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An Empirical Study of the Real Exchange Rate Misalignment and Its Effects on the Macro-Economic Performance of Bangladesh

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AN EMPIRICAL STUDY OF THE REAL EXCHANGE RATE MISALIGNMENT AND ITS EFFECTS ON THE MACRO-ECONOMIC PERFORMANCE OF BANGLADESH

by

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ABSTRACT

An Empirical Study of the Real Exchange Rate Misalignment and Its Effects on the Macro-Economic Performance of Bangladesh

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This paper provides the empirical study of whether there was a misalignment of the real exchange rate (RER) in the Bangladesh economy during 1976-1991. The time series of multilateral and bilateral RER indexes were computed for the period 1976-1991. The computed series of RER were indexed to a base year of when the RER attained its highest level and thereby appeared to be closer to the actual long-run equilibrium RER.

In the empirical part of this thesis, five different RER indexes were computed: multilateral real exchange rate index 1 (MRER1), multilateral real exchange rate index 2 (MRER2), bilateral real exchange rate index 1 (BRER1), bilateral real exchange rate index 2 (BRER2), and black market bilateral exchange rate index 1 (BMRER1). Computation of the multilateral and bilateral RER indexes involved data on trade

weights and wholesale and consumer price indexes of the domestic economy and its trading partners, besides their nominal official exchange rates. As a result, the study period was not large enough due to the unavailability of data on all variables involved.

Misalignment of RER refers to the sustained deviation of the observed RER from its long-run equilibrium level. Three different measures of RER misalignment were constructed: purchasing power parity (RERMISPP), instability (RERMISINSTA), and black market (RERMISBLK). The MRER1, BRER2, and BMRER1 indexes were used, respectively, in constructing RERMISPP, RERMISINSTA, and RERMISBLK measures of RER misalignment.

All of these measures demonstrated RER misalignment in Bangladesh during 1976-1991. In order to compute the long-run equilibrium RER, a multivariate regression was executed with respect to the RER fundamental real variables.

Later, a time series of three different measures of RER misalignment index was regressed on the time series of the growth rate of real GDP (gross domestic product), exports, imports, savings, and investment for 1976-1991 to bring about the effects of RER misalignment on the macroeconomic performance of Bangladesh. It was found that RER misalignment adversely affected the macroeconomic performance of Bangladesh. An effectiveness index of nominal devaluation policy was constructed for ten devaluation episodes, and it was found that if it is not accompanied by supplementary policies, the effectiveness of nominal devaluation as a preventive policy eroded in later years. Consequently, a cross episode regression was executed to appraise the efficacy of 10 nominal devaluation episodes. It was also found that when

supplementary macroeconomic policies, such as the growth rate of domestic credit, growth rate of domestic credit to the public sector, and the growth rate in the ratio of public sector to total domestic credit were taken into consideration, nominal devaluation became more effective in bringing about the real devaluation.

(141 pages)

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CHAPTER 1

INTRODUCTION

Bangladesh emerged as an independent country on December 16, 1971. During that time, the international exchange and monetary arrangement were passing through a significant transformation, which might be identified as the disintegration of the Bretton Woods' par value system. In fact, the independence day of Bangladesh had almost coincided with the advent of the collapse of the Bretton Woods' system. At that time, the central bank incumbents of 10 leading industrial states met on the issue of a future exchange rate relationship among the world currencies on December 17 and 18, 1971 at the Smithsonian Institute. The British pound sterling had been chosen as the intervention currency of Bangladesh right after independence and the new exchange rate was pegged at taka 18.9677 per pound sterling, resulting in an official rate of taka 7.27927 per U.S. dollar, in adherence to the former exchange rates of the Pakistani rupee with the Indian rupee—currency of the closest neighbor and a new ally.

However, the traditional link of Bangladesh with Britain had more to do with the selection of the pound sterling as an intervention currency rather than its economic significance in international trade. Consequently, Bangladesh changed its currency of reference from pound sterling to the U.S. dollar in 1983. Meanwhile, as soon as the black market taka per pound sterling exchange rate leaped up to almost taka 60/pound sterling by 1975, it was realized that the official exchange rate was unrealistic. As a result, the new official exchange rate was fixed at taka 30/pound sterling, resulting in the inoperative official rate of taka 10.36 per U.S. dollar and signifying a nominal devaluation of taka by 58 percent.

Devaluation of the nominal exchange rate is an official measure undertaken by the government in order to lower the gap or discrepancy between the officially fixed and free market nominal exchange rate. Discrepancy between the official and free market nominal exchange rates takes place due to the existence of government exchange control, which gives rise to the black market for foreign exchange. In a restricted foreign exchange rate regime, the black market foreign exchange rate also reflects the free market nominal exchange rate. The black market foreign exchange rate coincides with the official exchange rate if there exists an equilibrium in the foreign exchange market.

An inequilibrium in the foreign exchange market more frequently translates itself into an overvaluation of the nominal exchange rate, which has some serious implications for the economic condition of a country. In a fixed exchange rate regime, an overvaluation of the nominal exchange rate occurs when the officially fixed nominal exchange rate falls short of the free or black market nominal exchange rate of a particular currency in question. Overvaluation of the nominal exchange rate inflicts harmful effects on the export performance and, therefore, on the balance of payments of developing countries.

Figure I shows the discrepancy between the officially fixed and black market nominal exchange rate of the Bangladesh taka during the period 1976-1991. In the case of the black market nominal exchange rate, an annual average is considered to represent the data point for the year in question. However, it appears fairly clear that the official nominal exchange rate of the Bangladesh taka deviates a lot from the free market or, in

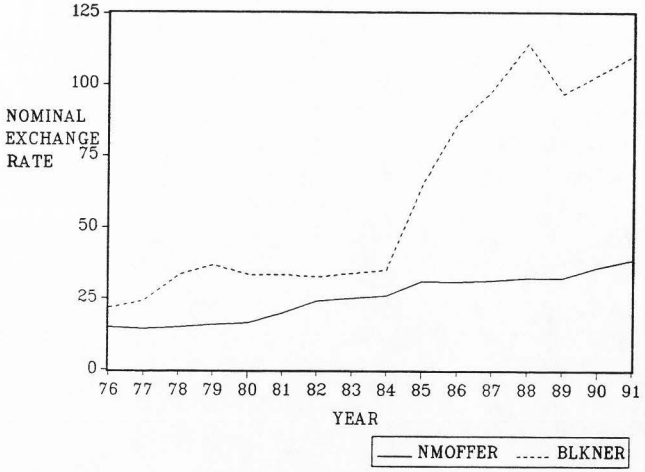

FIGURE I
Nominal Official and Black Market Exchange Rate of Bangladesh
Taka per U.S. Dollar

other words, the black market nominal exchange rate of the same. This may be called a chronic nominal overvaluation of the Bangladesh taka as the officially fixed nominal exchange rate of taka persistently remains below its black market rate for the whole of 1976-1991.

An overvaluation of the nominal exchange rate causes the loss of competitiveness of the external sector, i.e., the domestic price of export goods appears to be higher than the world price of the same. Domestic producers of export goods will have to sell their products at a price that cannot even cover their production cost. On the other hand, import goods become artificially cheaper to the domestic consumers.

Consequently, export revenues decline and import expenditures experience an undesirable hike. As a result, the trade deficit goes up, which needs to be financed by foreign borrowing.

CHAPTER 2

LITERATURE REVIEW

I. Review of Previous Work

This chapter will concentrate on the emergence of real exchange rate misalignment in Bangladesh and its effects on the macroeconomic performance of the same. It is now widely believed that the misalignment of RER (real exchange rate) is responsible for a poor macroeconomic performance in most of the developing countries. As a result, economists are now paying more attention in studying and analyzing the RER movements, especially in developing countries, as they are plagued with debt crisis, disappointing outcome of experimenting with free market policies and a poor performance of the agricultural sector [Edwards 1991, p. 1]. Although there are many external and internal factors responsible for the misalignment of RER, nevertheless, macroeconomic policies that prove to be inconsistent with the chosen exchange rate system of a country is assumed to be the most important factor resulting the RER misalignment. Although there is much enthusiasm in exploring the evolution of RER misalignment and its deleterious effects on the macroeconomic performance of developing countries, there is limited empirical evidence on its significance in explaining the poor macroeconomic performance of Bangladesh. Other RER studies (Agarwala [1983], Cottani et al. [1990], Dollar [1992], Edwards [1988a, 1991], Frenkel [1983], and Khan [1986]) have used broad geographical samples of developing countries which have involved African countries, but none of them have focused on the

issue of RER misalignment in Bangladesh. It is the purpose of this present study to explore how far the overvaluation of the RER, or RER misalignment in other words, is responsible for a poor macroeconomic performance in Bangladesh, which is believed to be initiated by a loss in the international competitiveness and misallocation of domestic resources. Moreover, it will also be examined whether a nominal devaluation can mitigate this RER misalignment as a policy measure. From a general equilibrium intertemporal dynamic model, this study will focus on the evolution of RER misalignment in the Bangladesh economy.

