGE RATES

(SEMI-LOG SCALE : 1980=100)



PHILIPPINES

REAL EFFECTIVE EXCHANGE RATES

(SEMI-LOG SCALE : 1980=100)

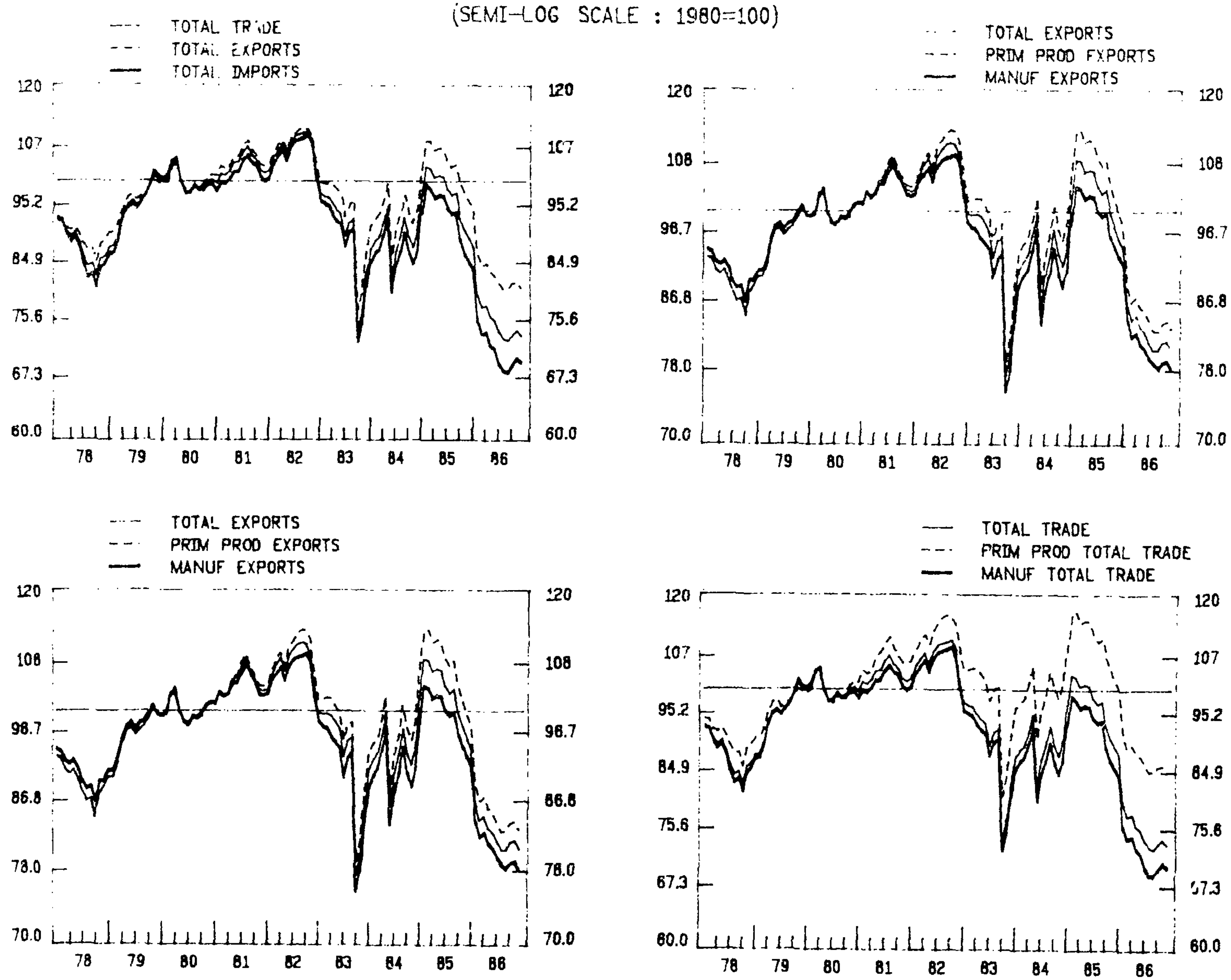


Chart 17

AUSTRALIA

REAL EFFECTIVE EXCHANGE RATES

(SEMI-LOG SCALE : 1980=100)

