REAL EXCHANGE RATE MISALIGNMENT IN DEVELOPING COUNTRIES: 
ANALYTICAL ISSUES AND EMPIRICAL EVIDENCE

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REAL EXCHANGE RATE MISALIGNMENT IN DEVELOPING COUNTRIES:

ANALYTICAL ISSUES AND EMPIRICAL EVIDENCE*

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ABSTRACT

This paper analyzes some of the more important aspects of real exchange rate misalignment in development countries. Some of the discussion is at the analytical level. A number of examples and real world situations are used to illustrate different points. Also, a large cross-country data is used to investigate problems related to real exchange rate behavior and with devaluations.

The paper is divided into four parts. Part I deals with the definition and measurement of the real exchange rate. Part II analyses equilibrium involvement of the real exchange rate. The main point made here is that the equilibrium real exchange rate is not an immutable number; on the contrary, it is a function of a number of variables. This part looks at how the equilibrium real rate changes when there are changes in import tariffs, export taxes, productivity gains, capital plans, and terms of trade. The dutch-disease case is also investigated in detail. Part III deals with real exchange rate misalignment and devaluation crises. Fifty-two devaluation episodes in the developing countries are identified and the events leading to the devaluation are scrutinized. Part IV deals with real exchange rate realignment and nominal devaluations. It is argued that the effectiveness of nominal devaluations as a policy tool to generate real devaluations will depend on the macro policies pursued alongside with it. Using a large cross-country data set it was found that, if accompanied by proper macro policies, nominal devaluations can result in quite substantial real devaluations in the medium run.
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1. Introduction

The exchange rate has been at the center of recent economic debates regarding developing countries. For example, Cline (1983) 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 of time have resulted in the dramatic deterioration observed in that continent's agricultural sector and external position (Gulhati et al, 1985). Still other experts have (i.e., Corbo et al, 1986) 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. 1/

There is little doubt that during the last 15 years of so, the exchange rate has claimed a crucial role in the economic literature devoted to economic performance and policies in developing countries. The type of exchange problems that developing countries (and developed countries, for that matter) face are varied. They are related, among other things, to issues like the promotion of nontraditional exports, economic instability, imported inflation, capital flight, and foreign investment. However, 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

1/ It should be noticed, however, that some authors have argued that the (relative) 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.
respect to its long-run equilibrium value. There is general agreement that maintaining the real exchange rate at the "wrong" level results in significant welfare costs. \(^2/\) On one hand, it generates incorrect signals to economic agents; on the other, it results in greater economic instability. The problem of real exchange rate misalignment is periodically addressed by policymakers. The typical questions deal with determining whether the exchange rate is indeed overvalued, and if so, by how much. Directly related questions refer to how to handle this overvaluation. From a policy perspective, one of the most important issues refers to the effectiveness of nominal devaluations to restore real exchange rate equilibrium (i.e., to correct the degree of overvaluation). Related questions deal with possible alternatives to devaluations, and with side effects of devaluations on variables like output, interest rates, inflation and employment.

The purpose of this paper is to analyze some aspects of the exchange rate misalignment problem in developing countries. The approach taken here emphasizes three important points: First, since real exchange rate misalignment (i.e., overvaluation) is defined relative to the long-run equilibrium value of the real exchange rate, it is crucial to first understand the process of determination of the equilibrium real exchange rate. Part II of the paper deals extensively with equilibrium movements of real exchange rates. In particular, it analyzes how the long-run equilibrium real exchange rate changes when its close determinants change. The effects of productivity changes, terms of trade changes, commercial policy and capital movements on

\(^2/\) On the welfare costs of disequilibrium real exchange rates, see Johnson's (1965) classical article. See, also, the recent analysis by Willet (1976).
the long-run equilibrium real exchange rate are discussed in detail. A crucial point made in this part is that the equilibrium real exchange rate is not a constant number; it can change, and does change through time, depending on the behavior of its fundamentals.

The second point emphasized in this study is that the effectiveness of nominal devaluations as a means to affect the real exchange rate will heavily depend on the initial conditions and on the macro policies pursued side by side with the devaluation. If the initial conditions are characterized by an acute overvaluation of the domestic currency, a nominal devaluation (with other things given) will tend to be successful, in the sense that it will help to restore the equilibrium in the real exchange rate. In this context the fundamental role of a devaluation is to generate a smoother transition towards a new equilibrium. On the contrary, if the initial condition is one of real exchange rate equilibrium, the nominal devaluation will basically have no real effect.

The third point emphasized in this study is that there is no single method for assessing the degree of misalignment of the real exchange rate in a particular country. The analysis of sustainability of real exchange rates is a difficult one that requires combining several tools, including (i) the comparision of real exchange rate indexes through time; (ii) the evolution and expected future behavior of the fundamentals that determine the long-run equilibrium value of the real exchange rate and; (iii) the expected future behavior of underlying sustainable capital flows. The fact of the matter is that when it comes to assessing the degree of misalignment of real exchange rates there is no alternative to the detailed painstaking country specific analysis. This view has also been taken by two recent studies on the subject.
dealing with the case of the developed countries (Artus and Knight, 1984; Williamson, 1983). However, these types of country-specific analyses can, and should, be performed using a common framework that emphasizes some of the fundamental aspects of equilibrium and disequilibrium real exchange rates. In that regard, the present study is useful since it reviews in detail, within this general framework, different aspects of real exchange rate behavior that are important for addressing the disequilibrium issue. Also the extensive empirical work presented here provides substantial cross-country evidence regarding the empirical definition of the real exchange rate, real exchange rate misalignment (i.e., devaluation crises), the effectiveness of devaluations and the empirical relation between the real exchange rates and its theoretical determinants.

Even though this paper does not provide an exhaustive treatment of all issues related to exchange rates in developing countries, its does provide a discussion on the more salient aspects of this problem, which presumably will be helpful to better understand the issues associated with real exchange rate misalignment. The paper is organized in the following form: In part one a brief discussion related to the definition and measurement of the real exchange rate is provided. Here some emphasis is placed on the use of alternative indexes and on the differences between bilateral and effective (i.e., basket) real exchange rates. In part two a discussion on equilibrium movements of real exchange rates is presented. This part analytically traces how different variables affect the equilibrium real exchange rate. The analysis emphasizes the interaction between commercial policies, terms of trade, capital inflows, productivity gains and the equilibrium real exchange rate. In parts three and four empirical analysis of 52 devaluation episodes
is presented. Part three deals with the period leading to these devaluations and analyzes the behavior of the real exchange rate and of international reserves. Part four analyzes the aftermath of the devaluations and enquires whether the devaluation indeed helped to generate a real exchange rate realignment. In this part the role of complementary policies is stressed. Finally, in part four some concluding remarks and policy recommendations are also provided.
PART ONE:

THE REAL EXCHANGE RATE:

DEFINITION AND MEASUREMENT PROBLEMS
2. **The Real Exchange Rate**

Exchange rates play a crucial role in determining the external position of a particular country. The long-run external (i.e., current account) equilibrium position of a country will be affected by the *real exchange* as opposed to the *nominal exchange* rate. It is indeed the *real exchange rate* that determines (among other variables) the trade and current accounts behavior. In the literature, however, there has been some disagreement regarding the definition of the real exchange rate. In this section, some of the alternative definitions offered in the literature are reviewed and discussed. The concept of "equilibrium" real exchange rate is introduced, and a distinction between the concepts of long-run sustainable equilibrium real exchange rate and short-run equilibrium real exchange rate is made. Finally in this section, the difference between equilibrium and disequilibrium real exchange rates is 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...

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rates of inflation. In this context a number of writers also refer to the real exchange rate as the Purchasing-Power-Parity (PPP) exchange rate. 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. 4/

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 (1980, 1984), Bruno (1983), and Williamson (1983a)]. 5/ It should be noted, however, that there is no universally accepted definition of "the" real exchange rate. Indeed, some authors even object to the idea of even considering that an exchange rate -- a nominal concept by definition -- could become a real variable [see Maciejewski (1985)]. Some authors still use the PPP 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

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5/ Connolly and Lackey (1983) have recently proposed a new definition of the real exchange rate, which they call the real monetary parity. This measure is defined as the nominal exchange rate times the ratio of the domestic to foreign stocks of money. In their empirical analysis of the Mexican case they found that the real monetary parity departed significantly from the more traditional measure of $e$. 


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:  

$$
e = \frac{E^*_T}{P_N}$$

(2.1)

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 and current accounts 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 current account is equal to the excess supply for tradable goods. Assuming the supply for tradables depends positively on the relative price of tradables ($E^*_T/P_N$) 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 real exchange rate. 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 improved current account. 7/ The real exchange rate, defined as the relative price of tradables to nontradables, then, captures the degree of

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

7/ On this type of models, see, for example Dornbusch (1980) and Mussa (1984a, 1984b). Notice that since, as explained below, the real exchange rate defined as in (2.1) 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.
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. 8/

As mentioned, in this paper and following the most recent literature,
this definition of the real exchange rate -- the relative price of tradables
over nontradables -- will be used during most of the analysis. In order to
have a clear understanding of the concepts involved, it is interesting to
compare the tradables-nontradables relative price definition with the (old)
PPP definition of the real exchange rate. The PPP real exchange rate is
defined as:

\[ e_{PPP} = \frac{P^*}{P} \]  
(2.2)

where \( P \) and \( P^* \) are domestic price indexes. Assuming that these indexes are
geometric weighted average of tradable and nontradable prices:

\[ P = P^\alpha \frac{1-\alpha}{N_T}; P^* = P^* \frac{\beta}{N_T} \]

Further assuming that the country in question is a small country and that the
law of one price holds for tradable goods (i.e., \( P_T = P_T^* \)), it is possible to
find the relation between percentage changes in the real exchange rate as
defined in (2.1) and the PPP real exchange rate (where, as usual, the "hat"
operator (\( \hat{} \)) represents percentage change):

8/ Williamson (1983a) writes: "[I]nternational competitiveness of our
goods,...can ceteris paribus be identified with the real exchange
index values [of the real exchange rate] may provide some broad indication
of the gain or loss in price (cost) competitiveness..." See also
\[
\hat{e} = (1/\alpha)\hat{e}_{ppp} + (\beta/\alpha)(\hat{P}_T^* - \hat{P}_N^*) 
\]  

(2.3)

From (3) it is possible to see, then, that in general, changes in the two definitions of the real exchange rate will differ (i.e., \(\hat{e} \neq \hat{e}_{ppp}\)). Further, 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) and the magnitudes of these misalignments. In this section the literature on the equilibrium real exchange rate is briefly and selectively reviewed. Also, a simple model of the long-run sustainable equilibrium is developed. This model is then used to highlight some of the

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

A common confusion sometimes 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 in equation (2.1), there is no reason for them to be equivalent. In fact, as will be discussed below (Section 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 showed, using a cross-country data set, that these two variables have tended to behave quite differently in the recent years. See also Edwards (1983, p. 60).
important aspects related to the equilibrium real exchange rate that are
covered in the rest of this study.

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 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) has 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 tradables and a nontradables sector. It is assumed that the production
of tradables depends positively on the real exchange rate, while the
production of nontradables depends negatively on the real exchange rate. On
the other hand, the demand functions for tradables and nontradables are
assumed to depend on the real exchange rate and real expenditure. The equi-
librium 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 e [Dornbusch (1980),
pp. 102-3]. Dornbusch also discusses how, under the assumptions of complete
price flexibility and full employment, different disturbances will affect the equilibrium real exchange rate (Dornbusch 1980, pp. 103-8).

A problem with a number of models on the equilibrium real exchange rate is that they do not allow for a distinction between the effects of temporary and permanent changes in the real exchange rate determinants. Once this distinction is made, it is then possible to define both a short- and a long-run equilibrium real exchange rate. This distinction can be crucial in some policy discussions. For example, 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 long-run equilibrium. This possibility has recently been emphasized by a number of authors including Williamson (1983b), Harberger (1983), Edwards (1984), Isard (1983), and Mussa and Frenkel (1984). This case will arise whenever the determinants of the equilibrium real exchange rate experience temporary changes. 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 important 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. 10/ 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)

In his recent monograph, 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 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)

The long-run equilibrium real exchange rate is defined, then, as the relative price of tradables to nontradables that is consistent with long-run sustainable external equilibrium. This long-run equilibrium real exchange rate should also be compatible with internal (i.e., full employment) equilibrium, and with the long-run desired levels of protection. Some of the

10/ What we have called here the long-run sustainable equilibrium real exchange rate is (somewhat) equivalent to Williamson's (1983) fundamental equilibrium real exchange rate.
elements affecting the long-run equilibrium real exchange rate can be captured
by the following simple model. 11/

\[(CA/y) + (KA/y) - (\Delta R/y) = 0\]  \hspace{1cm} (2.3)

\[(D/y)^* = d^*\]  \hspace{1cm} (2.4)

\[(R/y)^* = s^*\]  \hspace{1cm} (2.5)

\[(\Delta y/y)^* = \lambda\]  \hspace{1cm} (2.6)

\[KA = \Delta D\]  \hspace{1cm} (2.7)

\[(CA/y) = \alpha e - \beta z - r^f(D/y)\]  \hspace{1cm} (2.8)

where CA is the current account, KA is the capital account, D is the stock of
foreign debt, R are international reserves, y is real output and \(r^f\) is the
world real interest rate. Equation (2.3) is simply the external sector
constraint. It has been written relative to real output, and states that the
sum of the current and capital accounts have to be equal to the accumulation
or decumulation of international reserves. Equation (2.4) and (2.5) say that
in long-run equilibrium, there are desired (or sustainable) ratios of foreign
debt to output and reserves to output [see Harberger (1983a,b), Cohen and
Sachs (1986)]. These equilibrium ratios are denoted by \(d^*\) and \(s^*\). These
ratios will not be completely fixed; but will be functions of some other
fundamental variables. For example, \(d^*\) will depend, among other things, on
the perceptions lenders have on the country's ability to pay its foreign debt,
and in the lenders' perception of the degree of profitability in the borrowing

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11/ This model is fairly simple. In particular, it ignores dynamic aspects,
concentrating on the long-run equilibrium. A more detailed model will
replace equation (2.3) by an expression that would establish that the
external sector should e in equilibrium in a net present value sense.
country. S*, on the other hand, will depend on those variables determining the desired level of international reserves [see Frenkel (1983b)].

Equation (2.6) expresses the assumption that the long-run (i.e., steady state) rate of growth of output is equal to λ. Equation (2.7) captures the fact that at any moment in time the capital account is equal to the change in the gross foreign debt. Finally, equation (2.8) relates the current account, as a proportion of output, to its determinants. Following Hooper and Morton (1982), Mussa (1984), and Frenkel and Mussa (1984), it is assumed that the current account (as a fraction of real output) depends positively on the real exchange rate -- this assumes that the Marshall-Lerner condition holds -- and negatively on other variables summarized by the vector z. This vector will include variables like the level of imports protection (tariffs), foreign exchange restrictions and terms of trade, among others. The term rFD in (2.8) is the service account, and is equal to the (real) amount of interest payments on the foreign debt. 12/

From equation (2.3) it can be seen that once the long-run equilibrium capital account and balance of payments (as a proportion of output) are determined, the long-run sustainable current account can be found as a residual. 13/ Once the long-run equilibrium current account is found, it is possible to solve for the value of the real exchange rate required to achieve this long-run equilibrium. This, of course, will be the long-run equilibrium real exchange rate (e). In equilibrium, net capital flows, defined as gross

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13/ This statement is, of course, a simplification, since in reality all these accounts are determined simultaneously.
flows minus interest payments on the foreign debt (net capital flows \( \Delta D - r^f D \)) will be proportional to \((\lambda - r^f)\). This means that to the extent that the rate of growth of output exceeds the world's real rate of interest (i.e., \( \lambda > r^f \)), a country can (permanently) receive a positive net inflow of capital, which would be compatible with a constant debt-output ratio.

From equation (2.2), and using the fact that in long-run equilibrium the desired debt-output and reserves-output ratios are given by equations (2.4) and (2.5), the long-run sustainable current account as a fraction of output \((\bar{CA}/y)\) will be:

\[
(\bar{CA}/y) = \lambda s^* - \lambda d^*
\]  

(2.9)

Then, using (2.9), (2.4) and (2.8), the long-run equilibrium real exchange rate \(\bar{e}\) will be equal to

\[
\bar{e} = (\beta/\alpha) z + (1/\alpha) \left[ \lambda s^* - (\lambda - r^f) d^* \right]
\]  

(2.10)

Equation (2.10) provides some clues on how changes in some of the variables affecting external equilibrium will generate important changes in the equilibrium real exchange rate. For example, this equation indicates that

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14/ This follows from \((\Delta D - r^f D)/y = \lambda d^* - r^f d^* = d^*(\lambda - r^f)\).

15/ This proposition provides an important clue to the recent foreign debt problems of LDCs. In the early 1980s there was a sharp decline in \(\lambda\) and a dramatic increase in \(r^f\). This means that in order to maintain a constant debt-output ratio, a capital outflow would have had to take place. However, capital continued to flow into LDCs, resulting in a large increase of the debt-output ratio, over and above its sustainable level \(d^*\). Once the international banking community realized that actual \(d\) greatly exceeded \(d^*\), it abruptly halted the flow of capital into LDCs. Also, the realization that these LDCs had run into serious payment problems resulted in the international banking community (and also the borrowing countries) reassessing its (their) perception of what the value was of \(d^*\), the sustainable long-run debt-output ratio.
a higher world interest rate \( r^f \) will require in an increase in \( e \) (a real depreciation) in order to maintain the current account at its level of sustainable long-run equilibrium. On the other hand, a higher rate of growth of output (\( \lambda \)) could in principle generate either an equilibrium real appreciation or real depreciation. However, under the more realistic assumption that \( d^* > s^* \), a higher \( \lambda \) will require a real equilibrium appreciation (i.e., a reduction in \( e \)).

Also, according to equation (2.10), an increase in the equilibrium debt-output ratio (\( d^* \)) will also result in a real appreciation of the equilibrium long-run real exchange rate, provided that \( \lambda > r^f \). This is an important result, since some policies aimed at liberalizing and opening up the economy will usually tend to result in a higher equilibrium \( d^* \). This is the case, for example, of a liberalization reform aimed at opening the capital account of the balance of payments. To the extent that this reform is accompanied by a policy package that includes liberalizing the domestic capital markets, eliminating the fiscal deficit and reducing import tariffs, the international financial community will increase what it considers to be an adequate debt ratio for that particular country [see McKinnon (1973, 1984), Edwards (1984d)].

A number of other variables affecting the equilibrium real exchange rate -- like the terms of trade and commercial policy -- are captured by vector \( z \) in equation (2.10). In Part II of this paper, the way in which different variables, including those discussed here, affect the equilibrium real exchange rate will be analyzed in detail.
3. Measurement Problems

From an empirical point of view the first question that should be addressed is: how should the real exchange rate be measured? From equation (2.1) -- which defines the real exchange rate as the relative price of tradables to nontradables -- it is apparent that the main measurement problems are those related to the selection of the real-world counterparts of $P_T^x$ 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 $e$, 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. The behavior of some of these alternative measures will be empirical compared for a group of 14 developing countries. The analysis will deal both with unilateral and with multilateral (i.e., basket) real exchange rates.

As expressed in equation (2.1) $e$ should measure 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 \( e \) should be found. In some respects, the selection of the appropriate proxies for \( P_N \) and \( \frac{P_N}{P_T} \) resembles the definition of the adequate price levels in the old discussions of the Purchasing-Power-Parity theory (see, for example, Keynes 1924, Viner 1929, 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 old 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). 16/ Also some authors have suggested to use 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.

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16/ 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 Footnote 5 and Williamson (1983b). See also Connolly and Lackey's (1983) proposition for using the "real monetary parity." See footnote 3 above.
Of course, none of these indexes is perfect and all of them present some advantages and some 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; in section 3.2 below, the question of bilateral versus multilateral real exchange rates will be tackled in detail.

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 [see Tyler (1973) and Porzecanski (1978)]. 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). 17/ 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 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 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 1975, 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 for this is 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

17/ This criticism implicitly assumes that the "law of one price" holds for homogeneous tradable goods. See, however, Kravis and Lipsey (1978) and Isard (1977).
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 by the more traditional price indexes to construct proxies for the domestic price of tradables and untradables. For example, Lipsey and Kravis (1983) have suggested using (for most countries) the GDP deflator for services and government 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 of 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.

However, from a practical point of view and for most purposes, it is advisable to stick to real exchange rate indexes constructed from 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 How different are the traditional measures of the real exchange rate?

Annual bilateral comparisons

From an empirical point of view an important question is, how different are in practice the alternative measures of the real exchange rate? If it turns out that they are very similar, the problem of selecting an appropriate measure for $e$ is significantly reduced. On the contrary if they are very different, the problem of choosing an adequate $e$ becomes more
Table 1. CORRELATION COEFFICIENTS BETWEEN eC AND eW, eMW, eD: ANNUAL DATA

<table>
<thead>
<tr>
<th>Country</th>
<th>$\rho_{eC,eW}$</th>
<th>$\rho_{eC,eMW}$</th>
<th>$\rho_{eC,eD}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greece</td>
<td>0.819</td>
<td>0.650</td>
<td>0.980</td>
</tr>
<tr>
<td>Ireland</td>
<td>0.965</td>
<td>0.937</td>
<td>0.980</td>
</tr>
<tr>
<td>Turkey</td>
<td>--</td>
<td>0.722</td>
<td>--</td>
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<tr>
<td>Yugoslavia</td>
<td>0.764</td>
<td>0.444</td>
<td>0.989</td>
</tr>
<tr>
<td>Colombia</td>
<td>0.960</td>
<td>0.682</td>
<td>0.985</td>
</tr>
<tr>
<td>Ecuador</td>
<td>0.929</td>
<td>0.362</td>
<td>0.955</td>
</tr>
<tr>
<td>El Salvador</td>
<td>0.573</td>
<td>0.501</td>
<td>0.843</td>
</tr>
<tr>
<td>Guatemala</td>
<td>0.867</td>
<td>0.371</td>
<td>0.929</td>
</tr>
<tr>
<td>Mexico</td>
<td>0.945</td>
<td>0.783</td>
<td>0.802</td>
</tr>
<tr>
<td>Israel</td>
<td>0.908</td>
<td>0.386</td>
<td>0.361</td>
</tr>
<tr>
<td>India</td>
<td>0.887</td>
<td>0.328</td>
<td>0.803</td>
</tr>
<tr>
<td>Korea</td>
<td>--</td>
<td>0.619</td>
<td>0.744</td>
</tr>
<tr>
<td>Pakistan</td>
<td>0.958</td>
<td>0.838</td>
<td>0.939</td>
</tr>
<tr>
<td>Singapore</td>
<td>0.077</td>
<td>0.727</td>
<td>0.917</td>
</tr>
</tbody>
</table>
REAL EXCHANGE RATE, VARIOUS MEASURES
1975=100
COUNTRY=INDIA

TIME IN YEARS

SQUARE=NOMINAL EXCH. RATE × (US CPI/ DOMESTIC CPI)
DIAMOND=NOMINAL EXCH. RATE × (US WPI/ DOMESTIC WPI)
TRIANGLE=NOMINAL EXCH. RATE × (US GNP DEF./ DOMESTIC GDP DEF)
STAR=NOMINAL EXCH. RATE × (US MFG. WAGE/ DOMESTIC MFG WAGE)
REAL EXCHANGE RATE, VARIOUS MEASURES
1975=100
COUNTRY=EL SALVADOR

TIME IN YEARS

SQUARE=NOMINAL EXCH. RATE × (US CPI/ DOMESTIC CPI )
DIAMOND=NOMINAL EXCH. RATE × (US WPI/ DOMESTIC WPI )
TRIANGLE=NOMINAL EXCH. RATE × (US GNP DEF./ DOMESTIC GDP DEF)
STAR=NOMINAL EXCH. RATE × (US MFG. WAGE/ DOMESTIC MFG WAGE)
REAL EXCHANGE RATE, VARIOUS MEASURES
1975=100
COUNTRY=GREECE

TIME IN YEARS

SQUARE=NOMINAL EXCH. RATE \times ( US CPI / DOMESTIC CPI )
DIAMOND=NOMINAL EXCH. RATE \times ( US WPI / DOMESTIC WPI )
TRIANGLE=NOMINAL EXCH. RATE \times ( US GNP DEF. / DOMESTIC GDP DEF )
STAR=NOMINAL EXCH. RATE \times ( US MFG. WAGE / DOMESTIC MFG WAGE )
REAL EXCHANGE RATE, VARIOUS MEASURES
1975=100
COUNTRY=Ecuador

TIME IN YEARS

SQUARE=NOMINAL EXCH. RATE * (US CPI/DOMESTIC CPI)
DIAMOND=NOMINAL EXCH. RATE * (US WPI/DOMESTIC WPI)
TRIANGLE=NOMINAL EXCH. RATE * (US GNP DEF./DOMESTIC GDP DEF)
STAR=NOMINAL EXCH. RATE * (US MFG. WAGE/DOMESTIC MFG WAGE)
REAL EXCHANGE RATE, VARIOUS MEASURES
1975=100
COUNTRY=GUATEMALA

SQUARE=NOMINAL EXCH. RATE × (US CPI/DOMESTIC CPI)
DIAMOND=NOMINAL EXCH. RATE × (US WPI/DOMESTIC WPI)
TRIANGLE=NOMINAL EXCH. RATE × (US GNP DEFL./DOMESTIC GNP DEFL)
STAR=NOMINAL EXCH. RATE × (US MFG. WAGE/DOMESTIC MFG WAGE)
REAL EXCHANGE RATE, VARIOUS MEASURES
1975=100
COUNTRY=COLOMBIA

SQUARE = NOMINAL EXCH. RATE × (US CPI/DOMESTIC CPI)
DIAMOND = NOMINAL EXCH. RATE × (US WPI/DOMESTIC WPI)
TRIANGLE = NOMINAL EXCH. RATE × (US CNP DEF./DOMESTIC GDP DEF)
STAR = NOMINAL EXCH. RATE × (US MFG. WAGE/DOMESTIC MFG WAGE)
REAL EXCHANGE RATE, VARIOUS MEASURES
1975=100
COUNTRY=TURKEY