For empirical study, different measures of the RER misalignment have been used in this study as follows:

1. a measure using the purchasing power parity (PPP) (Balassa [1990], Agarwala [1983], and Cottani et al. [1990]);
2. a model-based measure using the nominal official exchange rate (Edwards [1991], Cottani et al. [1990], Dollar [1992]);
3. a measure using the black market premia over the nominal official exchange rate of Bangladesh taka.

Cottani et al. [1990] found empirical support for the model-based measure, but no support for the PPP measure. Balassa [1990] did not refer to the issue of RER misalignment directly in his study; nevertheless, the measure he used implies a PPP measure of RER misalignment and he offered an empirical support of the adverse effects of that measure of misalignment on export performance. This chapter uses both the PPP measure and the model-based measure (using the nominal official exchange

rate of Bangladesh taka). Besides, the RER misalignment is also proxied with the black market premia. The effects of these different measures of RER misalignment on the real GDP (gross domestic product) growth rate, exports, imports, investment, and saving are investigated too.

II. Justification of the Present Study from a Historical Perspective of Development Economics

International trade plays an unarguably significant role in the economic development of a resource poor and labor abundant country like Bangladesh. But unfortunately, the notion of "free trade" is vehemently opposed by the strong lobbies in almost every country in the name of "unfair foreign competition," which is allegedly responsible for encouraging more imports and thereby reducing domestic labor employment. The proponents of these lobbies can be easily identified as those who used to vote in favor of the "inward looking trade policy." However, the conventional wisdom underlying the theories of international trade and development asserts something very different from this popular allegation against free trade, which is presupposed to encourage more imports and result in fewer jobs.

The standard argument in favor of this latter school proceeds by stating that any protective trade policy that is designed to curtail imports will eventually end up with an equivalent decline in the value of exports.

As a matter of fact, this is the reason behind the failure of an "inward looking trade policy," which is used to implement a protective trade barrier that restricts

imports, while domestic producers are encouraged to produce the once imported goods. But consequently, the domestic export industry gets out of competition against its rivals in other countries as the export price of domestically produced goods becomes higher than the world market price of the same. It happens because the domestic export industry uses imported inputs too and a trade barrier raises their domestic price and consequently raises their production cost, which compels the domestic producers to charge a higher price for their produced goods than the world market price. On the other hand, it is very likely that the foreign countries will impose trade barriers as a retaliatory measure, which would restrict imports from the domestic country in question, consequently resulting in a decline in its export revenues. Finally, it is argued that a trade barrier which curtails imports will reduce the export revenues by the same amount. The argument proceeds by recognizing the fact that the demand for and supply of a currency respectively emerge from the import demand and export supply of a domestic country in question. Further, it has also been observed that the demand for and supply of a currency of a particular national origin will equate to each other, at least in the long run. On the basis of these two premises, it can be stated that the demand for Bangladesh taka emerges from the import demand of Bangladeshi exports by foreign countries and the supply of taka originates from Bangladesh's import demand for foreign products. Consequently, it follows that any trade barrier that reduces the import demand of Bangladesh will also reduce the demand for foreign currency required to satisfy that import demand. As the demand for foreign currency in Bangladesh declines, the exchange rate of taka becomes overvalued and this affects exports in an adverse way.

Hence, attaining the self-sufficiency through restrictive trade barriers and enhancing the export proceeds at the same time, appears to be an inconsistent policy objective. However, it has been recognized soon by the policy analysts that export diversification, which emphasizes the export of nontraditional items produced through a labor intensive technology, will prove to be an appropriate development strategy for the developing countries. It also emphasizes an intensive use of the most abundant resource domestically available. Moreover, a study done by Feder [World Bank 1982] for a group of semi-industrialized, less-developed countries shows that an export-oriented development strategy can bring about a higher growth rate than those that do not adopt this strategy. It clearly implies that exports have a positive role to play in economic growth. It is reflected in a higher marginal factor productivity in the export-oriented industries. Steep competition gives rise to an efficient use of resources in these industries, and, consequently, a positive externality may diffuse to the nonexport sectors. Therefore, an export-oriented development strategy, which emphasizes the export of nontraditional goods, is expected to take care of the domestic resource use and unemployment problem simultaneously and at the same time it enhances the overall growth rate of GNP by diffusing the positive production externalities to the nonexport sector in the developing countries.

From this perspective of an appropriate development strategy for the labor abundant and primary resource-based countries, it is appropriate to explore how a misalignment of RER can deter the achievement of an outward-oriented development strategy, based on export diversification in Bangladesh.

III. Effects of RER Misalignment on Growth

RER Misalignment Gives a Wrong Signal to Resource Allocation

It has already been stated that an outward-looking development strategy, which emphasizes the export of nontraditional items produced through a labor-intensive technology, is an appropriate policy objective for Bangladesh. But misalignment of RER is a major obstacle on the way of attaining this objective. An overvaluation of RER, i.e., RER misalignment, can cause a misallocation of resources as more of them might be allocated to the nontradables sector having a lower growth instead of the nontraditional export sector with a higher growth rate, which serves as a source of economic growth and development in the developing countries like Bangladesh.

International Competitiveness of Domestic Export Goods Declines

RER misalignment or overvaluation of RER reduces the international competitiveness of domestic export goods by increasing the domestic costs of production, brought about by government budget deficits.

IV. Drainage of Foreign Exchange Reserve and Worsening Balance of Payments

A system of multiple exchange rate exists in Bangladesh, which arises due to the operation of a wage earners' scheme (WES) and an export performance benefit scheme (XPB) in addition to an officially fixed commercial exchange rate. On July 27, 1972, a

premium taka or secondary market rate of taka 30.00 = 1 pound sterling was created for foreign remittances from Bangladesh nationals abroad, under WES and from freely negotiable import entitlement certificates issued under the XPB, which signified a partial devaluation [Cowitt 1985]. Moreover, there exists a black market for foreign exchange that gives rise to a black market nominal exchange rate, which, in fact, reflects the nominal exchange rate determined under the free market. Consequently, multiple real exchange rates are expected to exist corresponding to different nominal exchange rates. However, under this multiple nominal exchange rate system, the private sector's portfolio decisions will depend on the discrepancy between the officially fixed rate and other secondary exchange rates, which, in other words, are called the exchange rate premiums. More precisely, the private sector will decide what proportion of its wealth should be held in assets denominated in foreign currency, depending on the expected rate of devaluation of the secondary exchange rates.

