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REAL EXCHANGE RATES IN THE DEVELOPING COUNTRIES: CONCEPTS AND MEASUREMENT

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ABSTRACT

This paper deals with three important issues related to real exchange rates. First, it discusses the analytical concept of real exchange rate (RER) placing particular emphasis on providing an operational definition for the equilibrium real exchange rate. Of course, once this concept is defined we can begin to discuss in a meaningful way what we mean by real exchange rate misalignment, or deviations of the actual RER from its equilibrium value. Second, this paper deals with problems associated with measuring real exchange rates. Several proposals are analyzed and the more serious problems encountered when attempting to compute RER's in the developing countries are discussed. And third, I analyze the actual behavior of RER's in a number of developing countries. Here, issues related to the behavior of alternative indexes and to the statistical properties of real exchange rates are emphasized. Additionally, I study the real consequences of increased real exchange rate volatility.

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1. Introduction

The exchange rate has been at the center of recent economic debates regarding developing countries. For example, Cline (1989) has argued that the inappropriate exchange rate policies pursued by a number of developing countries in the late 1970s contributed in an important way to the current international debt crisis. Other authors have argued that the maintenance of overvalued exchange rates in Africa for a prolonged period have resulted in the dramatic deterioration observed in that continent's agricultural sector and external position (Gulhati et al., 1985). Still other experts (i.e., Corbo et al., 1986) have postulated that it was the failure to sustain an adequate exchange rate policy that triggered the collapse of the Southern Cone (Argentina, Chile, and Uruguay) experiments with economic reform and free market policies. Moreover, some authors have argued that the economic success of countries like Indonesia, Korea, Thailand and Colombia is to a large extent attributable to the fact that these countries have pursued realistic and appropriate exchange rate policies (Dervis and Petri, 1987).

There is little doubt that during the last 15 years or so, the real exchange rate has claimed a crucial role in the economic literature devoted to economic performance and policies in developing countries. One of the most important of these exchange rate-related problems has to do with defining whether a country's real exchange rate is overvalued, or out of line with its long run equilibrium value. A second important problem refers to how real exchange rates should be measured. Here there are remarkable disagreements, with different people arguing in favor or against the use of particular indexes.

The purpose of this paper is threefold: first, it discusses the analytical concept of real exchange rate (RER) placing particular emphasis on providing an operational definition for the equilibrium real exchange rate. Of course, once this concept is defined we can begin to discuss in a meaningful way what we mean by real exchange rate misalignment, or deviations of the actual RER from its equilibrium value. Second, this paper deals with problems associated with measuring real exchange rates. Several proposals are analyzed and the more serious problems encountered when attempting to compute RER's in the developing countries are discussed. And third, I analyze the actual behavior of RER's in a number of developing countries. Here, issues related to the behavior of alternative indexes and to the statistical properties of real exchange rates are emphasized. Additionally, I study the real consequences of increased real exchange rate volatility.[1]

2. Equilibrium and Disequilibrium Real Exchange Rates

Exchange rates play a crucial role in determining the external position of a particular country. The long run external equilibrium position of a country (i.e., current account) will be affected by the real exchange rate as opposed to the nominal exchange rate. In the literature, however, there has been some disagreement regarding the definition of the real exchange rate.[2] In this section some of the alternative definitions offered in the literature are critically reviewed. The concept of "equilibrium" real exchange rate is then introduced, and the difference between equilibrium and

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[1] The material presented in this paper summarizes and expands work I have been doing on real exchange rates in developing countries during the last 6 years. See the references for a list of related papers.

[2] See, for example, Dornbusch (1982) and IMF (1984). See Edwards and Ng (1985) for an exhaustive review of alternative definitions of the real exchange rate.

disequilibrium real exchange rates is briefly discussed.

2.1 The Definition of the Real Exchange Rate

The real exchange rate has been defined in a number of alternative ways in the economic literature. According to earlier views the real exchange rate was defined as the nominal exchange rate corrected (i.e., multiplied) by the ratio of the foreign to the domestic price level. The main idea was that in an inflationary world changes in the nominal exchange rate would have no clear meaning, and that explicit consideration should be given to changing values in the domestic and foreign currencies, as measured by the respective rates of inflation. In this context a number of writers referred to the real exchange rate as the Purchasing Power Parity (PPP) exchange rate. However, this approach to the real exchange rate is subject to the well-known criticisms and problems of the PPP theory, including those related to the selection of appropriate price indexes and of an adequate reference time period.[3]

More recently most authors have defined the real exchange rate in the context of a dependent economy type model, with tradable and nontradable goods. In this setting the real exchange rate has been defined as the (domestic) relative price of tradable to nontradable goods (see, for example, Dornbusch (1974, 1980), Krueger (1978, 1983), Mussa (1979, 1984), and Bruno (1982)). It should be noted, however, that there is no universally accepted definition of "the" real exchange rate. Indeed, some authors still object to the idea of even considering that an exchange rate -- a nominal concept by definition -- could become a real variable (see Maciejewski (1983)), while

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[3] See, for example, Krueger (1983, p. 18), McKinnon (1979, pp. 121-28), Officer (1982, pp. 148-50) and Williamson (1983b, p. 14). For discussions on the merits and problems of the PPP theory see, for example, Officer (1982) and Frenkel (1978, 1981).

others continue using the PPP notion of the real exchange rate.

Unless otherwise explicitly stated, in the rest of this study we will use the modern concept of the real exchange rate, defined as the relative price of tradable to nontradable goods. If E is the nominal exchange rate defined as units of domestic currency per unit of foreign currency, P_T^* is the world price of tradables in terms of foreign currency, and P_N is the price of nontradable goods, and no taxes on trade are assumed, the real exchange rate (e) is then defined as:[4]

$$e \equiv \frac{EP_T^*}{P_N}$$

The reason for defining the real exchange rate in this way is that in the context of a tradable and nontradable goods model, the trade account will depend on the (domestic) relative price of tradables to nontradables, and not on the PPP definition of the real exchange rate. This follows directly from the fact that the trade account is equal to the excess supply for tradable goods. In fact, assuming that the supply for tradables depends positively on the relative price of those goods (EP_T^*/P_N) and that the demand depends negatively on this relative price and positively on real income, the current account -- defined as the excess supply of tradables -- will be a positive function of real income and of the relative price of tradables to nontradables or <u>real exchange rate</u>. In this setting, a higher relative price of tradables will result in a higher supply and lower demand for these goods and, consequently assuming that the Marshall-Lerner condition holds, on an

[4]Notice that this definition assumes that the law of one price holds for tradable goods. This, of course, is a debatable issue.

improved current account.[5] The real exchange rate defined in this way, then, captures the degree of competitiveness (or profitability) of the tradable goods sector in the domestic country. With other things given, a higher e means a higher degree of competitiveness (and production), of the domestic tradables sector. Williamson (1983a) writes: "[I]nternational competitiveness of our goods, ... can ceteris paribus be identified with the real exchange rate ..." (p. 161). Maciejewski (1983), on the other hand, writes: "[S]uch index values [of the real exchange rate] may provide some broad indication of the gain or loss in price (cost) competitiveness ..." See also Diaz-Alejandro (1983), Neary and Purvis (1983) and Williamson (1983b).

It is interesting to compare further the tradables-nontradables relative price definition with the (traditional) PPP definition of the real exchange rate. The PPP real exchange rate is defined as:

$$e_{PPP} = \frac{EP^*}{P}$$

where P and P* are domestic price indexes. Assuming that these indexes are geometric weighted averages of tradable and nontradable prices:

$$P = P_N^{\alpha} P_T^{1-\alpha}; \quad P^* = P_N^{*\beta} P_T^{*(1-\beta)}.$$

and further assuming that the country in question is a small country and that the law of one price holds for tradable goods (i.e., $P_T = P_T^*E$), it is possible to find the relation between percentage changes in e and in the PPP real exchange rate (where, as usual, the "hat" operator (^) represents

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[5] On this type of model see, for example, Dornbusch (1980) and Mussa (1984). Notice that since, as explained below, the real exchange rate defined as above does not have to move in the same direction, then the PPP-defined real exchange rate (an improvement of the latter) does not necessarily result in an improvement of the current account.

percentage change):

$$\hat{e} = (1/\alpha)\hat{e}_{PPP} + (\beta/\alpha)\ (\hat{P}^{*}_{T} - \hat{P}^{*}_{N})$$

From this expression it is possible to see that, in general, changes in the two definitions of the real exchange rate will differ (i.e., $\hat{e} \neq \hat{e}_{PPP}$). Moreover, changes in the two definitions of the real exchange rate can even go in the opposite direction, depending on the behavior of foreign relative prices (P^{*}_{T}/P^{*}_{N}).

2.2 The Equilibrium Real Exchange Rate

From an analytical and policy perspective, a crucial question is related to the determination of the equilibrium value of the real exchange rate. Once this equilibrium level is established it is possible to determine, among other things, whether the actual real exchange rate is misaligned (i.e., overvalued or undervalued).[6] In this section the literature on the equilibrium real exchange rate is briefly and selectively reviewed.

Robert Mundell (1971) provided an early formal analysis of the determination of the equilibrium real exchange rate. Assuming the case of a small economy that faces given terms of trade, Mundell defines the equilibrium real exchange rate as the relative price of international to domestic

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[6] For recent discussions on the causes and magnitudes of disequilibrium or misalignments of the real exchange rates see, for example, Dornbusch (1982), Williamson (1983b) and McKinnon (1984).

A common confusion in the literature is to use the concepts of the real exchange rate and the terms of trade interchangeably. See, for example, Isard (1983). Of course, since the terms of trade are defined as the relative price of exportables to importables, and the real exchange rate is defined as the relative price of tradables to nontradable goods, there is no reason for them to be equivalent. In fact, as will be discussed below (Section 2.3), there are circumstances where these two variables will tend to move in the opposite direction. Williamson (1983b) has recently stressed the importance of distinguishing between the terms of trade and the real exchange rate. Katseli (1984) has recently shown, using a cross-country data set, that these two variables have tended to behave quite differently in the recent years.

goods that simultaneously equilibrates the money market, the domestic goods market and the international goods market. Even though Mundell does not explicitly use the term real exchange rate in this paper, his analysis rigorously describes how the equilibrium relative price of tradables to nontradables is determined.

More recently, Dornbusch (1974, 1980) developed a model of an open dependent economy to analyze the determination of the equilibrium real exchange rate. In its simpler version the model considers a two goods economy with a tradable and nontradable sector. It is assumed that the production of tradables depends positively on the real exchange rate, while the production of nontradables depends negatively on that relative price. On the other hand, the demand functions for tradables and nontradables are assumed to depend on the real exchange rate and real expenditure. The equilibrium real exchange rate is defined as the relative price of tradables to nontradables at which income equates expenditure, and both the tradables and nontradable goods markets are in equilibrium. Once the equilibrium real exchange rate is defined Dornbusch investigates the characteristics of disequilibrium in terms of an overvalued or undervalued RER (Dornbusch (1980, pp. 102-03)). Dornbusch (1980, pp. 103-08) also discusses how, under the assumptions of complete price flexibility and full employment, different disturbances will affect the equilibrium real exchange rate.

A problem with a number of models on the equilibrium real exchange rate, including those of Mundell and Dornbusch, is that they do not allow for a distinction between the effects of temporary and permanent changes in the real exchange rate determinants. This distinction can, in fact, be crucial in some policy discussions. For instance, it is possible to think that while a particular value of the real exchange rate can reflect a short-

run equilibrium situation, it may be way out of line with respect to its long-run equilibrium. This possibility has recently been emphasized by a number of authors including Williamson (1983b), Harberger (1983), Edwards (1984), Isard (1983), and Frenkel and Mussa (1984). For example, if there is a temporary transfer from abroad, the real exchange rate that equilibrates the external and internal sectors will appreciate. While this new real exchange rate will be a short-run equilibrium rate -- in the sense that it accommodates the transfer -- it will be out of line with respect to its equilibrium long-run value (i.e., once the transfer has disappeared).