TIME IN YEARS
SQUARE=NOMINAL EXCH. RATE * (US CPI/ DOMESTIC CPI)
DIAMOND=NOMINAL EXCH. RATE * (US WPI/ DOMESTIC WPI)
TRIANGLE=NOMINAL EXCH. RATE * (US GNP DEF./ DOMESTIC GDP DEF)
STAR=NOMINAL EXCH. RATE * (US MFG. WAGE/ DOMESTIC MFG WAGE)
REAL EXCHANGE RATE, VARIOUS MEASURES
1975=100
COUNTRY=YUGOSLAVIA

SQUARE=Nominal exch. rate × (US CPI/ Domestic CPI)
DIAMOND=Nominal exch. rate × (US WPI/ Domestic WPI)
TRIANGLE=Nominal exch. rate × (US GNP Def./ Domestic GDP Def)
STAR=Nominal exch. rate × (US MFG. WAGE/ Domestic MFG WAGE)
REAL EXCHANGE RATE, VARIOUS MEASURES
1975=100
COUNTRY=SINGAPORE

SQUARE=Nominal Exch. Rate × (US CPI/ Domestic CPI)
DIAMOND=Nominal Exch. Rate × (US WPI/ Domestic WPI)
TRIANGLE=Nominal Exch. Rate × (US GNP Def./ Domestic GDP Def)
STAR=Nominal Exch. Rate × (US MFG. WAGE/ Domestic MFG WAGE)
REAL EXCHANGE RATE, VARIOUS MEASURES

1975-100
COUNTRY: PAKISTAN

SQUARE=NOMINAL EXCH. RATE × (US CPI/DOMESTIC CPI)
DIAMOND=NOMINAL EXCH. RATE × (US WPI/DOMESTIC WPI)
TRIANGLE=NOMINAL EXCH. RATE × (US GNP DEF./DOMESTIC GDP DEF)
STAR=NOMINAL EXCH. RATE × (US MFG. WAGE/DOMESTIC MFG WAGE)

TIME IN YEARS:

REAL EXCHANGE RATE, VARIOUS MEASURES
1975=100
COUNTRY=MEXICO

TIME IN YEARS
SQUARE= NOMINAL EXCH. RATE * (US CPI/ DOMESTIC CPI)
DIAMOND= NOMINAL EXCH. RATE * (US WPI/ DOMESTIC WPI)
TRIANGLE= NOMINAL EXCH. RATE * (US GNP DEFL./ DOMESTIC GDP DEFL)
STAR= NOMINAL EXCH. RATE * (US MFG. WAGE/ DOMESTIC MFG WAGE)
difficult. In this subsection, annual data for 14 developing countries are used to construct the four traditional measures of the real exchange rate. The following notation for bilateral indexes using the U.S. dollar as the reference currency is used:

1. CPI based index: \( e_C = \frac{(E \times CPI^*)}{CPI} \)
2. WPI based index: \( e_W = \frac{(E \times WPI^*)}{WPI} \)
3. Manufacturing wages based index: \( e_{MW} = \frac{(E \times W^*)}{W} \)
4. GDP deflator based index: \( e_D = \frac{(E \times D^*)}{D} \)

The data on the nominal bilateral exchange rates and price indexes were taken from the IPS tape. The data on manufacturing wages were taken from various issues of the ILO Yearbook. Remember that according to the definition of the real exchange rate used here, an increase in \( e \) is reflecting a real depreciation, and a decline of \( e \) reflects a real appreciation. 18/

In Figures 1 through 14 the four traditional measures of \( e \) have been plotted for the countries considered. (For a list of the countries see Table 1.) As can be seen, for most countries the CPI and WPI measures of the real exchange rate have moved fairly closely through time. An exception to this is Korea, where the WPI based \( e \) experienced a dramatic jump in 1951. However, if that particular year is excluded, even for this country there are close movements of WPI and CPI bilateral real exchange rates. These diagrams also show that the real exchange rate measures constructed using GDP deflators have moved closely to those based on WPIs and CPIs. It can also be seen that for most countries there is an important divergence between the wage rate based real exchange rate and the other measures; these divergences are particularly

18/ Notice that this differs from the IMF practice, where a higher index of the real exchange rate reflects an appreciation.
large for the earlier years. The most plausible explanation for this lays on the poor quality of the wage rates data used. It is well-known that wage rates figures are not very reliable for these small countries; also these are indexes of actual wages, not corrected by productivity changes (see IFS, April 1984, p. 63).

An interesting aspect of these figures is that for most countries the real exchange rate has varied quite significantly through time. The fact that a number of these economies have been quite successful during a significant part of the period depicted in the figures suggests that changes in the real exchange rate through time are not incompatable with a healthy economy. Also, this behavior of the real rate through time suggests that in these countries the equilibrium real exchange rate has not been a constant, but that it has experienced significant movement.

Another characteristic of Figures 1 through 14 is that, even though there are changes in $e$, for a large number of countries there doesn't seem to be a clear trend in the behavior of the real exchange rate during the last thirty years. Exceptions to this are Colombia, Yugoslavia, Pakistan, Ireland, Israel and Mexico. This lack of a trend behavior of $e$ is also related to the issue of changes in the equilibrium value of the real exchange rate through time, which will be analyzed in detail in Part II of this paper.

In order to investigate further the nature of the relationship between these different measures of the real exchange rate, coefficients of correlation ($\rho$) among alternative pairs of rates were computed. Table 1, contains the correlation coefficients between the CPI-based real exchange rate and the other three measures. As may be seen the coefficients of correlations between $eC$ and $eW$ are very high: with the exception of Singapore and
El Salvador, they all exceed 70 percent. It is also interesting to note that the coefficients of correlation between the CPI real exchange rate and the GDP deflator are even higher. Here, only for the case of Israel this coefficient is below 70 percent, and in most cases it is above 80 percent. Finally, as the figures showed, the coefficients of correlation between the wage rate based real exchange rates and the CPI based fairly low. Only for Ireland, Mexico, Pakistan and Singapore it exceeds 70 percent.

Table 2, on the other hand, presents the coefficients of correlation between the other possible pairs of real exchange rate measures. As may be seen the story of the diagrams and Table 1 is confirmed: with the exception of the wage rate based real exchange rate the other indexes have moved fairly closely together for these countries. 19/

3.2 The real exchange rate in a world of floating: Effective real exchange rates vs. bilateral real exchange rates -- Quarterly comparisons 1978-1983

The preceding comparison of different definitions of the real exchange rate referred to bilateral rates between the domestic currency and 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

19/ This result is basically confirmed when a larger number of countries is used. In this study 67 countries were analyzed. However, only the 14 countries explicitly discussed here had data on wage rates for a long enough period. For diagrams for the rest of the countries, see the appendix.
### Table 2. CORRELATION COEFFICIENTS BETWEEN $e_W$ AND $e_{MW}$, $e_D$ AND BETWEEN $MW$ AND $e_D$ (ANNUAL DATA)

<table>
<thead>
<tr>
<th>Country</th>
<th>$\rho_{e_W,e_{MW}}$</th>
<th>$\rho_{e_W,e_D}$</th>
<th>$\rho_{e_{MW},e_D}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greece</td>
<td>0.909</td>
<td>0.937</td>
<td>0.859</td>
</tr>
<tr>
<td>Ireland</td>
<td>0.929</td>
<td>0.945</td>
<td>0.958</td>
</tr>
<tr>
<td>Turkey</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Yugoslavia</td>
<td>-0.073</td>
<td>0.808</td>
<td>0.764</td>
</tr>
<tr>
<td>Colombia</td>
<td>0.717</td>
<td>0.985</td>
<td>0.691</td>
</tr>
<tr>
<td>Ecuador</td>
<td>0.933</td>
<td>0.746</td>
<td>0.211</td>
</tr>
<tr>
<td>El Salvador</td>
<td>0.048</td>
<td>0.710</td>
<td>0.529</td>
</tr>
<tr>
<td>Guatemala</td>
<td>0.078</td>
<td>0.892</td>
<td>0.379</td>
</tr>
<tr>
<td>Mexico</td>
<td>0.914</td>
<td>0.758</td>
<td>0.884</td>
</tr>
<tr>
<td>Israel</td>
<td>0.069</td>
<td>0.229</td>
<td>0.539</td>
</tr>
<tr>
<td>India</td>
<td>0.274</td>
<td>0.873</td>
<td>0.544</td>
</tr>
<tr>
<td>Korea</td>
<td>0.426</td>
<td>0.645</td>
<td>0.926</td>
</tr>
<tr>
<td>Pakistan</td>
<td>0.426</td>
<td>0.645</td>
<td>0.926</td>
</tr>
<tr>
<td>Singapore</td>
<td>0.801</td>
<td>0.912</td>
<td>0.774</td>
</tr>
</tbody>
</table>
have been constructed. These exchange rates 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 from the behavior of any bilateral exchange rate. In order to illustrate this point, the real effective exchange rate is defined in the following form:

$$b_t = \frac{B_t}{P_t}$$

(3.1)

where $B_t$ is an index of the nominal basket, or nominal effective exchange rate, and $PW_t$ is the index of the price levels of the home country's trade partners. Assume that this country trades with $k$ countries. Then $B_t$ is defined as:

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

(3.2)

where $\alpha_i$ is the appropriate weight for country $i$, and $E_{cit}$ is an index of the bilateral nominal exchange rate between the home country's currency and country $i$'s currency in period $t$. 20/ Similarly, $PW$ is defined as a weighted average of the country's trade partners price indexes. If the same weights used to construct $B$ are used, then:

$$PW_t = \sum_{i=1}^{k} \alpha_i P_{it}$$

(3.3)

By triangular arbitrage:

20/ On the selection of the "appropriate" weights see Kenen (1975), Branson and de Macedo (1982) and Branson and Katseli (1982).
\[ E_{cl} = E_{01} E_{i1} \quad i = 1, 2, \ldots, k \]  

(3.4)

where \( E_{01} \) is, for example, the bilateral nominal exchange rate between the home country and the U.S. dollar, and \( E_{i1} \) 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, as before \( \hat{X} = \frac{dX}{dt} \)):

\[
\hat{B} = \hat{E}_{01} + \left[ \sum_{i=2}^{k} \frac{\alpha_i E_{i1}}{A} \right]
\]

(3.5)

where

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

Equation (3.5) indicates that in a world of floating rates the rate of change of the effective nominal rate \( \hat{B} \) will differ from the change in the bilateral rate with respect to the reference country \( E_{01} \), 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 \( \sum_{i=2}^{k} (\alpha_i E_{i1}/A) \hat{E}_{i1} < 0 \), the rate of nominal depreciation of the effective nominal rate will be smaller than the rate of nominal depreciation of the bilateral rate (\( \hat{B} < \hat{E}_{01} \)). This has been the case between the fourth quarter of 1980 and mid-1985, when the U.S. dollar began appreciated in the world market. Notice that from equation (3.5), it follows that the basket or effective nominal exchange rate can move in the opposite direction of the bilateral nominal rate (i.e., sign \( \hat{B} = \) sign \( \hat{E} \)). That is, while a country's bilateral rate with respect to the U.S. dollar may be depreciating (\( E_{01} > 0 \)), its basket rate could be appreciating (\( \hat{B} < 0 \))!

The magnitudes of the possible divergences between the real bilateral exchange rate and real effective exchange rates can be illustrated with an
Table 3: INDEX OF REAL EXCHANGE RATE IN COLOMBIA
1970-1982: 1975 = 100

<table>
<thead>
<tr>
<th>Year</th>
<th>INDEX b₁</th>
<th>INDEX b₂</th>
<th>INDEX b₃</th>
<th>INDEX e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>79.1</td>
<td>80.4</td>
<td>79.7</td>
<td>97.3</td>
</tr>
<tr>
<td>1975</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>1976</td>
<td>96.9</td>
<td>97.1</td>
<td>97.0</td>
<td>98.7</td>
</tr>
<tr>
<td>1977</td>
<td>84.4</td>
<td>83.8</td>
<td>84.2</td>
<td>83.8</td>
</tr>
<tr>
<td>1978</td>
<td>85.9</td>
<td>85.3</td>
<td>85.7</td>
<td>81.3</td>
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<tr>
<td>1979</td>
<td>84.8</td>
<td>83.3</td>
<td>84.1</td>
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</tr>
<tr>
<td>1980</td>
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<td>1980 IV</td>
<td>83.5</td>
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<td>83.8</td>
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</tr>
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<td>1982</td>
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<td>72.1</td>
<td>72.8</td>
<td>78.3</td>
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<tr>
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<td>80.5</td>
<td>82.2</td>
<td>81.5</td>
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</tr>
<tr>
<td>II</td>
<td>75.9</td>
<td>78.2</td>
<td>77.1</td>
<td>77.4</td>
</tr>
<tr>
<td>III</td>
<td>73.8</td>
<td>76.2</td>
<td>75.0</td>
<td>78.1</td>
</tr>
<tr>
<td>IV</td>
<td>77.2</td>
<td>78.4</td>
<td>77.9</td>
<td>79.7</td>
</tr>
<tr>
<td>1982 I</td>
<td>76.0</td>
<td>73.3</td>
<td>76.8</td>
<td>79.4</td>
</tr>
<tr>
<td>II</td>
<td>75.7</td>
<td>72.4</td>
<td>72.1</td>
<td>77.3</td>
</tr>
<tr>
<td>III</td>
<td>74.3</td>
<td>71.0</td>
<td>70.7</td>
<td>77.9</td>
</tr>
<tr>
<td>IV</td>
<td>75.0</td>
<td>71.6</td>
<td>71.5</td>
<td>78.5</td>
</tr>
</tbody>
</table>

Source: Computed by the author from data obtained in the IFS.

Notes: b₁ weights are: U.S. = 0.40; Germany = 0.24; Japan = 0.5; Italy = 0.04;
Netherlands = 0.07; France = 0.07; Venezuela = 0.10; Ecuador = 0.06.
b₂ weights are: U.S. = 0.56; Germany = 0.11; Japan = 0.14; Italy = 0.04;
Netherlands = 0.01; France = 0.05; Venezuela = 0.06; Ecuador = 0.03.
b₃ weights are: U.S. = 0.47; Germany = 0.17; Japan = 0.10; Italy = 0.04;
Netherlands = 0.04; France = 0.05; Venezuela = 0.08; Ecuador = 0.05.
In all cases (b₁, b₂ and b₃) a foreign countries index of WPI's was used as P, and the Colombian CPI was used as P.
REAL EXCHANGE RATE, VARIOUS MEASURES
1980 Q II = 100
COUNTRY = ECUADOR

PERIOD
SQUARE = NOMINAL EXCHANGE RATE * (US CPI/DOMESTIC CPI)
DIAMOND = NOMINAL EXCHANGE RATE * (US WPI/DOMESTIC WPI)
TRIANGLE = REAL EFFECTIVE EXCHANGE RATE (MERM)
REAL EXCHANGE RATE, VARIOUS MEASURES
1980 Q II = 100
COUNTRY = COLOMBIA

SQUARE = NOMINAL EXCH. RATE * (US CPI/DOMESTIC CPI)
DIAMOND = NOMINAL EXCH. RATE * (US WPI/DOMESTIC WPI)
TRIANGLE = REAL EFFECTIVE EXCHANGE RATE (MEAN)
REAL EXCHANGE RATE, VARIOUS MEASURES
1980 Q II = 100
COUNTRY = EL SALVADOR

SQUARE = NOMINAL EXCH. RATE × (US CPI/DOMESTIC CPI)
DIAMOND = NOMINAL EXCH. RATE × (US WPI/DOMESTIC WPI)
TRIANGLE = REAL EFFECTIVE EXCHANGE RATE (MERM)
REAL EXCHANGE RATE, VARIOUS MEASURES

1980 Q II = 100
COUNTRY = GUATEMALA

SQUARE = NOMINAL EXCH. RATE * (US CPI/ DOMESTIC CPI)
DIAMOND = NOMINAL EXCH. RATE * (US WPI/ DOMESTIC WPI)
TRIANGLE = REAL EFFECTIVE EXCHANGE RATE (MERAM)
REAL EXCHANGE RATE, VARIOUS MEASURES
1980 Q II =100
COUNTRY=INDIA

SQUARE=NOMINAL EXCH. RATE * (US CPI/DOMESTIC CPI)
DIAMOND=NOMINAL EXCH. RATE * (US WPI/DOMESTIC WPI)
TRIANGLE=REAL EFFECTIVE EXCHANGE RATE (MERAM)
REAL EXCHANGE RATE, VARIOUS MEASURES
1980 Q II = 100
COUNTRY = ISRAEL

PERIOD
SQUARE = NOMINAL EXCH. RATE × (US CPI / DOMESTIC CPI)
DIAMOND = NOMINAL EXCH. RATE × (US WPI / DOMESTIC WPI)
TRIANGLE = REAL EFFECTIVE EXCHANGE RATE (MER)
REAL EXCHANGE RATE, VARIOUS MEASURES
1980 Q II =100
COUNTRY=KOREA

SQUARE=NOMINAL EXCH. RATE \times (US CPI/ DOMESTIC CPI)
DIAMOND=NOMINAL EXCH. RATE \times (US WPI/ DOMESTIC WPI)
TRIANGLE=REAL EFFECTIVE EXCHANGE RATE (NEER)
REAL EXCHANGE RATE, VARIOUS MEASURES
1980 Q II = 100
COUNTRY = MEXICO

SQUARE = NOMINAL EXCHANGE RATE \times ( \text{US CPI/ DOMESTIC CPI} )
DIAMOND = NOMINAL EXCHANGE RATE \times ( \text{US WPI/ DOMESTIC WPI} )
TRIANGLE = REAL EFFECTIVE EXCHANGE RATE (MEAM)
REAL EXCHANGE RATE, VARIOUS MEASURES
1980 Q II = 100
COUNTRY = SINGAPORE
REAL EXCHANGE RATE, VARIOUS MEASURES

1980 Q I I = 100
COUNTRY = YUGOSLAVIA

SQUARE = NOMINAL EXCH. RATE × (US CPI/ DOMESTIC CPI)
DIAMOND = NOMINAL EXCH. RATE × (US WPI/ DOMESTIC WPI)
TRIANGLE = REAL EFFECTIVE EXCHANGE RATE (MEERM)
example. Table 3 present computations for Colombia for three measures of the effective real exchange rate (indexes b) and one measure of the bilateral Peso/U.S.$ rate (e). The effective rates were constructed using a small number of countries which account for more than 85 percent of Colombia's trade. Index $b_1$ uses relative exports as weights; index $b_2$ uses import weights and index $b_3$ uses trade weights. As may be seen from this Table, all measures of the effective real exchange rate (indexes $b_1$, $b_2$ and $b_3$) show a larger loss of competitiveness of Colombia's tradables sector between 1975 and the end of 1982 than the more traditional bilateral rate (e). These numbers illustrate the importance of the weights used in the computation of the real effective exchange rates. As may be seen, the recorded loss of competitiveness in Colombia is significantly larger according to $b_2$ and $b_3$ than to $b_1$.

Figures 15 to 28 present, for some of the 14 countries used in the previous computations, the quarterly evolution of two measures of bilateral real exchange rates relative to the dollar -- a CPI-based and a WPI-based rate -- and of an effective real exchange rate for 1978-1983. These effective rates have been obtained from the IMF. 21/ These diagrams confirm some of the previous findings based on annual data for a much longer period: the CPI-based and WPI-based indexes of bilateral real exchange rates have moved closely together for most countries (exceptions to this are El Salvador, Singapore and India).

21/ For most of these countries a CPI index has been used to construct the price deflators. For a description of how the MERM works see, for example, Artus and McQuirk (1981), Artus and Rhomberg (1973), Feltenstein, Goldstein and Schadler (1981), Hirsch and Higgins (1970) and Rhomberg (1976).
The most important fact reflected in these figures is that recently the effective real exchange rates have significantly diverged from the bilateral rates for most of these countries. As may be seen in all cases the effective rates are well below the bilateral rates for the more recent years. The reason for this, of course, has been the sharp appreciation that the U.S. dollar has experienced in the world financial markets starting in late 1980.

Table 4 presents the coefficients of correlation between the effective and CPI bilateral rates ($\rho_{eER,ec}$), between the effective rate and the WPI bilateral rate ($\rho_{eER,eW}$), and between the CPI and WPIs bilateral rates ($\rho_{eW,eC}$). Evidently, these results confirm the message obtained from the diagrams: while in most cases the CPI and WPI bilateral real rates have moved closely together, there are large divergences between the effective real rates and the bilateral real rates. For some countries the coefficient of correlation between these rates are even negative.

3.3 Summary

For the case of bilateral rates the analysis presented in this section indicates that, with the exception of the index based on wages, all of the traditional PPP-based real exchange rate indexes tend to move quite closely. Also, the evidence presented also shows that there have been significant differences in the behavior of bilateral rates and effective real exchange rates. These differences have been more marked during the recent period when the U.S. dollar has appreciated with respect to the currencies of other industrialized countries. The fact that the bilateral and effective real exchange rate indexes have behaved in such a different way suggests that
in policy-oriented exchange rate analysis both types of indexes should be looked at.

A problem with the traditional measures of the real exchange rate discussed in this section, including the effective rates constructed by the IMF, is that by using the same price indexes in the numerator and denominator -- CPIs, WPIs, wage rates or GDP deflators -- they are not proxying in any clear sense the domestic relative price of tradables to nontradables. A number of authors have indicated that one way of partially solving this problem is by constructing a real exchange rate index that has the domestic country's CPI in the denominator and the foreign country's WPI -- or a weighted average of the relevant foreign WPIs -- in the numerator: \( e = \frac{(E\ WPI^*)}{CPI} \). This index of the real exchange rate has been used by McKinnon (---), Dornbusch (----), Harberger (----) and Edwards (1984) among others, and has recently been strongly recommended by Harberger (1984) and Diaz-Alejandro (1984). Since foreign country's WPI can be considered as a fair proxy for the world price of tradables, and the domestic CPI contains a very high proportion of nontradable commodities, this index is the more reasonable proxy for the real exchange rate (see the extensive discussion in Edwards and Ng, 1985). A possible objection for this measure is that it does not incorporate directly taxes on international transactions. However, as shown in Edwards and Ng (1985), this is not a serious drawback of this measure. In fact, this index already incorporates all the information needed to compute the way in which the (domestic) relative price of tradables to nontradables evolve through time.
<table>
<thead>
<tr>
<th>Country</th>
<th>$\rho_{eB,eC}$</th>
<th>$\rho_{eCB,eW}$</th>
<th>$\rho_{eC,eW}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greece</td>
<td>-</td>
<td>-</td>
<td>0.979</td>
</tr>
<tr>
<td>Ireland</td>
<td></td>
<td>0.794</td>
<td></td>
</tr>
<tr>
<td>Turkey</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Yugoslavia</td>
<td>0.909</td>
<td>0.927</td>
<td>0.990</td>
</tr>
<tr>
<td>Colombia</td>
<td>0.533</td>
<td>0.512</td>
<td>0.617</td>
</tr>
<tr>
<td>Ecuador</td>
<td>0.284</td>
<td>-0.343</td>
<td>0.557</td>
</tr>
<tr>
<td>El Salvador</td>
<td>0.966</td>
<td>-0.297</td>
<td>-0.249</td>
</tr>
<tr>
<td>Guatemala</td>
<td>-0.732</td>
<td>-0.532</td>
<td>0.737</td>
</tr>
<tr>
<td>Mexico</td>
<td>0.972</td>
<td>0.957</td>
<td>0.994</td>
</tr>
<tr>
<td>Israel</td>
<td>0.112</td>
<td>0.656</td>
<td>0.750</td>
</tr>
<tr>
<td>India</td>
<td>-0.273</td>
<td>0.296</td>
<td>0.735</td>
</tr>
<tr>
<td>Korea</td>
<td>0.118</td>
<td>0.263</td>
<td>0.845</td>
</tr>
<tr>
<td>Pakistan</td>
<td>0.408</td>
<td>0.480</td>
<td>0.974</td>
</tr>
<tr>
<td>Singapore</td>
<td>-0.503</td>
<td>-0.574</td>
<td>0.030</td>
</tr>
</tbody>
</table>
PART TWO:

EQUILIBRIUM MOVEMENTS IN THE REAL EXCHANGE RATE
4. **Equilibrium Changes in the Real Exchange Rate**

In modern theories of the real exchange rate the *equilibrium* value of the real exchange rate can vary through time [see, for example Frenkel and Mussa 1984]. This contrasts with the old PPP oriented approach to the real exchange rate, which considered that there was one (almost) immutable equilibrium value of e, and that any deviation from it reflected a disequilibrium situation. 22/

An important implication of the modern approach is that equilibrium changes in the real exchange rates do not require policy interventions or adjustments. On the contrary, under these circumstances, policy actions will tend to interfere with equilibrium changes, rendering the adjustment process more difficult. 23/ From a policy perspective then, a crucial aspect of real exchange rate analysis, is to distinguish between equilibrium and disequilibrium movements of these rates. This of course is not an easy task. 24/

Empirical studies usually try to determine if the real exchange rate is in equilibrium by comparing its current value to the value it had in some period in the past, where the economy is assumed to have been in equilibrium.

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22/ There is a long literature on deviations from PPP and the PPP defined real exchange rate: see, for example, Adler and Lehman (1983), Aizenman (1983b), Blejier and Genberg (1981), Frenkel (1981), Jones and Purvis (1981), Officer (1982), and Roll (1978).


24/ On equilibrium and disequilibrium exchange rates see, for example, Dornbusch (1982).
This approach, however, is exclusively past-looking, and does not take into account possible events that could have generated changes in the equilibrium value of e, nor does it consider expected future changes in the real exchange rate determinants that could affect its future value. This part of the paper reviews the literature that deals with changes in the equilibrium real exchange rate. The discussion focuses on the way in which the equilibrium value of e reacts to changes -- either exogenous or policy induced -- of some of its close determinants. In particular the analysis deals with:

(a) The equilibrium real exchange rate and commercial policy;
(b) Terms of trade changes and the real exchange rate (including the Dutch Disease case);
(c) The real exchange rate and capital flows;
(d) Equilibrium real exchange rate movements and economic growth.