Now, if an expansionary macroeconomic policy is undertaken by the government under this multiple exchange rate system, which reveals itself as an increase in domestic credit that enhances the supply of domestic money vis-à-vis its demand, then an excess demand will be created for the tradable goods, nontradable goods, and financial assets. It seems quite plausible, since the demand for tradable and nontradable goods depends on the RER and on the level of real assets and the stock of domestic real money is a component part of total real assets, which go up due to an increase in domestic credit brought about by an expansive monetary policy. While the excess

demand for tradable goods gives rise to an increasing balance of payments deficit and drainage of scarce foreign exchange reserve, the excess demand for nontradable goods, on the other hand, translates itself as an appreciation of RER, and in the absence of any change in RER fundamental real variables, this will clearly indicate an overvaluation of RER. It has already been mentioned that an expansive macroeconomic policy may enhance the domestic real stock of money or, in other words, it may increase the supply of domestic real money in excess of its demand. As a result, the nominal exchange rate relevant to the capital account transactions, determined under the free market forces, has to go up for encouraging private investors to hold a higher domestic real stock of money instead of foreign currency denominated assets and thereby maintaining the money market equilibrium. Consequently, the spread between the officially pegged nominal exchange rate relevant to current account transactions and the free market nominal exchange rate applicable to the capital account transactions goes up. However, as a result of this joint impact of an increase in domestic stock of real money on one hand and an increase in the spread between the current and capital account transactions on the other, the total real assets in public possession go up and give rise to an excess demand for nontradables, which in turn raises the nontradables price for maintaining the equilibrium in the market for these goods. In the absence of any change in RER fundamental real variables, this increase in nontradables price translates itself as a misalignment of RER. On the other hand, the general public will gradually intend to get rid of an excess supply of domestic money and increase their portfolio holding of foreign money. Consequently, massive capital flight becomes frequent as speculation of

the devaluation of the officially pegged nominal exchange rate goes up, eventually resulting in a drainage of scarce foreign exchange reserve and exacerbating the balance of payments situation. Inconsistency of the macroeconomic policy in a nonunified nominal exchange rate regime sometimes appears to be the sole source of RER misalignment, which is also accompanied by the drainage of scarce foreign exchange reserve.

Nominal devaluation has long been suggested as an appropriate policy measure, which can curb down the RER misalignment although at the cost of an inflationary pressure. But nominal devaluation has always been a controversial policy issue which might even overthrow a ruling political regime or necessitate an early resignation of its finance minister, in spite of the frequent recommendation of IMF (International Monetary Fund) and the World Bank in favor of its implementation in developing countries.

Under these circumstances, analyzing the evolution of RER misalignment and evaluating the effectiveness of nominal devaluation in Bangladesh bears much significance for appraising alternative policy measures. This kind of study is useful from the policy point of view.

CHAPTER 3

DATA DESCRIPTION

I. Procedure Followed in Conducting the Empirical Analysis

The first stage of conducting the empirical analysis is performed by computing the historical time series of the RER index of Bangladesh for the period under study, 1976-1991, using the official nominal exchange rate. Theoretically, real exchange rate is defined as the domestic relative price of tradable goods (a composite of exportables and importables) with respect to the price of nontradable goods, i.e., $RER = \frac{E P_T^*}{P_N}$ [Edwards 1991], where E = nominal exchange rate of Bangladesh taka vis-à-vis its major trading partners, i.e., the value of the trading partners' currency in terms of taka. The major trading partners of Bangladesh are selected in accordance with their trade weights, i.e., the trade share of individual trading partners with Bangladesh in its total annual volume of trade. *International Financial Statistics Yearbook* [IMF 1993] has been used as the source of data on nominal exchange rate of Bangladesh taka vis-à-vis U.S. dollar. However, in order to carry on the empirical analysis, the following measures of RER will be computed.

II. Estimation of the Actual or Observed RER Based on the Official Nominal Exchange Rate

Since there are no available empirical counterparts of the theoretical constructs,

i.e., P_T^* (world price of tradables) and P_N (domestic price of nontradables), hence corresponding to the theoretical constructs of multilateral and bilateral real exchange rates, the empirical counterparts have been constructed as suggested by Edwards [1991]. By using annual data on the wholesale and consumer price index for Bangladesh and its major trading partners, four alternative measures of RER indexes are constructed for the period under study, 1976-1991. It is to be noted that wholesale and consumer price indexes of the ith major trading partner of Bangladesh are used as the proxies of world price of tradables in constructing the two alternative indexes of multilateral RER, while, in both cases, the consumer price index of Bangladesh stands as a proxy of domestic price of nontradables. On the other hand, the wholesale and consumer price indexes of the United States are used as the proxies of the tradables price index of the largest trading partner of Bangladesh in constructing the two alternative indexes of bilateral RER, while the consumer price index of Bangladesh stands as a proxy of the domestic nontradables price.

III. Estimation of the Actual or Observed RER Based on the Black Market Nominal Exchange Rate

By using the data on the black market nominal exchange rate of taka vis-à-vis U.S. dollar, a bilateral real exchange rate index is also computed, which is expected to reflect the RER prevailing in the black market for foreign exchange in Bangladesh. In order to construct this RER index, the formula used by Edwards [1991, p. 108] will be utilized. This formula is denoted as BMRER1 = real exchange rate *BRER1* prevailing

in the black market or black market real exchange rate in short. Hence, $BMRER1 = \frac{BME_t WPI_{U.S.}}{CPI_{BD}}$, where BME_t is an average of the 12 monthly data on the black market nominal exchange rate with respect to the U.S. dollar, $WPI_{U.S.}$ = wholesale price index in the United States, and CPI_{BD} = consumer price index in Bangladesh. BMRER is important because, in the presence of a pervasive exchange control as in Bangladesh, the real exchange rate, constructed by using the official nominal exchange rate, becomes useless in analyzing some international transactions, especially imports. However, *BMRER1* is the black market counterpart of BRER1 (bilateral real exchange rate computed using the bilateral nominal exchange rate of taka vis-à-vis U.S. dollar). Both RER indexes are computed in such a way so that $WPI_{U.S.}$ and CPI_{BD} stand as the wholesale price index of the United States and the consumer price index of Bangladesh, respectively. It is quite unlikely that *BRER1* and *BMRER1* will move together. Instead, in a country like Bangladesh, where the official nominal exchange rate is pegged to the U.S. dollar and domestic credit is often expanded under the pervasive exchange control, it is more than likely that *BRER1* and *BMRER1* will diverge from each other, and the larger their divergence becomes, the tighter would be the exchange control undertaken by the government. More precisely, the higher the coefficient of correlation between *BRER1* and *BMRER1* becomes, the lower will be the extent of government exchange control. The lower the coefficient of correlation between *BRER1* and *BMRER1* becomes, the higher will be the divergence between *BRER1* and *BMRER1*; consequently, it will indicate a higher degree of government exchange control. Plotting *BRER1* and *BMRER1* in the same diagram is expected to reflect significant implications

in this context. Obviously, if the curve representing BRER1 diverges quite significantly from the plot of BMRER1 both in terms of amplitude and curvature, then it will indicate a higher degree of government exchange control. Figure II plots the BRER1 and BMRER1 in the same diagram in order to show the discrepancy between the bilateral real exchange rate computed using the official nominal exchange rate of Bangladesh taka and the BMRER using the black market nominal exchange rate of Bangladesh taka.

Figure II signifies that the measure of BRER computed using the black market nominal exchange rate of Bangladesh taka lies far above the BRER using the official nominal exchange rate of taka and remembering the notion that a fall in the value of

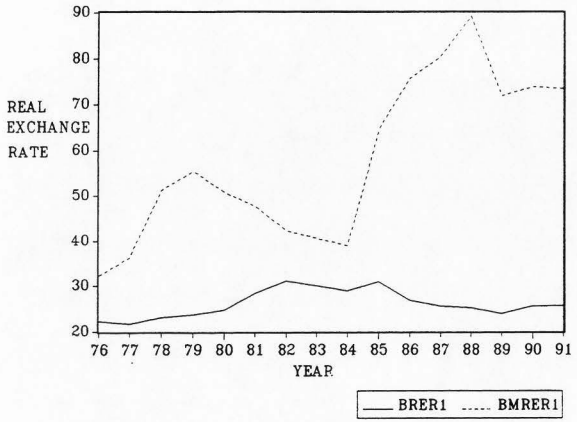

FIGURE II
Bilateral RER 1 and Bilateral Black Market RER 1

RER reflects an appreciation, and a rise in the value of RER indicates a real depreciation; Figure II therefore represents an overvaluation or misalignment of the BRER using the official nominal exchange rate of taka in comparison with the BRER using the black market nominal exchange rate of the same. Consequently, it can be deduced that there exists a high degree of government exchange control in the foreign exchange market of Bangladesh, which makes the official nominal exchange rate far more appreciated than its black market counterpart and eventually ends up with a misalignment of the BRER1 measure compared to the BMRER1 measure.