The distinction between the short-run equilibrium and long-run sustainable equilibrium real exchange rate has been introduced explicitly in some recent analyses of the determination of the equilibrium real exchange rate.[7] In most of these studies the "long-run equilibrium real exchange" rate has been associated with a situation where there is equilibrium in the internal and external sectors and where foreign assets are being accumulated or decumulated at the desired rate. For example, according to Hooper and Morton (1982):

> The equilibrium real exchange rate is defined as the rate that equilibrates the current account in the long-run. The long-run equilibrium or "sustainable" current account, in turn, is determined by the rate at which foreign and domestic residents wish to accumulate or decumulate domestic-currency-denominated assets net of foreign currency denominated assets in the long run. (1982, p. 43)

Williamson (1983b) writes:

> [T]he fundamental equilibrium exchange rate is that which is expected to generate a current account surplus or deficit equal to the underlying capital flow over the cycle, given that the country is pursuing international balance as best it can and not

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[7] What we have called here the long-run sustainable equilibrium real exchange rate is (somewhat) equivalent to Williamson's (1983b) "fundamental equilibrium real exchange rate."

restricting trade for balance of payments reasons. (1983b, p. 14)

Finally, in their chapter for the Handbook of International Economics, Frenkel and Mussa (1984) express:

> [T]he long-run equilibrium real exchange rate is expected to be consistent with the requirement that on average (in present and future periods), the current account is balanced. (1984, p. 64)

More recently, Peter Neary (1988) has developed an optimizing model of a real economy to analyze the determinants of the equilibrium real exchange rate. An important improvement in Neary's approach over the previous literature is that it explicitly considers that producers and consumers are rational and optimize some objective function. Also, by ignoring all monetary considerations Neary was able to concentrate on the long-run properties of the model, and, thus, on the determinants of the equilibrium real exchange rate. A shortcoming of Neary's model, however, is that it is basically static and does not allow us to make a distinction between temporary and permanent shocks, or between anticipated and unanticipated disturbances.

2.3 An Intertemporal Model of Equilibrium Real Exchange Rates

In this subsection I present a minimal fully optimizing model of equilibrium real exchange rates. The model is partially based on Edwards (1989a,b). The equilibrium real exchange rate (ERER) is defined as that relative price of tradables to nontradables that, for given sustainable (equilibrium) values of other relevant variables such as taxes, international prices and technology, results in the simultaneous attainment of internal and external equilibrium. Internal equilibrium means that the nontradable goods market clears in the current period, and is expected to be in equilibrium in future periods. In this definition of equilibrium RER it is implicit the idea that this equilibrium takes place with unemployment at the "natural" level. External equilibrium, on the other hand, is attained when

the intertemporal budget constraint that states that the discounted sum of a country's current account has to be equal to zero, is satisfied. In other words, external equilibrium means that the current account balances (current and future) are compatible with long run sustainable capital flows.

A number of important implications follow from this definition of equilibrium real exchange rate. First, the ERER is not an immutable number. When there are changes in any of the other variables that affect the country's internal and external equilibria, there will also be changes in the equilibrium real exchange rate. For example, the RER "required" to attain equilibrium will not be the same with a very low world price of the country's main export, than with a very high price of that good. In a sense, then, the ERER is itself a function of a number of variables including import tariffs, export taxes, real interest rates, capital controls and so on. These immediate determinants of the ERER are the real exchange rate "fundamentals". Second, the ERER will not only be affected by current "fundamentals," but also by the expected future evolution of these variables. To the extent that there are possibilities for intertemporal substitution of consumption via foreign borrowing and lending, and of intertemporal substitution in production via investment, expected future events -- such as an expected future change in the international terms of trade, for example -- will have an effect on the current value of the ERER. In particular, the behavior of the equilibrium real exchange rate will depend on whether changes in fundamentals are perceived as being permanent or temporary. If there is perfect international borrowing, a temporary disturbance to, say, the terms of trade, will affect the complete future path of equilibrium RERs. However, if there is rationing in the international credit market, intertemporal substitution through consumption will be

cut, and temporary disturbances will tend to affect the ERER in the short run only. In this case a distinction between short-run and long-run equilibrium real exchange rates becomes useful.

Although this framework is very general and it can accommodate many goods and factors, it is useful to think of this small economy as being comprised of a large number of profit maximizing firms, that produce three goods -- exportables (X), importables (M) and nontradables (N) -- using constant returns to scale technology, under perfect competition. It is assumed that there are more factors than tradable goods, so that factor price equalization does not hold. One way to think about this is by assuming that each sector uses capital, labor and natural resources.

There are two periods only -- the present (period 1) and the future (period 2) -- and there is perfect foresight. Residents of this small country can borrow or lend internationally. There are, however, taxes on foreign borrowing; the domestic (real) interest rate exceeds the world interest rate. The intertemporal constraint states that at the end of period 2 the country has paid its debts. The importation of M is subject to specific import tariffs both in periods 1 and 2. In this model the current account is equal to savings minus investment in each period. Consumers maximize intertemporal utility and consume all three goods.

There is a government that consumes both tradables and nontradables. Government expenditure is financed through nondistortionary taxes, proceeds from import tariffs, proceeds from the taxation of foreign borrowing by the private sector, and borrowing from abroad. As in the case of the private sector, the government is subject to an intertemporal constraint: the discounted value of government expenditure (including foreign debt service) has to equal the discounted value of income from taxation.

In addition to the private sector and government budget constraints, internal equilibrium requires that the nontradable market clears in each period. That is, the quantity supplied of nontradables has to equal the sum of the private and public sectors demands for these goods. The model is completely real; there is no money or other nominal assets.

The general model is given by equations (1) through (9), where the (world) price of exportables has been taken as the numeraire:

$$R(1,p,q,V,K) + \delta\tilde{R}(1,\tilde{p},\tilde{q};\tilde{V},K+I)$$

$$- I(\delta) - T - \delta\tilde{T} = E\{\pi(1,p,q),\delta\tilde{\pi}(1,\tilde{p},\tilde{q}),W\}, \tag{1}$$

$$G_X + p^*G_M + qG_N + \delta^*(\tilde{G}_X + \tilde{p}^*\tilde{G}_M + \tilde{q}\tilde{G}_N) = \tau(E_p - R_p) + \delta^*\tilde{\tau}(E_{\tilde{p}} - \tilde{R}_{\tilde{p}})$$

$$+ b(NCA) + T + \delta^*\tilde{T} \tag{2}$$

$$R_q = E_q + G_N, \tag{3}$$

$$\tilde{R}_{\tilde{q}} = E_{\tilde{q}} + \tilde{G}_N \tag{4}$$

$$p = p^* + \tau, \tag{5}$$

$$\tilde{p} = \tilde{p}^* + \tilde{\tau}, \tag{6}$$

$$\delta\tilde{R}_K = 1, \tag{7}$$

$$P_T^* = \gamma P_M^* + (1-\gamma)P_X^*;\ \tilde{P}_T^* = \gamma\tilde{P}_M^* + (1-\gamma)\tilde{P}_X^*;\ (P_X^* = \tilde{P}_X^* = 1) \tag{8}$$

$$RER = (P_T^*/P_N);\ R\tilde{E}R = (\tilde{P}_T^*/\tilde{P}_N) \tag{9}$$

Table 1 contains the notation used.

Equation (1) is the intertemporal budget constraint for the private sector and states that present value of income valued at domestic prices has to equal present value of private expenditure. Given the assumption of a tax on foreign borrowing, the discount factor used in (1) is the domestic factor δ, which is smaller than the world discount factor δ^*.

Table 1

Notation Used in Model of Equilibrium Real Exchange Rates

$R(\ )$; $\tilde{R}(\ )$	Revenue functions in periods 1 and 2. Their partial derivatives with respect to each price are equal to the supply functions.
p; $\tilde{p}$	Domestic relative price of importables in periods 1 and 2.
q; $\tilde{q}$	Relative price of nontradables in periods 1 and 2.
V; $\tilde{V}$	Vector of factors of production, excluding capital.
K	Capital stock in period 1.
$I(\ )$	Investment in period 1.
δ^*	World discount factor, equal to $(1+r^*)^{-1}$, where r^* is world real interest rate in terms of exportables.
δ	Domestic discount factor, equal to $(1+r)^{-1}$. Since there is a tax on foreign borrowing, $\delta < \delta^*$.
$b = (\delta^*-\delta)$	Discounted value of tax payments per unit borrowed from abroad.
p^*; $\tilde{p}^*$	World relative price of imports in periods 1 and 2.
τ; $\tilde{\tau}$	Import tariffs in periods 1 and 2.
T; $(\tilde{T})$	Lump sum tax in periods 1 and 2.
G_X, G_M, G_N; $\tilde{G}_X, \tilde{G}_M, \tilde{G}_N$	Quantities of goods X, M and N consumed by government in periods 1 and 2.
$E(\ )$	Intertemporal expenditure function.
$\pi(1,p,q)$; $\tilde{\pi}(\ )$	Exact price indexes for periods 1 and 2; which under assumptions of homotheticity and separability, correspond to unit expenditure functions.
W	Total welfare.

Table 1 continued

NCA	Noninterest current account of the private sector in period 2.
P_M^*, P_X^*; $\tilde{P}_M^*, \tilde{P}_X^*$	Nominal world prices of M and X in periods 1 and 2. Notice that we assume that $P_X^* = \tilde{P}_X^* = 1$.
P_N; $\tilde{P}_N$	Nominal price of nontradables in periods 1 and 2.
P_T^*; $\tilde{P}_T^*$	World prices of tradables, computed as an index of the prices of X and M, in periods 1 and 2.
RER; $\tilde{RER}$	Definition of the real exchange rate in periods 1 and 2.

Equation (2) is the government intertemporal budget constraint. It states that the discounted value of government expenditure has to equal the present value of government income from taxation. NCA, which is equal to $(\tilde{R}-\tilde{\pi}E_{\tilde{\pi}})$ in (2) is the private sector current account surplus in period 2, and b(NCA) is the discounted value of taxes on foreign borrowing paid by the private sector. Notice that the use of the world discount factor δ^* in (2) reflects the assumption that in this model the government is not subject to the tax on foreign borrowing.

Equation (3) and (4) are the equilibrium conditions for the nontradables market in periods 1 and 2; in each of these periods the quantity supplied of N (R_q and $\tilde{R}_q$) has to equal the sum of the quantity demanded by the private sector (E_q and $E_{\tilde{q}}$) and by the government. Given the assumptions about preferences (separability and homotheticity) the demand for N by the private sector in period 1 can be written as:

$$E_q = \pi_q E_\pi, \tag{10}$$

Equations (5) and (6) specify the relation between domestic prices of importables, world prices of imports, and tariffs. Equation (7) describes investment decisions, and states that profit maximizing firms will add to the capital stock until Tobin's "q" equals 1. This expression assumes that the stock of capital is made up of the numeraire good.

In this model we can distinguish between the "exportables real exchange rate" (1/q) and the "importables real exchange rate" (p/q). Since the relative price of X and M can change we cannot really talk about a tradable goods composite. It is still possible, however to <u>compute</u> how an index of tradables prices evolve through time. Equation (8) is the definition of the price index for tradables, where γ and $(1-\gamma)$ are the weights

of importables and exportables. Equation (9) defines the real exchange rate index as the domestic relative price of tradables to nontradables. Equations (1) through (9) fully describe the inter and intratemporal (external and internal) equilibria in this economy.