The analysis presented in this part is important since it will help to implement a forward-looking approach to equilibrium and disequilibrium real exchange rates. In such an approach the traditional historical comparison of real exchange rates indexes is supplemented by an investigation on how phenomena related to (a) through (d) above could have affected, or will affect, the long-run sustainable equilibrium rate. 25/

Finally, in the last section of this part some empirical results obtained from the statistical analysis of real exchange rate determinants for a group of developing countries are presented. These results provide some evidence supporting the idea that real exchange rates indeed respond to the behavior of their close fundamental determinant.

5. The Real Exchange Rate and Commercial Policy

In this section, the relationship between commercial policies and the behavior of the equilibrium real exchange rate will be analyzed. The main question addressed here is how is the equilibrium real exchange rate (i.e., the rate that results in sustainable external sector equilibrium) affected when there are changes in import tariffs and/or export taxes or subsidies? From a policy perspective, this is an important question. Many times countries introduce changes in their structure of protection which affect their external position and have an impact on the equilibrium real exchange rate. The discussion presented here will critically review the existing literature on the subject, and will present some of the analytics of the problem. Also the empirical literature is briefly surveyed.

5.1 Theory

The relation between commercial policy and the real exchange rate has been extensively discussed in the literature on economic liberalization attempts in developing countries. 26/ The generally accepted view is that a reduction (increase) in tariffs in a small country will result in an equilibrium real depreciation (appreciation). The argument usually given is based on the elasticities approach to exchange rate determination, and runs along the following lines: A lower tariff will reduce the domestic price of importables, and consequently increase the demand for imports [see Balassa

This, in turn, will generate an external imbalance (i.e., a current account deficit), which, assuming that the Marshall-Lerner condition holds, will require a devaluation to restore equilibrium. This view is clearly captured by the following quote from Balassa (1982):

[E]liminating protective measures would necessitate a devaluation in order to offset the resulting deficit in the balance of payments. (1982, p. 16)

On the other hand, according to Harry Johnson (1966):

One of the assumptions commonly made in the context of liberalization of trade by underdeveloped countries is that such liberalization would necessarily involve a balance of payments deficit and the consequent necessity of devaluation.... (1966, p. 159)

The proposition that a reduction (or elimination) of tariffs will necessarily result in a real depreciation has also been made in the shadow pricing literature. Some authors have proposed that the shadow exchange rate should be computed as the equilibrium (real) exchange rate under conditions of free trade (Bacha and Taylor 1971). It has then been postulated that an elimination of existing trade impediments will result in a higher equilibrium real exchange rate. For example, for the case of a small country, which faces initial trade equilibrium, Bacha and Taylor (1971, p. 216) have proposed the following expression for the free trade real exchange rate:

\[ e_F = e(l+t)Y \]  

(5.1)

where \( e_F \) is the free-trade equilibrium (real) exchange rate, \( e \) is the existing equilibrium (real) exchange rate prior to the elimination of tariffs, \( t \) is the level of the tariffs and \( Y = \eta_M/(\epsilon_x+\eta_M) \), for \( \eta_M \) elasticity of demand of imports and \( \epsilon_x \) elasticity of supply for exports. More recently using a

27/ This assumes away the Metzler paradox.
slightly different model, Taylor (1979, p. 207) has insisted on this point (where the same notation applies): 28/

[S]uppose that a preexisting tariff is reduced or removed altogether... [t]hen e will rise... [T]he result can be called the free-trade exchange rate \( e^F \). [N]aturally, \( e/e^F \) is less than 1...

(1979, p. 207)

One of the shortcomings of most traditional models that postulate a negative relation between tariffs and the real exchange rate (i.e., a higher tariff results in a lower \( e \)), is that they have ignored, among other things, the presence of intermediate inputs. This problem was first acknowledged by Harry Johnson (1966) in an article that uses effective rates of protection to analyze the effect of tariff changes on the equilibrium exchange rate (see also Corden 1971, ch. 5). Johnson pointed out that once intermediate goods were allowed into the picture the reduction or removal of tariffs could result either in a devaluation or in an appreciation. In Johnson's words:

[T]ariffs structures may bring about a situation in which appreciation rather than depreciation would be necessary to preserve equilibrium under de liberalization....

(1966, p. 159)

The reason for this is intuitively clear. With intermediate goods it is possible that some activities will have a negative effective rate of protection; that is the tariff structure will impose a tax on value-added in those activities. Consequently, the removal of tariffs will reduce the magnitude of this tax and, according to Johnson's model, will result in higher production. The effects of eliminating the negative rates of effective protection could be such that a balance of payments surplus could result in

---

28/ It should be noted that Bacha and Taylor (1971) and Taylor (1979) are using slightly different models. See the original references for details.
the consequent required appreciation [see also Corden (1971)]. Johnson
derives the following formula for the required rate of depreciation or
appreciation resulting from complete tariff removal (1966, 1967)

\[(1+d) = Ew_j (1 + \tau_j) \]  
(5.2)

where \(d\) is the required adjustment of the exchange rate to maintain external
equilibrium. A positive \(d\) indicates depreciation, while a negative \(d\)
represents an appreciation. \(\tau_j\) is the rate of effective protection in sector
\(j\), and the \(w_j\) are weights. From equation (5.2) it is clear that to the extent
that there are negative effective rates of protection (i.e., \(\tau_j < 0\)), and
their weights are high enough a trade liberalization can result in an
appreciation (\(d < 0\)). Even though Johnson's model is subject to the modern
criticisms to the effective rate of protection, it emphasizes a very important
point: in the presence of intermediate goods, once tariffs are removed,
almost anything can happen to the equilibrium real exchange rates (and other
key variables). 29/

Most traditional treatment of the relation between commercial policy
and the real exchange rate have also tended to (implicitly or explicitly)
ignore the presence of nontradable goods. 30/ However, once nontradable goods
are allowed into the picture the effect of tariff changes on the real exchange
rate can be very different from those obtained from simpler partial equilib-
rium models. It has been shown that in the context of a three goods model --

---

29/ On modern criticisms of the concept of effective rate of protection see,
for example, Bhagwati and Srinivasan (1983), Jones and Neary (1984),

30/ There are, of course, some exceptions to this case. See, for example,
Corden (1971, Ch. 5).
exportables, importables and nontradables -- the reduction in the tariff levels can result in a real appreciation, rather than real depreciation, even in the absence of intermediate goods [see, for example, Ethier (1972), Jones (1974), Dornbusch (1974, 1980, n.d.) and Edwards (1984)]. However, a problem with this type of analysis is that when there are tariff (or terms of trade) changes, it is not possible to talk about "the" price of tradables. Indeed, once the relative price between importables and exportables changes, it is not licit to lump these goods together in a Hicksian composite good. In some sense, it is possible to think that, in this case, there are two "real exchange" rates, given by the relative prices of importables to nontradables \( (P_M/P_N) \) and exportables to nontradables \( (P_X/P_N) \). Alternatively it is possible to construct an index for the price of nontradables formed by the prices of both importable and exportable goods.

From a formal point of view there are several possible ways to show that in this three goods world a tariff change could result either in an equilibrium real appreciation or real depreciation. In this section a traditional trade model that assumes price flexibility and full factor mobility will be used to investigate this problem.\(^{31}\) Consider the case of a small economy that produces exportables \( (x) \), importables \( (M) \) and nontradables \( (N) \), using two factors of production, capital \( (K) \) and labor \( (L) \). Assume also that technology has the usual characteristics, that there is perfect competition, that there is a fixed unitary nominal exchange rate and that there is an initial tariff on the importation of \( M \). Finally, assume that both factors of production can move freely across sectors. Under these

circumstances, and ruling out specialization, the world prices of exportables \( (P_X^*) \) and importables \( (P_M^*) \) plus the tariff \( (t) \) determine unequivocally the rewards of both factors \( (W \text{ and } r) \). These factors rewards, and under the assumption of competition, determine the nominal price of nontradables \( (P_N) \). Demand conditions for nontradables, on their turn, determine total output of nontradables and total factors used in their production. This leaves a certain amount of factors \( (K \text{ and } L) \) that is used in the production of exportables and importables in a traditional Heckscher-Ohlin fashion. The analysis presented in this section will focus on the effect of tariff changes on goods prices and factor rewards, ignoring the adjustments in quantities produced. For a discussion of the effects of changes in tradable goods prices on production in the context of similar models see Corden and Neary (1982) and Edwards (1983).

The model is given by equations (5.3) through (5.9).

\[
\begin{align*}
    a_{LMW} + a_{KM}r &= P_M \\
    a_{LXW} + a_{XX}r &= P_X \\
    a_{LNW} + a_{KN}r &= P_N \\
    P_X &= P_X^* \\
    P_M &= P_M^*(1+t)E \\
    P_T &= P_T^aP_M^{1-a} \\
    e &= P_T/P_N
\end{align*}
\]

32/ Notice that, as discussed above, since we are dealing only with effects on prices and factor rewards there is no need to specify the demand side of the model. See Corden and Neary (1982).
\[ E = 1 \]  

(5.10)

where the \( a_{ij} \)'s are input-output coefficients; \( W \) and \( r \) are the wage rate and the rental rate of capital; \( P_M^* \), \( P_X \) and \( P_N \) refer to the domestic price of importables, exportables and nontradables; \( P_X^* \) and \( P_M^* \) are the world prices of \( X \) and \( M \); \( t \) is the tariff rate, \( P_T \) is the domestic price of tradables; \( \alpha \) and \( (1-\alpha) \) are weights used in the construction of \( P_T \); and \( e \) is the real exchange rate. \( 33/ \)

Equations (5.3) and (5.4) can be used to determine the effects of a tariff change on factor rewards. In Jones's (1965) familiar notation:

\[ \hat{W} = \left( \frac{\theta_{Kx}}{\theta_{Kx} - \theta_{KM}} \right) \left( 1 + t \right) \]  

(5.11)

\[ \hat{r} = - \left( \frac{\theta_{Lx}}{\theta_{Kx} - \theta_{KM}} \right) \left( 1 + t \right) \]  

(5.12)

where \( \theta_{Kx} = \frac{a_{Kx}}{P_X} \); \( \theta_{Lx} = 1 - \theta_{Kx} \)

\[ \theta_{KM} = \frac{a_{KM}}{P_M} \); \( \theta_{LM} = 1 - \theta_{KM} \)

If it is assumed, as is the most plausible case for developing countries, that importables have the highest capital-labor ratio, then

\[ (\theta_{Kx} - \theta_{KM}) < 0 \] and:

\[ \left[ W / (1 + t) \right] < 0 \]

and

\[ 33/ \text{Notice that, given the simple nature of this model, the external sector is always in equilibrium.} \]
\[
[r/(1+t)] > 0
\]

This of course is Stolper-Samuelson's theorem and indicates that in a developing country, under the assumptions of this model, i.e., imports are capital-intensive the tariff reduction (i.e., \((1+t) < 0\)) will generate an increase in \(W\) and a reduction in \(r\). The effect of the tariff change on the price of nontradables is obtained using (5.11), (5.12) and (5.5):

\[
\hat{p}_{N} = \left[ \frac{\theta_{KK} - \theta_{KN}}{\theta_{KK} - \theta_{KM}} \right] (1+t)
\]  

(5.13)

It is possible to see from this expression that the effect of a change in \(t\) or the price of nontradables will depend on the difference in capital intensity between exportables and nontradables. If it is assumed that exportables have the lowest capital-labor ratio, \((\theta_{KK} - \theta_{KN}) < 0\) and consequently, 34/

\[
[P_{N}/(1+t)] > 0
\]  

(5.14)

This means that, under these assumptions, a reduction in the level of tariffs will result in an increase in the price of exportables relative to nontradables (i.e., \(\hat{p}_{X}/p_{N} < 0\)). As a consequence, of course, the production of exportables will increase. If, however, \((\theta_{KK} - \theta_{KN}) > 0\), that is, nontradables have the lowest capital-labor ratio, the liberalization of international trade could result in a reduction in the production of exportable goods.

34/ Of course, if \((\theta_{KK} - \theta_{KN}) > 0\), \([p_{N}/(1+t)] < 0\).
Notice also that since \( \theta_{KM} > \theta_{KN} > \theta_{KK} \), in (5.13)
\[ 0 < [\theta_{KM} - \theta_{KN}]/(\theta_{KK} - \theta_{KM})] < 1. \] This means that when there is a tariff reduction, \( P_N \) goes down by less than \( P_M \), so that \( P_M/P_N \) also declines. From equations (5.12), (5.9), (5.6) and (5.7) it is now possible to find the long-run effect of a tariff change and the real exchange rate:
\[
\left[ \frac{\hat{e}/(1+t)}{e} \right] = \left[ \frac{\alpha - (\theta_{KK} - \theta_{KN})/(\theta_{KK} - \theta_{KM})}{\theta_{KK} - \theta_{KM}} \right] \tag{5.15} \]

This confirms, then, that once nontradable goods are introduced in the picture, a tariff reduction can result either in a real appreciation or in a real depreciation. 35/

In the model presented above it was assumed that capital and labor could move freely between sectors. In that sense, this analysis can be considered to reflect the long-run effects of tariff changes on the real exchange rate. A more realistic assumption however, is that in the short run not all factors of production can move among sectors. Following Jones (1971), Mussa (1974, 1978, 1983), Mayer (1974), Leamer (1978) and Neary (1978a,b) it can be assumed that while in the short run labor can move freely across sectors, capital is sector-specific. This means that the structure of the model changes in a significant way. Now, instead of having two traded goods and two factors of production, there will be two traded goods and four factors (i.e., capital in each sector and mobile labor). Under these circumstances the nominal price of nontradables will be affected by the demand conditions for these goods. It is easy to show that in this case it is also possible

35/ Of course, if the assumptions regarding factor intensities is altered, the results discussed here will change.
that a tariff reduction could generate a real appreciation instead than a real
depreciation (Dornbusch, n.d., Edwards 1984). The reasons for this is
simple. Consider the case of a small tariff -- so that income effects can be
assumed away for the time being -- where all three goods are gross
substitutes. The initial effect of a tariff reduction will be to generate a
lower domestic price of importables relative to exportables (assuming away
Metzler's paradox), and of importables relative to nontradables. However the
latter effect -- the decline of the price of importables relative "to
nontradables -- will generate an incipient excess supply for nontradable
goods, which under the assumptions of gross substitutability will require an
increase in the price of exportables relative to importables to restore
equilibrium in the nontradable goods market and in the external sector. 36/

Under these assumptions, then, the elimination of a small tariff will
generate a decline in the price of importables relative to nontradables
($P_M/P_N$), and an increase in the price of exportables relative to nontradables
($P_M/P_N$). Since changes in the real exchange rate are equal to weighted
average of changes in the prices of importables and exportables relative to
nontradables, the tariff reduction can either generate a real appreciation or
real depreciation. 37/ In the present case, with short-run capital specificity,
however, the conditions required to generate a real appreciation are different
from those of the long-run case with fully mobile factors: in the long-run

36/ See Dornbusch (1974) for a proof that under this setting equilibrium in
the nontradable goods market, with income equal expenditure, implies trade
equilibrium. See also Section 6.

37/ The real exchange rate is equal to $e = P_T/P_N$ where $P_T = P_M^{\alpha} P_X^{1-\alpha}$. Then
d(e/t) = $\alpha [d(P_M/P_N)/(P_M/P_N)] + (1-\alpha) [d(P_X/P_N)/P_X/P_N] > 0$. 

model the capital-labor ordering of the three sectors was critical to generate the possibility of a real appreciation as a result of the tariff reduction. In the sector-specific short-run model, however, the capital intensities are of no importance to determine this result. In this case the crucial conditions (which by the way are inconsequential in the long-run model), are related to the degrees of substitutability in demand among the three sectors [Dornbusch (1974, 1980, n.d.); Edwards (1984)]. This case with short-run capital specificity is discussed in some detail in the next section within the context of the effects of changes in the terms of trade on the equilibrium real exchange rate.

The case of a large tariff is equivalent. The only difference is that the change in the tariff will also generate an income effect. If it is assumed, however, that the substitution effect dominates the income effect the results discussed above -- including the possibility that a tariff reduction will result in a real appreciation -- will still hold (Dornbusch (n.d.), Edwards (1984). In the next section, where the effect of changes of the external terms of trade on the equilibrium real exchange rate is derived, a model that can be formally used to analyze the short-term effects of tariffs changes on the real exchange rate.

It should be noted that the fact that a tariff reduction (increase) can result in an equilibrium real appreciation (depreciation), does not necessarily mean that this is empirically an important case. The actual effect will depend on the particular case being considered and on the values of the parameters involved. The main policy implication of the above discussion is that in the real world -- where there are, among other things, tariffs and nontradable goods -- a tariff reduction will possibly "require" a
smaller real depreciation to restore external equilibrium than what is implied by simple partial equilibrium estimations based on the elasticities approach.

5.2 Empirical evidence

There have been very few econometric studies that have empirically investigated the relation between commercial policies and the real exchange rate. The main reason for this is the lack of adequate data. First it is not easy to find appropriate time series for import tariffs and/or export subsidies. Moreover, even if these data were available, there is a serious problem with the definition of the average rate of protection. Second, in a number of developing countries tariffs are only one of the tools used in commercial policy, with quotas being the most important instrument. This fact makes the measurement of the level and degree of protection even more difficult.

In their empirical investigation on PPP for a group of Latin American countries, Clague and Tanzi (1972) included import duties as a proportion of imports and export taxes as a proportion of exports as explanatory variables in their regression analysis. In this study the dependent variable was the inverse of the PPP-defined real exchange rate, and income per capita was also included as an explanatory variable. The results obtained were marginally satisfactory, showing that, in accordance with the traditional view, for the countries under consideration a higher level of trade restrictions had resulted on average in a real appreciation. More recently Barro (1983) has

---

38/ See, for example, Corden (1967).
used annual data for 1952-1982 for 7 OECD countries to investigate the behavior of the real exchange rate. Barro uses the change of the bilateral real exchange rate relative to the U.S. as the dependent variable, and defines tariff restrictions as the ratio (minus 1) of an index of CIF import prices to a ratio of FOB import prices. 40/ When a pooled regression for all 7 countries is run the coefficient for the trade restrictions variable indicates that, with other things given, higher tariffs will tend to generate a real appreciation (the regression coefficient is almost 0.5).

While there have been relatively few econometric studies relating commercial policies to the real exchange rate, a number of investigations have computed, using some kind of partial equilibrium formula, the effects of a trade liberalization (i.e., complete removal of existing tariffs and other trade restrictions) on the equilibrium real exchange rate [Basevi (1968), Balassa (1971, 1982)]. Most of these studies have been done within the context of computations of "net" effective rates of protection, defined as the rate of effective protection corrected by exchange rate overvaluation [see, for example, Balassa (1982), Appendix X]. The simple partial equilibrium nature of these computations have generated some concern even among the authors that have used them. For example, in their study on Argentina, Berlinsky and Schydowski (1982) state that the computation of the free-trade exchange rate using Balassa's formula should only be viewed as a "benchmark figure for the purposes of comparison" (p. 96). Among the problems with this simplistic partial equilibrium formulation to compute the free trade rate they mention that it does "not explicitly account for the willingness of income

40/ Notice that this is a somewhat peculiar definition of trade restrictions.
recipients to accept reductions...in real incomes; nor do they incorporate the fluctuations in aggregate real incomes..." (p. 96). After having cautioned the reader about these problems, they calculate that in 1969 the Argentinian peso was overvalued by 40 percent in relation to its free trade value. [See also the papers in Balassa (1971) and Balassa (1982) for further case studies where the free trade real exchange rate is computed.]

Free trade real exchange rates have also been empirically computed within the context of calculations of the shadow price of foreign exchange [Bacha and Taylor (1971)]. Again, most empirical studies on the subject have used simple partial equilibrium models with no nontradables. For example, Chile is one of the countries where equilibrium free-trade exchange rates have been computed several times. Bacha and Taylor (1973) for example, calculated that the complete elimination of trade impediments in Chile in 1969 would result in a real devaluation of approximately 30 percent. This calculation was later updated by Ossa (1974) using a similar methodology. Ossa's computation suggested an overvaluation of Chile's currency of approximately 25 percent in 1974. Selowsky (1970) performed a similar exercise within the context of the computation of the welfare cost of protection. He concluded that a full elimination of trade impediments in Chile would result in a real depreciation of 35 percent. Jeanerett (1971) used Balassa's formula for computing the degree of overvaluation relative to free trade and found that in 1961 there was a real overvaluation of 68 percent in Chile. Edwards (1975), on the other hand, used a model with intermediate goods and effective rates of protection to compute the degree of real overvaluation of the Chilean currency, concluding that, depending on the values of the relevant elasticities, in 1974 Chile's Escudo was overvalued between 24 and 32
percent. More recently Coeymans (1978) used a general equilibrium simulation model to conclude that in 1977 the real exchange rate in Chile was overvalued by 20 percent.

Computable general equilibrium (CGE) models have also been used to simulate the relation between changes in tariffs and the real exchange rate in developing countries. De Melo (1978), for example used a model with tradables and nontradable goods to analyze the Colombian economy. He concluded that an elimination of all trade restrictions -- except those applicable to the coffee sector -- would require a real devaluation ranging from 4.1 to 11.2 percent to restore external equilibrium. Feltestein (1980) used a general equilibrium model to investigate the effects of trade liberalization in Argentina. He concludes that if tariffs are reduced by 50 percent and the exchange rate is not adjusted, there is a serious deterioration of the balance of trade would result. If, however, the tariff reduction is implemented at the same time as a devaluation, it is possible to generate an improvement in the balance of payments. Cavallo and Mundlak (1982) also analyze the Argentinian case, reaching conclusions similar to those obtained by Feltestein. They also found that a trade-liberalization-cum-devaluation will result in a significant increase in output.

Khan and Zahler (1983) have recently used a general equilibrium model to analyze the effect of the liberalization of the current and capital accounts on various variables. Using parameter values reflecting the economic structure of a "typical" developing country they conclude that this liberalization experience would result in an appreciation of the real exchange rate. Unfortunately, however, due to the nature of their simulation experiment, it is not possible to know if this real appreciation is the result
of opening the capital account or of reducing tariffs. Actually Domínguez (n.d.) has recently suggested that a real appreciation resulting as a consequence of tariff reduction could indeed have empirical importance in the case of the Southern Cone countries.
6. Real Exchange Rates and the Terms of Trade

During the last few years, there has been renewed interest in investigating the relationship between the terms of trade and the real exchange rate. Many of the recent studies have tended to focus on how an improvement of the terms of trade generated by a resource-based export boom will affect the real exchange rate, resource allocation and employment. This problem has come to be known in the professional literature as the Dutch Disease. 41/ In this section, the interaction between the terms of trade and the real exchange rate is investigated, analyzing first the standard three goods case. The analysis then proceeds to investigate the Dutch Disease, focusing on the short- and long-run effects of an export boom. Here both the real and monetary effects of an export boom are discussed.

6.1 Exogenous Changes in the Terms of Trade

The conventional wisdom is that, in a small open economy, a deterioration of the terms of trade will require a real depreciation to restore equilibrium (Díaz-Alejandro, 1983). The reasoning behind this idea emphasizes the income effect associated with the change in the external terms of trade.

In a small open economy the effects of changes in the terms of trade are equivalent to those generated by tariff changes. From the substitution effect side, the reason for this is that since in a small country the Metzler paradox -- which establishes the conditions under which a tariff may be

nonprotective -- is ruled out by assumption, changes in the external terms of trade will be reflected in a one-to-one fashion on the internal terms of trade.  42/ From the income effect point of view both effects (changes in tariffs and external terms of trade) are also similar; a tariff hike and an external deterioration of the terms of trade result in a negative income effect. However, for an equivalent proportional change the effect of the external deterioration of the terms of trade will be higher (Edwards and van Wijnbergen, 1985). As in the discussion on commercial policy presented in Section 5, it is important to make a distinction between the short- and long-run consequences of terms of trade changes. If, as before, it is assumed that in the short run, capital is sector-specific, demand conditions will become important for establishing the way in which changes in the terms of trade will affect e. In the long run, however, when factors of production are assumed to be able to move freely between sectors, demand conditions for nontradables will play no role in determining the relative prices of exportables and importables to nontradables. Since the long-run case with fully mobile factors of production was discussed in detail in Section 5, in this section we will concentrate on the effects of terms of trade changes on the real exchange rate in the short run.

Consider the case of a three-goods economy, where in the short run only labor can move between sectors. Assume that the nominal exchange rate is equal to one and that there are no impediments to trade. In equilibrium, the

42/ The domestic terms of trade are $P^*_X/P^*_M = P^*_X/P^*_M (1+t)$. Changes in $(P^*_X/P^*_M)$ can then be generated either by changes in $(P^*_X/P^*_M)$ or in $[1/(1+t)]$. 
nontraded goods market clears and income equals expenditure. Taking the price of exportables to be the numeraire, equilibrium in this economy is given by:

\[ N^d \left( \frac{P^N}{P_X}, \frac{P^M}{P_X}, y \right) = N^s \left( \frac{P^N}{P_X}, \frac{P^M}{P_X} \right) \]

(6.1)

\[ y = Z \]

(6.2)

\[ e = \frac{P^M \alpha}{P^N} \left( \frac{P_X}{P_X} \right)^{1-\alpha} \]

(6.3)

\[ P_M = P_M^*(1+t) \]

(6.4)

where \( N^d \) and \( N^s \) are the demand and supply functions for nontradables; \( y \) is real income in terms of exportables; \( Z \) is real expenditures in terms of exportables; and, as before, \( e \) is the real exchange rate. When equations (6.1) and (6.2) hold, the balance of trade is in equilibrium:

\[ (X^s - X^d) + \frac{P^M}{P_X} (M^s - M^d) = \frac{P^N}{P_X} (N^d - N^s) \]

(6.5)

Assume now that the terms of trade deteriorate due to an exogenous increase in \( P_M \) (with \( P_X \) constant). Then

\[ (\hat{P}_N/\hat{P}_M^*) = (\varepsilon_{NM} - \eta_{NM})/(\eta_{NN} - \varepsilon_{NN}) - [\eta_y/(\eta_{NN} - \varepsilon_{NN})] (y/P_M^*) \]

(6.6)

where \( \eta_{NN} \) and \( \eta_{NM} \) are elasticities of demand (own and crossed); \( \eta_y \) is the income elasticity of demand for nontradables; and the \( \varepsilon \)'s are elasticities of supply. As may be seen from equation (6.5), the sign of \( (\hat{P}_N/\hat{P}_M^*) \) is ambiguous. Even in the more usual case of substitutability (i.e., \( \eta_{NM} > 0, \varepsilon_{NM} < 0 \) [Dornbusch (1974, 1980)], the sign of \( (\hat{P}_N/\hat{P}_M^*) \) is not determined. If it is assumed, however, that the substitution effect dominates the income effect [i.e., Dornbusch (1980)], \( (\hat{P}_N/\hat{P}_M^*) \) will be positive, with a
deterioration in the terms of trade resulting in an increase in the price of nontradables relative to importables. From this discussion, it also follows that it is not possible to sign a priori the change in the price of exportables to nontradables \((P_X/P_N)\).