IV. Estimation of the Long-Run Equilibrium RER

Indexing the computed measure of RER in question to a particular base year facilitates in determining whether the RER of a particular type is misaligned. The base year is selected when the RER attains its highest value in a series of RERs and this appears to be a close approximation of long-run equilibrium RER. A decrease in the value of RER in a series of RERs, therefore, approximately indicates an RER misalignment. Nevertheless, without knowing the long-run equilibrium value of the RER index of a particular type, it is not possible to ascertain that the RER is misaligned. As a matter of fact, estimating the extent of RER misalignment is contingent upon the estimation of the long-run equilibrium RER. More precisely, it can be asserted that a thorough understanding of the way the ERER (equilibrium real exchange rate) responds to the changes in its fundamental real determinants will enable us to grasp the true meaning of the sustained deviations of the actual RER from its long-run equilibrium level, which is called the RER misalignment.

Misalignment of RER is defined to be the sustained deviations of the actual RER from its long-run equilibrium level. As a result, in order to understand the phenomenon of RER misalignment, we need to know about the procedure that leads to the determination of long-run ERER. Concisely, the long-run ERER is defined to be that value of actual RER that is required to attain the simultaneous equilibrium of the internal and external sectors. Internal equilibrium refers to the equilibrium in the nontradable goods market, and external equilibrium reflects the balance in current account. Although the PPP theory asserts the long-run ERER as a constant entity, nevertheless, from a strictly theoretical viewpoint, it does not have to be something like that. In fact, various exogenous shocks in the fundamental real determinants of RER, conventionally known as the RER fundamentals (such as changes in the terms of trade, changes in tariff, changes in productivity etc.), inflict significant shocks on the path of ERER. However, in order to unveil the process leading to the determination of ERER, Edwards [1991] developed an intertemporal real general equilibrium model for a small open economy, which is composed of the optimizing consumers, producers, and a government, all of whom are supposed to consume both the tradable and nontradable goods. Although at first Edwards recognized the perfect competition to prevail along with full employment, where prices and wages are flexible, nevertheless, he got rid of these strong assumptions later and allowed the wage/price rigidity and unemployment to hold true.

CHAPTER 4

MODEL SELECTION

I. Theoretical Definition of Equilibrium RER

In a precisely theoretical fashion, the equilibrium RER is defined as the domestic relative price of tradable goods with respect to the price of nontradables such as a sustainable or equilibrium value of the fundamental real variables, such as terms of trade, tariff, and productivity, which results in the simultaneous occurrence of internal and external equilibrium. Internal equilibrium signifies that the nontradables market is in equilibrium in the current period and will also be in equilibrium in future. On the other hand, the external equilibrium is attained when the intertemporal budget constraint is satisfied or, in other words, when the discounted sum of a country's current account becomes equal to zero. More precisely, external equilibrium indicates that the current account balances (current and future) are compatible with long-run sustainable capital flows. However, the ERER is not an unchangeable entity. Therefore, when there are changes in the variables which affect the external and internal equilibria, then concomitant changes will also be observed in the equilibrium RER.

II. A Benchmark Model of Equilibrium RERs

Edwards [1991] developed an abstract intertemporal real model for a small and open economy in order to analyze how the policy-induced and exogenous changes can affect the path of equilibrium RER. For the sake of lucidity of analysis, he took the

recourse of some simplifying assumptions, such as full employment of resources, where there will be no price rigidities and no international credit rationing. Moreover, it has also been assumed that this hypothetical real economy is composed of the optimizing producers and consumers who are guided by the motive of maximizing their profit and present value of utility, respectively. The profit-maximizing firms are also assumed to produce three broad categories of commodities, namely, exportables (X), importables (M), and nontradables (N), which are produced in the presence of the "constant returns to scale" technological state and a perfectly competitive market configuration.

It is also assumed that there is no change in the relative price of exportables to importables and, as a result, they can be aggregated into a single commodity, namely, tradable goods. Factor price is not equalized in this model, since there are two types of commodities to be produced, i.e., tradables and nontradables, and three different types of resources to be used, i.e., land, labor, and natural resources. There are two periods, i.e., current and future, in this intertemporal model and private consumers are allowed to borrow from foreign countries. This private foreign borrowing is subject to a tax payment and, consequently, the domestic discount rate falls short of the international rate of discount. Consumers are motivated to maximize their intertemporal utility by consuming all three types of goods. There is an optimizing government sector too and it has several sources of income, such as nondistortionary taxes, import tariff, borrowing from abroad, and proceeds obtained from taxes imposed on private borrowing from abroad. This government sector also confronts an international constraint, which states that the discounted value of government expenditure has to be

equal to the present value of government income earned from taxation. Finally, this model presumes the existence of an internal equilibrium, which requires that the private and public demand for nontradables needs to be equal to its aggregate supply, i.e., the nontradable goods market clears in each period. Moreover, the model is real; there is no money or other nominal assets.

The general intertemporal model constructed by Edwards [1991] is composed of the following equations. Edwards considered the world price of exportables as the numeraire. Consequently, the price of importables and the price of nontradables have been expressed in terms of the price of exportables. Therefore, it is better to think about the relative price of importables and the relative price of nontradables, both expressed in terms of the price of exportables. However, the following equations constitute the general model:

(1) $$R(1, p, q, V, K) + \delta R^{\sim}(1, p^{\sim}, q^{\sim}; V^{\sim}, K + I) - I(\delta) - T - \delta T^{\sim} = E[\pi(1, p, q), \delta\pi^{\sim}(1, p^{\sim}, q^{\sim}), W]$$

(2) $$G_X + p^{*}G_M + qG_N + \delta^{*}(G_X^{\sim} + p^{\sim *}G_M^{\sim} + q^{\sim}G_N^{\sim}) = \tau(E_p - R_p) + \delta^{*}\tau^{\sim}(E_{p^{\sim}} - R_{p^{\sim}}^{\sim}) + b(NCA) + T + \delta^{*}T^{\sim}$$

(3) $$R_q = E_q + G_N$$

(4) $$R_{q^{\sim}}^{\sim} = E_{q^{\sim}} + G_N^{\sim}$$

(5) $$p = p^{*} + \tau$$

(6) $$p^{\sim} = p^{\sim *} + \tau^{\sim}$$

(7) $$\delta R_K^{\sim} = 1$$

(8) $$P_T^{*} = \gamma P_M^{*} + (1 - \gamma)P_X^{*}, \quad P_T^{\sim *} = \gamma P_M^{\sim *} + (1 - \gamma)P_X^{\sim *}, \quad (P_X^{*} = P_X^{\sim *} = 1)$$

(9) $$RER = \frac{P_T^*}{P_N}, \quad RER^{\sim} = \frac{P_T^{\sim *}}{P_N^{\sim}}.$$

Equation (1) in the above model signifies the intertemporal budget constraint for the private sector. It states that the present value of private sector's income has to be equal to the present value of private expenditure, both measured in domestic prices. However, the given assumption of a tax imposed on foreign borrowing makes the domestic discount factor, δ, lower than the world discount factor, δ. Let i be the domestic real interest rate, and i^* be the world real interest rate. But the tax imposed on foreign borrowing makes the domestic real interest rate higher than the world real interest rate. Hence, $i > i^*$ and, consequently, $\frac{1}{1+i} < \frac{1}{1+i^*}$ or, in other words, $\delta < \delta^*$, where $\delta = \frac{1}{1+i}$ and $\delta^* = \frac{1}{1+i^*}$.

The left-hand side of equation (1) reflects the production or supply side of this model and the right-hand side indicates the demand side. It has to be noted that this supply side expression of equation (1) is developed with the aid of duality theory and the concept of revenue function. The revenue function exhibits the maximum revenue that the private firms can obtain by producing and selling the three types of goods in question at their given market determined prices. The first part of the left-hand side expression in equation (1) stands for the revenue function for the private sector in period 1. It includes the relative prices of importables (p) and nontradables (q), both with respect to the price of exportables, among its choice variables. The first argument in the parentheses is equal to 1, since this is the numeraire. Moreover, this period 1 revenue function encompasses the vector of factors of production and the capital stock as the other independent variables. Equation (1) also includes the private sector's

revenue function for period 2. The symbol "tilde" has been used to denote the private sector's revenue function in period 2 and its choice variables.