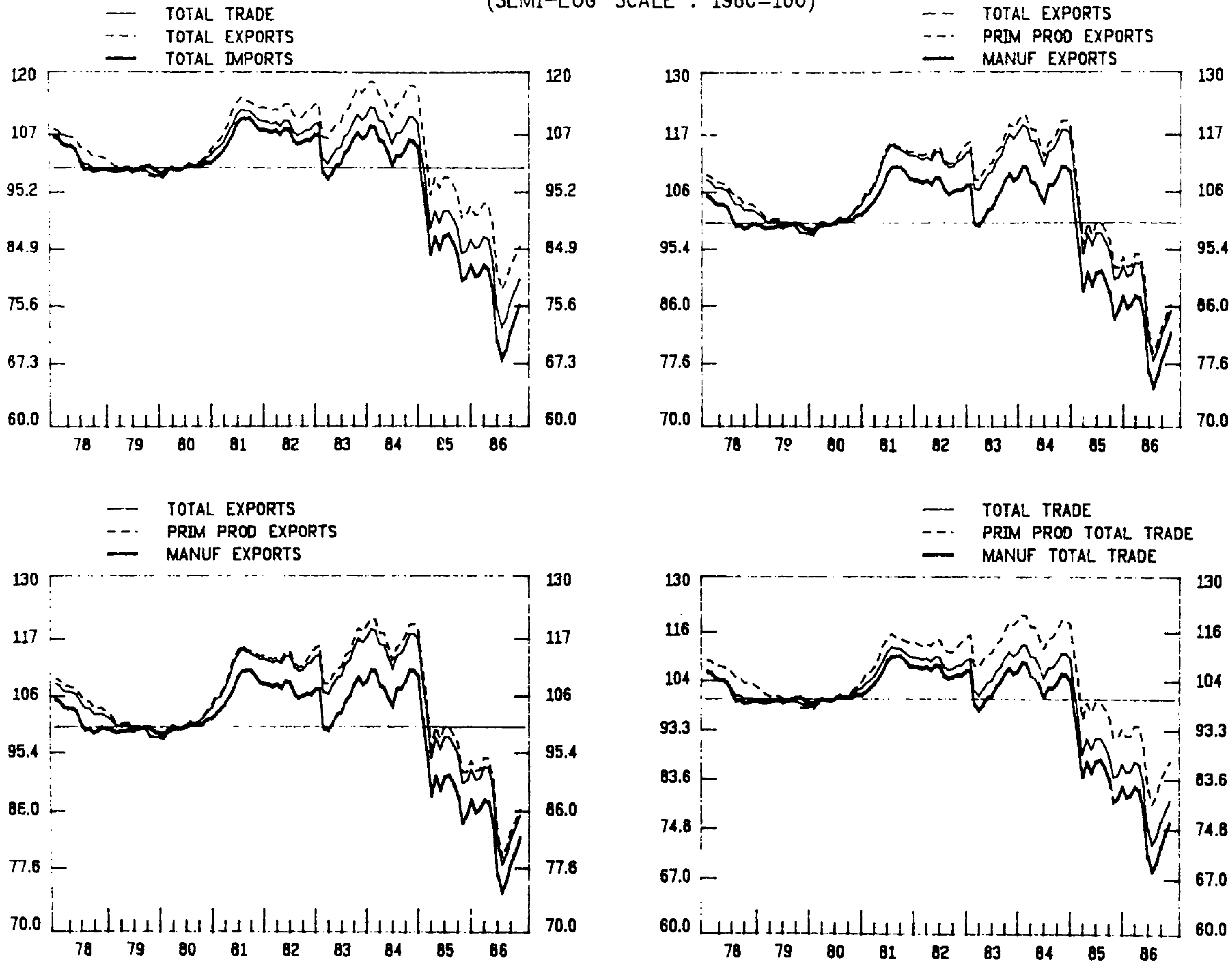


Chart 18

HUNGARY

REAL EFFECTIVE EXCHANGE RATES

(SEMI-LOG SCALE : 1980=100)