Using (6.6) and (6.4) it is possible to find the effect of a change in the terms of trade -- generated by a change in \(P_M\) -- on the real exchange rate.

\[
\frac{(e/P_M^*)}{(e/P_M)} = \left\{ \alpha + \left[ \eta_y/\left(\eta_{NN} - \varepsilon_{NN}\right) \right] \left( \eta_{NY} / \eta_{NN} \right) \right\} (6.7)
\]

This expression can be positive or negative. This means that if in equation (6.7), the income effect dominates, it is possible that a deterioration of the terms of trade will generate a real appreciation \([e/P_M^*] < 0\].

In the long run, however, both capital and labor can move freely across sectors. In this case, the two-factors, three-goods model of Section 5 can be used to analyze the effect of terms of trade on \(e\). As in the case of a tariff discussed in Section 5, the final effect can be either a higher or lower \(e\), and will depend on the relative ordering of capital-labor intensities for the three sectors.

An important aspect of this result -- and one often ignored -- is that in general the requirements for a deterioration of the terms of trade to generate a depreciation are the opposite of the requirements required for a lower tariff to generate a depreciation. In fact, as shown by Edwards and van Wijnbergen (1985) in the long-run model both popular propositions can never hold at the same time. In the short-run model both propositions can simultaneously hold only if the (negative) income effect is sufficiently large.
Since the way in which changes in the terms of trade affect the real exchange rate in the long and short run depend on different sets of conditions -- the long-run effects depend on relative capital-labor intensities, while the short-run reaction depends on the degree of substitutability -- the dynamic effects of terms of trade changes on the real exchange rate can get quite involved. It is possible to find a case where \( e \) will first appreciate and then depreciate as a result of a permanent deterioration of the terms of trade. For example, this will happen if, in equation (6.7)

\[
(\nu - \nu_{NN}) (\nu_{NN} - \nu) > \left( \alpha + \left[ \frac{\eta}{(\nu - \nu_{NN})} \left( \frac{\hat{y}}{P} \right) \right] \right) \text{ and if }
\]

\[\theta_{KM} > \theta_{KN} > \theta_{Kx} \cdot \] In this case, a deterioration in the terms of trade \((P > 0)\) will generate in the short run a real appreciation. However, as time goes by and capital begins to move across sectors \( e \) will increase, with the total long-run effect being a real depreciation. In this case, then, the dynamics of the real exchange rate will be (approximately) captured by Figure 6.1, where it is assumed that at time \( t_0 \) there is a (permanent) deterioration of the terms of trade \( e_0 \) is the initial equilibrium real exchange rate, \( e_s \) is the new short-run equilibrium real exchange rate after the terms of trade shock and \( e_L \) is the new (i.e., post-terms of trade shock) equilibrium real exchange rate. It is assumed that the new long-run equilibrium \( (e_L) \) is attained at \( t_1 \). The present analysis does not allow us to fully specify the dynamic path of \( e \) between \( e_s \) and \( e_L \). In order to establish such a path, the way in which the capital stock will move following the exogenous shock should be clearly specified (see, for example, Mussa 1978). The main message of Figure 6.1, however, is that it clearly points out the difference between short- and long-run equilibrium real exchange rate. The fact that after the terms of trade shock \( e \) declines, from \( e_0 \) to \( e_s \), and that \( e_s \) is well below the
Figure 6.1

![Graph with axes labeled e and time, showing different levels e_L, e_o, and e_S with time intervals and curves]

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new long-run equilibrium real exchange rate does not mean that during periods $t_0$ and $t_1$ the domestic currency is *overvalued* as the traditional approach would suggest.

The discussion presented here, as well as that in the previous section, does not make a distinction between changes in terms of trade perceived to be temporary from those perceived to be permanent. This is, however, an important distinction, since in many cases the terms of trade for a particular developing country deteriorate (or improve) as a result of a temporary major failure crop. 43/ If the change in the terms of trade is perceived to be permanent, the results discussed above will hold. However, in the case of temporary changes in the terms of trade, some modifications to the model should be made. First, actual real income in equation (6.1) can be replaced by permanent real income ($y^p$). In this case temporary changes in the terms of trade will have a smaller impact on $y^p$ than permanent changes. A second direction in which the model can be modified is by allowing a smaller supply response to temporary than to permanent relative price changes. Of course, one way of doing that is by assuming that whenever changes in the terms of trade are perceived to be temporary, the specific factor (i.e., capital in our model) will not move across sectors. 44/ Only labor -- the mobile factor -- will be reallocated. Under these circumstances, the effects of temporary and permanent terms of trade changes on the real exchange rate will be different: if the changes are temporary, we would only observe what

43/ For example, the dramatic increase in the price of coffee in 1975-79 was the result of a major freeze in Brazil.

44/ This will be the case, for example, if it is costly to move capital across sectors as in Mussa (1978). In this case, it may not pay for firms to incur such an expense if the movement of capital has soon to be reversed.
we have called short-run effects above. If the terms of trade changes are permanent, then both the short- and long-run effects will be experienced. It should also be noted that in this section following the real trade literature tradition, it has been assumed that resource movement and demand shift respond to actual relative price movements. In reality, however, agents try to anticipate relative price changes and many decisions actually depend on expected price movements. It is easy, however, to expand the above analysis to this case. Under these assumptions, the real exchange rate will respond not only to actual terms of trade changes, but also to anticipated or expected changes. 45/

6.2 The Dutch Disease Case

In recent years, export booms generated by increases in the price (or quantity) of a resource-based export (i.e., oil, coffee) have resulted in significant real appreciations. This has been the case, for example, in Colombia (1975-79), Indonesia (1973-80), and the United Kingdom after the discovery of the North Sea oil. As a consequence of these real appreciations, the rest of the tradables (i.e., non-resource-based) sectors have experienced a loss in competitiveness, production, and employment. This phenomenon is known as the Dutch Disease, as a reference to the effects of natural gas discoveries in the Netherlands during the 1960s. Since the real appreciation that followed these gas discoveries especially hurt the manufacturing sector

45/ In fact, the relative price changes will occur at the time the expected change in the terms of trade is perceived. If the actual terms of trade change differ from its expected value, a correction will take place.
in the Netherlands, the phenomenon has also been known as the deindustrialization process.

Most studies on the Dutch Disease have concentrated on the real effects of a resource-based export boom, investigating how production, wages, employment and profitability are affected [see, for example, Corden (1981), Corden and Neary (1982), Buitler and Purvis (1983), Neary and Purvis (1983), Bruno and Sachs (1983) and van Wijnbergen 1984a,b]. In his recent survey, Corden (1982) has divided the real consequences of a resource-based export boom in a developing economy into two distinct effects: a spending effect and a resource movement effect.

The spending effect is a direct result of the higher real income that the export boom generates. The higher price of the resource-based export -- which will be called oil for convenience -- will generate a positive real income effect in the country in question. If all goods -- oil, other tradables (or lagging sector in Corden's terminology), and nontradables -- are normal in demand, the real income effect will be translated into a higher demand for all these goods. In the case of nontradables this higher demand will result in a higher nominal price, for a given nominal exchange rate. 46/ This higher relative price of nontradables will provoke a real appreciation and a movement of resources out of the other tradable goods sectors and into the nontradable goods sector. Profitability is squeezed out of the traditional tradable goods or lagging sector (i.e., manufacturing sector) with production and unemployment declining. In Corden's (1982) words:

46/ Notice that in order for this demand to affect the price of nontradables, it is necessary to assume that the number of factors exceeds the number of tradable goods.
Assuming that at least some part of the extra income... is spent,... there is likely to be extra spending on N... [3]o the price of N relative to the prices of tradables must rise. This is a real appreciation. It will draw resources out of [the tradable goods sectors] into N... (1982, pp. 6-7)

However, this is not the only way in which the export boom will affect profitability and production in the rest of the economy. The resource movement effect is related to the way factor markets are affected. In his analysis, Corden assumes that labor is the only mobile factor. The increase in the price of oil will initially result in a higher wage rate in that sector, with labor moving out of nontradables and other tradables into oil. This, however, is not the end of the story as far as the adjustment of the labor market is concerned. Since the spending effect will result in a higher nominal price of nontradables, there will be a tendency for the wage rate to increase in that sector, with labor now moving out of the rest of the economy into the nontradables sector. Profitability, in the other-tradables sector is further squeezed, with its employment and production declining even more.

[For an elegant detailed discussion of this and other cases, see Corden and Neary (1982)].

Most studies on the Dutch Disease have focused exclusively on the long-run real effects of the export boom. A few authors, however, have also investigated the short-run monetary consequences of an export boom [Harberger (1983), Edwards and Aoki (1983), Neery and Purvis (1983)]. Harberger (1983), for example, does this by introducing a slowly clearing monetary sector into a three-goods simple simulation model. He includes the lagged excess supply for money as a determinant of the demands for nontradables and other tradables.

In this setting, an increase in the world price of the resource-based export generates an overshooting in the relative price of nontradables. That is, in
the short run, the real appreciation is higher than the long-run real appreciation generated by real factors only. Harberger (1983) calculates that for plausible parameter values, in the short run the relative price of nontradables will overshoot its final equilibrium value by approximately 50 percent.

The effects -- both real and monetary -- of a commodity-based export boom on relative prices, the real exchange rate and competitiveness are captured by the following simple model. \(47/\) Consider a small open economy, with a fixed exchange rate, that produces three goods: oil \((O)\), other (i.e., non-oil) tradables \((T)\) and nontradables \((N)\). Also assume, for simplicity, that the exchange rate is equal to one. (This assumption is relaxed later.) The excess demand for nontradables is assumed to depend on prices and income.

Consider first the case where this excess demand is not affected by the relative price of oil. As a first approximation, this can be justified by assuming that domestic residents don't consume oil -- or consume negligible amounts relative to exports -- and that factors used in the production of oil are sector-specific both in the short and long run. These assumptions are relaxed below. In equilibrium, the excess demand for nontradable goods will be equal to zero, and under these assumptions can be written as:

\[
N = N(q_T, Y) = 0
\]

\((+)\) \((+)\)

where \(q_T\) is the relative price of non-oil tradables to nontradable goods (i.e., \(q_T = P_T/P_N\)), and \(Y\) is real income in terms of nontradables. The signs in parentheses below the function's arguments refer to the assumed signs of

\(47/\) This model draws on Edwards and Aoki (1983) and on Edwards (1984--).
the partial derivatives. The positive sign of \( q_T \) stems from the assumption of gross substitutability between nontraded goods and tradable goods.

Equilibrium in the nontradables sector requires that the excess demand for this type of good be equal to zero, both in the short and long run.

In (6.8), \( Y \) is expressed in terms of nontradable goods, and given by

\[
Y = H_N^S + q_T H_T^S + q_O^S
\]  

(6.9)

where \( H_N^S \), \( H_T^S \) and \( q_O^S \) are supplies of nontradables, tradables and oil, and where \( q_O \) is the relative price of oil in terms of nontradable goods. The supply of oil is held fixed in order to simplify the analysis.

Maintaining the assumption of gross substitutability, we can depict the equilibrium situation in the nontradables market in Figure 6.2, which has been adapted from Dornbusch (1974). The NN schedule describes the combination of \( q_T \) and \( q_O \) that is compatible with equilibria in the nontraded goods market. The slope of this curve is given by:

\[
\frac{dq_T}{dq_O} = \frac{(3N/\partial y)^S}{[(3N/\partial q_T) + (3N/\partial y)H_T^S]} < 0
\]  

(6.10)

The Ray OT, on the other hand, measures the relative price of both tradable goods -- other tradables to oil (\( P_T/P_O \)). The initial equilibrium position is given by A with equilibrium relative prices being equal to \( q_T^0 \) and \( q_O^0 \) respectively.

Assume now that there is an exogenous increase in the price of oil. The OT ray will then rotate clockwise toward OT' in Figure 6.3. If the (nominal) price of nontradables were constant, the new equilibrium would be given by B, with a constant relative price of non-oil tradables with respect to nontradables. However, as long as the slope of the NN is negative, at B
there will be an excess demand for nontradables that will require an increase of the relative price of these goods, both with respect to the price of oil and other (non-oil) tradables. The final equilibrium will then be attained at C.

As a consequence of the increase in the price of oil, there has been a decrease in the relative price of non-oil tradables both with respect to oil (i.e., \( P_T/P_0^1 < P_T/P_0^0 \)) and with respect to nontradables (i.e., \( q_T^0 > q_T^1 \)). This reduction in the relative price of other tradables, of course, will encourage resources to move out of the other (non-oil) tradables sector into the other sectors of the economy. Notice that in the present framework where the oil sector has a life of its own, the more appropriate definition of the real exchange rate is given by the relative price of other tradables to nontradables. This relative price (\( q_T \)) is depicted in the vertical axis in figures 6.2, 6.3 and 6.5. Consequently, the behavior of the real exchange rate following a commodity export boom can be directly obtained from these figures.

It is important to notice from Figure 6.3 that the degree of loss of competitiveness of the non-oil tradables sector -- i.e., the degree of decline of \( q_T (= P_T/P_N) \) -- will depend on the slope of the NN curve. At one extreme, if the NN curve is a vertical line, the negative effect on \( q_T \) of an exogenous increase in the price of oil will be maximum. On the other hand, if all the additional income generated by the higher price of oil is spent on tradables, with none of it being spent on nontradables, the NN curve is a horizontal line, and there will be no effects of an increase in the price of oil on \( q_T \).

Consider now the more general case where oil is also consumed domestically, but where factors used in its production are still sector-
specific. Then, the excess demand for nontradables will be given by:

\[
N = N(q_T, q_0, Y) = 0 \\
(+) (?) (+)
\]  
\[ (6.11) \]

where the sign of \( \Delta N/\Delta q_0 \) will be positive if oil and nontradables are substitutes, and negative if they are complements. \(^{48/}\)

The slope of the NN curve will now be equal to:

\[
\frac{dq_T}{dq_0} = \frac{\Delta N/\Delta q_0 + (\Delta N/\Delta y)0}{(\Delta N/\Delta y)H_t^S + (\Delta N/\Delta q_T)}
\]  
\[ (6.12) \]

This expression can be either positive or negative, depending on the sign of \((\Delta N/\Delta q_C)\). If oil and nontradables are complements \((\Delta N/\Delta q_C < 0)\), it is possible that the numerator of equation \((6.11)\) will be negative and the slope of the NN curve will be positive. \(^{49/}\) Then, in this case, an increase in the price of oil would result in an increase in the relative price of other (non-oil) tradables, and thus in resources moving from the nontradable goods sector into the other tradable sector.

However, if oil and nontradables are substitutes -- which is the more plausible assumption, given the level of aggregation considered in this paper -- the NN curve will still be negatively sloped and the analysis presented in Figures 6.2 and 6.3 -- which indicates that a higher price of oil will reduce the degree of competitiveness of other tradables -- will still hold. In the rest of this section, it will be assumed, unless otherwise

\(^{48/}\) In the case where oil is used as an intermediate input in the production of nontradables, \(\Delta N/\Delta q_0 < 0\).

\(^{49/}\) Notice that \((\Delta N/\Delta q_C) < 0\) is a necessary (but not sufficient) condition for the NN curve to be positively sloped. The sufficient condition is that \([(\Delta N/\Delta q_C) = (\Delta N/\Delta y)C] < 0\).
indicated, that the three goods involved are substitutes in consumption, so that equation (6.12) is negative.

The analysis presented in this section shows that under a set of plausible assumptions increases in the price of oil will generate an equilibrium reduction in the relative prices of other tradables -- both in terms of oil and nontradables. This movement of relative prices will reduce the level of competitiveness of this sector (non-oil tradables), with resources tending to move out of it. To the extent that this is an equilibrium result, no particular policy measures should be taken to avoid it. 50/ However, if the change in the price of oil is only temporary, and the capital market presents some imperfections, there is an argument for implementing policies that will help firms in the non-oil tradables sector to "survive" this short-run squeeze 'n their profitability. The more interesting aspect of the model presented here, however, is that it shows that even in the absence of money and inflation, increases in the price of oil will tend to reduce the degree of profitability of other tradable goods.

The preceding analysis has focused on the long-run effect of an exogenous increase in the price of oil on the competitiveness of the rest of the tradable industries. The analysis, however, has abstracted from any dynamic aspects. Some dynamic considerations are now introduced into the model. To accomplish this a slowly clearing monetary sector is introduced into the model.

In order to organize the discussion, we assume that the exchange rate is fixed; this, however, is not an essential assumption [Edwards, (1984_)].

50/ At least on efficiency grounds, there is no reason for the economic authorities to try to prevent this equilibrium reallocation of resources.
Figure 6.3

Diagram showing a graph with axes $q_T$ and $q_C$. The graph includes labeled points and lines indicating relationships between $T$, $T'$, and the ratio $P_T/P_C$. The figure illustrates the concept of $T'$ as $P_T/P_C$. The specific points and curves are not detailed in the text provided.
Under these circumstances, an increase in the price of oil, in addition to its real effects, will affect both the supply and demand for money. It increases the supply of money by producing a balance of payments surplus which the central bank monetizes. (It is assumed that, as in most developing countries, the capital account is exogenous and subject to controls.) The demand for money will increase as well, as a result of the increase in income brought about by the higher price of oil. Theoretically, the overall result may be either a short-run excess (flow) supply or an excess demand for money. By Walras's Law, these situations respectively imply an excess demand for goods -- both tradables and nontradables -- or an excess supply of goods. In the former situation, the excess demand for nontradables goods caused by this short-run monetary disequilibrium will create inflationary pressures which will reinforce the effect caused by the real factors discussed previously (the increase in income resulting from the increase in oil prices). The result of this process will be that the real exchange rate or \( q_T \) will decrease in the short run by a greater amount than would be caused by real factors alone. In this case, then, the nominal price of nontradable goods will tend to overshoot its new long-run equilibrium, and the loss of competitiveness of the non-oil tradables sector -- measured by the decrease of \( q_T \) -- will be greater in the short than in the long run.

If, on the other hand, there is an excess demand for money, \( q_T \) will decrease in the short run by less than real factors alone would indicate. In either situation -- excess supply or excess demand for money -- as monetary equilibrium is restored through balance of payments surpluses or deficits (under the fixed rate assumption), \( q_T \) will move to its new long-run
equilibrium value as determined by the real factors in the model discussed in the previous section.

This discussion can be formalized in the following way: The excess supply for money in nominal terms ($M^S$) is given by:

$$M^S - M^D$$

where $M^S$ is the nominal supply for money, and $M^D$ is the demand for money in nominal terms. Assuming that the demand for money equation $M^D$ (in nominal terms) depends on the usual arguments -- real income, the interest rate ($i$) and the price level -- we can write $M^D$ as:

$$M^D = P^\alpha P^{1-\alpha} L(1, y)$$

where $P$ is the price level given by:

$$P = P_T^\alpha P_T^{1-\alpha}$$

and where the domestic price of the non-oil tradable goods is given by

$$P_T = E P^*_T$$

for $E$ = the exchange rate and $P^*_T$ the international price of non-oil tradables. Notice that in order to simplify the exposition, the price of oil has not been included in the definition of the price level.

We further assume that $M^E$ is equal to zero only in the long run. In particular, an increase of $M^S$ will result in a short-run excess supply of money which, under the assumption of fixed rates, will be slowly eliminated through the balance of payments. It is further assumed that an excess supply of money will be reflected in an excess demand for nontradables and an excess demand for non-oil tradables. Then, equation (6.8) has to be modified to
incorporate the assumption that in the short run, an excess flow supply of money is partially translated into an excess demand for nontradables.

\[ N = N(\ q_t, \ M^E, \ y) \]  

\[ (\ + \ ) \ (\ + \ ) \ (\ + \ ) \]  

(6.16)

In terms of Figure 6.2, an increase in \( M^E \) will result in a downward shift of schedule NN. The model is completed by specifying the balance of payments and the money supply equations.

The balance of payments is defined as:

\[ B = \Delta R = P^C - P^T E_T + CF \]  

(6.17)

where \( E_T \) stands for excess demand for traditional tradables; \( C \) is the amount of oil exported; \( CF \) refers to capital flows, which are assumed to be exogenous, and \( \Delta R \) is the change in international reserves. It is also assumed that \( \frac{\partial B}{\partial P^C} > 0 \); that is, an increase of the price of oil will result in an improvement of the balance of payment. 51/

The supply of money, on the other hand, is given by

\[ M^S = M^S_{-1} + \Delta R + \Delta D \]  

(6.18)

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51/ The effect of an increase in the price of coffee on the balance of trade will be given by

\[ \frac{dE_T}{dP^C} = \frac{P^T dE_T}{dP^C}, \]  

where \( \frac{dE_T}{dP^C} \geq 0. \n
A sufficient condition, then, for an increase in the price of coffee to result in a \( dB > 0 \) is that \( dE_T \leq 0. \)
Figure 6.4
where $M^S_t$ is the supply of money in the previous period, $\Delta R$ is the change in international reserves (i.e., the balance of payments) and is given by equation (6.17), and $\Delta D$ is the increase in domestic credit.

From (6.17) and (6.18), it is easy to see that to the extent that an increase in the price of oil results in a balance of payments surplus, $M^S$ will increase. Further, assuming that this increase in $M^S$ results in a short-run excess flow supply for money, $M^E$ will increase and there will be an excess demand for nontradable goods [see equation (6.16)]. In terms of our diagrammatical analysis, this case is captured by Figure 6.4. The exogenous increase in the price of oil simultaneously results in a downward shift of the NN curve to N'N' (as a consequence of the excess supply of money), and in a rotation of the OT ratio to OT'. The NN curve will shift downward, since if there is an excess supply of money at the old relative prices for nontradables, there will be an excess demand for these goods. The new short-run equilibrium is attained at $S$.

Final equilibrium is obtained, as before, at $C$. The dynamics are characterized by shifts of the N'N' curve to the right towards the NN curve. The speed of this adjustment depends on how fast the excess supply of money is eliminated. As may be seen, in this case, the relative price of non-oil tradables undershoots its final equilibrium level. This means that the loss

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52/ Actually, $\frac{dM^S}{dP_C} = \bar{C} - P_T \frac{dE_T}{dP_C}$, and if, $dE_T/dP_C < 0$, then $dM^S/dP_C > 0$.

53/ Formally we are assuming a slowly clearing money market. This assumption can be represented in the following form: $\Delta M^*_t = \theta(M^*_t - M^*_{t-1})$, where $\theta$ is the coefficient that measures the speed at which the money market will equilibrate.
of competitiveness of the non-oil tradables sector (as measured by the decline of $q_T$) is greater in the short run than in the long run. 54/

In sum, the analysis presented here indicates that under a set of plausible assumptions, changes in the price of a commodity export (oil) would tend to have important effects on the rest of the economy. Specifically, it was shown that an increase in the price of oil would reduce the level of competitiveness of the other (non-oil) tradable goods sector by generating a real appreciation. The model indicates that a higher price of oil will tend to result in a balance of payments surplus, an increase in the quantity of money, and inflation. This increase in the price level, in turn, will generate a real appreciation of the domestic currency, squeezing the profitability out of the non-oil tradable goods sector. Very few studies have analyzed empirically the effects of commodity export booms on the real exchange rate. However, the existing evidence indicates that the implications of the model discussed here are indeed highly realistic. 55/

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54/ Notice that this result is based on the assumption that the higher oil price results in a short-run excess supply for money. Theoretically, this is not necessarily the case. See Edwards and Aoki (1983).

7. Capital Flows and the Real Exchange Rate

During the last decade, capital movements in and out of developing countries have increased dramatically (World Bank, 1979). This higher degree of capital mobility has affected the developing countries in a number of ways. First, in some sense it allowed the emergence of the present foreign debt crisis. Second, it altered the level of the real exchange rate in the recipient countries, generating a drastic real appreciation in most countries that received massive capital inflows. This was particularly severe in the countries of the cone of South America. 56/

The relationship between capital inflows and the real exchange rate is analytically simple, and can be traced back to the traditional discussions on the effects of transfers from abroad in the donor and recipient countries. 57/ An increase in the net amount of funds received from abroad allows expenditure to increase relative to income; if a proportion of this additional expenditure falls on nontradables, an incipient excess demand for this type of goods will emerge, and a higher relative price of nontradables to tradables (i.e., a real appreciation) will be required to restore equilibrium. 58/ In terms of the real exchange rate model of Section 2, an increase in the level of net capital flows will allow a higher current account deficit which will be


57/ Notice, however, that most of the traditional transfer problem literature was abstracted from the existence of nontradable goods.

58/ Notice that it is implicitly assumed that demand conditions influence the relative price for nontradables. As discussed previously a sufficient condition for this to hold is that the number of factors exceed the number of tradable goods.
attained by a reduction in e (i.e., by an appreciation). 59/ If, on the other hand, there is a drop in the level of net capital inflows, or if there is a capital outflow, a real depreciation will result. An important question which will be addressed below is whether the change in the degree of net capital inflows is permanent or temporary. If it is temporary, the required adjustment in e to accommodate the change in the capital account will also be temporary.