However, the domestic discount factor, δ, is used to discount the private sector's revenue function for period 2. It has to be noted that this left-hand side expression of equation (1) indicates the net private sector revenue, since the amounts of lump sum taxes imposed on the private sector in periods 1 and 2 have been deducted from the total private revenue. On the other hand, the right-hand side expression of equation (1) stands for the expenditure function, which signifies the minimum discounted value of the private sector expenditure that is required to attain a certain level of utility W* for the given domestic prices in periods 1 and 2. Finally, it is also possible to express the expenditure function as a function of the unit expenditure functions and the level of utility, W*, where $\pi(\,)$ and $\pi^{-}(\,)$ are the exact price indexes for periods 1 and 2.

On the other hand, equation (2) stands for the intertemporal budget constraint for the government sector. It signifies that the present value of government expenditure has to be equal to the discounted value of government revenue earned from taxation. More specifically, the sum of the current and future discounted value of government expenditure should have to be equal to the sum of the current (period 1) and future (period 2) discounted value of government income earned from distortionary and nondistortionary taxes. Since the government is not subject to a tax imposed on borrowing from abroad, the discount factor used in computing the discounted value of government expenditure is the world discount factor (δ^*), which is smaller than the domestic discount factor (δ). Moreover, the partial derivative of the expenditure

function with respect to the importables relative price, i.e., E_p, indicates the demand for these goods and the partial derivative of the revenue function with respect to the importables relative price, i.e., R_p, stands for the supply of these goods. As a result, the discrepancy between the domestic demand for and supply of importables, i.e., $(E_p - R_p)$, indicates the magnitude of import. t is the rate of import tariff, and when it is multiplied by the amount of import, then the product stands for the government tariff revenue. T and $T^{\sim}$ stand for the lump sum taxes imposed on the private sector in periods 1 and 2, respectively. NCA stands for the noninterest current account of the private sector in period 2, and $b = (\delta^* - \delta)$ = discounted value of tax payments per unit borrowed from abroad. But, in short, equation (2) represents the intertemporal budget constraint for the government sector. Equations (3) and (4) indicate the equilibrium conditions for the domestic nontradable goods market in periods 1 and 2, respectively. They signify that the sum of private and government sector demands for the nontradables goods has to be equal to their supply in both periods in order to attain an equilibrium in the market of these goods. More specifically, where R_q = nontradables supply in period 1, E_q = private sector's demand for nontradables in period 1, and G_N = government sector's demand for nontradables in period 1, the expression $R_q = E_N + G_N$ conspicuously reflects the equilibrium condition for nontradables market in period 1. On the other hand, where $R_{q}^{\sim}$, $E_{q}^{\sim}$, and $G_N^{\sim}$ indicate the supply of nontradables in period 2, private sector's demand for nontradables in period 2, and the government demand for nontradables in period 2, respectively, the expression $R_{q}^{\sim} = E_{q}^{\sim} + G_N^{\sim}$ obviously signifies the equilibrium condition for nontradables market in period 2. Equations (5)

and (6) point out the relationship between the domestic and world prices of the importable goods in periods 1 and 2, respectively. p and p^- are the domestic prices of the importable goods in periods 1 and 2, respectively. t and t^- are the import tariff imposed on the importables in periods 1 and 2, respectively. Finally, p^* and p^{-*} stand for the world prices of importables in periods 1 and 2, respectively. Tariff has been assumed to play a different role in the present analysis. Instead of its traditional role as a measure to curb the deficit in the balance of payments, in the present analysis, tariff is assumed to play a different role. Now, tariff is expected to be imposed for changing the long-run allocation of resources. Equation (7) states the primary criterion of the private sector's investment decision. It implies that the profit-maximizing firms will add to the capital stock until Tobin's "q" becomes equal to 1. This equation presumes that the stock of capital is composed of the exportable goods. Equation (8) defines the price index for tradable goods in such a way so that it becomes possible to use the notion of a tradable goods composite.

This definition of the price index for tradable goods seems very significant from a theoretical viewpoint, since if the relative price of exportables and importables change, then it is not possible to state something as a tradable goods composite. However, the weights assigned to the importables and exportables to deduce a composite tradable goods price index are γ and $(1 - \gamma)$, respectively. Finally, equation (9) provides a definition of the RER index as the domestic relative price of tradables to nontradables.

This intertemporal real model deals with a vector of equilibrium relative prices

of tradable goods with respect to nontradables or, in other words, a vector of equilibrium RERs instead of a single equilibrium value of RER. More precisely, it concentrates its focus on the equilibrium path of RER. From this perspective, the equilibrium RER, prevailing in a particular period, can be defined as that relative price of tradable goods which equilibrates the internal or nontradables and the external sectors for the given sustainable or equilibrium values of other exogenous variables, such as tariffs, production technology, and internal terms of trade.

However, the vector of equilibrium RERs includes those RERs that satisfy all the equations in this intertemporal model for given values of the other fundamental variables. Edwards's model presumes the nonexistence of any externalities or market failures, and, therefore, it implies the prevalence of full employment. An exogenous shock in the fundamental real variables is expected to affect the vector of equilibrium RERs through two interrelated channels. The first one works through creating an intratemporal effect and the second one activates through an intertemporal effect. It can be explained with the aid of an example. Let us suppose that an exogenous worsening in the external terms of trade takes place. As a result, domestic producers will produce more of the importable goods and the consumers will consume less of these goods. On the other hand, the worsening of the terms of trade will inflict a negative income effect on behalf of the consumers, and, assuming that the importable goods are normal goods, this negative income effect will reduce their consumption. Both of these effects will cause a disequilibrium in the nontradables market and necessitate a change in the relative price of these goods or, in other words, a change in the equilibrium RER. This

is called the intratemporal effect, and, in the absence of foreign borrowing, this will be the only relevant effect. However, in the presence of foreign borrowing and capital mobility, this worsening international terms of trade will change the intertemporal allocation of consumption expenditure too from one period to the other one, and, consequently, a different kind of change will be observed on the equilibrium RER.

Finally, although it is not possible to explicitly write down the vector of equilibrium RERs without specifying the functional forms of the revenue, expenditure, and other relevant functions included in the equations underlying the model, it seems plausible to express the vector of equilibrium RERs in the implicit functional forms where they are expressed as the functions of the sustainable levels of all exogenous variables in the system as follows:

$$RER = h(p^*, p^{-*}, \tau, \tau^-, \delta, \delta^*, V, T, T^-, G_X, G^-_X, \ldots), \tag{10}$$

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

where p^* = international terms of trade in period 1, p^{-*} = international terms of trade prevailing in period 2, t = magnitude of tariff imposed on the importables in period 1, t^- = magnitude of tariff imposed on the importables in period 2, δ = domestic discount factor prevailing in period 1, δ^* = domestic discount factor prevailing in period 2, V = vector of the factors of production, T = lump sum taxes imposed on the private sector in period 1, T^- = lump sum taxes imposed on the private sector in period 2, G_X = government expenditure on the exportables in period 1, and G^-_X = government expenditure on the exportables in period 2.

III. Effects of Exogenous Changes in Fundamental Real Variables on the RER Vector

It has been assumed that there are only two periods at the discretion of the economic agents under this intertemporal model. Now, we have to analyze the probable effects of an expected import tariff in period 2 on the RER in both periods. In order to avoid the complication that is expected to arise from the first-order income effects if an initial tariff is supposed to be positive, it has been assumed that there exists no import tariff in either period. However, in these circumstances, if the people almost precisely expect that an import tariff of a certain amount will be imposed on the importable goods in period 2, then they will shift their expenditure away from period 2 and reallocate this to period 1 as their future consumption becomes more expensive. The assumption of intertemporal substitution in consumption made it possible to reach this concluding remark regarding their consumption behavior. Consequently, this intertemporal substitution of consumption from period 2 to period 1 will enhance the consumers' demand for all types of commodities, including the nontradable ones. But as the propensity to consume the nontradables is higher than the tradables, consumers will allocate a proportionately higher amount of their increased consumption expenditure on nontradables in period 1. As a result, the relative price of nontradables with respect to that of tradables will go up and result in an appreciation of equilibrium RER in that period.