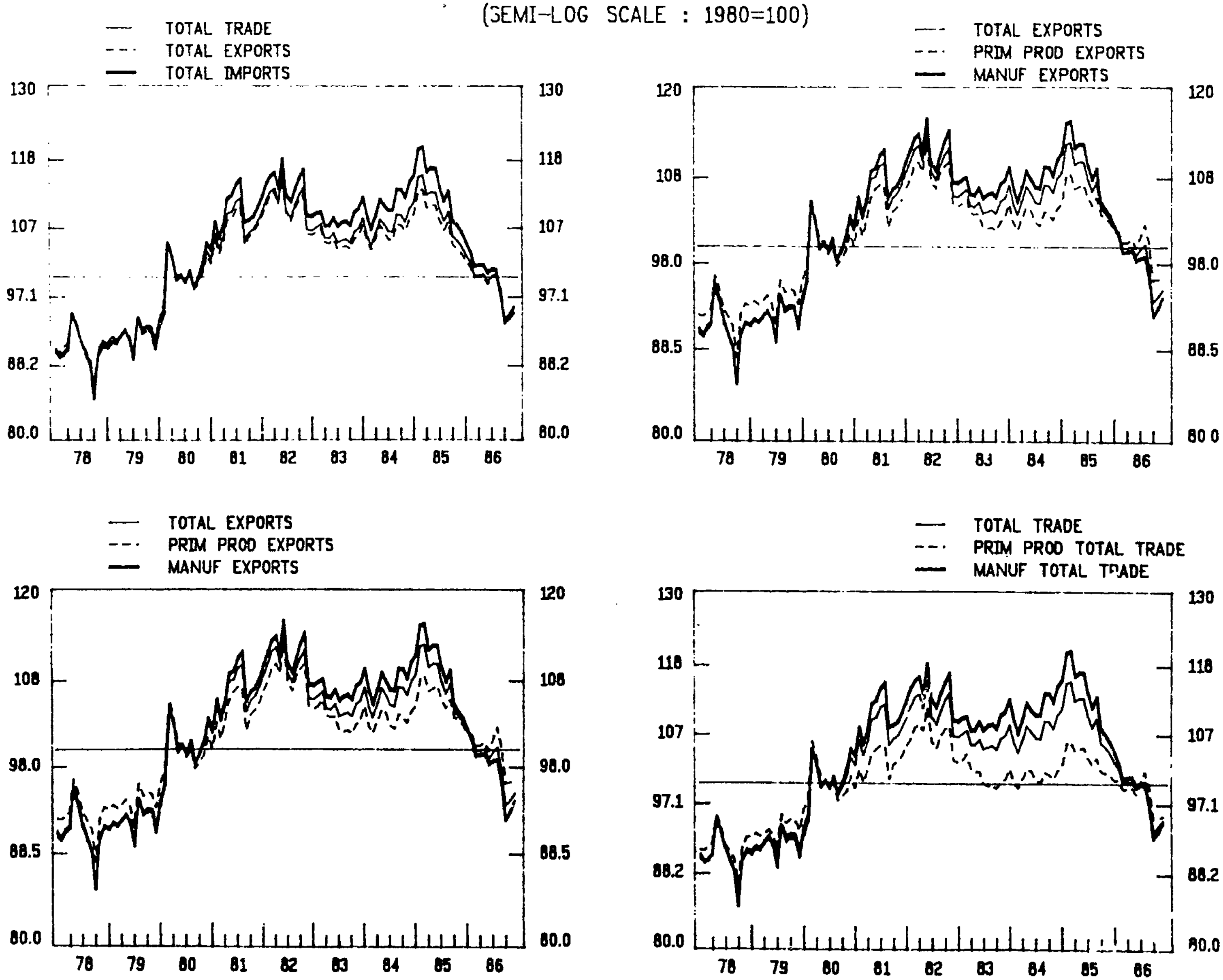


Chart 19

NEW ZEALAND

REAL EFFECTIVE EXCHANGE RATES

(SEMI-LOG SCALE : 1980=100)

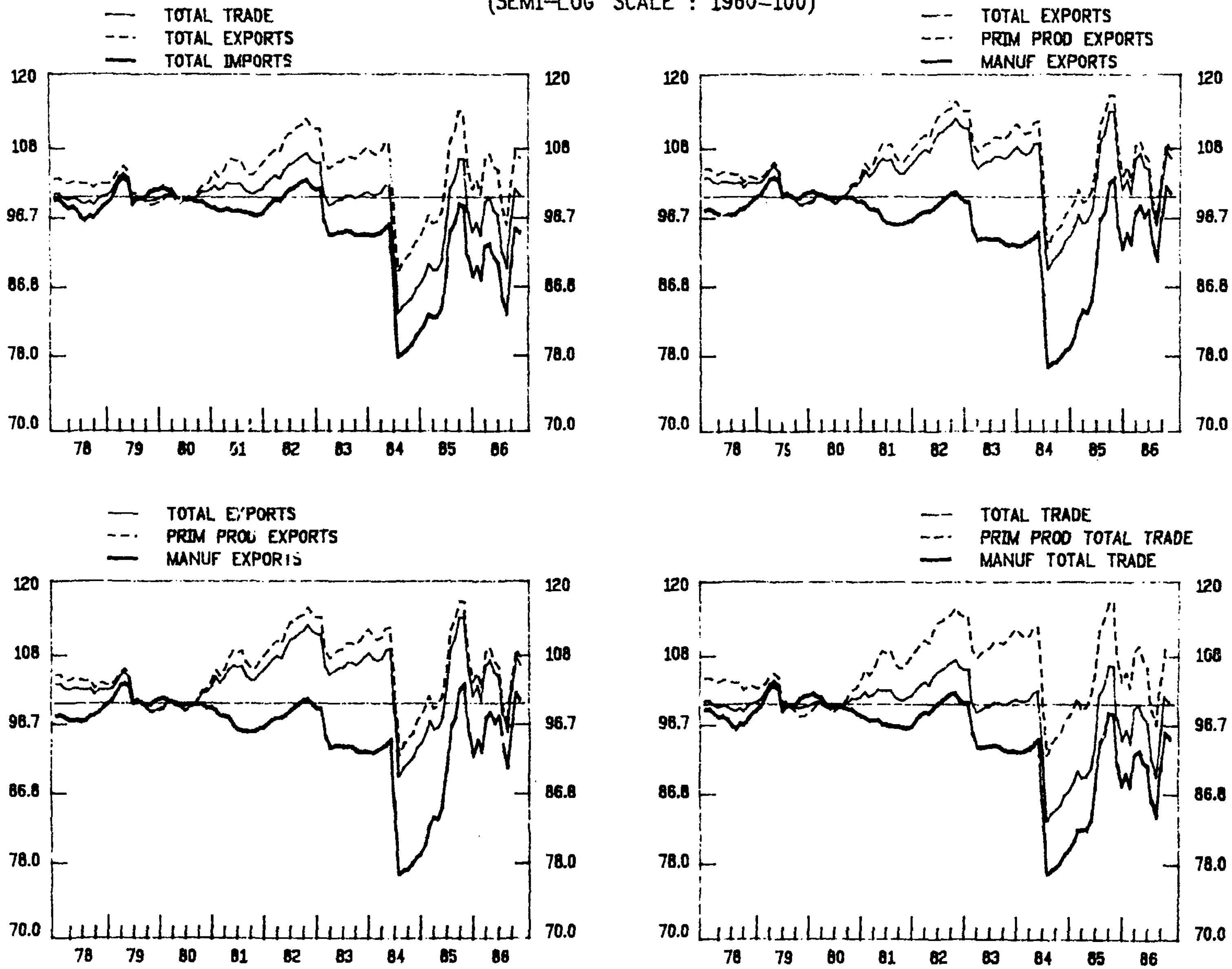


Chart 20

PORTUGAL

REAL EFFECTIVE EXCHANGE RATES

(SEMI-LOG SCALE : 1980=100)