The key for establishing a negative relationship between capital flows and the real exchange rate -- higher inflows result in a decline in e -- is that some of these additional funds are spent on nontradables. If, on the contrary, the extra funds are completely devoted to increasing the demand for tradables, there will be no pressure on the real exchange rate. 60/

McKinnon (1976) provides an early and clear analysis of the relation between capital inflows and the real exchange rate. Assuming a two-goods (tradables and nontradables) model with factor specificity, he considers the effect of an exogenous capital inflow on the relative price of tradables to nontradables. His analysis can be summarized in Figure 7.1 where TT is the production possibilities frontier and OC is the income expansion path consistent with the original relative prices. Initially (prior to the capital inflow) equilibrium is attained at point E where income equals expenditure, and both markets clear. The initial equilibrium real exchange rate is given by the slope of line \( e_0 \). Assume now that an exogenous capital inflow takes

59/ Notice that this statement assumes that the capital account surplus is not matched by all equivalent accumulation of international reserves.

place. The amount of this inflow is assumed to be equal to $I$ in terms of tradables. This inflow of capital allows expenditure to exceed income. The expenditure possibilities frontier then becomes $ST$, and at the existing (old) real exchange rate, production will still be given by $E$, while consumption will move to point $C$, on the intersection of the income expansion path and the new expenditure possibilities frontier. This, however, is a disequilibrium point since there is an excess demand for nontradables. (Remember that at this point, production is still given by $E$ on the production possibilities frontier $TT$.) To restore equilibrium, the relative price of nontradables has to rise — a real appreciation has to take place. In the diagram this new equilibrium is attained with a relative price $(e_1)$, consumption at $L$ and production at $M$.

Harberger (1982, 1983) and Khan and Zahler (1983a,b) have constructed simulation models to investigate the effects of capital movement on the real exchange rate. Both of these studies have concentrated on the effects of capital inflows on the real exchange rate. Their results, however, apply equally well to the case of outflows of capital. An interesting characteristic of Harberger's model is that the propensity to spend out of new net foreign borrowing (both on tradables and nontradables) is different than the propensity to spend out of real income. This follows from the assumption that economic agents don't consider foreign borrowing in the same way as they consider real income. Harberger uses his model to analyze the recent Chilean experience and suggests that the opening of the capital account -- which resulted in a massive increase in capital inflows in 1979 through 1981 -- can

61/ In this paper, McKinnon also discusses the way in which the economy would adjust if some price rigidities are assumed.
Figure 7.1
explain a large fraction of the real appreciation observed in that country during the late 1970s and early 1980s. This conjecture has recently been confirmed by Edwards (1985) in an econometric analysis of the determinants of the real exchange rate in Chile using quarterly data. In this study, the effective real exchange rate was the dependent variable; the set of independent variables included the terms of trade, the per capita income growth differential between Chile and the U.S., an indicator of the level of import protection, lagged net capital inflows and a lagged dependent variable. The results obtained indicated that (lagged) net capital flows had an important role explaining the drastic appreciation of the real exchange rate observed in Chile between 1979 and 1982. Their coefficient was significantly negative with a value of around -0.1.

Diaz-Alejandro (1984) has recently used the ratio of import to exports as a proxy for the level of capital inflows in his empirical analysis of real exchange rate behavior in some Latin American countries. His results support the implications of the analysis presented here; an increase (decrease) in the level of capital inflows results in a real appreciation (depreciation). Khan and Zahler, on the other hand, use their model to investigate the reaction of the economy to a simultaneous inflow of capital and relaxation of trade barriers. They find that the opening of the economy will generate, for a plausible set of parameters, a real appreciation.

The analyses of McKinnon (1975), Corden (1982) and Harberger (1982, 1983) are carried out under the assumption that the change in the level of capital flows is largely exogenous. This, of course, needs not be the case. In real life, capital movements are largely endogenous. One instance of endogenous capital flows that has been discussed in the literature, refers to
an economic liberalization process where existing restrictions to capital movements are lifted. These analyses have pointed out that to the extent that the liberalization of the capital account takes place after the domestic capital market has been reformed and interest rates freed, capital inflows will result. In this case, it has also been argued that the consequence will be a real appreciation. McKinnon (1973) for example has discussed this case in the context of a liberalization affecting foreign trade. He has pointed out that a trade liberalization will require a real depreciation in order to be successful. If, however, the capital account is opened at the same time as tariffs are reduced, the resulting inflow of capital will move the real exchange rate towards an appreciation. In McKinnon's words:

"N unusally large inflows of foreign capital...inhibit the exchange rate to depreciate sufficiently....[P]revi ously protected competing industries, which face a significant adjustment problem, could have their difficulties magnified....[H]ence the capital inflow could trigger a decline in overall domestic output..."

(p. 160)

Due to this real appreciation effect, the required depreciation associated with the reduction of tariffs will be precluded. McKinnon (1973) has consequently advocated that an economy that wishes to liberalize its trade sector should "deliberately avoid an unusual...injection of foreign capital" (1973, p. 161). This position has recently been echoed by other authors. Dornbusch (1983; p. 176), for example, has expressed that "the worst thing to

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63/ The argument goes along the lines discussed in the section on tariffs and the real exchange rate.
do is to liberalize the capital account... before the required real appreciation has been achieved."

If the opening of the capital account results in a higher long-run sustainable debt/output ratio, long-run net capital flows will increase and the long-run equilibrium real exchange rate will decline. 64/ This will be a long-run equilibrium real appreciation. The short-run dynamic behavior of $e$, however, will depend on the form in which the capital account is opened. Consider the case of a country where capital inflows are restricted. In this case, the behavior of capital flows can be captured by the following equation:

$$\Delta K = \min [\theta(D^* - D_{-1}), \Delta \bar{K}]$$

where $D^*$ is the desired (or sustainable) level of foreign debt, which will depend on the level of the world interest rate, real income, and real wealth, among other things. $D_{-1}$ is the actual stock of debt in the previous period, $\theta$ is a partial adjustment coefficient, and $\Delta \bar{K}$ is the maximum (possibly zero) amount of (net) capital inflow allowed by the economic authority in every period. Clearly, if $\Delta \bar{K} < \theta(D^* - D_{-1})$, and if $D^*$ grows through time, the gap between desired and actual debt will increase through time. Once the restrictions on capital inflows are lifted, actual inflows will become equal

64/ See, for example, Williamson (1983).
to $\theta(D^* - D_{-1})$. That means that immediately following the opening of the capital account, capital flows will jump to a fraction $\theta$ of the accumulated gap between the desired and actual debt. As this gap is closed, the level of capital inflows will slowly be reduced until they reach a new equilibrium level. For a case of a simple economy, the behavior through time of capital flows that emerges from this formulation can be represented in Figure 7.2.

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65/ The term $\theta[D^* - D_{-1}]$ responds to the idea, advanced by Harberger, 1982) for example, that there is a long-run equilibrium ratio of foreign debt to GDP. If GDP grows at $g$ percent per annum so will the stock of debt. If, on the other hand, the real interest rate on the foreign debt is $r^*$, net annual capital inflows will grow at a rate of $(g - r^*)$. Notice that a problem with this formulation is that it only looks at the phase where foreign debt is accumulated, and does not explicitly incorporate the existence of an intertemporal budget constraint. On the different phases of the accounts of the balance of payments, see Fischer and Frenkel (1972).
This sudden increase (i.e., overshooting) of capital inflows will produce a large current account deficit. 66/ As long as a fraction of these flows is spent on nontradable goods, the absorption of these capital inflows will require an increase in the relative price of these goods and a real appreciation of domestic currency. Once the gap between desired and actual debt begins to close, the relative price of nontradables will slowly tend to decline towards its new long-run equilibrium, meaning that the real exchange rate will now have to increase relative to its value immediately after the opening of the capital account. At this point of the adjustment process, another problem may emerge if the country has fixed its nominal exchange rate: If for some reason -- the existence of minimum wages, or of backward indexation, for example -- the nominal price of nontradables is inflexible downward, the decline of the price of tradables relative to nontradables will not occur, and unemployment will result.

An important question related to the impact of capital flows on the real exchange rate in developing countries refers to whether these inflows are temporary or permanent. Obviously, a temporary increase (decrease) in the level of net capital inflows will result in a temporary real appreciation (depreciation). These temporary changes in the level of capital flows generate a particularly interesting situation. Consider the case of a temporary increase in the level of capital inflows into a developing country. 67/ As discussed above, to the extent that a fraction of these funds

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67/ There are many reasons why this temporary increase in the level of flows can occur. One such reason is related with the implementation of economic
Figure 7.2
is spent on nontradables, the absorption of the capital inflow will require a real appreciation. This real appreciation will have an interesting characteristic: While it will be a short-run equilibrium phenomenon, it will represent a deviation from the long-run, sustainable equilibrium real exchange rate. The reason, of course, is that by definition, this short-run, higher-capital inflow will not be sustainable in the long run. Policymakers should generally take this difference into account. The general case here is that a real appreciation which is the result of a short-term extraordinary inflow of capital should not be seen as a disequilibrium phenomenon; it should be considered as a short-term divergence between the long- and short-term equilibrium rates.
8. Economic Growth and the Real Exchange Rate

8.1 Theory

A proposition which is now widely accepted is that with other things given, in rapidly growing countries (i.e., countries that grow faster than their partners in bilateral exchange rate comparisons), the equilibrium real exchange rate will tend to decline through time, (i.e., there will be a real appreciation). 68/ This proposition is generally regarded to be valid for the exchange rate defined as the (home) relative price of tradables to nontradables, as well as for PPP real exchange rate. A related proposition states that in countries with a higher income per capita, the real exchange rate will tend to be lower. There is, however, less acceptability in the profession regarding this last proposition.

David Ricardo (1821) is considered to have been the first to explicitly postulate the existence of a negative relationship between economic growth and the relative price of tradables to nontradables. Later a number of authors, including Pigou (1922) and Hagen (1960), pointed out within the context of the PPP debate that there is a tendency for the relative prices of tradables to nontradables to differ across countries; higher-income countries would tend to have a lower relative price between these two groups of goods.

However, it was only in Balassa's (1964) reinterpretation of the PPP theory that the theoretical foundations of this proposition were clearly set forward. According to Balassa, the rate of productivity improvements are higher in countries with higher rate of growth than in countries with a lower

rate of growth. Moreover, the rate at which productivity improves is not uniform across sectors within each country; gains in productivity are larger in the tradable than in the nontradable goods sector in all countries. This means that in each country the equilibrium relative price of tradables to nontradables will tend to decline through time. Since the prices of tradable goods will move together across countries, the differential in productivities improvements across countries and sectors will result in an appreciation of the PPP defined real exchange rate. While sometimes this argument is presented in a dynamic form (i.e., growth of output rather than levels of income per capita), in Balassa’s (1964) original article the analysis was presented in a static form. However, Balassa’s (1964) empirical study dealt both with the static and the dynamic versions of the proposition. For a recent ingenious presentation of the theoretical foundations of the Balassa Effect, see Marris (1984).

Even though Balassa did not formally state his argument, it can be formally presented using the following simple model. Following Balassa, assume that the country in question uses labor to produce two goods -- tradables (T) and nontradables (N) -- with a Ricardian technology. Assume further that the nominal exchange rate is unity (E=1), that the world price of tradables (P_T^*) is given, and that the law of one price prevails for tradables. It is also assumed that there is perfect labor mobility across sectors, and consequently a unique nominal wage rate (W). Equations (8.1) and (8.2) present prices of tradables and nontradables, where a_{NT} and a_{LT} are the corresponding input-output coefficients. Equation (8.3) is the relative price of tradables to nontradables or real exchange rate. The demand side for nontradables is not specified in this model. The reason for this is that
since there are an equal number of tradable goods and factors, under the assumption of perfect competition the price of nontradables is given by supply conditions only. [See Komiya (1969) and the discussion in Section 5 above.]

\[ P_T = a_{LT}W = P^*_T \]  \hspace{1cm} (8.1)

\[ P_N = a_{LN}W \]  \hspace{1cm} (8.2)

\[ e = P_T/P_N \]  \hspace{1cm} (8.3)

Equation (8.1) captures the assumption that the law of one price holds for tradables. Suppose now, as in Balassa (1964), that while both sectors are subject to gains in productivity, these are larger in the tradables sector. Since gains in productivity will be reflected by a decline in the \( a_{Li} \) 's, (i.e., \( \hat{a}_{LN} < 0, \hat{a}_{LT} < 0 \)), this assumption is captured by (where as before \( X = d \log X \)):

\[ \hat{\theta} \hat{a}_{LT} = \hat{\theta} \hat{a}_{LN} \]  \hspace{1cm} (8.4)

where \( 0 < \theta < 1 \), measures the constant differential in productivity gains across sectors. Taking logarithmic differentials of (8.1), (8.2) and (8.3), using (8.4), and assuming that \( P^*_T = 0 \), it is found that for the case of a small open economy the change in the equilibrium real exchange rate will be:

\[ \hat{e} = (1-\theta)\hat{a}_{LT} < 0 \]  \hspace{1cm} (8.5)

According to this equation if productivity gains are larger in the tradable goods sector (i.e., \( 0 < \theta < 1 \)) there will be a secular tendency for the real exchange rate -- defined as the relative price of tradables to nontradables -- to appreciate through time.

Consider now the more traditional PPP measure of the real exchange rate \( (e_{PPP}) \); where \( P \) and \( P^* \) are price indexes abroad and at home:
\[ e_{PPP} = p^* / p \]  \hspace{1cm} (8.6)

\[ p = p^\alpha p^{(1-\alpha)}_N p^*_T \]  \hspace{1cm} (8.7)

\[ p^* = p^\alpha N^* p^{(1-\alpha)*}_T \]  \hspace{1cm} (8.8)

From (8.7) and (8.8) the percentage change in the price level at home \( \hat{p} \) and abroad is:

\[ \hat{p} = \alpha \hat{p}_N + (1-\alpha) \hat{p}_T \]  \hspace{1cm} (8.9)

\[ \hat{p}^* = \alpha^* \hat{p}^*_N + (1-\alpha^*) \hat{p}^*_T \]  \hspace{1cm} (8.10)

Using equations (8.1) and (8.5), expression (8.9) can be rewritten as:

\[ \hat{p} = \hat{p}^* + \alpha(\theta - 1) \hat{a}_{LT} \]  \hspace{1cm} (8.11)

Consider now, as in Balassa (1964), that the gains in productivity are larger in the domestic country (i.e., the domestic country grows faster). This assumption can be captured by:

\[ \hat{a}^*_{LT} = \lambda \hat{a}_{LT} \]  \hspace{1cm} (8.12)

where \( 0 < \lambda < 1 \).

Logarithmically differentiating (8.6), using (8.10), (8.11) and (8.12) it is possible to find the following expression for the rate of change of the PPP real exchange rate:

\[ e_{PPP} = \hat{a}_{LT} [\alpha(1-\theta) - \lambda(1-\theta^*) \alpha^*] \quad \geq 0 \]  \hspace{1cm} (8.13)

As may be seen from (8.13) the equilibrium change in the long-run PPP real exchange rate, as a consequence of growth differentials, can be either positive or negative. This contrasts with the result obtained in equation
(8.5) for the effect of growth (i.e., productivity gains) on the real exchange rate defined as the relative price of tradables to nontradables. In that case growth resulted unequivocally on a real appreciation. The fact that different results are obtained for $\hat{e}$ and $\hat{e}_{ppp}$ points out, once more, towards the importance of clearly defining what is meant by "the" real exchange rate in the analysis at hand.

Consider now the simplified case where $\theta = \theta^*$ and $\alpha = \alpha^*$. That is the case where the productivity gains differential across sectors is the same in both countries and where the weights used for computing the price level are also equal. Then (8.13) can be rewritten as:

$$\hat{e}_{ppp} = \hat{a}_{LT} \alpha(1-\theta)(1-\lambda) < 0$$

(8.14)

This means that $\theta = \theta^*$ and $\alpha = \alpha^*$ is a sufficient condition for higher productivity gains in the tradables sector and in the home country to result in an equilibrium real appreciation of the PPP real exchange rate. The necessary condition is that:

$$\alpha > \alpha^* \left[ \lambda(1-\theta^*)/(1-\theta) \right]$$

(8.15)

The interpretation of (8.15) is simple. Since in both countries the relative price of nontradables will increase as a consequence of productivity gains (equation (8.5)), $e_{ppp}$ will only decline if the price of nontradables has a high-enough weight in the domestic price level. Equation (3.16) defines exactly what a "high-enough" weight means in this context.

8.2 **Empirical Evidence**

A number of papers, including Balassa's (1964) own study, have empirically investigated the validity of the hypothesis that countries with
higher growth (and/or higher income per capita) will experience a real appreciation through time. Balassa (1964) used cross-section data from 12 industrialized countries to analyze this proposition. He basically performed two tests. First he ran regressions using PPP/E (i.e., the inverse of the PPP real exchange rate) as the dependent variable and GNP per capita as the explanatory variable. The results were very satisfactory and significant positive coefficients were found. Second, he tested a relative version of the proposition by running regressions of the ratio of the GNP deflator to the wholesale price index of manufactured goods on an index of manufacturing output per man. The results obtained also provided strong support to the hypothesis that faster-growing countries tend to experience a real appreciation through time.

Later a number of authors tested different versions of the Balassa effect using alternative groups of countries and time periods. While some authors -- most notably Officer (1974) -- have rejected the importance of this effect (see also Grunwald and Salazar-Carrillo 1968 and Clague and Tanzi 1972), by and large most empirical investigations have supported Balassa's proposition, finding that higher growth (and/or income per capita) is associated with an equilibrium real appreciation (see, for example, McKinnon 1971, Kravis and Lipsey 1978, Krugman 1978, and Dornbusch 1978, 1979).

Harberger (1981) recently used a sample of 58 countries to investigate the extent to which real exchange rate changes have been related to economic growth. In his analysis, he deals both with a relative and an

69/ The GNP per capita figures were expressed in U.S. dollars using the official exchange rate. This procedure was later criticized by Officer (1974).
absolute version of the Balassa proposition. Using the rate of change of the 
CPI bilateral real exchange rate with respect to the U.S. dollar between 1960 
and 1978 as the dependent variable he finds that the coefficient of the rate 
of growth of (real) per capita income is significantly negative (-0.266) as 
expected. Harberger then expands the set of explanatory variables, including 
the average annual change in imports, as a percentage of output, and the 
changes in the terms of trade. The former variable is included as a measure 
of "improved terms of trade, of improved export capacity, and of capital 
flows." The results obtained show that, as expected, this variable has a 
negative and insignificant coefficient (-0.417).

Barro (1983) has investigated the real determinants of real exchange 
rates for a group of seven OECD countries using annual data for 1952-1982. He 
develops a general empirical model that relates the change in the bilateral 
real exchange rate to a set of real (as opposed to monetary) variables. Among 
these variables he included: (a) differential rates of growth of per capita 
iccome across countries; (b) differential changes in real wage costs; 
(c) changes in the terms of trade (contemporaneous and lagged); (d) changes in 
the relative price of oil; (e) changes in tariff receipts; and (f) changes in 
tax receipts. He estimates the model both using pooled data for all seven 
countries, and using a seemingly unrelated regressions procedure. When pooled 
data is used the results are highly favorable to the Balassa effect, with the 
coefficient of real wage rate changes and real per capital income changes 
having the expected signs, and being highly significant. The results for the 
individual countries are somewhat less favorable, with some countries 
(Germany, Sweden and Switzerland) having a real per capital income coefficient 
with the wrong sign.
Kravis and Lipsey (1983) have recently summarized their project on international comparisons of prices and incomes. Among the many tests performed, they tried to statistically explain the behavior of an index of price levels -- or inverse of the PPP real exchange rate. A number of regressions were run, with real GDP per capita, openness, the nontradables share of GNP, and the share of the labor force working in the nontradables sector, as explanatory variables. The results obtained for a cross-section of 34 countries are remarkably good and support the Balassa effect hypothesis. For example, using 1975 as the benchmark year and the U.S. as the reference country, the following result was obtained (t-statistics in parentheses): 70

\[
\frac{1}{e_{PPP}} = -0.0611 + 0.0068 \text{[income per capita]} + 0.00014 \text{[openness]} + 0.0100 \text{[share of nontradables]}
\]

\[
\begin{align*}
(0.5) & \quad (6.4) & \quad (1.5) \\
(2.8) & & \\
\end{align*}
\]

\[R^2 = 0.859\]

\[S.E.E. = 0.1092\]

---

70/ This is Kravis and Lipsey's (1983) equation (15).
9. Empirical Evidence on the Determinants on the Real Exchange Rate

In this section, new evidence on the behavior of the real exchange rate in developing countries is presented. The purpose of the empirical analysis is to determine the extent to which some of the variables considered in the preceding sections -- growth per capita, changes in the terms of trade, among others -- have in fact played an important role in determining the behavior of the real exchange rate in some developing countries. 71/ The results reported here refer to a group of seven countries -- Greece, Ireland, Yugoslavia, Colombia, El Salvador, Israel and Korea. These countries were selected because of data availability; they are the only countries for which data for both terms of trade and wages were available for a long enough period of time. For most cases, the regressions refer to the period 1955-1982.

There are three basic hypotheses being tested in this analysis. The first is that the rate of change in the real exchange rate and the rate of growth in income per capita are inversely related. While a series of papers has investigated this proposition, most of them have tested it using regressions on the levels of (the logs of) the relevant variables. In this study, however, rates of change of the variables are used. In rigor, the theoretical proposition -- known as the Balassa effect -- is that countries with a higher rate of productivity gains would experience a real appreciation. In the present study, following Barro (1983) and others, two variables are used to capture this productivity effect. First, as in most traditional studies, the rate of growth of real income per capita is used [Balassa (1964), Officer (1976), Harberger (1981)]. Also, the rate of growth of real wages in

71/ In some sense, the approach taken here is similar to that of Barro (1983).
the manufacturing sector is used in an effort to capture this productivity effect [Barro (1983)].

The second hypothesis that is tested refers to the relationship between changes in the terms of trade and the real exchange rate. In the analysis presented in Section 6, it was shown that in a general equilibrium setting with exportables, importables and nontradables, the effect of a change in the terms of trade on the equilibrium real exchange rate is not determined a priori. However, for most countries, the presumption is that in accordance with the more traditional view, a worsening in the terms of trade will generate a real depreciation of the domestic currency.

Finally, the third main hypothesis tested is that an inflow of capital from abroad will tend to generate a real appreciation. 72/ However, there are serious data problems for directly testing this hypothesis. The main problem is that from an analytical perspective only net capital inflows -- gross inflows minus interest payments to the rest of the world -- will exercise a downward pressure on the real exchange rate. Unfortunately, however, there are no data ready available on net inflows. In order to solve this problem we have opted to use the annual change in imports, expressed as a fraction of GDP as a proxy for capital flows. This procedure has been previously suggested by Harberger (1981). The main idea here is that a higher level of capital inflows indeed makes possible higher imports relative to GDP [Harberger (1981), p. 22].

The main equation fitted for the seven countries under consideration was the following:

---

72/ As discussed above, this will only be the case if a proportion of these funds are spent on nontradables.
\[ \hat{e}_t = \gamma_0 + \gamma_1 \hat{y}_{t-1} + \gamma_2 \hat{\tau}_t + \gamma_3 \Delta m_{t-1} + w_t \]  

(9.1)

where \( w_t \) is an error term with the usual properties and where the variables were defined in the following way:

\( \hat{e} \): rate of change of the real exchange rate \( e \), was defined as

\( e = (E \text{ WPI}_{\text{US}})/\text{CPI} \), where \( E \) is the nominal exchange rate, \( \text{WPI}_{\text{US}} \) is the U.S. wholesale price index and \( \text{CPI} \) is the domestic consumer price index. All the data were taken from the IFS tape. Notice that according to this definition a positive \( \hat{e} \) represents a real depreciation.

\( \hat{y} \): rate of growth of real GDP per capita. The data were also obtained from the IFS tape.

\( \hat{\tau} \): rate of change of the terms of trade. The terms of trade \( \tau \) are defined as the ratio of export prices in U.S. dollars to import prices in dollars. A positive \( \hat{\tau} \), then, means that there has been an improvement in the terms of trade. The data on export and import prices were taken from the IFS tape.

\( \Delta m \): Annual change in imports relative to GDP. \( \Delta m_t = (\text{Imports}_t - \text{Imports}_{t-1})/\text{GDP}_t \). The raw data to construct this variable were also taken from the IFS tape.

In addition to equation (9.1), regressions that also included the rate of growth of real wages (\( \hat{W} \)) were run. The data on real wages were taken from the ILO Yearbook. Finally, in order to test if some monetary variables have played any substantive role in the behavior of the real exchange rate in these countries, the rate of growth of nominal money (\( M_1 \)) was also added to the regression analysis; the data on \( M_1 \) was taken from the IFS tape.
During the estimation process, a number of alternative lag structures was tried. The one presented in equation (9.1) was the most satisfactory. 73/ A possible problem with this lag structure, however, is that the change in the terms of trade enters contemporaneously on the right-hand side of (9.1). A well-known proposition in international trade is that under certain conditions, a devaluation will generate an improvement of the terms of trade. 74/ If this is the case, \( \tau_t \) would not be independent of the error term \( w_t \), and the use of OLS would be inappropriate. Since the present study, however, deals with (very) small countries, it is highly unlikely that changes in their exchange rates would affect the terms of trade. Also, Morgan and Davis (1982) found that devaluations have had no significant effects on the terms of trade in developing countries. For this reason, the regressions were run using OLS. 75/

The results obtained from the estimation of equation (9.1) and some of its variants are presented in Table 5. Broadly speaking, these results are satisfactory. This is especially the case considering that the regressions were run with the variables expressed in rates of growth. In most of the cases (21 out of 28 cases) the coefficient for the rate of growth of GDP per capita is negative as expected. However, these coefficients turned out to be significant at the conventional levels only in regressions for Greece and Korea.

With the exception of Israel, the coefficient of changes in the terms of trade are in all cases negative as suggested by the traditional view. This

73/ It should be noted, however, that when other lag structures were used, there were no major changes in the results.

74/ See, for example, Joan Robinson's famous article, "Beggar-my-Neighbour," (1937).

75/ Notice, however, that Barro's (1983) paper is subject to this problem.
means that an improvement (worsening) in the terms of trade will tend to
generate a real appreciation (depreciation). Again, however, for only some of
the countries considered, the coefficient for $\tau_t$ was significant. Ireland,
Colombia and Korea. The case of Colombia is particularly interesting since it
has been well established that changes in the world price of coffee --
Colombia's main export and principal determinant of its terms of trade -- have
had dramatic effects on its real exchange rate (Diaz-Alejandro, 1976).