On the other hand, an expected import tariff in period 2 also causes an appreciation of RER in period 2. However, in this case, there will be an intratemporal

effect in addition to an intertemporal effect brought about by the change in relative prices in period 2. Initially, an expected government imposition of an import tariff in period 2 will increase the importables price in that period and make their future consumption more expensive in comparison with period 1 when no import tariff is imposed. Intertemporal substitution in consumption will enable the consumers to shift their expenditure away from period 2 and into period 1. As a result, demand for all kinds of goods will fall in period 2 and so will the relative price of nontradables, i.e., q^{-} falls. But an intratemporal effect can either strengthen or weaken this downward force on the nontradables relative price in period 2, i.e., q^{-}. It is obvious that an expected import tariff in period 2 will enhance the domestic price of imported goods in that period and reduce their domestic demand. However, the most plausible assumption suggests in this case that importables and nontradables are substitutes. Consequently, as an expected imposition of an import tariff enhances the domestic price of importables and reduces their demand, consumers are very likely to substitute importables by the nontradables, eventually leading to an increased demand for nontradables and an increase in their relative price or an appreciation of the equilibrium RER. In conclusion, an expected imposition of an import tariff in period 2 will enhance the relative price of nontradables or, in other words, cause an appreciation of the equilibrium RER in both periods 1 and 2.

IV. Effects of an Exogenous and Permanent Change in the International Terms of Trade on the Equilibrium RER

In order to analyze the effect of a permanent change in international terms of trade on the equilibrium path of RER, Edwards [1991] adopted some simplifying assumptions to modify his original model to some extent and thereby avoided unnecessary complications. These simplifying assumptions include the absence of government consumption, investment, and taxes on foreign borrowing. Moreover, he also assumed the existence of a very low initial tariff imposed on the imported goods. However, under these circumstances, a permanent change in international terms of trade, a permanent deterioration of international terms of trade, for instance, will create both the negative income effect and substitution effect. The negative income effect comes into existence when the permanent deterioration of international terms of trade reduces the real income of consumers and compels them to reduce their expenditure on nontradables as they appear to spend a higher proportion of their real income on these goods. Consequently, the demand for nontradables falls and eventually necessitates a decrease in the relative price of these goods in order to restore the equilibrium in the nontradables market. However, the equilibrium RER depreciates as a result. On the other hand, a permanent deterioration of international terms of trade will also create a substitution effect. The permanent deterioration of international terms of trade will increase the relative price of importables. Consequently, people will reduce their consumption of importables and substitute them with the nontradables, provided that the assumption of perfect substitutability between these two goods exists. As a result,

an eventual incident of an increased demand for these goods will develop and results in a higher relative price for them, which finally translates itself as an appreciation of equilibrium RER. But it is not possible to know a priori whether the substitution effect or the income effect will be stronger due to this permanent deterioration of international terms of trade and whether the RER will appreciate or depreciate due to the joint effect. It is to be noted that a permanent deterioration of the terms of trade indicates an equiproportional increase in the importables price in both periods. However, if the substitution effect dominates the income effect, then a permanent deterioration of the external terms of trade will result in an appreciation of equilibrium RER. If, on the other hand, the income effect overpowers the substitution effect, then a depreciation of equilibrium RER will be forthcoming.

Effects of a Change in Exchange Controls and Exogenous Capital Flows on the Equilibrium Real Exchange Rate

In the present study, a tax imposed on private borrowings from abroad reflects the extent of capital control. However, as a result of this tax imposed on foreign private borrowing, the domestic real interest rate exceeds the world real interest rate, implying a lower domestic discount factor vis-à-vis the world discount factor. Now, if the government changes the extent of capital control by changing the amount of tax imposed on foreign private borrowing, then corresponding effects will be observed on the equilibrium path of RER. It seems reasonable to assume that an inflow of borrowed foreign capital will allow the private consumption expenditure to increase even more than the disposable income. Consequently, an excess demand for nontradables will be

created, which will in turn increase their relative price with respect to the tradable goods price and eventually will result in an appreciation of the equilibrium RER. This deduction follows Mackinnon's analysis [Hall et al. 1994], which presumes that capital flows are exogenous. But, in reality, capital flows are endogenous as they are influenced by the differential between the domestic and world real interest rates.

Edwards [1991] emphasized the effects of a change in capital control on intertemporal allocation of consumption expenditure and, therefore, on the equilibrium RER. However, a change in the capital flow restrictions affects the equilibrium relative price of nontradables or the equilibrium RER through two possible channels. One of them might be occurred through an intertemporal substitution effect and the other one might be brought about through a welfare or income effect. Let us suppose that the government reduces the restrictions on capital flows by reducing the tax imposed on foreign private borrowing. As a result, the domestic real interest rate will fall from its previous level and result in an increase in domestic discount factor more than it was before vis-à-vis the world discount factor, since $\delta = \frac{1}{1+i}$ and $\delta^* = \frac{1}{1+i^*}$; and if i falls, then δ increases, where i = domestic real interest rate, δ stands for the domestic discount factor, δ^* = world discount factor, and i^* = world real interest rate. Consequently, as the domestic discount factor goes up and becomes closer to the world discount factor, the future consumption becomes more expensive and, as in this case of a two-period intertemporal model, consumers will substitute their expenditure away from period 2 and reallocate it in period 1. They will consume more of everything in period 1, and, as a result, an upward pressure will be exerted on the relative price of

nontradables and eventually an appreciation of equilibrium RER in period 1 will take place. However, this kind of liberalization of government restrictions on the capital flow can bring about an appreciation of the equilibrium RER in period 1 through a welfare or income effect. It has already been mentioned that a relaxation of government restrictions on foreign capital inflow increases the domestic discount factor and brings it closer to the world discount factor. The lower this discrepancy becomes between the world and the domestic discount factor, the lower will be the distortion in the economy; and, as a consequence, there will be a positive welfare effect on behalf of the consumers, which in turn encourages them to spend more on everything. Eventually, there will be an excess demand for nontradables, and their equilibrium relative price will go up and cause an appreciation of equilibrium RER in period 1. However, the appreciation of equilibrium RER in period 1, brought about by the income effect, depends on the propensities to consume in periods 1 and 2 and the initial level of distortion. The higher the propensities to consume in both periods and the higher the initial level of distortion becomes, the higher will be the effect of a government capital account liberalization program on the equilibrium RER, i.e., the higher will be the extent of RER appreciation in period 1. Liberalization of government restrictions on the capital inflow can bring about an appreciation of equilibrium RER through a different channel. It is obvious that a relaxation of government restrictions on capital inflow will increase private borrowing from abroad, and, as a result, there will be more consumption expenditure than before, which will eventually end up with an increase in the equilibrium relative price of nontradables or, in other words, an appreciation of

equilibrium RER. Finally, an appreciation of the equilibrium RER in period 2 will depend on the relative force of intertemporal substitution and the income effect.

Effect of an Exogenous Inflow of Foreign Capital on the Equilibrium RER

In the less-developed countries, capital flows often assume the form of foreign aid and capital flights originating from uncertain political atmosphere. The first category obviously indicates a capital inflow, while the second one reflects a capital outflow. These kinds of capital flows are not influenced by the interest rate differentials. However, they have important effects on the equilibrium path of RER. Assuming that the propensities to consume nontradable goods in periods 1 and 2 are nonzero and the income elasticities to consume these goods are positive, an exogenous capital inflow such as foreign aid will result in an appreciation of equilibrium RER in both periods. On the other hand, a capital outflow, which takes the form of a capital flight, will create a depreciation of equilibrium RER in both periods.

Effects of a Change in the Composition of Government Expenditure and Fiscal Debt on the Equilibrium RER

Edwards's [1991] model concentrates on the RER misalignment in the less-developed countries, and the government sector is observed to play a significant role in these countries. Since the issue of RER misalignment claims a thorough analysis of the way the fundamental real determinants affect the equilibrium path RER, we have to elucidate how the real aspects of government policy, a change in the composition of government expenditure and fiscal debt for instance, influence the equilibrium RER.