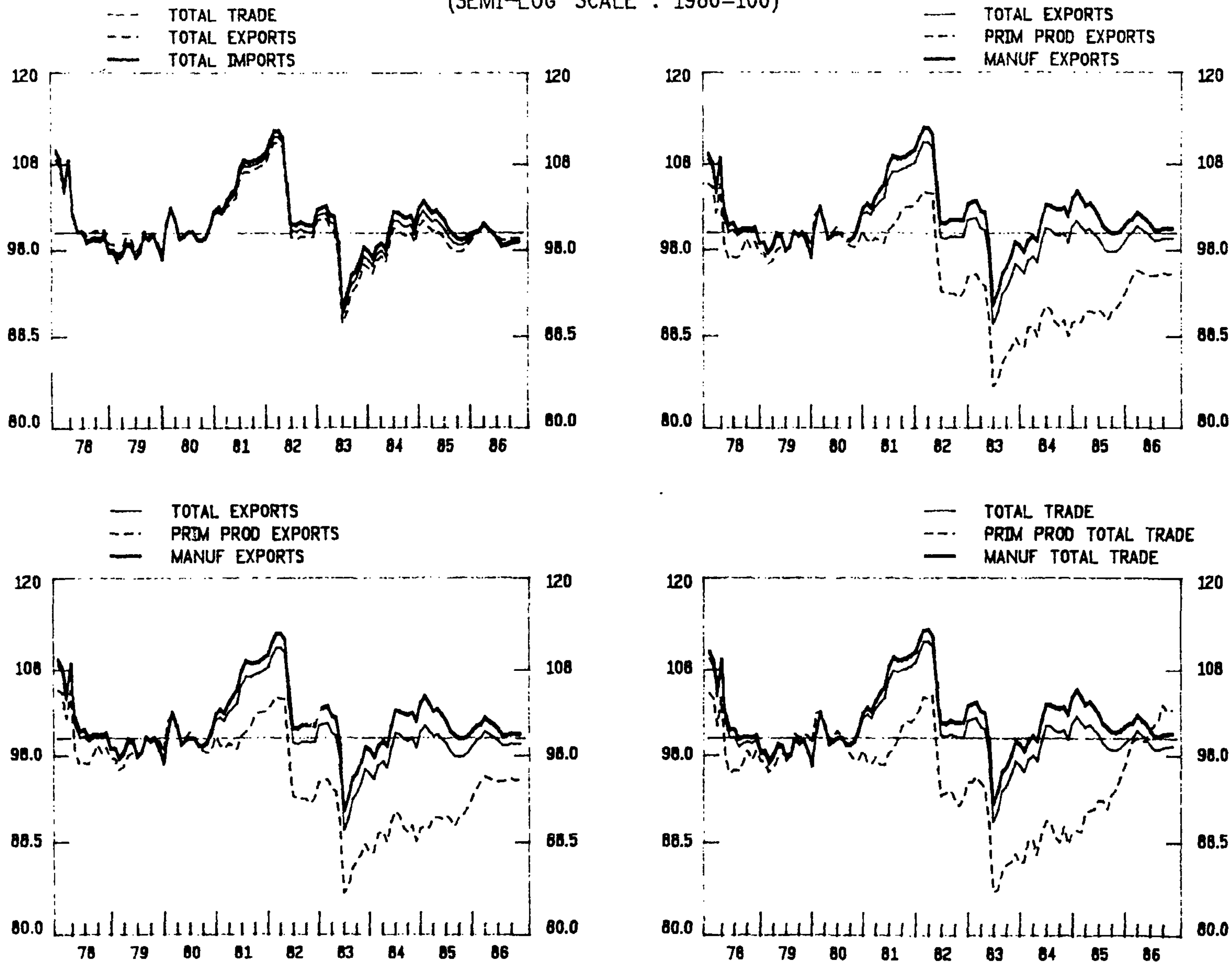


Chart 21

CHILE

REAL EFFECTIVE EXCHANGE RATES

(SEMI-LOG SCALE : 1980=100)