Probably the most interesting result is that the coefficient of
$\Delta m_{t-1}^*$ -- the change in imports as a fraction of GDP -- is negative (as
expected) in six of the seven countries; the exception being Yugoslavia.
Furthermore, in the cases of Greece, Ireland, El Salvador and Korea, the
coefficient is significant at the conventional levels. 76/ This result provides
preliminary and indirect support to the hypothesis that an increase in the net
capital inflows -- which result in higher $\Delta m$'s -- will exercise a downward
pressure on the equilibrium real exchange rate.

76/ Notice that these results contrast with Harberger's (1981), who using
cross-section data for 59 LDCs found a negative but insignificant
coefficient for $\Delta m_t$. 
<table>
<thead>
<tr>
<th>Eq.</th>
<th>Constant</th>
<th>$\hat{y}_{t-1}$</th>
<th>$\hat{T}_t$</th>
<th>$\Delta m_{t-1}$</th>
<th>$\hat{W}_{t-1}$</th>
<th>$\hat{M}_{t-1}$</th>
<th>n</th>
<th>R²</th>
<th>DW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greece (1)</td>
<td>0.078 (2.115)</td>
<td>-1.220 (-2.102)</td>
<td>-0.105 (-0.278)</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>30</td>
<td>0.142</td>
<td>1.973</td>
</tr>
<tr>
<td>(2)</td>
<td>0.124 (2.823)</td>
<td>-1.285 (-2.296)</td>
<td>-0.168 (-0.462)</td>
<td>-1.625 (-1.779)</td>
<td>--</td>
<td>--</td>
<td>30</td>
<td>0.235</td>
<td>2.039</td>
</tr>
<tr>
<td>(3)</td>
<td>0.111 (2.040)</td>
<td>-1.107 (-1.844)</td>
<td>-0.068 (-0.179)</td>
<td>--</td>
<td>--</td>
<td>-0.221 (-0.823)</td>
<td>30</td>
<td>0.163</td>
<td>1.792</td>
</tr>
<tr>
<td>(4)</td>
<td>0.034 (1.610)</td>
<td>-0.417 (-1.432)</td>
<td>-0.082 (-0.665)</td>
<td>--</td>
<td>-0.185</td>
<td>--</td>
<td>20</td>
<td>0.199</td>
<td>1.250</td>
</tr>
<tr>
<td>Ireland (1)</td>
<td>-0.004 (-0.151)</td>
<td>0.061 (0.083)</td>
<td>-0.468 (-1.507)</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>33</td>
<td>0.071</td>
<td>1.382</td>
</tr>
<tr>
<td>(2)</td>
<td>0.023 (0.823)</td>
<td>0.083 (0.119)</td>
<td>-0.581 (-1.923)</td>
<td>-0.548 (-1.998)</td>
<td>--</td>
<td>--</td>
<td>33</td>
<td>0.184</td>
<td>1.160</td>
</tr>
<tr>
<td>(3)</td>
<td>0.002 (0.050)</td>
<td>0.154 (0.196)</td>
<td>-0.461 (-1.461)</td>
<td>--</td>
<td>--</td>
<td>-0.091 (-0.367)</td>
<td>33</td>
<td>0.076</td>
<td>1.382</td>
</tr>
<tr>
<td>(4)</td>
<td>0.008 (0.320)</td>
<td>-0.738 (-1.150)</td>
<td>-0.209 (-0.740)</td>
<td>--</td>
<td>--</td>
<td>0.172 (0.489)</td>
<td>23</td>
<td>0.100</td>
<td>1.847</td>
</tr>
<tr>
<td>Yugoslavia (1)</td>
<td>-0.015 (-0.127)</td>
<td>0.933 (0.503)</td>
<td>-0.496 (-0.337)</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>19</td>
<td>0.019</td>
<td>1.453</td>
</tr>
<tr>
<td>(2)</td>
<td>-0.015 (-0.120)</td>
<td>0.930 (0.477)</td>
<td>-0.497 (-0.325)</td>
<td>0.019 (0.011)</td>
<td>--</td>
<td>--</td>
<td>19</td>
<td>0.019</td>
<td>1.454</td>
</tr>
<tr>
<td>(3)</td>
<td>0.100 (0.668)</td>
<td>0.683 (0.370)</td>
<td>-0.673 (-0.461)</td>
<td>--</td>
<td>--</td>
<td>-0.441 (-1.201)</td>
<td>19</td>
<td>0.105</td>
<td>1.603</td>
</tr>
<tr>
<td>(4)</td>
<td>0.041 (0.362)</td>
<td>-1.893 (-0.806)</td>
<td>-0.125 (-0.089)</td>
<td>--</td>
<td>--</td>
<td>0.235 (1.791)</td>
<td>19</td>
<td>0.192</td>
<td>2.064</td>
</tr>
<tr>
<td>Colombia (1)</td>
<td>0.048 (1.218)</td>
<td>-1.055 (-0.758)</td>
<td>-0.252 (-1.756)</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>24</td>
<td>0.156</td>
<td>1.732</td>
</tr>
<tr>
<td>(2)</td>
<td>0.074 (1.672)</td>
<td>-0.756 (-0.542)</td>
<td>-0.261 (-1.843)</td>
<td>-1.576 (-1.249)</td>
<td>--</td>
<td>--</td>
<td>24</td>
<td>0.217</td>
<td>1.603</td>
</tr>
<tr>
<td>(3)</td>
<td>0.098 (1.235)</td>
<td>-0.791 (-0.544)</td>
<td>-0.248 (-1.706)</td>
<td>--</td>
<td>--</td>
<td>-0.267 (-0.725)</td>
<td>24</td>
<td>0.178</td>
<td>1.785</td>
</tr>
<tr>
<td>(4)</td>
<td>0.048 (1.054)</td>
<td>-1.042 (-0.714)</td>
<td>-0.251 (-1.681)</td>
<td>--</td>
<td>--</td>
<td>0.013 (0.041)</td>
<td>24</td>
<td>0.156</td>
<td>1.726</td>
</tr>
</tbody>
</table>
Table 5
Determinants of the Real Exchange Rate:
Regression Results

<table>
<thead>
<tr>
<th>Eq.</th>
<th>Constant</th>
<th>$y_{t-1}$</th>
<th>$T_t$</th>
<th>Δ$m_{t-1}$</th>
<th>$W_{t-1}$</th>
<th>$M_{t-1}$</th>
<th>n</th>
<th>$R^2$</th>
<th>DW</th>
</tr>
</thead>
<tbody>
<tr>
<td>El Salvador (1)</td>
<td>-0.001</td>
<td>-0.070</td>
<td>-0.024</td>
<td>$\cdots$</td>
<td>$\cdots$</td>
<td>$\cdots$</td>
<td>27</td>
<td>0.015</td>
<td>1.511</td>
</tr>
<tr>
<td>(2)</td>
<td>0.007</td>
<td>0.325</td>
<td>-0.034</td>
<td>-0.583</td>
<td>$\cdots$</td>
<td>$\cdots$</td>
<td>27</td>
<td>0.213</td>
<td>1.619</td>
</tr>
<tr>
<td>(3)</td>
<td>0.008</td>
<td>-0.127</td>
<td>-0.003</td>
<td>$\cdots$</td>
<td>$\cdots$</td>
<td>-0.083</td>
<td>27</td>
<td>0.066</td>
<td>1.593</td>
</tr>
<tr>
<td>(4)</td>
<td>0.001</td>
<td>-0.290</td>
<td>-0.008</td>
<td>$\cdots$</td>
<td>0.008</td>
<td>$\cdots$</td>
<td>21</td>
<td>0.037</td>
<td>1.144</td>
</tr>
<tr>
<td>Israel (1)</td>
<td>0.031</td>
<td>-0.280</td>
<td>0.536</td>
<td>$\cdots$</td>
<td>$\cdots$</td>
<td>$\cdots$</td>
<td>27</td>
<td>0.073</td>
<td>2.452</td>
</tr>
<tr>
<td>(2)</td>
<td>0.041</td>
<td>-0.316</td>
<td>0.484</td>
<td>-0.098</td>
<td>$\cdots$</td>
<td>$\cdots$</td>
<td>27</td>
<td>0.072</td>
<td>2.375</td>
</tr>
<tr>
<td>(3)</td>
<td>0.010</td>
<td>-0.188</td>
<td>0.570</td>
<td>$\cdots$</td>
<td>0.068</td>
<td>$\cdots$</td>
<td>27</td>
<td>0.083</td>
<td>2.517</td>
</tr>
<tr>
<td>(4)</td>
<td>0.037</td>
<td>-0.171</td>
<td>0.532</td>
<td>$\cdots$</td>
<td>-0.204</td>
<td>$\cdots$</td>
<td>24</td>
<td>0.067</td>
<td>2.440</td>
</tr>
<tr>
<td>Korea (1)</td>
<td>0.031</td>
<td>-0.533</td>
<td>-0.430</td>
<td>$\cdots$</td>
<td>$\cdots$</td>
<td>$\cdots$</td>
<td>18</td>
<td>0.339</td>
<td>1.770</td>
</tr>
<tr>
<td>(2)</td>
<td>0.117</td>
<td>-0.576</td>
<td>-0.671</td>
<td>-1.158</td>
<td>$\cdots$</td>
<td>$\cdots$</td>
<td>18</td>
<td>0.545</td>
<td>1.729</td>
</tr>
<tr>
<td>(3)</td>
<td>0.078</td>
<td>-0.392</td>
<td>-0.443</td>
<td>$\cdots$</td>
<td>$\cdots$</td>
<td>-0.192</td>
<td>18</td>
<td>0.440</td>
<td>1.997</td>
</tr>
<tr>
<td>(4)</td>
<td>0.031</td>
<td>-0.037</td>
<td>-0.470</td>
<td>$\cdots$</td>
<td>-0.427</td>
<td>$\cdots$</td>
<td>17</td>
<td>0.494</td>
<td>2.183</td>
</tr>
</tbody>
</table>

Notes: t-statistics in parentheses
Regarding the rate of change of real wages ($w$), the results are somewhat similar to those obtained by Barro (1983) for seven OECD countries, indicating that once growth of GDP per capita is incorporated into the analysis, wage growth does not add to it. The coefficients of the rate of growth of nominal money ($M$) were in all cases negative, and always insignificant. These results suggest that, at least in the countries and period considered, monetary factors have not affected the behavior of the real exchange rate. To some extent, this is a surprising result since in some of these countries significant real appreciations of the domestic currency have been associated with inflationary processes generated by high rates of growth of money. 77/ On the other hand, however, the nonsignificance of the coefficients of the monetary variables correspond to Barro's (1983) recent findings.

In order to check if there was a difference in the behavior of the real exchange rate in the Bretton Woods and the more recent period a dummy variable which took a value of zero in years prior to 1973 and one after (and including) 1973 was also included. While in most cases the dummy was negative, it was never significant. Also equations that included the rate of change in the world real interest rate, proxied by the U.S. treasury bills ex post real interest rate, were run. In most cases, the coefficients were positive and insignificant.

A shortcoming of these results is that these equations are only able to explain a very small proportion of the variation of the real exchange rate in these countries. While this is a typical result in analyses performed with

77/ There have been cases in Colombia prior to 1967 and Israel in the late seventies.
the variables expressed as rates of change, it still suggests that there might be some important variables that have been left out. Among these variables, one of the more important ones is the degree of protection provided by the tariff system. Unfortunately, however, there are no data on time series for the degree of protection really available for any of these countries. 78/

78/ One possible proxy, used by some authors, is the ratio of import duties collected to imports. However, data on import (or export) tax collections are only available for a large number of country for short periods of time. For example, the IMF Government Finance Statistics tape has data for some countries, starting in 1971 only.
PART THREE:

DISEQUILIBRIUM REAL EXCHANGE RATES AND EXCHANGE RATE CRISES
10. Disequilibrium Real Exchange Rates, International Reserves and Devaluation Rate Crises: An Overview

Many LDCs have recently gone through severe balance of payments crises, which in some countries have resulted in the abandonment of their exchange rate policy (i.e., Mexico, Indonesia, Chile, Peru). Historically, the typical devaluation crisis situation follows a period of overvalued real exchange rates. At some point, it is not possible to maintain this overvalued rate, and a nominal devaluation is implemented in the hope that the real overvaluation will be solved. Since this type of devaluation crisis is usually the outcome of extreme cases of real exchange rate overvaluation, their close study will provide helpful insight on the behavior of an economy under overvalued real exchange rates. In particular, the empirical analysis of a situation leading to a devaluation crisis should be useful. By understanding how a number of indicators evolve in the period immediately preceding the crisis, helpful information that will allow policymakers to better assess real exchange rate misalignment will be provided.

Usually the events leading to an exchange rate crisis can be characterized in the following way: For some reason, generally related to a loose monetary policy, the country loses international reserves and experiences an inflation higher than the rest of the world. If the authorities don't succeed in stopping the reserves drainage, a point when the country simply "runs out" of reserves is reached and the authorities are forced to devalue. 79/ During the process leading to the balance of payments crisis,

79/ In the present context, "running out of reserves" should be interpreted as "reserves reaching a lower bound.". Usually when the reserves are fairly low, speculators anticipate the crisis. This results in an acceleration of the crisis.
there is usually a significant real appreciation generated, in a fixed-rate country, by a domestic rate of inflation higher than world inflation (Krueger, 1978). This decline in the real exchange rate constitutes, in general, a disequilibrium situation.

It is safe to say that one of the distinctive characteristics of periods where the currency experiences a significant real overvaluation (i.e., the real exchange rate is in disequilibrium) is that the real exchange rate appreciates at the same time as the level of international reserves decline. 80/ One should be careful, however, with the interpretation of this statement. In rigor, in this case the decline in reserves should be measured relative to their desired level, and not in absolute terms (see Edwards, 1983). It is also important to notice that a disequilibrium situation can also present itself without any significant movement in any of the indexes of the real exchange rate. This would be the case, for example, if for a given real exchange rate, there are events that lead the equilibrium rate to change. Harberger (1984, p. 6) has recently argued that a real exchange rate disequilibrium situation with currency overvaluation is characterized by: (a) prices of tradables sharply "too low" relative to nontradables; (b) recession in the manufacturing sector; (c) wages are "out of line" on the high side; and (d) the country has been losing international reserves.

Recently, some theoretical studies have dealt with exchange rate crisis problems; among these the most important are those by Krugman (1978), Blanco and Garber (1983), Obstfeld (1984), and Connolly and Taylor (1984). 81/

80/ Symmetrically it is possible to have a significant real undervaluation with reserves increasing. This would also be a disequilibrium situation.

81/ See also Salant and Henderson (1978) and Salant (1983).
Krugman's (1979) study deals with the timing and characteristics of the exchange rate crisis in a country with speculators that hold both foreign and domestic money. His analysis shows that to the extent that speculators are rational, they will anticipate the abandonment of the fixed rate, and at some point prior to the crisis will acquire the entire stock of central bank reserves. This means that the crisis will always take place before the date at which the government would have run out of reserves in the absence of speculation. Krugman also shows that if the government policy is uncertain, the speculative attacks may be "incomplete," in the sense of not exhausting the existing reserves. In this case, after the incomplete attack, confidence about the "strength" of the currency will recover and foreign capital will flow into the country. Of course, in this setting there is no reason to rule out new speculative attacks at some future date.

Blanco and Garber (1983) have extended Krugman's analysis by explicitly computing the probability of an exchange rate devaluation crisis at every moment, and by incorporating the expected value of the exchange rate after the devaluation in the event of a crisis. According to them, the equilibrium value of a freely floating exchange rate provides a lower bound for the value of the exchange rate after the crisis. If, however, after the crisis, the government authorities want to set a new nominal parity that would allow them to (at least partially) replenish the reserves lost during the crisis episode, they will set a new (nominal) exchange rate that will exceed

---

82/ Krugman (1979) models an exchange rate crisis using the basic framework of the analysis of exhaustible resources.
the free floating rate. 83/ Blanco and Garber also apply empirically their
approach to the case of the two recent balance of payments crises in Mexico.
The results obtained indicate that their model is extremely powerful and that
it tracks fairly closely the Mexican case.

Harberger and Edwards (1982) have investigated, for a large number of
countries, the behavior of some key economic indicators during periods leading
to an exchange rate crisis. The indicators analyzed included the ratio of
foreign assets to high-powered money, domestic credit creation as a fraction
of income, and the proportion of credit going to the government. This study
compared the behavior of these indicators in the quarter prior to an exchange
rate crisis to their behavior in countries that successfully maintained a
fixed exchange rate (i.e., a control group). The analysis showed that under
every possible circumstance countries that experienced an exchange rate crisis
were less "prudent" than those countries that successfully defended their
parity. In particular it was found that the ratio of foreign assets to
domestic credit plus foreign assets of the banking system was significantly
lower for the devaluation crisis countries. This means that countries that
run into severe exchange rate crises tend to hold, on average, less interna-
tional reserves than countries that successfully defended their parity.

Edwards (1983), on the other hand, using a sample of 18 developing countries
for 1964-1972, found that in the year prior to an exchange rate crisis, the
level of international reserves was, on average, 30 percent below its short-
run desired level.

83/ In rigor, the setting of the new nominal parity will be extremely
problematic and should take into account a number of issues including
credibility and income distribution effects.
Most studies on exchange rate devaluation crises have focused on the relationship between the abandonment of the exchange rate policy (i.e., a fixed nominal parity) and the loss in reserves. In practice and as mentioned above, real exchange rate movements have also been closely related with large changes in the nominal exchange rate (i.e., real exchange rate overvaluations) and in some cases the abandonment of the fixed rate has taken place without the country losing a significant amount of reserves (i.e., the Indonesian devaluation of 1978-79). John Bilson (1979), for example, has developed an empirical model of exchange rate crises that combines international reserves movements with real exchange rate behavior to determine the likelihood of a devaluation. He then applies his model successfully to the case of five Latin American devaluations. Generally speaking, the evidence presented by him suggests that historically devaluation crises have been closely related both to sharp losses in reserves and significant declines in the real exchange rate. In the next section of this paper, 52 episodes of devaluation crises for 32 developing countries are analyzed empirically. The results confirm the idea that exchange rate crises have not been associated exclusively with losses of reserves, but that they have also been closely related to important declines in the level of the real exchange rate.
11. Exchange Rate Crises: The Empirical Evidence

In this section, 52 episodes of exchange rate devaluation crises are analyzed. An important problem faced by any study that looks at devaluation episodes is to exactly define what is meant by a crisis. For the purpose of this study, an exchange rate crisis was (arbitrarily) defined as an episode where there is a nominal devaluation of at least 10 percent in a given quarter. However, a 10-percent devaluation is a necessary but not sufficient condition to qualify as a crisis. In addition, it is required that the devaluation take place after a period of at least eight quarters of exchange rate "tranquility," defined as either no nominal exchange rate changes, or very small changes. Also, the crisis episodes are not confined to a single quarter and can be spread through several quarters. Finally, in order for an episode to qualify as a crisis, it is required that once the crisis is over, a period of at least eight quarters of relative exchange rate normality follow. In many of the cases considered here the period of exchange rate stability that followed the devaluation lasted for only eight quarters. After that period a recurrent devaluation took place. While it is recognized that this is an arbitrary depiction of a crisis, it serves the purpose of making a distinction between sharp parity changes and those exchange rate movements generated by the crawling peg system, for example.

The approach followed in this section consists of focusing on the broad cross-country evidence provided by these 52 crisis episodes. While focusing on these cross-sections has some advantages -- especially being able to look at a large body of data -- it also has some disadvantages. In particular, sometimes by following this type of broad cross-country analysis, the researcher misses some country-specific characteristics affecting a
particular episode. For this reason, when possible, the available homogeneous cross-country data used in this analysis is supplemented by information pertaining to the circumstances under which devaluations occurred in specific countries.

In Table 6, the 52 exchange rate crisis episodes considered in this study are presented. Column (A) defines the crisis period; column (B) contains the initial devaluation and the accumulated devaluation throughout the crisis; column (C) presents the value of the nominal exchange rate (defined as units of domestic currency per unit of U.S. dollars) the quarter prior to the crisis and eight quarters after the crisis. This column also contains the accumulated nominal devaluation between the quarter before the crisis and eight quarters after the crisis. In some cases, this figure differs from the accumulated devaluation during the crisis period (column (B)) since after the crisis some countries implemented minor exchange rate adjustments. Finally, column (D) includes the index of the real exchange rate in the quarter prior to the devaluation and eight quarters after the devaluation crisis. For the construction of this index period, 1960-69 was set equal to 100.

As can be seen from Table 6, in many cases the crisis is spread through several quarters, indicating that once the decision to alter the parity was taken, the authorities initially devalued by less than what they finally considered to be required to restore real exchange rate equilibrium. An important shortcoming of the data presented in this table is that it refers to nominal official exchange rates (line rf of the IMF's International Financial Statistics). These exchange rate data, then, do not capture the fact that in some cases prior to a devaluation episode, countries had multiple
<table>
<thead>
<tr>
<th>Country</th>
<th>Crisis Period</th>
<th>Nominal Devaluation</th>
<th>Exchange Rate</th>
<th>Real Exchange Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Initial</td>
<td>$\Sigma$</td>
<td>Qtr. Before Crisis</td>
</tr>
<tr>
<td>Ecuador</td>
<td>61-3</td>
<td>61-3</td>
<td>20.0%</td>
<td>20.0%</td>
</tr>
<tr>
<td>Ecuador</td>
<td>70-3</td>
<td>70-4</td>
<td>26.0%</td>
<td>38.9%</td>
</tr>
<tr>
<td>Mexico</td>
<td>76-3</td>
<td>76-4</td>
<td>20.1%</td>
<td>73.6%</td>
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<tr>
<td>Nicaragua</td>
<td>79-2</td>
<td>79-2</td>
<td>40.8%</td>
<td>40.8%</td>
</tr>
<tr>
<td>Peru</td>
<td>67-3</td>
<td>67-4</td>
<td>14.2%</td>
<td>44.3%</td>
</tr>
<tr>
<td>Venezuela</td>
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<td>64-1</td>
<td>34.4%</td>
<td>34.4%</td>
</tr>
<tr>
<td>Guyana</td>
<td>68-1</td>
<td>68-1</td>
<td>10.5%</td>
<td>10.5%</td>
</tr>
<tr>
<td>Guyana</td>
<td>81-3</td>
<td>81-3</td>
<td>11.1%</td>
<td>11.1%</td>
</tr>
<tr>
<td>Jamaica</td>
<td>68-1</td>
<td>68-1</td>
<td>10.5%</td>
<td>10.5%</td>
</tr>
<tr>
<td>Jamaica</td>
<td>78-1</td>
<td>78-3</td>
<td>15.5%</td>
<td>78.3%</td>
</tr>
<tr>
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<td>68-1</td>
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<td>10.5%</td>
</tr>
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<td>68-1</td>
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<td>10.5%</td>
</tr>
<tr>
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<td>62-1</td>
<td>62-2</td>
<td>44.4%</td>
<td>66.7%</td>
</tr>
<tr>
<td>Israel</td>
<td>68-1</td>
<td>68-1</td>
<td>10.5%</td>
<td>10.5%</td>
</tr>
<tr>
<td>Israel</td>
<td>71-4</td>
<td>71-4</td>
<td>12.5%</td>
<td>12.5%</td>
</tr>
<tr>
<td>Israel</td>
<td>74-4</td>
<td>75-1</td>
<td>28.6%</td>
<td>42.3%</td>
</tr>
<tr>
<td>Egypt</td>
<td>62-2</td>
<td>62-3</td>
<td>16.9%</td>
<td>25.3%</td>
</tr>
<tr>
<td>Egypt</td>
<td>79-1</td>
<td>79-1</td>
<td>78.9%</td>
<td>78.9%</td>
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<tr>
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<td>68-1</td>
<td>15.4%</td>
<td>15.4%</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>72-3</td>
<td>72-3</td>
<td>16.7%</td>
<td>16.7%</td>
</tr>
<tr>
<td>India</td>
<td>66-2</td>
<td>66-3</td>
<td>19.2%</td>
<td>57.6%</td>
</tr>
<tr>
<td>Indonesia</td>
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<tr>
<td>Country</td>
<td>Crisis Period Begins</td>
<td>Crisis Period Ends</td>
<td>(A) Crisis Nominal Devaluation</td>
<td>(B) Nominal Exchange Rate</td>
</tr>
<tr>
<td>-----------</td>
<td>----------------------</td>
<td>--------------------</td>
<td>-------------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Greece</td>
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<td>75-3</td>
<td>11.5%</td>
<td>11.5%</td>
</tr>
<tr>
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<td>60-2</td>
<td>44.4%</td>
<td>125.9%</td>
</tr>
<tr>
<td>Iceland</td>
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<td>69-1</td>
<td>10.9%</td>
<td>80.1%</td>
</tr>
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<td>Ireland</td>
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<td>10.5%</td>
<td>10.5%</td>
</tr>
<tr>
<td>Malta</td>
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<td>68-1</td>
<td>10.5%</td>
<td>10.5%</td>
</tr>
<tr>
<td>Spain</td>
<td>59-3</td>
<td>59-3</td>
<td>42.9%</td>
<td>42.9%</td>
</tr>
<tr>
<td>Spain</td>
<td>67-4</td>
<td>67-4</td>
<td>11.1%</td>
<td>11.1%</td>
</tr>
<tr>
<td>Spain</td>
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<td>77-3</td>
<td>20.6%</td>
<td>20.6%</td>
</tr>
<tr>
<td>Yugoslavia</td>
<td>65-3</td>
<td>65-4</td>
<td>211.1%</td>
<td>244.9%</td>
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<tr>
<td>Yugoslavia</td>
<td>71-1</td>
<td>71-2</td>
<td>13.3%</td>
<td>19.1%</td>
</tr>
<tr>
<td>New Zealand</td>
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<td>68-1</td>
<td>14.9%</td>
<td>14.9%</td>
</tr>
<tr>
<td>New Zealand</td>
<td>74-4</td>
<td>75-3</td>
<td>11.0%</td>
<td>26.1%</td>
</tr>
<tr>
<td>South Africa</td>
<td>75-4</td>
<td>75-4</td>
<td>19.3%</td>
<td>19.3%</td>
</tr>
<tr>
<td>Argentina</td>
<td>66-3</td>
<td>67-2</td>
<td>10.5%</td>
<td>84.2%</td>
</tr>
<tr>
<td>Argentina</td>
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<td>72-2</td>
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<tr>
<td>Bolivia</td>
<td>72-4</td>
<td>73-1</td>
<td>47.6%</td>
<td>68.4%</td>
</tr>
<tr>
<td>Bolivia</td>
<td>80-1</td>
<td>80-1</td>
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<td>13.6%</td>
</tr>
<tr>
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<td>63-1</td>
<td>15.6%</td>
<td>16.2%</td>
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<tr>
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<td>50%</td>
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<td>61-4</td>
<td>61-4</td>
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<td>11.3%</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>74-2</td>
<td>74-3</td>
<td>19.2%</td>
<td>28.9%</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>81-1</td>
<td>81-4</td>
<td>76.8%</td>
<td>303.5%</td>
</tr>
</tbody>
</table>
Table 6 (continued)

<table>
<thead>
<tr>
<th>Country</th>
<th>Crisis Period</th>
<th>(A) Crisis Period</th>
<th>(B) Crisis Nominal Devaluation</th>
<th>(C) Nominal Exchange Rate</th>
<th>(D) Real Exchange Rate Index (1960–69=100)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Begins</td>
<td>Ends</td>
<td>Initial</td>
<td>Σ</td>
<td>Initial</td>
</tr>
<tr>
<td>Pakistan</td>
<td>72-2</td>
<td>72-3</td>
<td>87.8%</td>
<td>131.7</td>
<td>4.76</td>
</tr>
<tr>
<td>Philippines</td>
<td>62-1</td>
<td>62-1</td>
<td>78.1%</td>
<td>78.1%</td>
<td>2.02</td>
</tr>
<tr>
<td>Philippines</td>
<td>70-1</td>
<td>70-2</td>
<td>21.4%</td>
<td>57.9%</td>
<td>3.90</td>
</tr>
<tr>
<td>Kenya</td>
<td>75-4</td>
<td>75-4</td>
<td>11.2%</td>
<td>11.2%</td>
<td>7.14</td>
</tr>
<tr>
<td>Morocco</td>
<td>59-1</td>
<td>59-1</td>
<td>16.7%</td>
<td>16.7%</td>
<td>4.20</td>
</tr>
<tr>
<td>Nigeria</td>
<td>81-3</td>
<td>81-3</td>
<td>10.8%</td>
<td>10.8%</td>
<td>.605</td>
</tr>
<tr>
<td>Zambia</td>
<td>76-3</td>
<td>76-3</td>
<td>24.6%</td>
<td>24.6%</td>
<td>.643</td>
</tr>
<tr>
<td>Western Samoa</td>
<td>75-4</td>
<td>75-4</td>
<td>19.2%</td>
<td>19.2%</td>
<td>.607</td>
</tr>
</tbody>
</table>

Notes: The real exchange rate index refers to the bilateral rate with respect to the U.S. dollar and was constructed as the nominal exchange rate times the U.S. WPI index, divided by the domestic CPI index.
exchange rates or that they had extensive and cumbersome exchange controls. However, in spite of these limitations -- which of course should be kept in mind -- the data contained in this table and in those that follow do provide a broad picture on the behavior of some key variables in the periods surrounding a devaluation.