In this model there is an equilibrium path for the RER. The vector of equilibrium RERs, $\mathbf{RER} = (RER, R\tilde{E}R)$ is composed of those RERs that satisfy equations (1) through (9) for given values of the other fundamental variables. Notice that since we have assumed no rigidities, externalities, or market failures, our equilibrium real exchange rates imply the existence of "full" employment (see, however, Edwards 1989a).

From the inspection of equations (1)-(9) it is apparent that exogenous shocks in, say, the international terms of trade, will affect the vector of equilibrium relative prices and RERs through two interrelated channels. The first one is related to the intratemporal effects on resource allocation and consumption and production decisions. For example, as a result of a temporary worsening of the terms of trade, there will be a tendency to produce more and consume less of M in that period. This, plus the income effect resulting from the worsening of the terms of trade will generate an incipient disequilibrium in the nontradables market which will have to be resolved by a change in relative prices and in the equilibrium RER. In fact, if we assume that there is an absence of foreign borrowing these intratemporal effects will be the only relevant ones. However, with capital mobility and investment, as in the current model, there is an additional intertemporal channel through which changes in exogenous variables will affect the vector of equilibrium RERs. For example, in the case of a worsening of the terms of trade, the consumption discount factor $\tilde{\pi}\delta/\pi$ will be affected, altering the intertemporal allocation of consumption. Also, in that case the investment

equilibrium condition (7) will be altered, affecting future output.

Naturally, without specifying the functional forms of the expenditure, revenue, and other functions in (1)-(9) it is not possible to write the vector of equilibrium relative prices of nontradables, nor the equilibrium real exchange rates, in an explicit form. It is possible, however, to write them implicitly as functions of all the sustainable levels of all exogenous variables (contemporaneous and anticipated) in the system:

$$RER = h(p^*, \tilde{p}^*, \tau, \tilde{\tau}, \delta, \delta^*, V, T, \tilde{T}, G_X, \tilde{G}_X, \ldots) \tag{11}$$

$$R\tilde{E}R = \tilde{h}(p^*, \tilde{p}^*, \tau, \tilde{\tau}, \delta, \delta^*, \tilde{V}, T, \tilde{T}, G_X, \tilde{G}_X, \ldots) \tag{12}$$

A crucial question is related to the way in which the equilibrium vectors of relative prices and RERs will change in response to different types of disturbances. That is, we are interested in the (most plausible) signs of the partial derivatives of RER and $R\tilde{E}R$ with respect to their determinants. The actual discussion of these effects is beyond the scope of this paper, and can be found in Edwards (1989a,b,c). The main conclusions from the manipulation of the model can be summarized as follows:

(1) With low initial tariffs the imposition of import tariffs (either temporarily or permanently) will usually generate an <u>equilibrium real appreciation</u> in the current and future periods. A sufficient condition is that we have (net) substitutability in demand among all three goods X, M and N. If initial tariffs are high, for this result to hold, we need, in addition, income effects to be dominated by substitution effects. If, however, there is complementarity in consumption it is possible that the imposition of import tariffs will generate a real equilibrium depreciation.

(2) If the income effect associated with a terms of trade deterioration dominates the substitution effect, a worsening in the terms of trade will

result in an equilibrium real depreciation.

(3) Generally speaking, it is not possible to know how the effect of import tariffs and terms of trade shocks on the ERER will be distributed through time.

(4) It is crucially important to distinguish between permanent and temporary shocks when analyzing the reaction of the equilibrium real exchange rate.

(5) A relaxation of exchange controls will always result in an equilibrium real appreciation in period 1. Moreover, in that period we will observe simultaneously a real appreciation and an increase in borrowing from abroad.

(6) A transfer from the rest of the world -- or an exogenously generated capital inflow for that matter -- will always result in an equilibrium real appreciation.

(7) The effect of an increase in government consumption on the equilibrium RERs will depend on the composition of this new consumption. If it falls fully on nontradables there is a strong presumption that the RER will experience an equilibrium real appreciation. If it falls fully on tradables there will be an equilibrium real depreciation.

2.4 Real Exchange Rate Misalignment

Even though, as suggested by the model presented above, long run equilibrium real exchange rates are a function of real variables only, actual real exchange rates respond both to real and monetary variables. The existence of an equilibrium real exchange rate does not mean that the actual real exchange rate has to be permanently equal to this equilibrium value. In fact, the actual RER will normally exhibit departures from its long run equilibrium; short run and even medium run deviations of the actual from the

equilibrium RER, that are typically not very large and that stem from short term frictions and adjustment costs, can be quite common. However, there are other types of deviations that can become persistent through time, generating major and sustained differentials between actual and equilibrium real exchange rates, or real exchange rate misalignments.

In order to construct a model of real exchange rate misalignment it is necessary to abandon the frictionless "real" world of the previous subsection; we need to introduce monetary and financial sectors, as well as rigidities that impede instantaneous adjustments. Although the construction of such a model is well beyond the scope of this paper, in the rest of this section I discuss some of the most important characteristics of misalignment situations.

A fundamental principle of open economy macroeconomics is that in order to have a sustainable macroeconomic equilibrium it is necessary for monetary and fiscal policies to be consistent with the chosen nominal exchange rate regime. This means that the selection of an exchange rate system imposes certain limitations on the extent of macropolicies. If this consistency is violated severe disequilibrium situations, which are usually reflected on real exchange rate misalignment, will take place.

Perhaps the case of a "high" fiscal deficit under fixed nominal exchange rates is the most clear example of macro and exchange rate inconsistencies. In most developing countries fiscal imbalances are partially or wholly financed by money creation. The inflation required to finance a fiscal deficit equal to a fraction δ of GDP can be calculated as:

$$\pi = \delta/\lambda \tag{13}$$

where π is the rate of inflation required to finance the government deficit, and λ is the ratio of high-powered money to GDP. If the required

rate of inflation is "too high," it will possibly result in the price of nontradables (P_N) growing faster than the international price of tradables (P_T^*) and in a real appreciation. This type of "inconsistent" fiscal policy will result in domestic credit creation above money demand growth. This, in turn will be translated into an excess demand for tradable goods, nontradable goods, and financial assets. While the excess demand for tradables will be reflected in a higher trade deficit (or lower surplus), in a loss of international reserves, and in an increase in (net) foreign borrowing above its long run sustainable level, the excess demand for nontradables will be translated into higher prices for those goods, and consequently into a real exchange rate appreciation. If there are no changes in the fundamental real determinants of the equilibrium RER this real appreciation induced by the expansive domestic credit policy will represent a departure of the actual RER from its equilibrium value, or real exchange rate misalignment. Naturally, since this policy is unsustainable, something will have to give. Either the inconsistent macropolicies will have to be reverted, or at some time the central bank will "run out" of reserves and a balance of payments crisis will ensue.

The consistency between monetary and exchange rate policies is not only needed under fixed rates, but also under most types of predetermined and managed nominal exchange rates such as an active crawling peg. Perhaps Argentina in the late 1970s is the most notorious recent case of an inconsistent fiscal and crawling nominal exchange rate policies. During that period the Argentinian government implemented the by-now famous preannounced rate of devaluation or "tablita" as a means to reduce inflation. However, the preannounced rate of crawl was clearly inconsistent with the inflation tax required to finance the fiscal deficit (Calvo 1986). This inconsistency not only generated a real appreciation, but also a substantial speculative

activity where the public basically bet on when the "tablita" would be abandoned.

Nonunified (or multiple) nominal exchange rates have traditionally had some appeal for the developing countries, and have recently become fairly common. Under this type of system different international transactions are subject to differential nominal exchange rates, giving rise to the possibility of having more than one real exchange rate. Under nonunified exchange rates, the relation between macroeconomic policies and the rest of the economy will depend on the nature of the multiple rates system. If, for example, the multiple rates regime consists of two (or more) predetermined (i.e., fixed) nominal rates, the system will work almost in the same way as under unified predetermined nominal rates. This is because multiple fixed nominal exchange rates are perfectly equivalent to a unified rate system with taxes on certain external transactions. In this case, as with unified predetermined rates, inconsistent macroeconomic policies will result in loss of international reserves, a rate of domestic inflation that will exceed world inflation, and in real exchange rate overvaluation. This situation, of course, will be unsustainable in the long run and the authorities will have to introduce corrective macropolicies.

A different kind of nonunified nominal exchange rates consists of a fixed official rate for current account transactions and an (official) freely fluctuating rate for capital account transactions. The main purpose of this system is to delink the real side of the economy from the effects of supposedly highly unstable capital movements. In this dual exchange rate system, portfolio decisions are highly influenced by the differential between the free and fixed rates or exchange rate premium. The private sector decisions on what proportion of wealth to hold in the form of foreign

currency denominated assets is directly influenced by the expected rate of devaluation of the free rate.

Under a dual exchange rate regime, even if no current account transactions slip into the free rate, changes in the fluctuating nominal rate will exercise an influence on the real exchange rate. Consider, for example, the case of an increase of domestic credit at a rate that exceeds the increase in the demand for domestic money. As before this will provoke an excess demand for goods and financial assets. As a result of this policy there will be a decline in the stock of international reserves, an increase in the price of nontradable goods, and consequently a real appreciation. In addition, there will be an increase in the demand for foreign assets, which will result in a nominal devaluation of the free rate, and in changes in the domestic interest rate. The devaluation of the free rate will, in turn, have secondary effects over the official real exchange rate via a wealth effect. The bottom line, however, is that in this case inconsistent macropolicies will eventually be also unsustainable, as international reserves are drained. By partially delinking the current from the capital account, all the dual rates system can hope to do is delay the eventual crisis. A system that is particularly relevant for the developing countries consists of the coexistence of a fixed rate for commercial transactions with a floating parallel (either black or grey) market rate governing the financial transactions.[8]

3. Measuring Real Exchange Rates

From an empirical point of view the first question that should be addressed is: how should the real exchange rate be measured? From equation

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[8] Edwards (1989a) develops a formal model of exchange rate misalignment and balance of payments crises.

(9), which defines the real exchange rate as the relative price of tradables and nontradables, it is apparent that the main measurement problems are those related to the selection of the real-world counterparts of P_T^* and P_N. In reality, it is extremely difficult -- if not impossible -- to define which goods are actually tradables and which are nontradables. A second measurement problem is related to the definition of E. Should the nominal exchange rate with respect to the U.S. dollar be considered? Or is the exchange rate with respect to the DM the most appropriate? Or, should an average of both rates be used? These and other problems related to the measurement of the real exchange rate will be discussed in this section. The analysis will be restricted to the actual measurement of the RER, without entering into the important and difficult question of the empirical definition of the equilibrium level of the real exchange rate. The analysis presented in this section will first discuss, briefly, the arguments traditionally given in favor of alternative measures of the real exchange rate. The discussion will be quite general and will provide a broad cover of the literature. That is, the presentation will also deal -- even though briefly -- with the PPP real exchange rate. Section 4, on the other hand, deals with the actual behavior of different RER indexes in the developing countries.

As expressed in equation (9), RER is defined as the relative price of tradable to nontradable goods. Ideally, one would want to have data on tradables and nontradables. In almost every country, however, these are not available. For this reason, some proxy for the analytical concept of the RER should be found. In some respects, the selection of the appropriate proxies for P_N and P_T^* resembles the definition of the adequate price levels in the old discussions of the Purchasing Power Parity theory (see, for example, Keynes, 1924, Viner 1937, and Officer's 1976 review). Indeed,

most of the discussion on the appropriate measurement of the real exchange rate has been closely related to the PPP literature.