For the sake of simplicity of this analysis, let us assume that the government raises its revenue through nondistortionary taxes, such as lump sum taxes in periods 1 and 2, and terms of trade remain unchanged. Consequently, it seems possible to integrate the importables' and exportables' relative prices into a composite tradables price. Moreover, the government sector is assumed to consume both tradables and nontradables and borrow from abroad at an interest rate that is equal to the rate at which the private sector borrows internationally. On the other hand, the government sector is also assumed to confront an intertemporal budget constraint, which signifies that the present value of government expenditure needs to be equal to the discounted value of government revenue obtained from nondistortionary taxes and foreign borrowing. It implies that the fiscal deficit accrued in period 1 has to be covered up by an increase in government revenue in period 2, which is obtained through an increase in nondistortionary taxes. Now, if the government introduces a tax cut in period 1, it will have to enhance its foreign borrowing at the same time to cover up the deficit. But in order to satisfy the intertemporal budget constraint, government will have to enhance the nondistortionary taxes in period 2. However, this kind of government fiscal action will have no effect on the equilibrium RER as the consumers adjust their consumption expenditure exactly in the same proportion to which their disposable income goes down. It happens due to the validity of the assumption of a perfect foresight. Changes in the government consumption level will also have an important effect on the equilibrium path of RER. Let us suppose that government enhances its consumption of nontradable goods in period 1 and accommodates this additional expenditure through

borrowing. However, this excess government demand for nontradables in period 1 will result in a higher equilibrium relative price of nontradables in period 1. Consequently, the equilibrium RER in period 1 gets appreciated. On the other hand, this government borrowing in period 1 has to be financed by a higher level of taxes in period 2, which lowers the disposable income in that period.

This tax hike in period 2, initiated by the government to cover up its public debt incurred in period 1, will reduce both the future and the present values of the private sector's income, resulting in a lower demand for nontradables in both periods 1 and 2. As a result, the equilibrium relative price of nontradables goes down in both of these periods. Consequently, a depreciation of equilibrium RER in period 1 is very likely. It has been assumed in this model that importables and nontradables are perfect substitutes. As the government substitutes nontradables for tradables in period 1, nontradables' relative price as well as the equilibrium RER goes up in period 1 due to this substitution effect. But as the tax hike in period 2 reduces the private disposable income in period 2 and the present value of private income in period 1, nontradables demand goes down in both periods, resulting in a depreciation of equilibrium RER in both periods. Now, whether the equilibrium RER in period 1 will appreciate or not, it depends on the relative forces of the positive substitution effect arising from a higher level of government consumption of nontradables in period 1 and the negative income effect resulting from a fall of the private sector's nontradables demand in periods 1 and 2 due to a fall in its present value of income and future disposable income, respectively.

As the dominant substitution effect is presumed to be true in this case, an appreciation of equilibrium RER in period 1 is very likely.

Effects of Technological Progress on the Equilibrium Path of RER

Technological progress is an important factor affecting the equilibrium path of RER. There are many postulates regarding the probable relationship between the PPP-defined equilibrium RER and the technological progress. Ricardo [1971] postulated that there exists a negative relationship between technological progress and the equilibrium relative price of tradables to nontradables or equilibrium RER. As a result, the higher the technological progress becomes in a country, the lower the equilibrium relative price of tradables to nontradables and vice versa, or, in other words, the PPP-defined equilibrium RER appreciates as technological progress proceeds in a country. Later, Pigou [1922] observed that higher income countries have a lower PPP-defined equilibrium RER than the lower income countries. However, Balassa [1964] offered an interpretation of these observations. He stated that productivity improvement or technological progress is higher in the higher growth countries than the countries having a lower growth rate. On the other hand, he also mentioned that productivity improvement is higher in the tradable goods sector than the nontradable goods sector. Balassa's interpretation may be concluded by stating that the PPP-defined equilibrium RER gets appreciated in each country as it experiences the technological progress in the course of time. But the present discrepancy of technological progress between different countries will allow the PPP-defined equilibrium RER to appreciate

in the countries with a higher growth rate than those with a lower rate of economic growth.

However, in the context of Edwards's [1991] intertemporal two-period model, a technological progress will create a positive income effect, which translates itself into a higher demand for nontradable goods and eventually results in a lower equilibrium relative price of tradables to nontradables or an appreciation of equilibrium RER. It is to be noted that this type of technological progress will also have different effects on the equilibrium RER. If a product augmenting technological progress creates an overproduction of nontradable goods, which results in an excess supply of these goods, then the equilibrium relative price of tradables to nontradables will increase and end up with a depreciation of equilibrium RER.

V. A Theoretical Exposition of the Process Leading to the RER Misalignment in the Light of Edwards's [1991] Model

It has been emphasized in Edwards's [1991] model that, although the long-run equilibrium RER depends on the fundamental real variables, the actual or observed RER may depend both on real and monetary variables. As long as the observed RER appears to be equal to the long-run equilibrium RER, neither undervaluation nor overvaluation of the RER takes place. However, short-term deviations of the observed RER from its long-run equilibrium level should not be identified as a misalignment of the RER. More precisely, the misalignment of the RER is defined to be the sustained deviations of the observed RER from the long-run equilibrium RER. But it is also

emphasized and empirically observed that the long-run equilibrium RER varies through time, i.e., it does not remain constant. However, the misalignment of RER or the overvaluation of RER is examined in various exchange rate regimes, such as a fixed or predetermined nominal exchange rate along with its variants including the managed and crawling peg. On the other hand, it is also examined how the misalignment of RER evolves under the nonunified nominal exchange rate regime that includes dual exchange rates where a parallel foreign exchange market is in coexistence with the official market.

Choosing an appropriate macroeconomic policy in a particular nominal exchange rate regime is of crucial importance. More precisely, a particular macroeconomic policy is contingent upon the nominal exchange rate regime in existence. The latter imposes some restrictions on the former. In a predetermined nominal exchange rate regime, the chosen macroeconomic policy should be consistent with this too. Otherwise, serious macroeconomic disequilibrium will take place. For instance, if an expansionary macroeconomic policy is undertaken under the predetermined nominal exchange rate regime, then there will be an excess supply of domestic money vis-à-vis its demand since most of this excess supply of money used to be created with the help of fiscal deficit financing. Consequently, there will be an excess demand for tradable, nontradable, and financial assets denominated in domestic currency. An excess demand for tradable goods will translate itself into a trade deficit. On the other hand, an excess demand for nontradable goods will give rise to an increase in the relative price of these goods, which may also be called an appreciation of the real exchange rate. But in the absence of any change in the fundamental real variables

affecting the long-run equilibrium RER, this appreciation of the RER will indicate a misalignment of the RER. Macroeconomic policies, which are inconsistent with the chosen nominal exchange rate regime, can cause the loss of scarce foreign exchange reserve, a higher domestic rate of inflation compared to the international rate, and, worst of all, it can give rise to a severe misalignment of the RER. The relationship between the chosen macroeconomic policy and the nominal exchange rate system will depend on the type of the latter. At the present, a particular type of nominal exchange rate system is practiced in a growing number of developing countries, which assumes the form of ascertaining a fixed official rate for the current account and a freely fluctuating rate for the capital account transactions with the objective of alienating the real side of the economy from the highly volatile monetary side and thereby protecting the economy from its harmful effects. In short, the harmful effects of an expansionary macroeconomic policy will create a higher demand for the nontradable goods, and the relative price of these goods will be increased, which in turn will cause an appreciation of the RER and, in the absence of any change in the fundamental real variables affecting the long-run equilibrium RER, this appreciation of the observed RER will indicate a misalignment of the RER. On the other hand, since domestic investors will have a higher proportion of their financial assets denominated in domestic currency, they will be highly prone to converting an increasing proportion of their financial assets into foreign currency denominated assets. Obviously, this will create a devaluation of the domestic foreign exchange rate and, consequently, exacerbate the RER misalignment situation.