The most interesting information in this table, refers to the real exchange rate index and is contained in column (D). First, it may be seen that in 44 of the 52 devaluation episodes, the quarter before the crisis the index of the real exchange rate was below its 1960-69 average. Even though there is no reason to consider 1960-69 as an equilibrium situation for any particular country, it is still a long enough period during which most (but not all) economies were developing along (semi-)normal paths. Another interesting piece of information contained in this column refers to the comparison of the real exchange rate in the quarter before the crisis and eight quarters after the crisis. The evidence here is mixed. While in some cases, after eight quarters the real exchange rate had returned to its pre-devaluation level (i.e., Argentina 1971/77; Spain 1977; Bolivia 1980; Colombia 1962/63; Israel 1971; Kenya 1975), in other countries two years after the devaluation crisis, the real exchange rate was still significantly higher than its pre-devaluation level (i.e., Yugoslavia 1965; Spain 1959; Colombia 1965; Israel 1961/62; Egypt 1975).

The comparison of the pre-devaluation real exchange rate and its value some time after the devaluation is crucial for assessing the effectiveness of a nominal devaluation as a policy measure aimed at correcting real exchange rate disequilibrium. This problem, which will be discussed in detail in the
next section is at the center of the discussion on the effectiveness of nominal exchange rate adjustments as a policy tool. 84/

In order to investigate further the characteristics of exchange crises, the behavior of some key indicators prior to the devaluation episodes were analyzed. This was done for the group of 52 devaluation episodes of Table 6 and for a more reduced group that included only those cases where the initial devaluation was equal or greater to 20 percent. Tables 7 and 8 present the average, first quartile, median and third quartile of changes in: (a) the real exchange rate index; (b) non-gold international reserves; (c) the ratio of foreign assets of the central bank to reserve money (FA/H); and (d) the ratio of total foreign assets to the sum of total foreign assets and domestic credit of the monetary system [TFA/(TFA + DC)], for the period comprised between eight quarters before the crises and the quarter prior to the crises. The reason for focusing on these variables is simple. In theory, and as discussed above, it is expected that devaluation crises will generally follow a period of rapid foreign exchange reserve losses and increasing real exchange rate overvaluation. However, in order to make this statement more operational, it is useful to find out by how much in practice these variables changed in the period immediately preceding the crisis. It is also important to investigate the behavior of alternative increases of the availability of foreign exchange during the period preceding the crisis.

84/ Previous papers have investigated in detail the effectiveness of exchange rate adjustments in terms of their effect on the balance of payments and balance of trade (see Miles 1978). However, there has been very little empirical work on the equally important problem of the effectiveness of nominal devaluations to affect the real exchange rate [see, however, Krüeger (1978)].
Table 7: CHANGE IN KEY INDICATORS DURING EIGHT QUARTERS
PRIOR TO CRISIS (DEV ≥ 10%)
(N = 52)

<table>
<thead>
<tr>
<th></th>
<th>Distribution</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>First Quartile</td>
<td>Median</td>
<td>Third Quartile</td>
<td></td>
</tr>
<tr>
<td>Δ% Real Exchange Rate</td>
<td>-4.1%</td>
<td>-11.3%</td>
<td>-4.1%</td>
<td>1.4%</td>
<td></td>
</tr>
<tr>
<td>Δ% Non-gold International Reserves</td>
<td>-13.8%</td>
<td>-43.1%</td>
<td>-4.8%</td>
<td>20.1%</td>
<td></td>
</tr>
<tr>
<td>Δ(FA/H) a/</td>
<td>-0.101</td>
<td>-0.238</td>
<td>-0.050</td>
<td>0.067</td>
<td></td>
</tr>
<tr>
<td>Δ[TFA/(DC+TFA)] a/</td>
<td>-0.075</td>
<td>-0.121</td>
<td>-0.067</td>
<td>0.002</td>
<td></td>
</tr>
</tbody>
</table>

Notes: (FA/H) is the ratio of foreign assets of the central bank (FA) to high-powered money (H). TFA are total foreign assets of the monetary system; DC is total domestic credit.

a/ These figures refer to the changes measured in percentage points.
### Table 8: CHANGE IN KEY INDICATORS DURING EIGHT QUARTERS PRIOR TO CRISIS (DEV $\leq 20\%$)
(N = 19)

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Mean</th>
<th>First Quartile</th>
<th>Median</th>
<th>Third Quartile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Δ Real Exchange Rate</td>
<td>-4.2%</td>
<td>-17.8%</td>
<td>-6.3%</td>
<td>1.3%</td>
</tr>
<tr>
<td>Δ Non-Gold International Reserves</td>
<td>-18.0%</td>
<td>-79.9%</td>
<td>-7.1%</td>
<td>40.5%</td>
</tr>
<tr>
<td>Δ(FA/H) $^a/$</td>
<td>-0.131</td>
<td>-0.221</td>
<td>-0.041</td>
<td>0.101</td>
</tr>
<tr>
<td>Δ[TFA/(DC+TFA)] $^a/$</td>
<td>-0.086</td>
<td>-0.129</td>
<td>-0.061</td>
<td>0.014</td>
</tr>
</tbody>
</table>

$^a/$ These figures refer to the change measured in percentage points.
As can be seen and as expected, these tables clearly support the idea that for most of the cases considered, both the real exchange rate and the level of reserves holdings had declined significantly in the two years preceding an exchange rate crisis. As it would be expected, these tables also show that the decline in the value of these indicators was more dramatic for those cases that lead to devaluations equal or greater than 20 percent. These tables also show that for at least one quarter of the cases, the real exchange rate and/or international reserves indicators increased during the two years prior to the crisis.

In Tables 9 and 10 the value of some key indicators in the quarter before the crisis, and eight quarters prior to the crisis are presented. Panel A of these tables provides some general information on the values of these indicators that triggered the crises. For example, according to Table 10, which deals with the group of more severe crises, more than half of the devaluation episodes were triggered by a ratio of foreign assets of the central bank to reserve money equal to 0.33 or lower. Several interesting results emerge from these tables. First, in more than half of the cases analyzed, international reserves (in all the alternative measures used), declined quite sharply during the eight quarters preceding the devaluation. It can also be seen that the decline was sharper for non-gold reserves (13.8% on average) and the ratio of foreign assets of the central bank to high-powered money. This suggests that negative movements of these two variables may be a more reliable indicator of serious real exchange rate misalignment. However, what indeed is a remarkable result is that in at least one third of the cases considered, international liquidity increased during the eight quarters preceding the devaluation. Moreover, in the case of non-gold
reserves, the rate of growth corresponding to the third quartile is quite large (20.1 percent in Table 7). The main implication of this finding is that analysts should be quite careful when interpreting the interaction between exchange rates and international reserves movements. The figures in Tables 7 and 8 indicate that a major realignment of the official nominal exchange rate has indeed taken place following a period of accumulation of foreign exchange.

Tables 7 and 8 also show that for most countries, the eight-quarter period preceding the devaluation has also been characterized by a decline of the index of the real exchange rate. That is, the devaluation crisis has been preceded by an apparent ongoing overvaluation. Again, however, a somewhat surprising result is that this is not the case for all countries. In fact, at least one quarter of them experienced a slight real depreciation in the eight quarters preceding the crisis.

In order to gain further insight on the process leading to an exchange rate crisis, data on a control group of countries that maintained a (semi-) fixed rate for a long period of time was also gathered and compared to the crisis episodes. This information is presented in Table 11. In order for a country to be included in the control group its rate of devaluation cannot have exceeded 2 percent in any given year during 1960-1975. The control data, however, refers only to period 1960-69. This was done in order to avoid the contamination of the control group with countries that towards the end of the period -- 1975 for example -- were approaching a crisis (i.e., Mexico). As may be seen from a casual comparison of these tables, the devaluation crisis countries and the control group behaved quite differently. Further, a nonparametrical statistical test performed on these data indicates that the null hypothesis that these two groups of countries (crises and control) come
from the same population is strongly rejected. Moreover, from the comparison of Table 11 and Table 9, the following conclusions emerge:

(1) The year prior to the crisis the median of foreign assets to high-powered money, (FA/H) is lower than all but two of the values of (FA/H) for the control countries.

(2) The year prior to the crisis the median of [TFA/TFA+DC] is also lower than all but two of the value of the same indicator for the control countries.

(3) The year prior to the crisis, the median value of the index of real exchange rate is lower than the median of this index for all the control group countries. Moreover, the year prior to the crisis, the third quartile of the real exchange rate index is lower than all but two of the real exchange rate indexes for the control countries.

The comparison of the behavior of these indicators for the crisis countries in the period preceding the devaluation, and the control countries indicate that these two groups have had a significantly different behavior. Furthermore, they also indicate that since these indicators have behaved differently for the crisis countries, they are indeed useful indexes of real exchange rate overvaluation difficulties.
Table 9: VALUES OF KEY INDICATORS IN QUARTER PRIOR TO DEVALUATION AND EIGHT QUARTERS PRIOR TO DEVALUATION (DEV ≥ 10%)  
(N = 53)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>First Quartile</th>
<th>Median</th>
<th>Third Quartile</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. One Quarter Before Devaluation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Index of Real Exchange Rate (1960-69 = 100)</td>
<td>89.1</td>
<td>77.7</td>
<td>91.4</td>
<td>97.8</td>
</tr>
<tr>
<td>(FA/H)</td>
<td>0.552</td>
<td>0.211</td>
<td>0.354</td>
<td>0.781</td>
</tr>
<tr>
<td>[TFA/(TFA+DC)]</td>
<td>0.083</td>
<td>-0.030</td>
<td>-0.050</td>
<td>0.149</td>
</tr>
<tr>
<td><strong>B. Eight Quarters Prior to Devaluation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Index of Real Exchange Rate (1960-69 = 100)</td>
<td>92.1</td>
<td>82.7</td>
<td>92.7</td>
<td>101.2</td>
</tr>
<tr>
<td>(FA/H)</td>
<td>0.662</td>
<td>0.315</td>
<td>0.552</td>
<td>87.8</td>
</tr>
<tr>
<td>[TFA/(TFA+DC)]</td>
<td>0.148</td>
<td>0.027</td>
<td>0.117</td>
<td>0.253</td>
</tr>
</tbody>
</table>
### Table 10: Values of Key Indicators in Quarter Prior to Devaluation and Eight Quarters Prior to Devaluation (Dev ≥ 20%)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>First Quartile</th>
<th>Median</th>
<th>Third Quartile</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Quarter Prior to Devaluation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Index of Real Exchange Rate</td>
<td>85.3</td>
<td>66.1</td>
<td>84.0</td>
<td>92.8</td>
</tr>
<tr>
<td>(1960-69 = 100)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(FA/H)</td>
<td>0.409</td>
<td>0.253</td>
<td>0.338</td>
<td>0.574</td>
</tr>
<tr>
<td>[TFA/(TFA+DC)]</td>
<td>0.164</td>
<td>-0.053</td>
<td>0.031</td>
<td>0.116</td>
</tr>
<tr>
<td><strong>B. Eight Quarters Prior to Devaluation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Index of Real Exchange Rate</td>
<td>86.3</td>
<td>69.3</td>
<td>89.1</td>
<td>98.7</td>
</tr>
<tr>
<td>(1960-69 = 100)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(FA/H)</td>
<td>0.561</td>
<td>0.256</td>
<td>0.503</td>
<td>0.690</td>
</tr>
<tr>
<td>[TFA/(TFA+DC)]</td>
<td>0.117</td>
<td>0.008</td>
<td>0.118</td>
<td>0.252</td>
</tr>
<tr>
<td>Country</td>
<td>Real Exchange Rate Index (1960-69=100)</td>
<td>(\frac{FA}{H})</td>
<td>(\frac{TFA}{TFA+DC})</td>
<td>Δ%Domestic Credit</td>
</tr>
<tr>
<td>--------------</td>
<td>--------------------------------------</td>
<td>-----------------</td>
<td>----------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Portugal</td>
<td>100.10</td>
<td>0.960</td>
<td>0.310</td>
<td>9.7%</td>
</tr>
<tr>
<td>Spain</td>
<td>95.30</td>
<td>0.440</td>
<td>0.083</td>
<td>18.9%</td>
</tr>
<tr>
<td>Dominican Rep.</td>
<td>99.40</td>
<td>0.292</td>
<td>&lt; 0</td>
<td>12.1%</td>
</tr>
<tr>
<td>El Salvador</td>
<td>99.80</td>
<td>0.620</td>
<td>0.152</td>
<td>5.3%</td>
</tr>
<tr>
<td>Guatemala</td>
<td>99.30</td>
<td>0.547</td>
<td>0.169</td>
<td>10.9%</td>
</tr>
<tr>
<td>Honduras</td>
<td>97.50</td>
<td>0.627</td>
<td>0.161</td>
<td>12.6%</td>
</tr>
<tr>
<td>Mexico</td>
<td>99.30</td>
<td>0.412</td>
<td>0.200</td>
<td>13.6%</td>
</tr>
<tr>
<td>Nicaragua</td>
<td>100.00</td>
<td>0.826</td>
<td>0.102</td>
<td>13.8%</td>
</tr>
<tr>
<td>Iran</td>
<td>100.40</td>
<td>0.343</td>
<td>0.144</td>
<td>19.4%</td>
</tr>
<tr>
<td>Iraq</td>
<td>99.60</td>
<td>0.851</td>
<td>0.466</td>
<td>12.6%</td>
</tr>
<tr>
<td>Jordan</td>
<td>100.00</td>
<td>1.105</td>
<td>0.824</td>
<td>18.3%</td>
</tr>
<tr>
<td>Malaysia</td>
<td>100.15</td>
<td>1.364</td>
<td>0.606</td>
<td>12.7%</td>
</tr>
<tr>
<td>Singapore</td>
<td>99.83</td>
<td>2.921</td>
<td>0.741</td>
<td>28.3%</td>
</tr>
<tr>
<td>Thailand</td>
<td>98.62</td>
<td>1.502</td>
<td>0.517</td>
<td>13.9%</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>99.83</td>
<td>0.622</td>
<td>0.466</td>
<td>14.3%</td>
</tr>
<tr>
<td>Ivory Coast</td>
<td>99.77</td>
<td>0.525</td>
<td>0.290</td>
<td>7.7%</td>
</tr>
<tr>
<td>Morocco</td>
<td>98.44</td>
<td>0.368</td>
<td>0.140</td>
<td>10.6%</td>
</tr>
<tr>
<td>Nigeria</td>
<td>99.62</td>
<td>0.750</td>
<td>0.299</td>
<td>32.5%</td>
</tr>
<tr>
<td>Tunisia</td>
<td>100.04</td>
<td>0.384</td>
<td>&lt; 0</td>
<td>13.7%</td>
</tr>
<tr>
<td>Zambia</td>
<td>103.65</td>
<td>3.381</td>
<td>1.024</td>
<td>--</td>
</tr>
</tbody>
</table>
PART FOUR:

EXCHANGE RATE REALIGNMENT
12. Nominal Devaluations, Real Devaluations and Wage Rate Policy

Economic authorities usually attempt to resolve situations of eminent real exchange rate overvaluation by implementing a (major) nominal devaluation, which most of the time (but not always) is accompanied by demand management measures. Generally, the main objective of this package is to restore the real exchange rate to its equilibrium level and to solve a balance of payments crisis. Many times, however, the objective pursued by nominal devaluations is not accomplished; quite on the contrary there are times when a devaluation (plus other measures) make things even worse. In this part of the paper some aspects related to nominal devaluations and real exchange rate misalignment are addressed. The discussion reviews some empirical evidence and covers issues including the role of wage rate policies, and the role of monetary and credit policy during a process of exchange rate realignment. The relationship between exchange rate adjustment and the level of economic activity (i.e., contractionary devaluations), is also briefly touched on.

The effects of nominal devaluations on the behavior of the different accounts of the balance of payments have been studied by a number of authors in the empirical literature including Cooper 1971a, 1971b, Connolly and Taylor (1976), Laffer (1976), Miles (1979) and Morgan and Davis (1982). However, very few studies have empirically addressed the issue of the effectiveness of nominal evaluations as a means to alter the real exchange rate. 85/ From an analytical perspective, there are several reasons why a nominal devaluation could result in little or no changes of the real exchange rate. For example,

85/ A major exception to this is Krueger's (1978) extensive study of the effects of a devaluation within the context of foreign trade liberalization.
if tradable goods are used as intermediate inputs in the production of nontradables, a devaluation will be transmitted into a higher price of nontradables, partially frustrating the impact of the devaluation on the real exchange rate. 86/

Also, if a nominal devaluation is accompanied with an expensive monetary policy leading to a higher rate of domestic inflation, the real exchange rate effect of the nominal devaluation is likely to be small. 87/ In fact, Morgan and Davis (1982) have found out that most unsuccessful devaluations in developing countries have been related to cases where following the exchange rate adjustment monetary policy has been fairly loose.

Finally, another case is given by the existence of wage rate indexation. 88/ In fact, in the extreme case where it is assumed that nontradables are produced using labor and tradable intermediate goods only, and that nominal wages are 100 percent indexed, a nominal devaluation will have no effect on the domestic relative price of tradables to nontradables. 89/

This section presents a simple partial equilibrium model that investigates the relationship between exchange rate adjustments, wage rate indexation, expectations and competitiveness. In order to focus on the most important aspects of the problem, a number of simplifying assumptions are made. The following notation is used:

87/ Krueger (1978).
\( P_T \) = domestic price of tradables

\( P_N \) = domestic price of nontradables

\( a_{ji} \) = input-output coefficient between factor \( j \) and good \( i \)

\( E \) = nominal (basket) exchange rate

\( W \) = nominal wage rate

\( w \) = real wages

\( P \) = Price Index

\( e \) = real exchange rate

\( r \) = rental rate of capital (nominal)

\( P^*_T \) = world price of tradables

\( \tau \) = index of import tariffs and export taxes.

The model is given by equations (12.1) to (12.5):

\[
\begin{align*}
P_T &= E \ P^*_T \ (1+\tau) \quad (12.1) \\
P_N &= a_{1N} \ W + a_{KN} \ r + a_{TN} \ P_T \quad (12.2) \\
w &= W/P \quad (12.3) \\
P &= P^*_T \ P^*_N \quad (12.4) \\
e &= E \ P^*_T / P_N \quad (12.5)
\end{align*}
\]

The primary objective of the model is to investigate to what extent adjustments in the nominal exchange rate (\( \hat{E} \)) will help to improve the real exchange rate, under alternative assumptions regarding the extent of wage indexation in this economy. Specifically, the value of the elasticity \( e/\hat{E} \) is analyzed. The distinct effects of two alternative methods of nominal exchange rate adjustments will also be briefly analyzed. These methods are a crawling peg where \( \hat{E} \) increases and remains at a positive level for some time, and abrupt changes in the exchange rate.
The Simplest Case

From (12.1), we obtain:

\[ \hat{P}_T = \hat{E} + \hat{P}^* \]  \hspace{1cm} (12.6)

Then, from (12.2): 90/

\[ \hat{P}_N = \lambda_{1N} \hat{W} + \lambda_{KN} \hat{r} + \lambda_{tN} \hat{P}_t \]  \hspace{1cm} (12.7)

where \( \lambda_{iN} \) is the share of input \( i \) in the cost of nontradable goods. Notice that:

\[ \lambda_{1N} + \lambda_{KN} + \lambda_{tN} = 1 \]  \hspace{1cm} (12.8)

Then, assuming for the time being that factor rewards don't change as a result of the devaluation (i.e., \( \hat{W} = \hat{r} = 0 \)), we obtain:

\[ \hat{P}_N = (1-\lambda_{1N} - \lambda_{KN}) \hat{E} \]  \hspace{1cm} (12.9)

and, by using (12.5), the improvement of the real exchange rate, under the unrealistic assumptions that \( \hat{W} = \hat{r} = 0 \) is found to be equal to:

\[ \hat{e} = (1-\lambda_{tN}) \hat{E} \]  \hspace{1cm} (12.10)

90/ Notice that in (4.12), the following expression would also appear:

\[ [\lambda_{1N} \hat{a}_{LN} + \lambda_{KN} \hat{a}_{LN} + \lambda_{tN} \hat{a}_{TN}] \]. However, to the extent that firms minimize costs, this expression will be equal to zero. Also, notice that in the derivation of (12.7), it has been assumed that there is no change in the productivity of labor. This, of course, is a simplifying assumption.
In spite of the restrictive simplifying assumptions used, this is a very intuitive expression that says that even if nothing else happens, as a result of a devaluation, the real exchange rate will improve by less than the devaluation, if there are intermediate tradable inputs used in the production of nontradables.

However, as already mentioned, the assumption regarding factor rewards is highly unrealistic. In order to illustrate how the relaxation of this assumption affects the outcome of the model, assume that nominal wages will adjust by a percentage $k$ of the rate of inflation. It is possible to think that equation (12.10) gives us the exogenously institutionally imposed rule of wage rate indexation.

$$\hat{W} = k \hat{P}$$  \hspace{1cm} (12.11)

where $0 < k < 1$

If $k=0$, we obtain equation (12.10). If $k<1$, we have that as a consequence of inflation, real wages will go down. If $k=1$, real wages will be constant. (This could be the case of full indexation of wages as, for example, in Chile 1975-82.) In a more general setting, $k$ will not be a constant but will depend on the conditions of the labor market (i.e., the existing rate of unemployment). However, in order to simplify the model, we will assume a constant $k$.

Then, from (12.4), we know that:

$$\hat{P} = \alpha \hat{P}_T + (1-\alpha) \hat{P}_N$$  \hspace{1cm} (12.12)

but, assuming that the law of one price holds for tradables, $\hat{P}_T = \hat{E}$, and using (12.13) in (12.12) and the resulting expression in (12.7), we obtain:

$$\hat{P}_N = \frac{\lambda_{LN} \alpha k + \lambda_{TN}}{1-\lambda_{LN} k (1-\alpha)} \hat{E}$$  \hspace{1cm} (12.14)
Logarithmically differentiating (12.5) and (12.13), we obtain:

\[ \hat{e} = \left[ 1 - \frac{(\lambda_{LN}^{AK} + \lambda_{KN}^{TN})}{1 - \lambda_{LN}^{TN}} \right] \hat{E} \]  

(12.15)

The expression in brackets is smaller than one, showing that the improvement in the real exchange rate will be smaller than the devaluation.

Furthermore, this expression \((1 - \frac{(\lambda_{LN}^{AK} + \lambda_{TN}^{KN})}{1 - \lambda_{LN}^{TN}}) \hat{E}\) is smaller than \((1 - \lambda_{TN}^{KN})\), indicating that \(\hat{e}\) in (12.15) is smaller than \(\hat{e}\) in (12.11). Equation (12.15) can be written as:

\[ \hat{e} = \frac{(1 - \lambda_{LN}^{TN} - \lambda_{KN}^{TN})}{1 - \lambda_{LN}^{TN}} \hat{E} \]  

(12.16)

From here it is easy to verify that if \(k=1\) (real wages constant) and \(\lambda_{KN}^{TN}=0\) (capital is not used in the production of nontradables), \(\hat{e}=0\). This is the case of superneutrality of a devaluation, where independently of the magnitude of the nominal devaluation, the real exchange rate does not change. Notice, however, that the assumptions required to obtain this superneutrality are very strong. First it is assumed that there is one hundred percent indexation of wages; and second it is assumed that capital is not used in the production of nontradables.