Basically four alternative price indexes have been traditionally suggested as possible candidates for the construction of the real exchange rate index. However, as we will see, most of these propositions relate to the traditional PPP definition, and are not entirely appropriate as proxies for the relative price of tradables to nontradables. The following price indexes have actually been suggested: (1) the Consumer Price Indexes at home and abroad (CPI); (2) the Wholesale Price Indexes (WPI); (3) the GDP deflators (GD); (4) and wage rate indexes (WR).[9] Also some authors have suggested using specific components of the CPI and WPI as proxies for the prices of tradables and nontradables. In practice, however, this procedure has the same type of problems as those arising from the use of more standard price indexes. The relative merits of these indexes are also somewhat related to the old PPP discussion.

Of course, none of these indexes is perfect and all of them present some advantages and disadvantages. The relevant question, then, is which index, or indexes, are preferable for analyzing changes in the real exchange rate and the degree of competitiveness. In the rest of this subsection the discussion will be restricted to the merits of the alternative price indexes. Below, the question of bilateral versus multilateral real exchange rates will be tackled in detail.

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[9]Some authors have also suggested using an alternative indicator of competitiveness constructed as the ratio of export unit cost to import unit costs. Of course the problem with this is that it confuses the terms of trade with the real exchange rate! See Williamson (1983b). See also Connolly and Lackey's (1983) proposition for using the "real monetary parity".

Within the context of the PPP real exchange rate, the most commonly used index of the real exchange rate in empirical and policy discussions, is that constructed using CPIs as the relevant price indexes (see DeVries (1968)). It has been argued that this indicator will provide a comprehensive measure of changes in competitiveness since the CPIs include a broad group of goods, including services (see Genberg 1978). Another advantage of this index is that almost every country periodically (i.e., monthly) publishes fairly reliable data on CPI behavior. However, an obvious problem with this measure is that since the CPI includes a large number of nontraded goods, it will tend to provide a biased measure of the changes in the degree of competitiveness of the tradable goods sector (see Frenkel (1978), Officer (1982)).

Some authors have suggested that this problem would be solved if WPI indexes, which contain mainly tradable goods, are used in the computation of the real exchange rate. This measure, however, has also been subject to criticism. It has been argued, for example, that since these indexes contain highly homogeneous tradable goods, whose prices tend to be equated across countries when expressed in a common currency, the real exchange rate computed using WPIs will vary very little, without really measuring actual changes in the degree of competitiveness (see Keynes 1930, Officer 1982).[10] Also, the use of WPI (as well as other) indexes, is subject to the problem arising from the use of different weights across countries.

The main merit of the GDP deflator as a candidate for the construction of the RER is that it is a genuine price index of aggregate production, while both the CPI and the WPI are indexes of consumption prices. It has been

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[10]This criticism implicitly assumes that the "law of one price" holds for homogeneous tradable goods. See, however, Kravis and Lipsey (1983) and Isard (1977).

thought, then, that a real exchange rate index computed using GDP deflators will provide a good indicator of changes in the degree of competitiveness in production (see Officer 1976, 1982; Barro 1983). On the other hand, a crucial drawback of the GDP deflator is that, for most developing countries it is only available on a yearly basis, and that as in the case of the CPI it has a large component of nontradable goods (see Harberger (1981)).

Many authors, including the IMF staff (Artus (1978), Artus and Knight (1984)), prefer to compute the real exchange rate as a ratio of unit labor costs (see also Houthakker (1962, 1963)), the reason being that this index is, in some sense, a direct measure of relative competitiveness across countries (see Maciejewski (1983)). It has also been argued that relative labor costs are more stable than relative goods prices (Artus (1978), Officer (1982)). As in the case of the other indexes, there are a number of analytical problems related to the use of this type of measure for the real exchange rate. First, an indicator based on wage rates behavior will be highly sensitive to cyclical productivity changes. For this reason the IMF has constructed the so-called normalized unit labor costs indexes which correct the competitiveness measure by these productivity changes (see Maciejewski (1983), and International Financial Statistics (April 1984, p. 63)). Unfortunately, however, due to data availability limitations, the IMF only computes these normalized unit labor costs for the OECD countries. A second shortcoming of the wage rate based measure of the real exchange rate is that it takes into account only one factor of production. To the extent that the capital/labor ratio differs across countries, this will introduce a bias into the index. Finally, the poor quality and limited availability of wage rates data for developing countries is also a serious drawback for the use of this indicator.

Recently some authors have argued that the best way to construct a real exchange rate index is to use some component of the more traditional price indexes to construct proxies for the domestic price of tradables and nontradables. For example, Kravis and Lipsey (1983) have suggested using (for most countries) the GDP deflator for services and government expenditures to construct a proxy for nontradables and the deflators of the rest of the sectors to construct a proxy for tradables. Even though this sounds like a sensible proposition, it has two important drawbacks. First, the existing disaggregation at the national account level in most countries is too broad to allow for really meaningful comparisons across sectors. Second, and more important, with very few exceptions, national account data are only available on a yearly basis and with a substantial delay. This, unfortunately, defeats the whole idea of having a reliable and fast index of external competitiveness. At this level, a more practical proposition is to construct the real exchange rate using components of the consumer and wholesale price indexes to build the proxies for tradables and nontradables prices. These indexes are available fairly quickly and in almost every country on a monthly basis. A problem with this proposition, however, is how to make the selection of which components to be included as part of what index. Another problem, of course, is related to the selection of the weight to attach to each component in the construction of the proxies. Even though these are tricky problems, they are not insurmountable. Their solution will basically require good judgment.

Thus, from a practical point of view and for most purposes, it is advisable to stick to real exchange rate indexes constructed with the traditional price indexes. There are two main advantages to this. First, the cost involved in building these series is relatively low; and second, in

this way cross-country comparisons can be made more easily. In the rest of this section, the discussion will be restricted to the behavior of real exchange rate indexes constructed using CPIs, WPIs, GDP deflators and wage indexes. A growing number of authors have recently proposed that an adequate proxy for the relative price of tradables to nontradables can be constructed if the foreign WPI is used in the numerator and the domestic CPI is used in the denominator. Later in this section a more detailed discussion on the merits and demerits of this particular index will be provided.

3.1 The Real Exchange Rate in a World of Floating: Effective Real Exchange Rates vs. Bilateral Real Exchange Rates

The preceding discussion referred to bilateral rates between the domestic currency and, say, the U.S. dollar. However, in a world where the main currencies are floating there are many different bilateral rates, and there is no reason why one rate should be preferred over another. For this reason indexes of real exchange rates that take into account the behavior of all the relevant bilateral rates have been constructed. These exchange rate indexes have been called real effective exchange rates or real basket exchange rates.

The behavior of the effective exchange rate can be, at least in theory, very different form the behavior of any bilateral exchange rate. In order to illustrate this point we will concentrate on effective vs. bilateral nominal exchange rates. The analysis follows easily for the case of real exchange rates. Assume that a country trades with k countries. Then the effective nominal exchange rate B_t is defined as:

$$B_t = \sum_{i=1}^{k} \alpha_i E_{cit} \tag{14}$$

where α_i is the appropriate weight for country i, and E_{ci} is an index

of the bilateral nominal exchange rate between the home country's currency and country i's currency in period t.[11] By triangular arbitrage:

$$E_{ci} = E_{c1} E_{1i} \quad i = 1,2,\ldots,k$$

where E_{c1} is, for example, the bilateral nominal exchange rate betwen the home country and the U.S. dollar, and E_{1i} is the rate between the U.S. dollar and country i's currency (i.e., the U.S./Yen Rate).

The rate of change of the nominal effective exchange rate B_t can be written as (where $\hat{X} = dX/dt\ 1/X$):

$$\hat{B} = \hat{E}_{c1} + \left[\sum_{i=2}^{k} \left(\frac{\alpha_i E_{1i}}{A}\right) \hat{E}_{1i}\right] \tag{15}$$

where

$$A = \alpha_1 + \sum_{j=2}^{k} \alpha_j E_{1j}$$

Equation (15) indicates that in a world of floating rates the rate of change of the <u>effective nominal rate</u> $\hat{B}$ will differ from the change in the bilateral rate with respect to the reference country $\hat{E}_{c1}$, by the term in square brackets. In particular, if the U.S. dollar -- the currency in terms of which the bilateral rate is defined -- is appreciating in the world market (i.e., $\Sigma_{i=2}^{k} (\alpha_i E_{1i}/A)\ \hat{E}_{1i} < 0$), the rate of nominal depreciation of the effective nominal rate will be <u>smaller</u> than the rate of nominal depreciation of the bilateral rate ($\hat{B} < \hat{E}_{c1}$). Of course, the contrary would be the case if the dollar depreciated relative to the other currencies, as has been the case since 1985.

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[11] On the selection of the "appropriate" weights see Branson and de Macedo (1982) and Branson and Katseli (1982).

4. Real Exchange Rate Behavior In Selected Developing Countries

The purpose of this section is to investigate how different indexes of RERs have behaved in a large number of developing countries. In particular, the analysis compares the behavior of bilateral, effective, official and parallel market exchange rates. The discussion concentrates on determining whether RERs have exhibited trends and on how volatile RERs have been. In addition the analysis inquires into whether it really makes a difference which price indexes are used to construct RER indexes.

4.1 Official Nominal Exchange Rates and RER Behavior in 33 Developing Countries

Effective Real Exchange Rates and Bilateral Exchange Rates

In the construction of the effective indexes of real exchange rate the following equation was used:

$$MRER_{jt} = \frac{\sum_{i=1}^{k} \alpha_i E_{it} P^*_{it}}{P_{jt}}$$

where $MRER_{jt}$ is the index of the multilateral or effective real rate in period t for country j; E_{it} is an index of the nominal rate between country i and country j in period t; $i = 1,\ldots,k$ refers to the k partner countries used in the construction of the MRER index; α_i is the weight corresponding to partner i in the computation of $MRER_{jt}$; P^*_{it} is the price index of the i partner in period t; and P_{jt} is the price index of the home country in period t. An increase in the value of this index of MRER reflects a real depreciation, whereas a decline implies a real appreciation of the domestic currency.

Two indexes of multilateral real exchange rates were constructed and their behavior compared. The first index -- which is a proxy for the

relative price of tradables to nontradables -- used the partner countries' WPIs as the P^*_{it}'s and the home country CPI as P_{jt}. For notation purposes this index was called MRER1. The second index -- which is related to the more traditional PPP measure of the real exchange rate -- used consumer price indexes for both partner countries and the home country. This index was called MRER2.

In the construction of both indexes the following procedure was followed: (1) The weights (α's) were trade weights constructed using data from the International Monetary Fund Directions of Trade. (2) For each country the ten largest trade partners in 1975 were used for the construction of the real exchange rate indexes. (3) In all cases the nominal exchange rate indexes (E_{ij}) were constructed from data on official nominal exchange rates obtained from the International Financial Statistics (IFS). In those cases where there were multiple official exchange rates the "most common" rate as listed by the IFS, was used. This means that these indexes are capturing some of the distortions introduced by the existence of multiple rates. What they do not capture, however, is the role of non-official black or parallel markets for foreign exchange (see, however, Edwards 1989a).

Two indexes of bilateral real exchange rates with respect to the U.S. were also constructed using data on official nominal rates. These indexes were defined as:

$$\text{BRER1} = \frac{E \ WPI^{US}}{CPI} ,$$

and,

$$BRER2 = \frac{E\ CPI^{US}}{CPI},$$

where E is the bilateral (official) nominal exchange rate with respect to the U.S. dollar; WPI^{US} and CPI^{US} are the wholesale and consumer price indexes; and CPI is the domestic country consumer price index. BRER1, then, is the bilateral counterpart of MRER1. On the other hand, BRER2 uses both the domestic country and the U.S. CPIs and has historically been the most popular RER index in policy analyses.