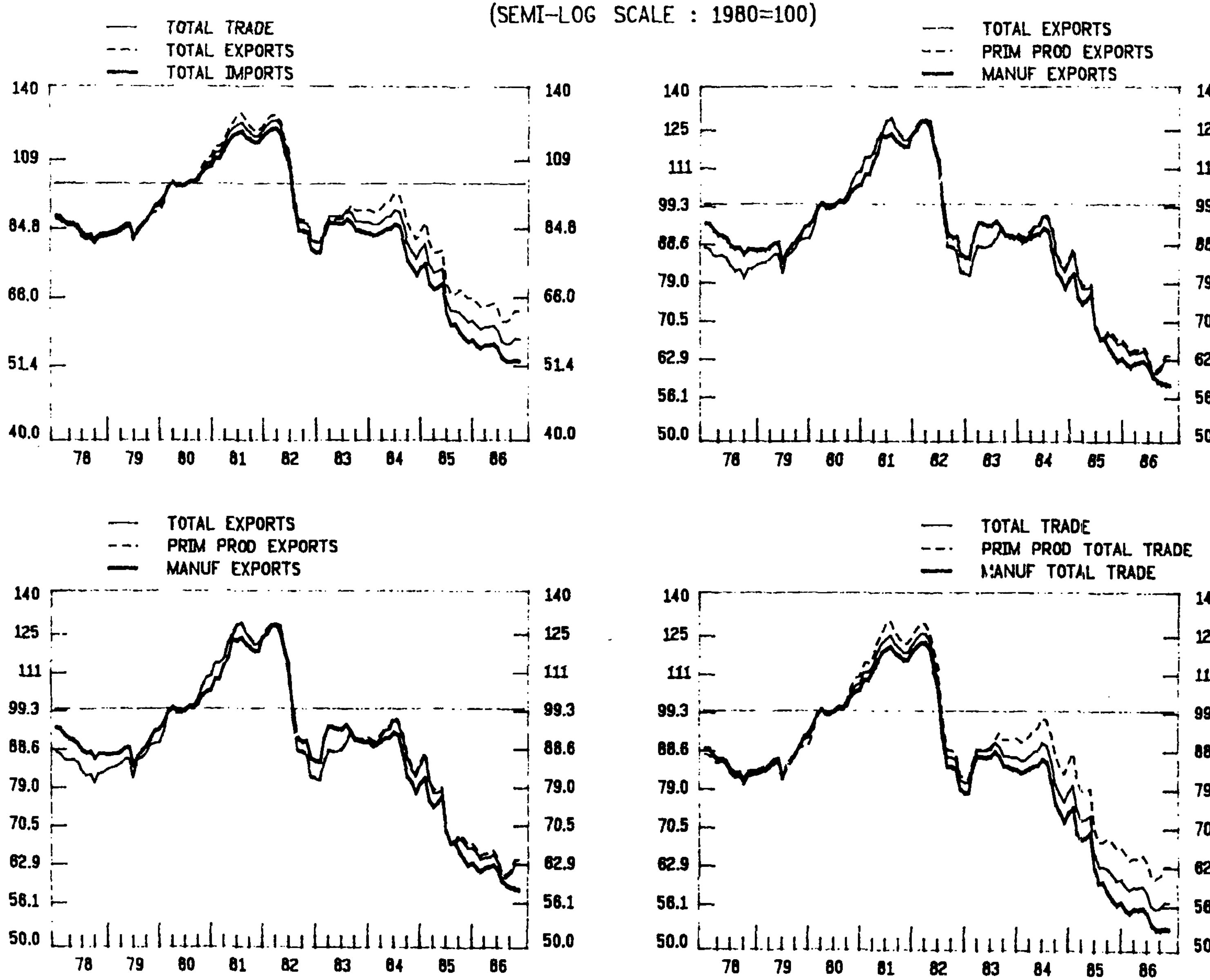


Chart 22

HONDURAS

REAL EFFECTIVE EXCHANGE RATES

(SEMI-LOG SCALE : 1980=100)