Finally, assume that \(r\) (i.e., the nominal rental rate of capital) also reacts to the devaluation. Since \(r\) is the rental rate of capital it can be written as:

\[ r = (1 + \delta - \hat{p}_k^e) \frac{\hat{p}_k}{p_k} \]  

(12.17)

where \(i\) is the nominal interest rate, \(\delta\) is the rate of depreciation of physical capital, \(\hat{p}_k^e\) is the expected rate of change in the price of capital.
goods and $P_k$ is the actual price of capital goods. Assuming that capital goods (i.e., machines) are tradable and choosing the right dimensions, $P_k$ can be replaced by $P_T$ in (12.17).

Then, logarithmically differentiating (12.17), we obtain

$$\hat{r} = \gamma_0 \hat{i} + \gamma_1 \hat{\delta} - \gamma_2 \hat{p}^e_T + \hat{p}_t$$  \hspace{1cm} (12.18)

where $\gamma_0 = 1/(1+\delta-\hat{p}^e_T)$; $\gamma_1 = \delta/(1+\delta-\hat{p}^e_T)$; $\gamma_2 = \hat{p}^e_T/(1+\delta-\hat{p}^e_T)$. And where $\hat{p}^e_t$ is the change in the expected rate of change of the domestic price of tradables.

The analysis of (12.18) is very important, since the actual magnitude of $\hat{r}$ will depend on whether $\hat{E}$ is achieved by accelerating the rate of depreciation of the crawling peg, or if it is attained by a stepwise maxi (or midi) devaluation. 91/ Assuming that there is some connection between this country's capital market and the world capital markets, we have that some type of interest arbitrage will hold:

$$i = i^* + \hat{E}^e + R$$  \hspace{1cm} (12.19)

where $i^*$ is the world interest rate, $\hat{E}^e$ is the expected rate of devaluation, and $R$ is a premium term that captures all relevant prices. Then, applying the $\hat{}$ operator to (12.19) and assuming that $i^* = R = 0$, we obtain

$$\hat{i} = \hat{E}^e$$  \hspace{1cm} (12.20)

This says the domestic nominal interest rate will increase by the change in the expected rate of depreciation. If this country's authorities try to attain the increase in $e$ by accelerating the rate of the crawl, then $(\hat{E}^e) > 0$ and $\hat{i} > 0$. On the other hand, if this objective (increase of $e$) is

91/ If the country in question originally had a fixed rate, an "acceleration of the crawling peg" should be interpreted as the adoption of the crawling peg.
pursued by a once-and-for-all maxidevaluation, it is possible that the expected rate of depreciation will not increase. However, if the public does not perceive the magnitude of the devaluation as adequate, (i.e., sufficiently high to solve the external disequilibrium) \( \hat{e}^e \) could still be positive.

Using (12.20) in (12.18), assuming that \( \hat{P}_T^e = (e^e) \) and that \( \hat{P}_T = \hat{E} \), and using the expressions required to solve for \( \hat{e} \), we obtain:

\[
\hat{P}_N = \frac{(\lambda_{1N} k\alpha + \lambda_{KN} + \lambda_{TN})}{1-k(1-\alpha)\lambda_{1N}} \hat{E} + \frac{\lambda_k (Y_0 - Y_2)(e^e)}{1-k(1-\alpha)\lambda_{1N}}
\]

(12.21)

and from (12.5), we get:

\[
\hat{e} = (1 - \frac{[\lambda_{1N} k\alpha + (1-\lambda)\lambda_{1N} + \lambda_k (\delta_0 - \delta_1)\varepsilon]}{1-k(1-\alpha)\lambda_{1N}} \hat{E}
\]

(12.22)

where \( \varepsilon \) is the elasticity of the expected rate of devaluation with respect to the actual rate of devaluation, i.e., \( \varepsilon = (e^e)/\hat{E} \). Assuming that \( \delta_0 - \delta_1 \) and that \( \varepsilon > 0 \), expression (12.22) is smaller than (12.15), indicating that when the prices of all factors and inputs are allowed to adjust as a result of changes in \( E \), the change in the real exchange rate is smaller than obtained when some of these prices are held constant.
13. The Effectiveness of Nominal Devaluation as a Policy Tool: The Empirical Evidence

From a policy perspective, nominal devaluations are usually undertaken in order to generate -- at least in the short run -- some real effects in the economy. In particular, it is expected that a devaluation will have a positive effect on the external sector, improving the degree of competitiveness, and the balance of trade and/or payments. Some experts, however, have argued that nominal devaluations are generally not effective and historically they have basically resulted in additional inflation. The available empirical evidence, however, does not fully support this view. On the contrary, most of the evidence shows that devaluations have generally resulted in an (short-run) improvement of the balance of payments and in none or very little change in the balance of trade (Cooper, 1971a,b; Miles, 1979; Morgan and Davis, 1982).

In this section, the behavior of a number of variables -- and in particular, the real exchange rate -- after the devaluation is investigated empirically for the case of the 52 devaluation crises presented in section 11. This analysis is important since it will provide information on the role played by nominal devaluations in the process of real exchange rates realignments. In addition to the real exchange rate, the analysis focuses on the behavior of the level of non-gold international reserves measured in U.S. dollars; the ratios of foreign asset to money, which provide alternative...
measures of international liquidity held in the country in question; and the real quantity of money. 92/

Regarding the real quantity of money, it has been recently suggested that one of the possible effects of a devaluation is to reduce the attractiveness of domestic money, inducing economic agents to substitute it for foreign money or other assets. This approach would suggest, then, that in general, and with other things given, a devaluation would be followed by a reduction in the stock of real money in the economy. In rigor, however, this substitution effect would only take place if a devaluation leads to expectations of additional devaluations in the future. If, however, the devaluation is "large enough," and does not generate expectations of further exchange rate adjustments, the demand for domestic money will tend to grow relative to its pre-crisis level. 93/

In Tables 12 and 13, the change in the value of some key indicators between the period prior to the crisis and eight quarters after the end of the crisis are presented. Table 12 deals with the 52 devaluation episodes, while Table 13 contains information on the 19 more severe episodes characterized by an initial devaluation of at least 20 percent. Of particular interest are the results regarding percentage changes in the real exchange rate index and in the level of international reserves. As may be seen, for both definitions of devaluations crisis, in more than three quarters of the cases, the real exchange rate was significantly higher two years after the crisis than the

92/ Of course, changes in the (total) level of reserves are equal to the balance of payments.

93/ Moreover, as it is argued below, if agents fully anticipate the devaluation, they will substitute away from domestic money before the crisis.
quarter before the crisis. This is also true for the case of non-gold international reserves and the ratio of the central banks' foreign assets to high-powered money.

Broadly speaking, this evidence suggests that, for the cases under study, nominal devaluations succeeded both in generating a real devaluation and in improving the international reserves position of the respective countries. These results tend to confirm those reported by Krueger (1978) for a smaller number of cases. In that study, it was found that in 13 out of 22 nominal devaluation episodes, the real exchange rate was higher two years after the crisis than one year before the crisis. A problem with this type of analysis, however, is that it only compares the real exchange rate index before and after the devaluation crisis, without considering the effects of other variables like changes in the terms of trade, monetary policy or commercial policy. An attempt to partially solve this problem is reported below, where the result from regressions of the real devaluation on the nominal devaluation and other variables are presented.

Tables 12 and 13 also show that in most cases the real quantity of money, defined both in a narrow and in a broad sense, increased during the two years following the devaluation. This, however, is not as generalized across episodes as the effect of the devaluation on the real exchange rate and reserve holdings. As may be seen, in at least one quarter of the episodes, the real quantity of money was actually lower two years after the crisis had ended than in the quarter prior to the crisis. An important and related question has to do with the behavior of the real quantity of money prior to the exchange rate crisis. If economic agents anticipate the crisis, they will
Table 12: CHANGES IN KEY INDICATORS BETWEEN THE QUARTER PRIOR TO CRISIS AND EIGHT QUARTERS AFTER CRISIS (DEV ≥ 10%)
(N = 53)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>First Quartile</th>
<th>Median</th>
<th>Third Quartile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Δ% Index of Real Exchange Rates (1960-69 = 100)</td>
<td>19.2%</td>
<td>5.8%</td>
<td>12.8%</td>
<td>30.2%</td>
</tr>
<tr>
<td>Δ% of Non-gold International Reserves</td>
<td>69.7%</td>
<td>21.5%</td>
<td>51.2%</td>
<td>106.8%</td>
</tr>
<tr>
<td>Δ% Real Quantity of Money (M1)</td>
<td>8.8%</td>
<td>-6.9%</td>
<td>13.0%</td>
<td>23.4%</td>
</tr>
<tr>
<td>Δ% Real Quantity of Money (M2)</td>
<td>16.9%</td>
<td>0.7%</td>
<td>17.6%</td>
<td>32.7%</td>
</tr>
<tr>
<td>Δ(FA/H) a/</td>
<td>0.151</td>
<td>-0.026</td>
<td>0.100</td>
<td>0.378</td>
</tr>
<tr>
<td>Δ[TFA/(TFA+DC)] a/</td>
<td>-0.019</td>
<td>-0.083</td>
<td>-0.004</td>
<td>0.093</td>
</tr>
</tbody>
</table>

a/ Refers to change measured in percentage points.
Table 13: CHANGES IN KEY INDICATORS BETWEEN THE QUARTER PRIOR TO CRISIS AND EIGHT QUARTERS AFTER CRISIS (DEV 2 20%) (N = 19)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>First Quartile</th>
<th>Median</th>
<th>Third Quartile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Δ% Index of Real Exchange Rate (1960-69 = 100)</td>
<td>33.4%</td>
<td>11.2%</td>
<td>30.4%</td>
<td>53.5%</td>
</tr>
<tr>
<td>Δ% of Non-gold International Reserves</td>
<td>104.8%</td>
<td>26.7%</td>
<td>90.4%</td>
<td>133.9%</td>
</tr>
<tr>
<td>Δ% of Real Money M1</td>
<td>4.8%</td>
<td>-8.2%</td>
<td>3.7%</td>
<td>28.0%</td>
</tr>
<tr>
<td>Δ% of Real Money M2</td>
<td>17.8%</td>
<td>-6.2%</td>
<td>19.5%</td>
<td>33.6%</td>
</tr>
<tr>
<td>Δ(FA/H) a/</td>
<td>0.311</td>
<td>0.127</td>
<td>0.230</td>
<td>0.574</td>
</tr>
<tr>
<td>Δ[TFA/(TFA+DC)] a/</td>
<td>0.050</td>
<td>-0.024</td>
<td>0.053</td>
<td>0.187</td>
</tr>
</tbody>
</table>

Note: See Table 12.
move out of domestic money before the crisis takes place. 94/ However, for most of the cases under study, the real quantity of money (under both definitions) also increased between the eighth quarter before the devaluation and the quarter prior to the devaluation (See Table 14).

While Tables 12 through 14 provide a summary of the behavior of these indicators for all episodes as a group, there are individual cases where the real quantity of money held by the public indeed declined both prior to the crisis and after the crisis. A good example of this kind of behavior is provided by Chile during and since the 1982 devaluation. 95/

The values of some key parameters eight quarters after the crisis are presented in Table 15 for both definitions of devaluation crisis. An interesting fact reported in this table is that, contrary to the pre-crisis period, for more than half of the cases, the value of the real exchange rate index is higher two years after the crisis than its 1960-69 average.

A problem with the preceding analysis is that it only compares the values of the real exchange rate index in two periods of time, without trying to determine if there have been other factors besides the nominal devaluation that have affected the value of the real exchange rate. In order to tackle this problem, a regression analysis relating changes in the real exchange rate to the nominal devaluation and other variables were run.

\[ \hat{e} = \alpha_0 + \alpha_1 \hat{E} + \sum \beta_j \hat{Z}_j + \mu \]  

where \( \hat{e} \) is the percentage change in the real exchange rate index between the

94/ Of course, as postulated by the theoretical models on exchange rate crises, the movement out of the domestic currency and into foreign currency will accelerate the crisis.

Table 14: Behavior of the Real Quantity of Money Between Eight Quarters Before Crisis and a Quarter Prior to Crisis

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>First Quartile</th>
<th>Median</th>
<th>Third Quartile</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Devaluation ≤ 10%</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Δ% Real Money M1</td>
<td>6.4%</td>
<td>-1.2%</td>
<td>6.9%</td>
<td>15.1%</td>
</tr>
<tr>
<td>Δ% Real Money M2</td>
<td>8.2%</td>
<td>1.8%</td>
<td>10.5%</td>
<td>15.9%</td>
</tr>
<tr>
<td><strong>B. Devaluation ≥ 20%</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Δ% Real Money M1</td>
<td>12.7%</td>
<td>5.0%</td>
<td>12.7%</td>
<td>17.0%</td>
</tr>
<tr>
<td>Δ% Real Money M2</td>
<td>12.2%</td>
<td>7.1%</td>
<td>14.4%</td>
<td>21.3%</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>First Quartile</td>
<td>Median</td>
<td>Third Quartile</td>
</tr>
<tr>
<td>------------------</td>
<td>------</td>
<td>----------------</td>
<td>--------</td>
<td>----------------</td>
</tr>
<tr>
<td><strong>A. Devaluation ≥ 10%</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Δ% Real Money M1</td>
<td>6.4%</td>
<td>-1.2%</td>
<td>6.9%</td>
<td>15.1%</td>
</tr>
<tr>
<td>Δ% Real Money M2</td>
<td>8.2%</td>
<td>1.8%</td>
<td>10.5%</td>
<td>15.9%</td>
</tr>
<tr>
<td><strong>B. Devaluation ≥ 20%</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Δ% Real Money M1</td>
<td>12.7%</td>
<td>5.0%</td>
<td>12.7%</td>
<td>17.0%</td>
</tr>
<tr>
<td>Δ% Real Money M2</td>
<td>12.2%</td>
<td>7.1%</td>
<td>14.4%</td>
<td>21.3%</td>
</tr>
</tbody>
</table>
Table 16. VALUE OF KEY PARAMETERS EIGHT QUARTERS AFTER A CRISIS

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>First Quartile</th>
<th>Median</th>
<th>Third Quartile</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I. Devaluation ≤ 10%</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Index Real Exchange Rate (1960-69 = 100)</td>
<td>105.9</td>
<td>95.3</td>
<td>105.1</td>
<td>113.0</td>
</tr>
<tr>
<td>(FA/H)</td>
<td>0.683</td>
<td>0.284</td>
<td>0.549</td>
<td>0.998</td>
</tr>
<tr>
<td>[TFA/(TFA+DC)]</td>
<td>0.07</td>
<td>-0.003</td>
<td>0.069</td>
<td>0.238</td>
</tr>
<tr>
<td><strong>II. Devaluation ≥ 20%</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Index Real Exchange Rate (1960-69 = 100)</td>
<td>110.7</td>
<td>96.2</td>
<td>110.7</td>
<td>128.9</td>
</tr>
<tr>
<td>(FA/H)</td>
<td>0.682</td>
<td>0.112</td>
<td>0.304</td>
<td>0.535</td>
</tr>
<tr>
<td>[TFA/(TFA+DC)]</td>
<td>0.081</td>
<td>-0.021</td>
<td>0.089</td>
<td>0.260</td>
</tr>
</tbody>
</table>
Table 17: NOMINAL DEVALUATIONS AND REAL DEVALUATIONS: REGRESSIONS RESULTS

[Equation 12.1]

<table>
<thead>
<tr>
<th></th>
<th>(A)</th>
<th>(B)</th>
<th>(C)</th>
<th>(D)</th>
<th>(E)</th>
<th>(F)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Constant</strong></td>
<td>-0.028</td>
<td>0.075</td>
<td>0.036</td>
<td>0.055</td>
<td>0.077</td>
<td>0.069</td>
</tr>
<tr>
<td></td>
<td>(-0.742)</td>
<td>(1.852)</td>
<td>(0.511)</td>
<td>(0.546)</td>
<td>(2.267)</td>
<td>(1.414)</td>
</tr>
<tr>
<td>(\hat{E})</td>
<td>0.600</td>
<td>0.645</td>
<td>0.624</td>
<td>0.621</td>
<td>0.708</td>
<td>0.688</td>
</tr>
<tr>
<td></td>
<td>(7.678)</td>
<td>(9.552)</td>
<td>(4.034)</td>
<td>(3.782)</td>
<td>(11.369)</td>
<td>(4.745)</td>
</tr>
<tr>
<td>(\hat{C})</td>
<td>--</td>
<td>-0.265</td>
<td>-0.212</td>
<td>-0.242</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-4.050)</td>
<td>(-1.977)</td>
<td>(-2.338)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\hat{M})</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>-0.374</td>
<td>-0.279</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(-5.809)</td>
<td>(-3.310)</td>
</tr>
<tr>
<td>(\hat{\tau})</td>
<td>--</td>
<td>--</td>
<td>-0.175</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(-0.553)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GD</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>-0.094</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(-0.948)</td>
</tr>
<tr>
<td>G</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>-0.056</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(-0.360)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(R^2)</td>
<td>0.590</td>
<td>0.709</td>
<td>0.644</td>
<td>0.491</td>
<td>0.560</td>
<td>0.586</td>
</tr>
<tr>
<td>SEE</td>
<td>0.152</td>
<td>0.130</td>
<td>0.122</td>
<td>0.133</td>
<td>0.122</td>
<td>0.117</td>
</tr>
</tbody>
</table>

**Note:** Numbers in parentheses refer to t-statistics.
quarter before the crisis and eight quarters after the crisis. \( \hat{E} \) is the percentage change in the nominal exchange rate during the same period, and in most cases is equal to the rate of nominal devaluation during the exchange rate crisis. 96/ The \( \hat{Z}_j \)'s represent other variables, that one would expect would affect the change in the real exchange rate. The following \( \hat{Z} \) were actually considered.

\[
\begin{align*}
\hat{C} &= \text{Percentage change in nominal domestic credit during the same period.} \\
\hat{\tau} &= \text{Percentage change in the terms of trade during the same period.} \\
\hat{M} &= \text{Percentage change in M1 during the same period.} \\
\hat{G}_D &= \text{Change in government deficit during the same period.} \\
\hat{G} &= \text{Average value of government deficit during the same period.}
\end{align*}
\]

The terms of trade index was defined as the ratio of an export price and an import price index.

The results obtained from the estimation of equation (12.1) are presented in Table 17. As may be seen in all cases, the coefficient of \( \hat{E} \) is positive, smaller than one, and highly significant. Broadly speaking, these results correspond to what was expected and indicate that, on average, a nominal devaluation results in a less than proportional increase in the real exchange rate. (On this see the discussion in the previous section.)

According to equation (B), for example, with 95 percent confidence, a 10 percent nominal devaluation generates a real devaluation ranging from 5.1 percent to 7.8 percent, holding other things constant. However, if nominal domestic credit is increased during the period immediately following the

\[96/ \text{ See Table 6.}\]
devaluation, the improvement in the real exchange rate will be significantly smaller. For example, also according to equation (3), a 10 percent nominal devaluation coupled with a 10-percent increase in domestic credit will result, on average, in only a 3.8-percent improvement in the real exchange rate.

Regressions that also included changes in the terms of trade and fiscal policy variables are also reported in this table. The signs obtained for these coefficients correspond to what is usually expected; however, they turned out to be nonsignificant at conventional levels. Table 17 also includes regression results that use the rate of growth of M1 instead of domestic credit. Even though the results are similar to those obtained using the rate of change of money, they have the problem that in an open economy with a fixed rate, money will be endogenous.

A problem with the interpretation of results reported in Table 17 stems from the fact that these regressions exclude changes in commercial policy. As discussed above, in some of the cases considered, the devaluation was accompanied with the reduction -- or rationalization -- of the protective system. To the extent that these tariff changes affected the equilibrium real exchange rate, it would be expected that e would move independently of the behavior of E. Another shortcoming of the results presented in Table 17 is that they exclude changes in real income as a possible variable affecting e.

In spite of these potential problems, the results reported have the virtue of providing a general approximation to the question of the effectiveness of nominal devaluations using information on a large number of devaluation episodes. The evidence presented here, as well as that reported in Krueger (1978) for a smaller number of cases, suggests that in general, nominal devaluations have been fairly successful, in the sense of generating
an increase in the real exchange rate. Moreover, the results suggest that for these countries, and with other things given, in order to generate a 10 percent increase in the real exchange rate, on average, a nominal devaluation of 17 percent would be required. The empirical evidence reviewed here suggests that, if adequately implemented, nominal devaluations can play a crucial role in the process of realigning the real exchange rate. The evidence presented in this section also shows that in most of the countries considered in this study, nominal devaluations resulted in a substantial improvement of the external position of the country, as measured by alternative measures of their holdings of international reserves.
14. Concluding Remarks

In this paper a broad range of issues related to real exchange rate misalignment are discussed. Even though the topics covered do not exhaust the subject, they do cover some of the more important points. In that regard, even though this paper is not exactly a primer, it does provide a large amount of information that will be helpful to policymakers to evaluate a number of exchange rate problems that have recently become recurrent in the developing countries.

The paper begins with a discussion on the concept and measurement of "the" real exchange rate. In modern treatments, the real exchange rate has usually been defined as the relative price of tradables to nontradable goods. From a measurement perspective this definition introduces some problems; it is not immediately obvious which of the price indexes regularly computed should be considered as appropriate proxies of tradable and nontradable prices. In Part I of the paper some problems related to the measurement of the real exchange rate are presented. The concept of effective real exchange rate is discussed, and it is argued that in order to assess the behavior of the degree of competitiveness of a particular country, it is necessary to compute these effective real exchange rates.

Also in Part I the concept of the equilibrium real exchange rate is reviewed. It is pointed out that the equilibrium real rate is that rate that equilibrates, in the long run, the current account of the balance of payments. Of course, this long-run equilibrium is attained when other variables (and policies) that affect the current account are also at their long-run level. Among these other variables the more important are commercial policy, the external terms of trade, the level of long-run (sustainable)
capital flows, and fiscal policy. If any of these variables experiences a long-run (permanent) change, so will the equilibrium real exchange rate. For example, if for some reason the (sustainable) long-run level of capital inflows increases in a particular country, at the ongoing real exchange rate a higher balance of payments surplus will result (this is since the capital account will now improve, with no change in the current account). In order to restore equilibrium, and with other things given, the real exchange rate will have to appreciate.

In Part II of the paper the different forces that generate changes in the equilibrium real exchange rate are discussed in detail. One of the most important points made here is that when there are long-run equilibrium changes in the real exchange rates, policies that preclude these changes should not be implemented.

Another important point that follows from this discussion is that if there are temporary short-run changes in the determinants of the real exchange rate, there will be temporary changes in the short-run equilibrium real exchange rate. For example, if a country experiences a temporary worsening in the terms of trade, in order to maintain external equilibrium, it will require a short-run real devaluation (see, however, the discussion in Section 6).

In Part II the following specific problems related to equilibrium changes in the equilibrium real exchange rate are discussed: Interaction between changes in commercial policy and the equilibrium real rate (Section 4); effects of changes in the terms of trade or the equilibrium real exchange rate, including the Dutch Disease case (Section 6); effects of changes in the level of capital flows on the real exchange rate (Section 7);
economic growth, differential productivity gains and the equilibrium real exchange rate (Section 8).

Finally in Section III some empirical evidence regarding the behavior of real exchange rates through time is presented. Even though the regression results -- using data on seven countries -- are not overwhelming they do point out that, at least for these countries, real exchange rates have responded to the variables suggested by the theory.

In Part III of the paper a number of issues related to devaluation crises are presented. Many times the actual real exchange rate differs from its long-run (and even short-run) equilibrium value. If this divergence lasts for some time, the degree of disequilibrium will accumulate and, most of the time, a crisis will erupt. In this part of the paper a number of crises related to exchange rate overvaluation are investigated empirically.

52 episodes of major devaluations are selected and analyzed. The study of these devaluation episodes covers both the period leading to the crisis as the period that follows the crisis. 97/ It was found that in the period preceding the devaluation crisis the majority of these countries followed loose monetary policies, and experienced severe losses of international reserves. Also, in the period leading to the crisis the vast majority of the devaluing countries experienced acute real overvaluation of their currencies. In order to highlight the more important characteristics of periods with overvalued currencies, these countries' behavior was also compared to a control group.

---

97/ A shortcoming of this discussion is that it concentrates on the official exchange rate. In Edwards (1985) an analysis that considers both official and parallel exchange rates can be found.
In Part IV the aftermath of the devaluation crisis is analyzed. The discussion focuses on the ability, or lack thereof, of a nominal devaluation to generate, in the short or medium run, a real devaluation. From a preliminary and casual analysis of the data it was found that in a number of episodes eight quarters after the nominal devaluation, the real exchange rate had returned to its original value; of course in these cases devaluations had not been successful. In most cases, however, eight quarters after the devaluation the real exchange rate was still significantly higher than before the crisis. In this part it is forcefully argued that the effect of a nominal devaluation on the real exchange rate will depend crucially on the macro policies implemented along with the devaluation. In particular, it was shown that if there is wage indexation the likelihood of a successful devaluation will be greatly reduced. Other important policies, that will greatly affect the outcome of a nominal devaluation relate to domestic credit creation and fiscal policy. A loose domestic credit policy or a fiscal policy that generates a large deficit will generally conspire against the success of the nominal devaluation.

In order to investigate this issue more thoroughly a regression analysis was carried out using data on the 52 devaluation episodes. It was found that, with other things given, a nominal devaluation of 10 percent had resulted, on average, in a real devaluation between 6 and 7 percent after eight quarters. However, if the 10 percent nominal devaluation was accompanied by an increase of domestic credit also of 10 percent, the real devaluation would only be 4 percent, on average, after eight quarters. The most important point made in this part of the paper, then, is that the
potential success of a nominal devaluation will very closely depend on the
other macro policies implemented with it.

Although in this paper a number of issues have actually been analyzed
in a fairly detailed fashion, there are some important problems related to
exchange rates in developing countries which have not been covered. Among
these topics not covered, it is possible to mention: the welfare effects of
real exchange rate misalignment, the selection of an appropriate exchange rate
system for a developing country, the potential role of multiple exchange
regimes under certain conditions, and the interaction between black market
exchange rates and official rates.
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