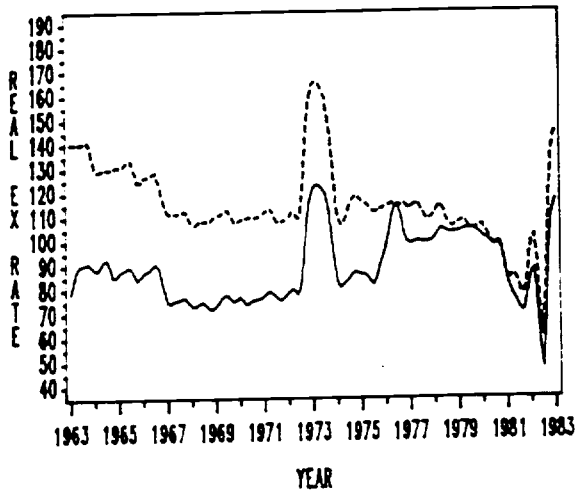
Figures 4-1 through 4-8 show the evolution of two real exchange rate indexes, the multilateral MRER1 index and the bilateral BRER1 index, for 33 developing countries. As may be seen, in most cases both indexes tended to move roughly in the same direction throughout most of the period, and in particular between 1960 and 1971. After the collapse of the Bretton Woods system, in many of the countries depicted in these diagrams the multilateral and bilateral indexes started to exhibit some difference in behavior.

In order to formally compare the behavior of the four alternative indexes of the real exchange rate constructed using official data, coefficients of correlations between the multilateral and the bilateral real exchange rate indexes were computed using quarterly data for the period that goes from the first quarter of 1965 up to the second quarter of 1985. The following regularities emerged from this analysis. First, in most countries the two alternative definitions of the bilateral real exchange rate index moved closely together during this period. In 27 out of the 33 countries considered the coefficient of correlation between log(BRER1) and log(BRER2) was above 0.9 and in all cases it exceeded 0.8. Second, the two indexes of trade weighted multilateral RER also moved closely together. In 30 out of the 33 countries the coefficient of correlation between the logs

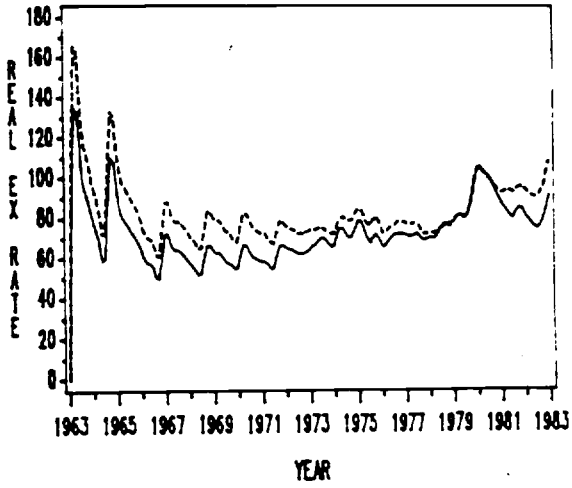
FIGURE 4.1

MULTILATERAL AND BILATERAL REAL EXCHANGE RATE

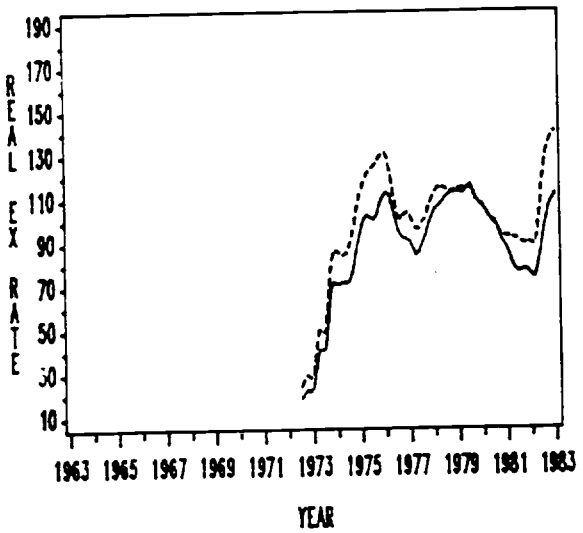
BOLIVIA



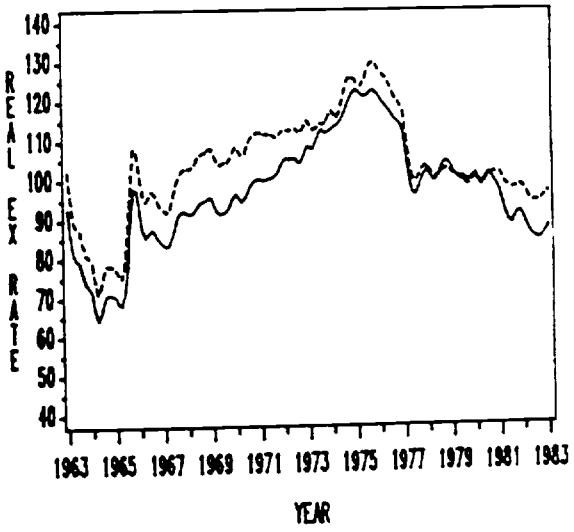
BRAZIL



CHILE



COLOMBIA



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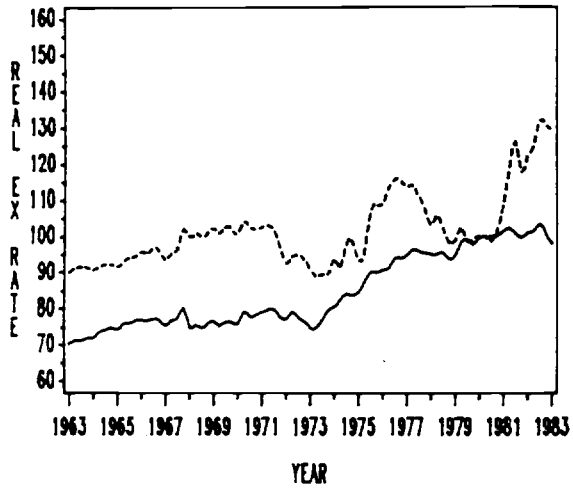
SOURCE: CONSTRUCTED FROM RAW DATA OBTAINED FROM THE I.F.S.

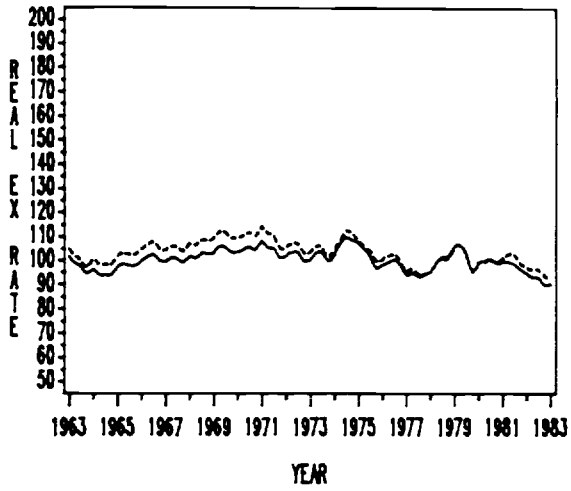
FIGURE 4.2

MULTILATERAL AND BILATERAL REAL EXCHANGE RATE

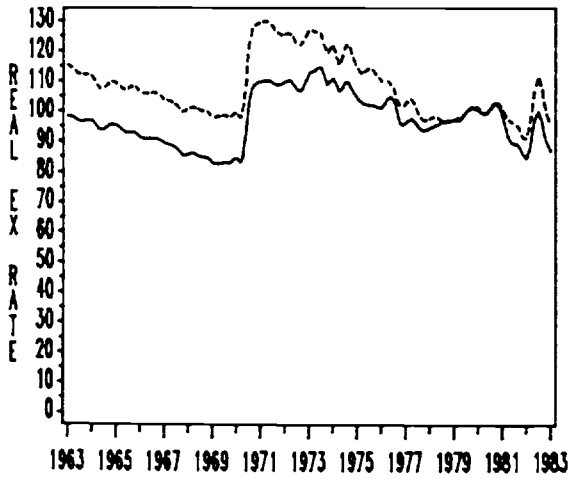
CYPRUS



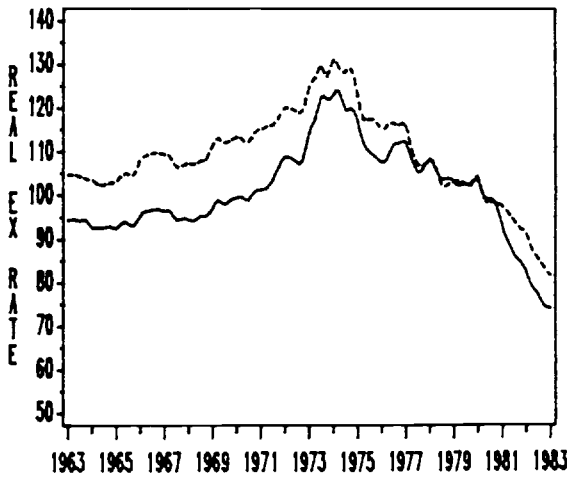
DOMINICAN REP.



ECUADOR



EL SALVADOR



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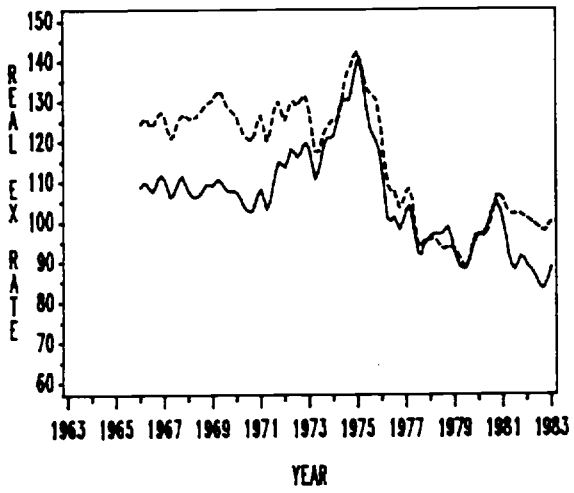
SOURCE: CONSTRUCTED FROM RAW DATA OBTAINED FROM THE I.F.S.