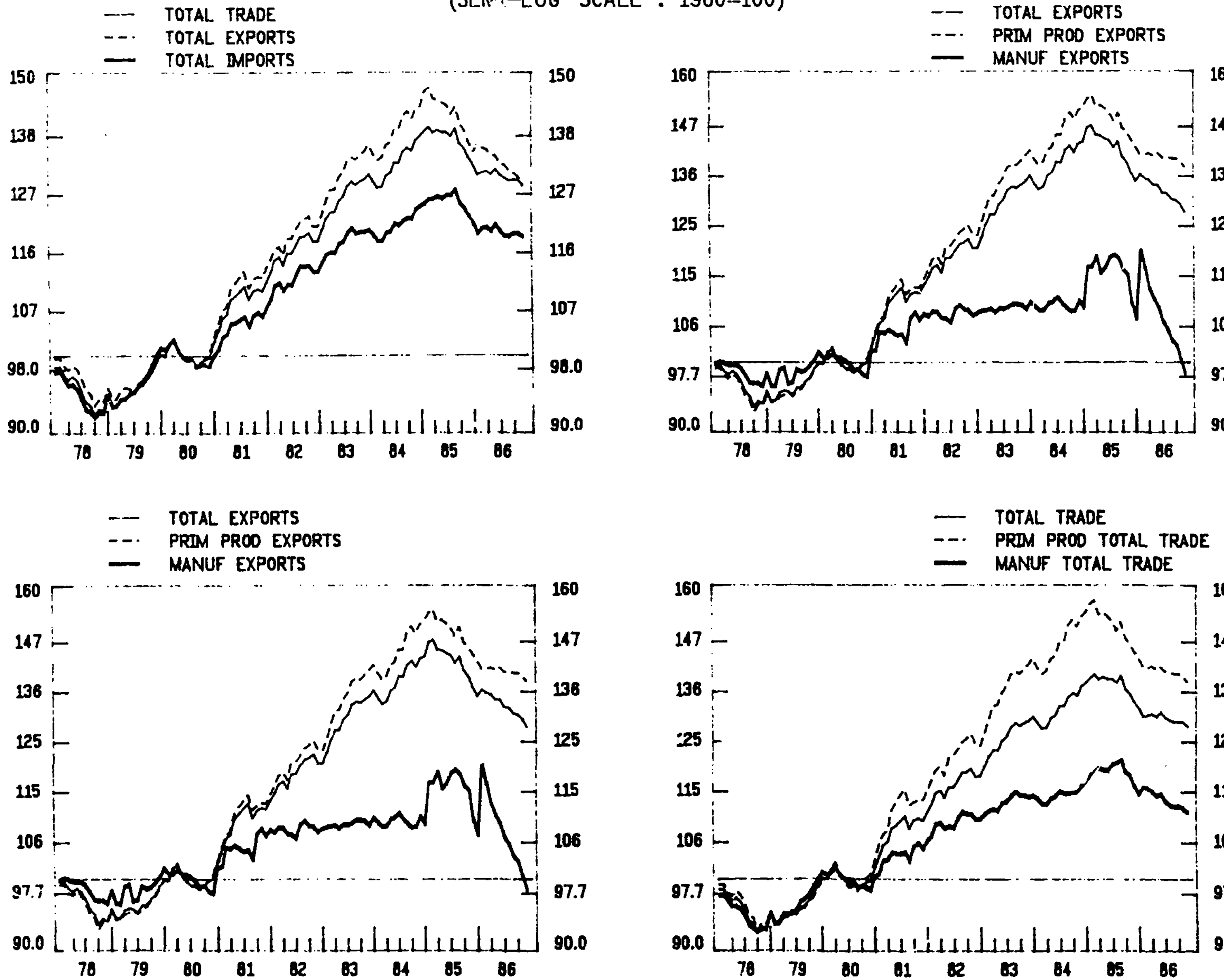


Chart 23

GERMANY

REAL EFFECTIVE EXCHANGE RATES

(SEMI-LOG SCALE : 1980=100)

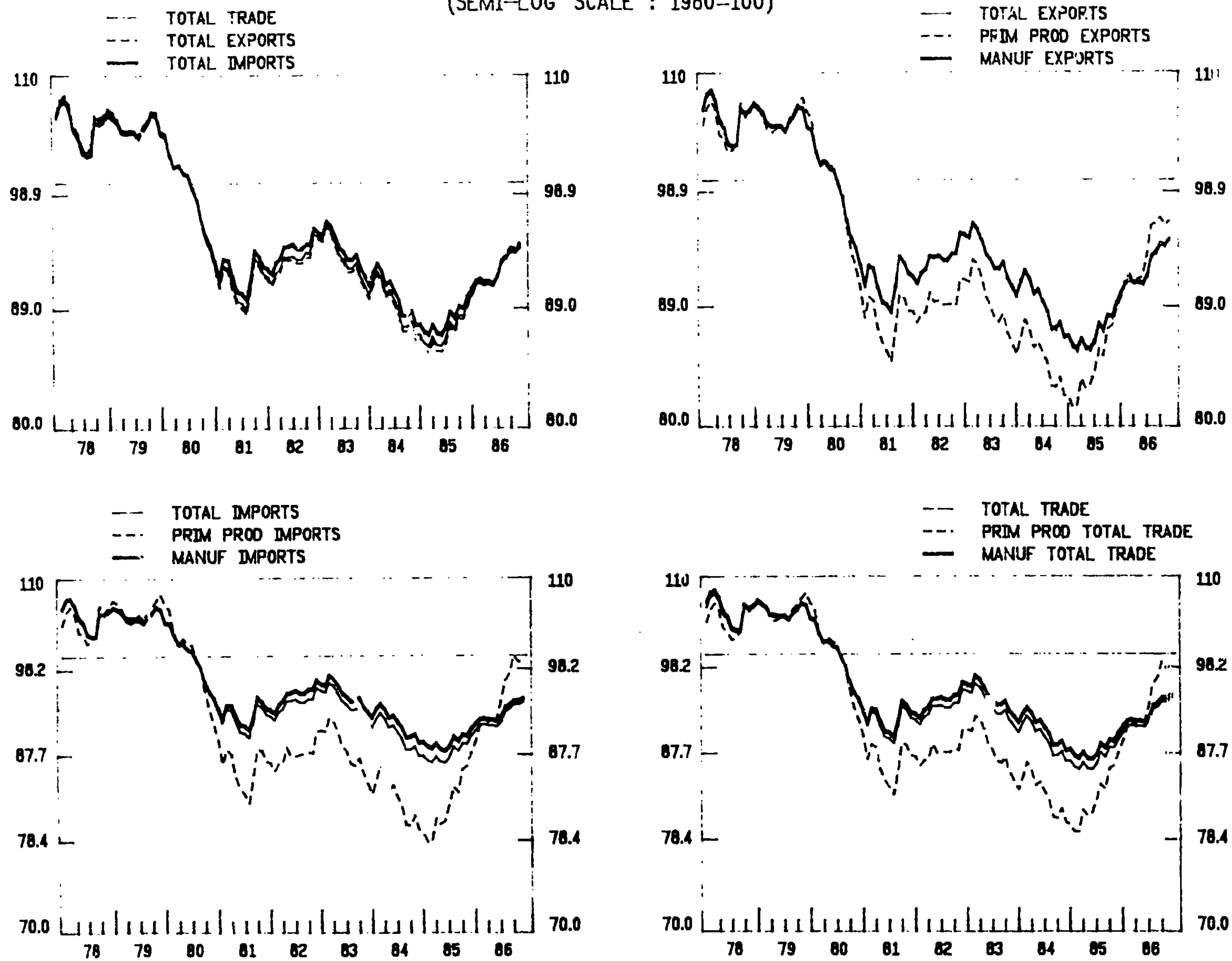
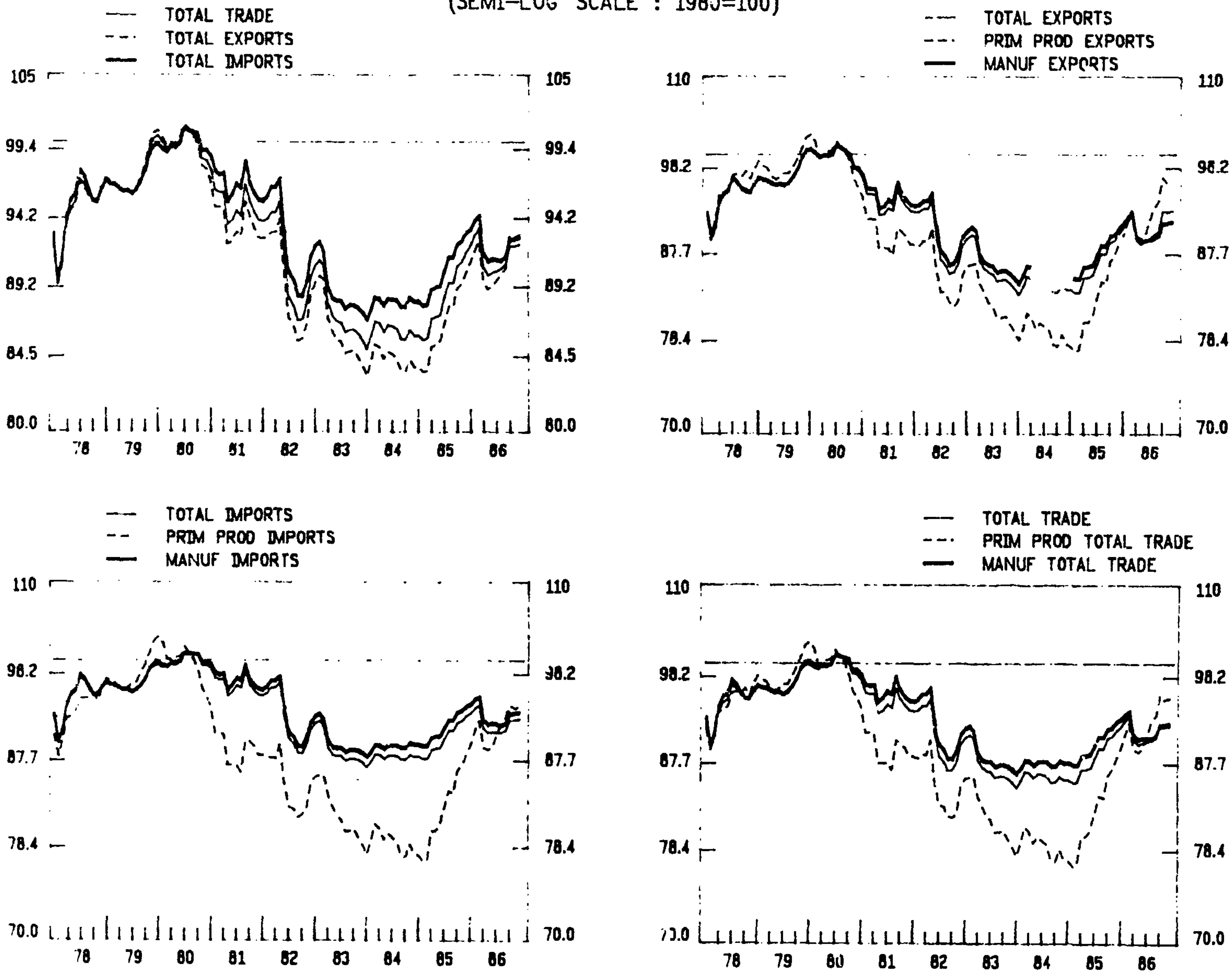


Chart 24

FRANCE

REAL EFFECTIVE EXCHANGE RATES

(SEMI-LOG SCALE : 1980=100)



A Simple Model of Trade in a Primary Product 1/

The model referred to in the text can be set up in the following way. Let:

X(i) = the volume of country i's exports of a primary product;

M(j) = the volume of country j's imports of a primary product;

E($,i) = the exchange rate of country i expressed in terms of U.S. dollars per local currency unit;

P($) = the world price of the commodity in U.S dollars;

P(i) = overall price or cost index in country i;

$\mu(i)$ = export supply price elasticity in country i;

$\tau(j)$ = import demand price elasticity in country j;

The export supply and import demand functions can be written in log-linear form as:

$$(1)\quad X(i) = X(i,0)\,\overline{Z}(i)^{\theta(i)}\,[P(\$)/E(\$,i).P(i)]^{\mu(i)} \qquad i = 1,\ldots.,m$$

$$(2)\quad M(j) = M(j,0)\,\overline{Y}(j)^{\pi(j)}\,[P(\$)/E(\$,j).P(j)]^{\tau(j)} \qquad j = m+1,..,n$$

$\overline{Z}(i)$ denotes other factors influencing export supply; the bar over the variable implies that these factors are assumed constant so that the analysis can concentrate on relative price effects. The same holds for the import demand function where a vector of variables Y(j) appears. No further reference will be made to the role of the Z(i) and Y(j) in influencing export and import performance.

Taking percentage changes, equations (1) and (2) can be rewritten as:

$$(3)\quad \dot{X}(i) = \mu(i)\,[\dot{P}(\$) - \dot{E}(\$,i) - \dot{P}(i)]$$

$$(4)\quad \dot{M}(j) = \tau(j)\,[\dot{P}(\$) - \dot{E}(\$,j) - \dot{P}(j)]$$

1/ A similar model is presented in Wattleworth (1987).

APPENDIX

Equilibrium in the world market requires:

$$(5)\quad \Sigma i\ \alpha(i)\ \dot{X}(i) = \Sigma j\ \beta(j)\ \dot{M}(j)$$

where: $\alpha(i)$ = country i's share in world exports of the commodity;

$\beta(j)$ = country j's share in world imports of the commodity.