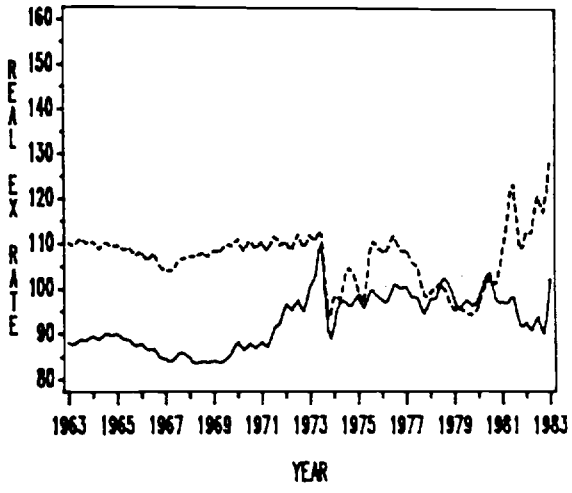
FIGURE 4.3

MULTILATERAL AND BILATERAL REAL EXCHANGE RATE

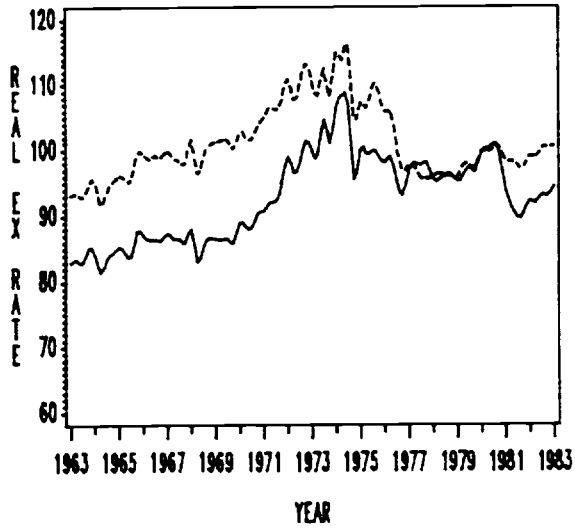
ETHIOPIA



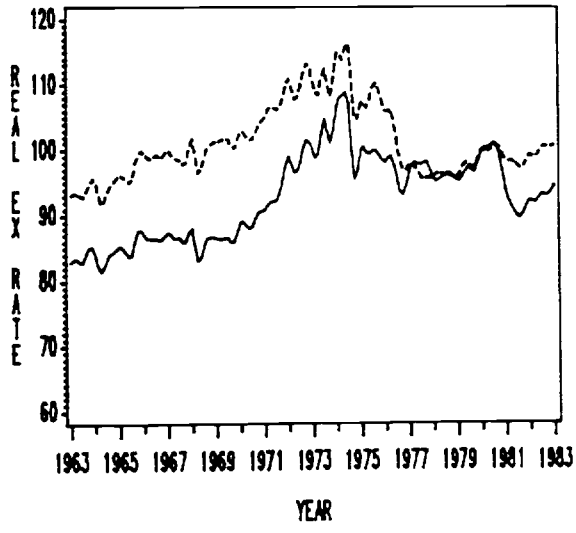
GREECE



GUATEMALA



GUYANA



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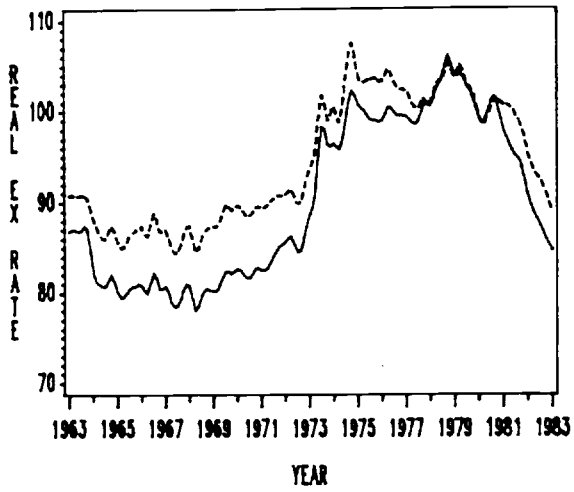
SOURCE: CONSTRUCTED FROM RAW DATA OBTAINED FROM THE I.F.S.

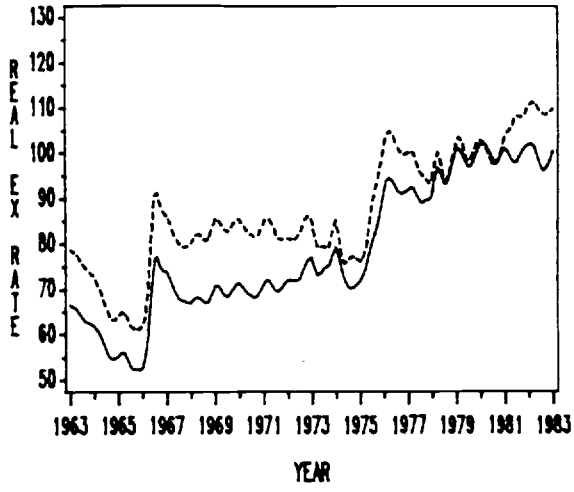
FIGURE 4.4

MULTILATERAL AND BILATERAL REAL EXCHANGE RATE

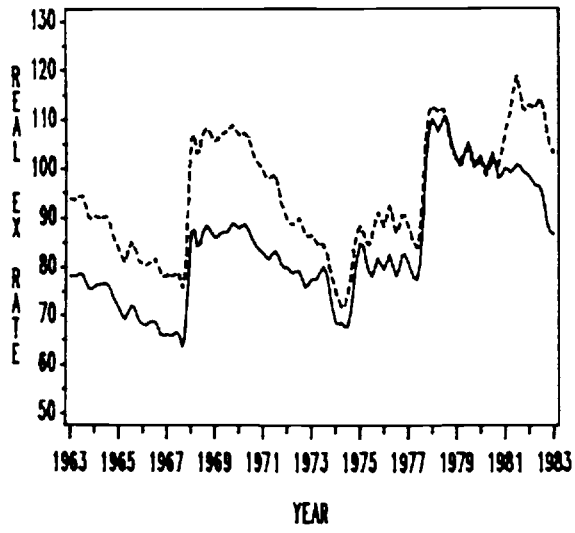
HONDURAS



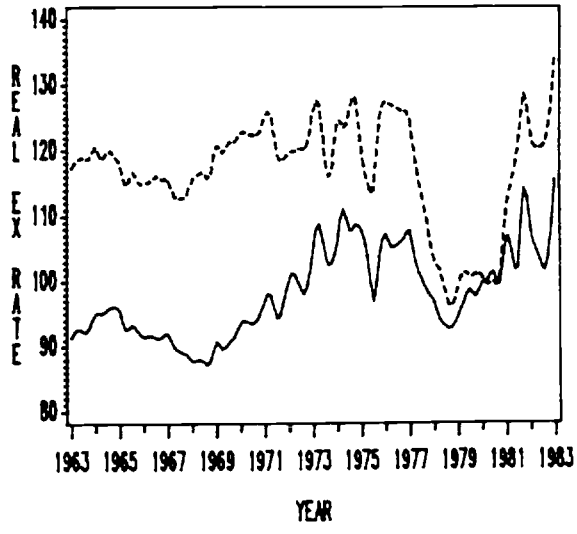
INDIA



ISRAEL



KENYA



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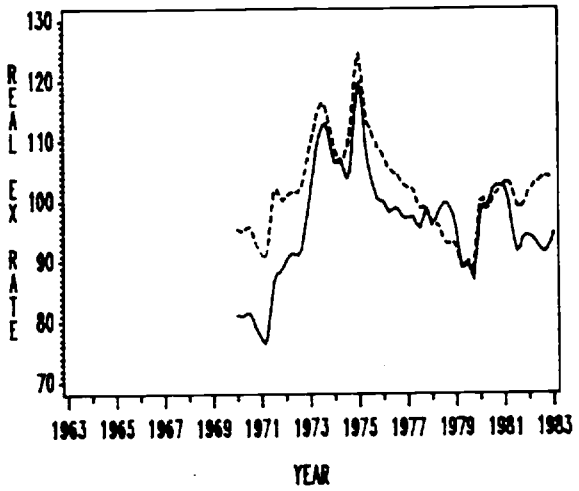
SOURCE: CONSTRUCTED FROM RAW DATA OBTAINED FROM THE I.F.S.

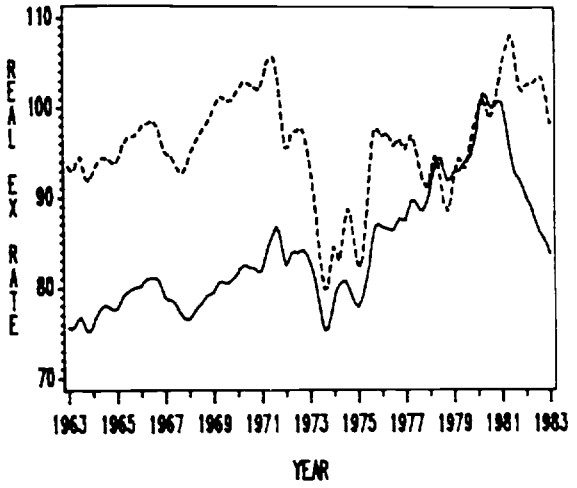
FIGURE 4.5

MULTILATERAL AND BILATERAL REAL EXCHANGE RATE

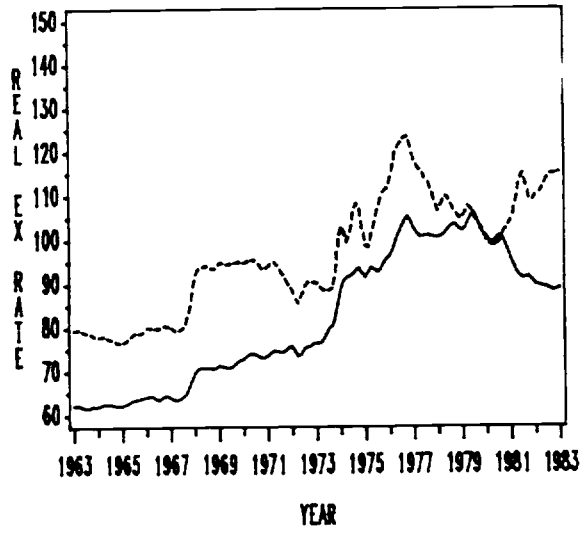
KOREA



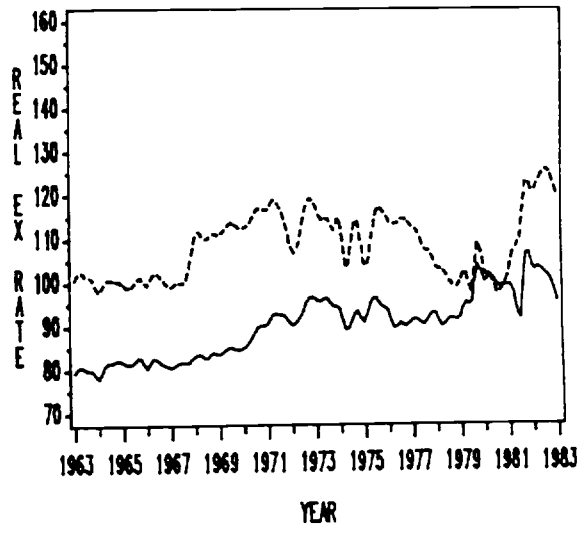
MALAYSIA



MALTA



MAURITIUS



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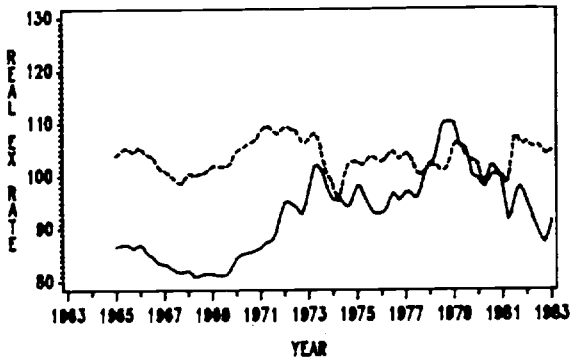
SOURCE: CONSTRUCTED FROM RAW DATA OBTAINED FROM THE I.F.S.