Substituting into (5) from (3) and (4) gives:

$$(6)\quad \Sigma i\ (i)\ \mu(i)\ [\dot{P}(\$) - \dot{E}(\$,i) - \dot{P}(i)]$$
$$= \Sigma j\ \beta(j)\ \tau(j)\ [\dot{P}(\$) - \dot{E}(\$,j) - \dot{P}(j)]$$

Rearranging:

$$(7)\quad \dot{P}(\$)\ [\ \Sigma i\ \alpha(i)\ \mu(i) - \Sigma j\ \beta(j)\ \tau(j)]$$
$$= -\ \Sigma j\ \beta(j)\ \tau(j)\ [\dot{E}(\$,j) + \dot{P}(j)] + \Sigma i\ \alpha(i)\ \mu(i)\ [\dot{E}(\$,i) + \dot{P}(i)]$$

Letting:

$\Sigma i\ \alpha(i)\ \mu(i) = \mu$ and $\Sigma j\ \beta(j)\ \tau(j) = \tau$,

and assuming that $\mu(i) \approx \mu$ and $\tau(j) \approx \tau$, equation (7) can be solved for the percentage change in the world price due to the changes in exchange rates and cost conditions in exporting and importing countries.

$$(8)\quad \dot{P}(\$) =$$
$$-\frac{\tau}{\mu - \tau}\ \Sigma j\ \beta(j)[\dot{E}(\$,j) + \dot{P}(j)] + \frac{\mu}{\mu - \tau}\ \Sigma i\ \alpha(i)[\dot{E}(\$,i) + \dot{P}(i)]$$

With $\mu > 0$ and $\tau < 0$ and making the strong assumption that $[\mu] = [\tau]$, equation (8) can be rewritten as:

$$(9)\quad \dot{P}(\$) = [0.5\ \Sigma i\ \alpha(i)[\dot{E}(\$,i) + \dot{P}(i)] + 0.5\ \Sigma j\ \beta(j)[\dot{E}(\$,j) + \dot{P}(j)]]$$

Or:

$$(10)\quad \dot{P}(\$) = [0.5\ \Sigma i\ \alpha(i)[\dot{P}(i) + \dot{E}(\$,i)] + 0.5\ \Sigma j\ \beta(j)[\dot{P}(j) + \dot{E}(\$,j)]]$$

The relevant variables for determining changes in the world price of the commodity are the exchange rate-adjusted cost developments in the importing and exporting countries.

Bibliography

Armington, Paul S., "A Theory of Demand for Products Distinguished by Place of Production", Staff Papers, International Monetary Fund (Washington), Vol. 16 (March 1969), pp.159-76.

Artus, Jacques R., and Anne Kenny McGuirk, "A Revised Version of the Multilateral Exchange Rate Model," Staff Papers, International Monetary Fund (Washington), Vol. 28 (June 1981), pp. 275-309.

Artus, Jacques R., and Rudolf R. Rhomberg, "A Multilateral Exchange Rate Model," Staff Papers, International Monetary Fund (Washington), Vol. 20 (November 1973), pp. 591-611.

Belanger, Gerard, "An Indicator of Effective Exchange Rates for Primary Producing Countries", Staff Papers, International Monetary Fund (Washington), Vol. 23, (March 1976), pp. 113-36.

Black, Stanley W., "Multilateral and Bilateral Measures of Effective Exchange Rates in a World of Traded Goods," Journal of Political Economy, University of Chicago, Vol. 84 (June 1976), pp. 615-21.

Branson, William H., and Louka T. Katseli-Papaefstratiou, "Exchange Rate Policy in Developing Countries," in S. Grassman and E. Lundberg, The World Economic Order: Past and Prospects, (London: Macmillan, 1981; New York: St. Martins, 1981), pp. 391-419.

Feltenstein, Andrew, Morris Goldstein, and Susan M. Schadler, "A Multilateral Exchange Rate Model for Primary Producing Countries", Staff Papers, International Monetary Fund (Washington), Vol. 26, (September 1979), pp. 543-82.

Goldstein, Morris, The Global Effects of Fund-Supported Adjustment Programs, Occasional Paper No. 42, (Washington, International Monetary Fund, March 1986).

Isard, Peter, "How Far Can We Push the 'Law of One Price'?", American Economic Review, Vol. 67, (December 1977), pp. 942-48.

Kravis, I.G., and R.E. Lipsey, "Price Behavior in the Light of Balance of Payments Theories," Journal of International Economics, May 1978.

McGuirk, Anne K., "Measuring Price Competitiveness for Industrial Country Trade in Manufactures" (unpublished, International Monetary Fund (Washington), April, 1987).

McKinnon, Ronald I., "Money in International Exchange: The Convertible Currency System ", New York, Oxford University Press, 1979.

Rhomberg, Rudolf R., "Indices of Effective Exchange Rates," Staff Papers, International Monetary Fund (Washington), Vol. 23 (March 1976), pp. 88-112.

Ridler, Duncan and Christopher A. Yandle, "A Simplified Method for Analyzing the Effects of Exchange Rate Changes on Exports of a Primary Commodity", Staff Papers, International Monetary Fund (Washington), November 1972.

Wattleworth, Michael, "The Effects of Collective Devaluation on Commodity Prices and Exports" (unpublished, International Monetary Fund (Washington), January 1987).