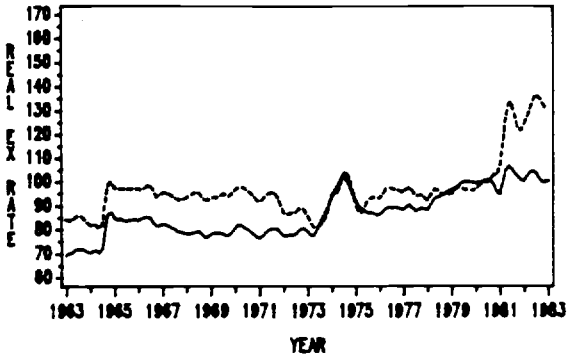
FIGURE 4.8

MULTILATERAL AND BILATERAL REAL EXCHANGE RATE

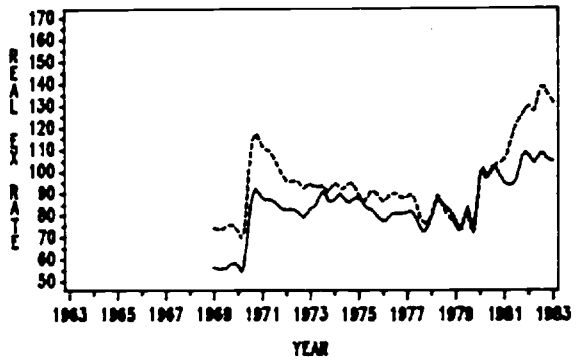
THAILAND



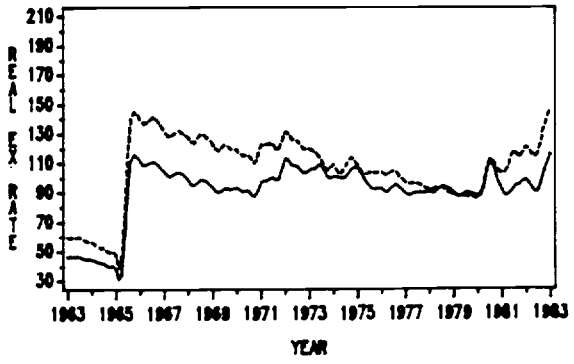
TUNISIA



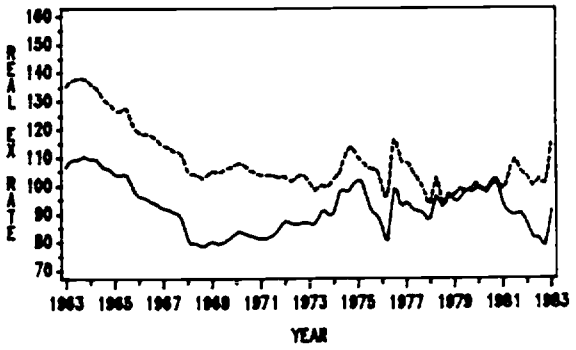
TURKEY



YUGOSLAVIA



ZAMBIA



MULTILATERAL _____ BILATERAL _ _ _ _ _ _

SOURCE: CONSTRUCTED FROM RAW DATA OBTAINED FROM THE I.F.S.

of MRER1 and MRER2 exceeded 0.9. And third, the behavior of the bilateral and multilateral RER indexes has been quite different in many of these countries. In 16 cases the coefficient of correlation between log MRER and log BRER was below 0.5 and in two countries it was even negative. These findings indicate that for most countries, and within a particular type of index -- bilateral or multilateral -- the selection of the price indexes used in the construction of the RER measure is not a major practical problem. The results also show that the bilateral and multilateral real exchange rate indexes move in different, and even opposite, directions. This means that when evaluating policy-related situations it is necessary to use or construct a broad multilateral index of real exchange rate. A failure to do this, can result in misleading and incorrect inferences regarding the evolution of a country's degree of competitiveness.

Trends and Variability

The real exchange rate indexes depicted in Figures 4-1 through 4-8 have two important characteristics. First they show that in most countries the real exchange rate has been fairly variable. Second, in spite of the observed variability, in several of these countries it appears that these indexes have not had significant long term trends during the whole period under consideration. For the shorter, more recent periods, however, negative trends can be detected in a number of cases.

Tables 2 and 3 contain data on the main statistical properties of the multilateral real exchange rate index MRER1 for our 33 countries. These indicators have been calculated for two periods of time: 1965-71 and 1972-85. The years 1965-71 correspond to the last years of the Bretton Woods period, where a majority of countries were pegged to the U.S. dollar. The last period, 1972-85, corresponds to the post-Bretton Woods era, a period

TABLE 2

Basic Statistical Properties of Multilateral Real Exchange Rate Index MRER1 (Quarterly Data 1965-1971)

	Mean	St. Dev.	C.V.	Max	Min
Bolivia	78.95	5.79	7.33	90.62	72.05
Brazil	62.73	9.05	14.43	92.37	50.02
Colombia	90.93	8.39	9.23	101.59	68.26
Cyprus	76.98	1.58	2.05	80.26	74.34
Dominican Republic	102.35	2.82	2.75	108.43	97.67
Ecuador	92.17	7.36	10.15	110.19	82.69
El Salvador	97.31	3.37	3.46	106.49	92.30
Ethiopia	108.06	2.82	2.60	115.09	102.51
Greece	86.66	2.34	2.70	92.53	83.65
Guatemala	87.48	2.63	3.00	94.02	83.13
Guyana	68.64	4.32	6.30	75.59	62.46
Honduras	81.11	1.61	1.98	85.14	78.03
India	66.90	6.77	10.12	76.53	52.45
Israel	78.10	9.12	11.68	88.88	65.72
Kenya	91.94	2.85	3.10	97.83	87.60
Korea	81.57	3.98	4.87	88.29	77.12
Malaysia	80.43	2.43	3.02	86.18	76.48
Malta	68.81	4.49	6.53	74.88	62.31
Mauritius	84.61	3.79	4.48	92.65	80.91
Mexico	96.82	2.00	2.06	100.04	51.09
Pakistan	53.31	2.32	4.35	58.12	-
Paraguay	84.53	3.63	4.29	91.40	56.82
Peru	64.95	4.20	6.47	72.29	56.39
Philippines	78.78	11.65	14.79	102.45	68.40
Singapore	88.28	3.04	3.45	94.47	83.89
South Africa	83.37	2.65	3.18	88.03	80.08
Sri Lanka	29.82	2.11	7.10	32.91	26.22
Thailand	84.45	2.67	3.16	91.09	80.99
Tunisia	80.74	2.68	3.32	85.23	76.41
Turkey	71.88	15.78	21.95	92.35	55.68
Yugoslavia	94.77	17.87	18.85	115.91	35.65
Zambia	87.72	8.25	9.41	104.05	78.96

Source: See text.

TABLE 3

Basic Statistical Properties of Multilateral Real Exchange Rate Index MRER1 (Quarterly Data 1972-1985)

	Mean	St. Dev.	C.V.	Max	Min
Bolivia	91.00	17.99	19.76	122.92	47.17
Brazil	82.38	16.30	19.79	115.23	61.85
Chile	93.47	26.44	28.29	147.66	18.67
Colombia	103.15	11.12	10.78	124.12	84.71
Cyprus	93.57	8.68	9.27	103.40	74.73
Dominican Republic	100.57	17.68	17.58	175.51	59.95
Ecuador	98.86	7.93	8.03	114.38	79.60
El Salvador	95.71	21.25	22.20	123.94	51.07
Ethiopia	100.09	17.65	17.63	140.18	64.27
Greece	98.35	4.03	4.10	112.29	90.38
Guatemala	94.60	7.85	8.30	108.46	67.93
Guyana	89.38	12.15	13.59	105.08	63.03
Honduras	92.94	9.47	10.79	106.10	74.58
India	90.93	11.01	12.10	105.30	70.44
Israel	89.42	11.39	12.74	110.68	67.91
Kenya	104.49	6.04	5.78	118.96	92.83
Korea	98.92	6.54	6.61	119.72	87.02
Malaysia	86.80	6.76	7.79	101.72	75.49
Malta	93.12	8.40	9.02	106.02	73.43
Mauritius	97.23	6.17	6.34	111.62	89.15
Mexico	106.72	15.70	14.72	148.95	85.06
Pakistan	97.59	10.81	11.07	125.48	54.81
Paraguay	90.81	17.43	19.19	131.60	56.82
Peru	87.07	16.40	18.83	117.96	61.64
Philippines	101.61	6.43	6.33	123.87	87.99
Singapore	88.68	6.41	7.23	100.99	75.84
South Africa	98.91	8.26	8.35	116.21	84.50
Sri Lanka	72.64	28.11	38.70	105.63	27.41
Thailand	96.42	5.77	5.98	110.21	84.85
Tunisia	95.32	8.87	9.30	107.50	77.51
Turkey	92.70	13.39	14.45	123.08	73.11
Yugoslavia	103.25	13.94	13.50	133.93	87.76
Zambia	95.43	17.32	18.15	213.73	79.12

Source: See text.

during which most advanced countries have adopted a dirty (or managed) floating nominal exchange rates system and most of the developing nations have maintained some kind of peg. The more important findings that emerge from these tables can be summarized as follows: First, as the diagrams suggested, real exchange rates have been quite volatile in many of these countries, with the extent of this variability being quite different across countries. For example, while in Zambia the difference between the maximum and minimum values of the index for the complete 1965-85 period surpasses 130 points, it was only 25 points in Singapore. A second fact that emerges from Tables 2 and 3 refers to the increased real exchange rate variability through time. A comparison of the coefficients of variation for 1965-71 and 1972-85 reveals that in all but 4 countries (Ecuador, Philippines, Turkey and Yugoslavia), the multilateral real exchange rate has been significantly more volatile during the post-Bretton Woods era.

In all of these countries a steady depreciation of the multilateral real exchange rate was observed until a certain date -- usually late 1970s -- and a fairly steep real appreciation has been detected since. Not surprisingly a number of these countries have pegged, or managed their currency against the U.S. dollar; as the U.S dollar appreciated in the first part of the 1980s so did these countries real exchange rates. It can also be identified a group of countries whose RERs have exhibited clear long term trends: Cyprus, India, Malta, Mauritius, Tunisia and Turkey have a definitively strong positive trend (i.e., the RER has depreciated through time), while Bolivia, Ecuador, Ethiopia, Paraguay and Zambia have exhibited a negative (real appreciation) long run trend. Finally, there are those countries whose RERs do not show a significant long term trend. However, in spite of the absence of a long term trend, in some of these cases, as in Kenya and Mexico, there

have been some fairly abrupt jumps in RERs usually as a result of major nominal devaluations. The degree of RER instability across these countries has also been fairly different, with Kenya, for example, being quite stable, while Mexico has exhibited a fair amount of instability.

In order to further investigate RER behavior, linear trends regressions were estimated for four time periods: 1965-1985, 1965-1971, 1972-1985 and the more recent period 1978-1985. For most countries the absolute value of the estimated coefficients for the whole period were small, although in most cases they were significant. A comparison of the number of negative signs of the trend coefficients in the earlier Bretton Woods era and the more recent period shows that during 1965-71 in only 8 out of the 33 countries the trend coefficient was small but negative, indicating a weak tendency towards appreciation. However, during 1978-85 in 23 out of 33 countries the trend coefficient was negative, and in some cases like Ecuador, Paraguay and Bolivia, fairly large.

4.2 Parallel Markets and RER Behavior: The Cross Country Evidence

The RER indexes used in the analysis of subsection 4.1 were constructed using data on official nominal exchange rates. However, as pointed out in Section 3 above, in many developing countries at different points in time there have been quite significant parallel (or black) markets for foreign exchange. The coverage and importance of these parallel market varies from country to country and from period to period. In some cases they are quite thin, and are mainly used by those nationals that want to spend their vacations abroad and are only allowed a limited quota of foreign exchange at the official rates. In other cases, the coverage of the parallel market is very broad and the parallel market exchange rate is the relevant marginal rate for most transactions. The degree of legality of these parallel

markets also varies from case to case. While in some cases they are quasi-legal and accepted by the authorities as a minor nuisance, in others they are strongly repressed with the authorities severely persecuting those that engage in black market transactions.

By the very nature of these markets -- illegal or quasi-illegal -- it is not possible to have accurate data on their volume of transactions and on their relative importance. However, there are relatively reliable data on parallel market quotations and parallel market premia. Generally speaking, the parallel market premium will become higher as exchange controls become more pervasive and generalized and as fewer transactions are allowed through the official market. In fact, under conditions of generalized exchange controls and rationing the RER indexes computed using official rates will become more and more irrelevant for a number of transactions and in particular for imports.

There is no reason why the parallel market RER index (PMRER) should move closely with the indexes constructed using the official nominal exchange rates. In fact, there are a number of circumstances under which, in a country with pegged nominal official rates, these two RER indexes will tend to move in opposite directions. This will be the case, for example, when there is a massive domestic credit creation under generalized exchange controls and active parallel markets. Under these circumstances, the higher growth of domestic credit will simultaneously generate an appreciation of the official RER index and a depreciation of the parallel market RER. In order to investigate this issue further coefficients of correlation between the parallel market RER and official RER bilateral indexes were calculated (see Edwards 1989a). The parallel market index was constructed as:

$$PMRER1_t = (PM)_t \frac{WPI^{US}}{CPI}$$

where $(PM)_t$ is an index of the parallel market bilateral nominal exchange rate with respect to the U.S. dollar, WPI^{US} is the U.S. wholesale price index and CPI is the domestic country consumer price index. PMRER1, then is the bilateral parallel index equivalent to BRER1 in Section 4.1. The results obtained clearly capture the fact that the parallel and official RER index indeed behave very differently. In fact in 13 out of the 28 cases the coefficients of correlation turned out to be negative!

5. Real Exchange Rate Volatility and Economic Performance[12]

An important finding on RER behavior reported in the previous section refers to the increased degree of volatility experienced by RERs. From a theoretical perspective it has been well established that real exchange rate disequilibrium and heightened uncertainty regarding RER behavior will have negative effects on economic performance (Willet, 1986). Empirically, however, there has been more difficulty finding evidence that supports these theoretical insights. According to the IMF (1984), for example, there is insufficient evidence linking increased real exchange rate instability to less active international trade. To quote the Fund (1984, page 36):

> The large majority of empirical studies on the impact of exchange rate variability on the volume of international trade are unable to establish a systematic significant link between measured exchange rate variability and the volume of international trade, whether on an aggregate or on a bilateral basis.

In its own empirical investigation the Fund found no empirical evidence of a relationship between exchange rate instability and bilateral trade flows for 7 industrial nations. Cavallo and Cotani (1985), however, were

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[12]This section draws partially on Edwards (1989d).

able to find some evidence on a negative relation between RER variability and economic performance. Their analysis looked only at bilateral rates and concentrated on official nominal exchange rates. We have seen above, however, that not only effective and bilateral rates behave in a significantly different way, but also, that black market and official rates many times move in opposite directions.

In this section we report some regression results on the relation between real exchange rate instability and economic performance using cross section data for 23 out of the 33 countries of the previous section.[13] The data were broken into two periods: 1965-1971 corresponding to the last six years of the Bretton Woods System, and 1978-1985 corresponding to the most recent period with an international floating exchange rate system. The analysis dealt with four different measures of economic performance: (1) average rate of growth of real GDP over each of the two periods considered; (2) average rate of growth of real GDP per capita; (3) average rate of growth of real export; and (4) average investment-output ratio. The regressions were estimated both in levels as well as in logs. The structural form of the equations actually estimated were:

$$X_n = \alpha + \beta\, \delta_n + \Sigma\, j_i\, Z_{ni} + \omega_n \tag{16}$$

and,

$$\log X_n = \alpha' + \beta' \log \delta_n + \Sigma\, j_i \log Z_{ni} + \epsilon_n \tag{17}$$

where the following notation has been used:

X_n - performance variable (average growth of GDP; average growth of exports; and average investment ratio) for country n.

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[13] These are the only countries for which there are data on all the required variables.

δ_n = coefficient of variation of the real exchange rate index for country n. Three indexes were considered: bilateral; effective and black market.

Z_{in} = other relevant variables.

ϵ_n, ω_n = error terms, assumed to have the usual properties.

Depending on the left hand side variable different Z_{in}'s were included. In the two output growth equations, two Z_{in}'s (i.e., "other" variables) were incorporated to the regressions: investment-output ratio and variability (coefficient of variation) of the international terms of trade. The investment variable was incorporated as a way to capture the effects of capital accumulation in explaining cross country growth differentials. Its coefficient is expected to be positive. The terms of trade variability was added in an effort to incorporate other sources of external instability faced by these nations, and its sign is expected to be negative. In the growth of exports equations the variability index of the terms of trade was the only Z_{in} included; its sign is expected to be negative. Finally, in the investment ratio equation no additional variables (Z_{in}'s) were incorporated.

Our interest is to find out whether greater real exchange rate instability has indeed been associated to some kind of "poorer" economic performance. In terms of equations (15) and (16) we are interested in testing whether the coefficients β and β' are significantly negative, or if as suggested by the IMF, there has been no relation between exchange rate instability and economic performance. The output growth equations performed better when they were estimated in levels. The exports and investment equations, on the other hand, generated better fits when estimated in logs. For the sake of saving space we only report the better results. Other estimates, including those obtained when nonlinear terms were added, are

available from the author on request.

Tables 4 through 6 contain the regression results obtained when "official" RER indexes were used in the computation of the RER variability measure. A number of interesting results emerge from these tables. In particular, there seems to be a definite difference in the way these variables have interacted during the Bretton Woods and the floating rates periods. The results are quite strong in indicating a structural break between the two periods. While real exchange rate instability played no role in the Bretton Woods era, they help explain cross country differentials in economic performance during the more recent period. Moreover, during the more recent floating rates era there is a quite clear negative relation between real exchange rate instability and our real performance measures.

Table 4 contains the regression results for the average rate of growth of real GDP and real GDP per capita. The results are quite satisfactory, especially for the floating rates era. The R^2s indicate that a fairly significant fraction of the variability of average rates of growth across countries can be explained by these equations. Not surprisingly, the investment ratio is positively related to the average rates of growth. Those countries that accumulate capital more rapidly have generally grown at a faster average rate. This result holds both for the Bretton Woods period as well as for the floating rates period. Notice, however, that there is a marked difference in the magnitude of the coefficients. For the more recent era the point estimates are almost one half of those obtained for the Bretton Woods period. As noted, the coefficients of the RER variability indexes are quite different across periods. The results do provide quite strong support to the hypothesis that, during the floating rates period, higher real exchange rate instability has been associated to poorer economic

TABLE 4

Cross Country Regressions: Average Growth of
Real GDP and Real Exchange Rate Variability,
1965-1971 and 1978-85 (OLS)

		Variability of RER		Investment	Variability	
Period	Constant	Bilateral	Effective	Ratio	T of T	R^2
65-71	1.716	-0.091	-	0.303	-0.068	0.306
	(0.600)	(-0.747)		(2.436)	(-0.457)	
65-71	1.460	-	-0.086	0.310	-0.056	0.302
	(0.519)		(-0.681)	(2.428)	(-0.383)	
78-85	1.898	-0.185	-	0.194	-0.043	0.579
	(1.036)	(-3.044)		(3.261)	(-0.895)	
78-85	2.244	-	-0.279	0.157	-0.016	0.532
	(1.120)		(-2.593)	(2.500)	(-0.300)	

Numbers in parentheses are t-statistics.

Table 5

Cross Country Results: Investment Ratio and Real Exchange Rate Variability, 1965-71 and 1978-86 (OLS)*

		log of RER Variability		
Period	Constant	Bilateral	Effective	R^2
65-71	2.886 (64.113)	0.038 (0.626)	-	0.013
65-71	2.839 (24.464)	-	0.033 (0.507)	0.009
72-85	3.203 (39.849)	-0.158 (-2.092)	-	0.127
72-85	3.472 (16.940)	-	-0.173 (-2.048)	0.123

*The dependent variable is the log of the gross investment to GDP Ratio.

Table 6

Cross Country Regressions:

Export Growth and RER Variability,

1965-1971 and 1978-85 (OLS)*

Period	Constant	log of Variability		log of Variability	R^2
		Bilateral RER	Effective REER	T of T	
1965-71	2.067 (1.715)	-	-0.121 (0.296)	-0.664 (-1.487)	0.147
1965-71	2.644 (6.488)	-0.333 (-1.615)	-	-0.145 (-0.953)	0.195
1978-85	1.353 (2.928)	0.326 (0.898)	-	0.099 (0.205)	0.067
1978-85	0.917 (1.207)	-	0.286 (0.789)	0.019 (0.093)	0.054

*The dependent variable is the log of the average rate of growth of real exports.

Numbers in parentheses are t-statistics.

performance. It is interesting to note that the coefficients of the index of variability of the real effective rate are higher than those of the index of variability for the real bilateral rate. In all equations the index of instability of external terms of trade turned out to be non-significantly different from zero.

How can we account for the differences in the results for the Bretton Woods and floating rates period? A possible explanation lays on the different nature of real exchange rate instability in both periods. During the old institutional arrangements real exchange rate movements were much more predictable, since the institutional framework rule out wide daily fluctuations in third parties bilateral exchange rates.

Table 5 presents the regression results for the investment equation. A double log specification was used. In many ways these results are similar to those on real output growth, indicating that during the floating rates period there has been a pretty strong negative relation between the degree of real exchange rate instability and investment. Notice, however, that these equations only explain a very low percentage of the cross country variation of investment ratios. Finally, Table 6 contains the results for the export growth equations. Interestingly enough, these results are in line with those of the IMF, indicating that there is no significant connection between RER instability and exports performance. However, a word of caution related to measurement is needed here. The exports growth data used in these regressions refer to exports in real U.S. dollars, and have been computed as the rate of growth of exports in U.S. dollars deflated by the U.S. WPI. There is, then, a potential valuation problem that may be responsible for the fact that the coefficients of the variability indexes are nonsignificant.

The reports reported above were obtained using indexes of instability of RER which were constructed using official data on nominal exchange rates. However, as was shown in Section 4 above, in the developing countries many times there are significant departures of the black market rate from the official rates. For this reason performance equations using instability of black market rates were also estimated. The following result was obtained for the floating rates period and for the rate of growth of real GDP.

$$\text{Growth Real GDP} = \underset{(1.812)}{2.507} - \underset{(-3.445)}{0.190}\ \text{Variability BMRER} + \underset{(2.939)}{0.166}\ \text{Investment Ratio} - \underset{(-0.910)}{0.004}\ \text{Variability T of T}$$

$$R^2 = 0.646$$

This result supports our previous findings, indicating that higher real exchange rate instability has been clearly associated with poorer economic performance (i.e., real growth) during the Bretton Woods period. the interesting thing here is that since we are dealing with black market instability, this measure is clearly dependent on the policies followed by the government. In order to further analyze these issues regressions including both official RER instability and variability of the black market RER were estimated. This allows us to have some idea of how, with other things given, each of these sources of instability have affected economic performance:

$$\text{Growth Real GDP} = \underset{(1.767)}{3.208} - \underset{(-1.427)}{0.711}\ \text{Variability RER} + \underset{(2.767)}{0.153}\ \text{Investment Ratio} + \underset{(0.176)}{0.009}\ \text{Variability T of T} - \underset{(-2.239)}{0.138}\ \text{Variability BMRER}$$

$$R^2 = 0.694$$

6. Concluding Remarks

In this paper I have analyzed some of the most important aspects related to the concept and measurement of real exchange rates. In addition I have provided an empirical analysis of real exchange rate behavior in a large group of developing countries. The discussion emphasized that it is crucially important to make a distinction between equilibrium and disequilibrium changes of real exchange rates. For this purpose I presented an intertemporal model of equilibrium real exchange rate behavior in a fully optimizing economy, and I discussed how alternative macroeconomic policies can result in real exchange rate misalignment.

The empirical analysis showed that in the recent years bilateral and multilateral real exchange rates have exhibited markedly different behavior. This indicates that ignoring those problems emerging from the existence of floating rates international monetary system can result in greatly biased policy recommendations. It is also pointed out that in a large number of developing countries parallel markets for foreign exchange can be quite important. This means that in these cases using RER constructed with official nominal rates can also result in misleading conclusions.

Finally, in this study I investigate empirically the effects of real exchange rate variability on economic development in a group of developing countries. It is found using a cross section data set that higher RER volatility has been associated with lower output growth and lower investment. There are no indications, however, that higher variability in the RER affects the level of exports.

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