Edwards [1991] offered an extension of the Calvo-Rodriguez [1977] model in order to explain the relationship between the RER misalignment, the executed macroeconomic policy in question, and the role of nominal devaluation in this context. The phenomenon of RER misalignment in Bangladesh will be discussed in the light of this model. However, there are some simplifying assumptions underlying this model as follows:

1. There exists a dual nominal exchange rate regime—an officially fixed exchange rate for the current account transactions and a freely fluctuating exchange rate for the capital account transactions;
2. the exportables and importables are aggregated into a single sector called the tradable sector;
3. there exist two sectors in this small economy, i.e., the private sector and the government sector, and they are supposed to consume two domestically produced goods called tradables (T) and nontradables (N);
4. the private sector investors are supposed to hold both domestic money (M) and foreign money (F);
5. the government sector is expected to consume both the tradables and nontradables, and it raises its revenue from nondistortionary taxes and with the help of domestic credit creation;
6. both the private and the government sectors can borrow from abroad, and there is no domestic public debt;
7. there exists a fixed nominal exchange rate for current account transactions (E)

and a freely floating nominal exchange rate for the capital account transactions (d), and this latter rate can assume whatever level is required to achieve the equilibrium in the asset market;

8. it has also been assumed that the price of tradables is fixed in terms of foreign currency and equal to 1, i.e., (P*T = 1); and

9. there is a perfect foresight on behalf of the economic decision makers.

This model can be represented with the help of the following equations:

Portfolio decisions:

(12) $$A = M + \delta F$$

(13) $$a = m + \rho F,$$

where a = A/E, m = M/E, and $\rho = \frac{\delta}{E}$.

(14) $$m = \sigma\left(\frac{\delta^{\cdot}}{\delta}\right)\rho F, \quad \sigma' < 0$$

(15) $$F^{\cdot} = 0.$$

Demand side:

(16) $$e = \frac{E}{P_N}$$

(17) $$C_T = C_T\,(e,a): \frac{\partial C_T}{\partial e} < 0, \quad \frac{\partial C_T}{\partial a} > 0$$

(18) $$C_N = C_N(e,a): \frac{\partial C_N}{\partial e} > 0, \quad \frac{\partial C_N}{\partial a} > 0.$$

Supply side:

(19) $$Q_T = Q_T(e): \quad \frac{\partial Q_T}{\partial e} > 0$$

(20) $$Q_N = Q_N(e): \quad \frac{\partial Q_N}{\partial e} < 0.$$

Government sector:

(21) $$G = P_N G_N + E G_T$$

(22) $$\frac{E G_T}{G} = \lambda$$

(23) $$G = t + D^{\cdot}.$$

External sector:

(24) $$CA = Q_T(e) - C_T(e,a) - G_T$$

(25) $$R = CA$$

(26) $$M = D^{\cdot} + ER^{\cdot}.$$

The equations stated above have specific interpretations in the context of this hypothetical small open economy. For instance, equation (12) signifies the total nominal assets in terms of domestic currency as the sum of domestic money (M) and foreign money (F), the latter being multiplied by the free market nominal exchange rate relevant to the financial transactions, i.e., (δ). Now, dividing both sides of equation (12) by the officially fixed nominal exchange rate relevant to the commercial transactions, i.e., by E, we end up with equation (13), which defines the total domestic real assets in terms of tradable goods (since E stands for the nominal exchange rate prevailing in the market for the tradable goods). It is to be noted that $\rho = \frac{\delta}{E}$ denotes the spread between the officially fixed commercial nominal exchange rate and the free market nominal exchange rate relevant to the financial transactions. Equation (14) stands for the portfolio composition equation, and it signifies that the desired ratio of

domestic real money to the real foreign money in terms of tradable goods, i.e., $\frac{m}{\rho F}$, is negatively related to the actual rate of depreciation of the free capital market nominal exchange rate , i.e., δ, where $\frac{\delta}{\delta}$ stands for the expected rate of depreciation of the free market nominal exchange rate, which turns out to be the actual rate of depreciation under the assumption of perfect foresight. However, equation (15) implies that $\frac{\partial F}{\partial t} = 0$, i.e., there is no change in the stock of foreign nominal money, which, in other words, may be viewed as a situation when there is no capital mobility although the model precludes the possibility of a zero foreign balance by assuming that the economy in question has a positive stock of foreign nominal money, i.e., $F_0 \neq 0$. However, it is also emphasized that there exists no commercial transaction which can be negotiated at a free market nominal exchange rate δ.

On the other hand, the set of equations ranging from (16) to (20) represents the demand side and the supply side of this economy, respectively, while the RER is defined to be $e = \frac{E}{P_N}$, as it has been assumed that $P_T^* = 1$, i.e., the price of tradables in terms of foreign currency is fixed and equal to 1. Beginning from the demand side, equation (17) describes the demand for tradables as a function of the RER (e) and real assets (a), while an increase in the RER (a rise in the relative price of tradables with respect to nontradables) causes a fall in the demand for these goods and vice versa as signified by the negative sign of the partial derivative term $\frac{\partial C_T}{\partial e}$. The real assets in terms of commercial goods is another determinant of the tradables demand, and an increase in its possession will obviously endow its owners with more real income as they spend more of it on both tradables and nontradables. However, equation (18)

denotes the nontradables demand function, and it exhibits that their demand goes up as the real exchange rate goes up as the relative price of nontradables goes down vis-à-vis the tradables and their demand also experiences an increase due to the same reason, which explains the increase in tradables' consumption because of an increase in the possession of real assets.

Equation (19) signifies the supply of tradables as an increasing function of the real exchange rate (e), i.e., as the real exchange rate or the tradables' relative price increases, producers will be encouraged to produce more of these goods. Contrast to the tradables supply function, the nontradables supply function denotes the nontradables supply as a negative function of the real exchange rate, i.e., as the real exchange rate increases (i.e., nontradables relative price decreases), producers will be producing less of these goods and vice versa. However, the supply functions of tradables and nontradables are expressed as the functions of real exchange rate alone. It needs to be emphasized that for the sake of simplicity of analysis, taxes are not allowed to enter the demand functions.

The government sector behavior has been depicted by the set of equations ranging from (21) to (23). Equation (21) reflects the total nominal expenditure of the government sector on the tradables and nontradables, where G_T and G_N stand for its consumption on the tradables and nontradables, respectively. P_N stands for the nominal price of the tradables and, thus, $P_N G_N$ gives the nominal government expenditure on the nontradables. Since the price of tradables in terms of foreign currency is assumed to be fixed, i.e., $P_T^* = 1$, as a result, EG_T gives the total government nominal expenditure on

the tradables, where E stands for the nominal official exchange rate for the commercial transactions in terms of domestic currency. Now, dividing both sides of equation (21) by the officially determined nominal exchange rate E, we end up with the total real government expenditure in terms of the tradables as shown as $\frac{G}{E} = \frac{P_N G_N}{E} + \frac{E G_T}{E}$ or $g = g_N + g_T$, where $g = \frac{G}{E}$, $g_N = (P_N G_N)/E = \frac{G_N}{e}$ and $g_T = G_T$. Equation (22) shows the proportion of total nominal expenditure of the government sector spent on the tradables or, in other words, λ stands for the ratio of the government sector's total expenditure on the tradables to its aggregate nominal expenditure on both the tradables and nontradables. It needs to be noted that $\lambda = \frac{E G_T}{G} = \frac{G_T}{\frac{G}{E}} = \frac{g_T}{g}$ since $g_T = G_T$ and $g = \frac{G}{E}$.

However, equation (23) indicates the budget constraint for the government sector and thus reflects that government has to cover up its expenses on tradables and nontradables by raising the nondistortionary taxes (t) on one hand and domestic credit creation ($D^{\cdot}$) on the other. It has to be emphasized that in the presence of a predetermined nominal exchange rate for the commercial transactions, government consumption expenditures cannot be supported in the long run. Consequently, a stationary equilibrium is achieved when $G = t$, that is, $D^{\cdot} = 0$. However, a positive domestic credit creation, i.e., $D^{\cdot} > 0$, is allowed to exist only when there exists a crawling peg for the commercial nominal exchange rate, i.e., when $\frac{E^{\cdot}}{E} > 0$, and, in this particular case, the positive domestic credit creation should have to be consistent with the rate of crawling peg nominal official exchange rate relevant to the commercial transactions. On the other hand, the

external sector of this hypothetical economy is represented by the set of equations ranging from (24) to (26). Equation (24) reflects the current account balance in terms of foreign currency as the difference between the total output produced of the tradable goods and its total consumption, composed of the private and public consumption of these goods, i.e., $C_T = C_T(e,a)$ and G_T, respectively. Equation (25) signifies the balance of payment of this economy, and it states that in the absence of any foreign capital mobility, i.e., $F = 0$ and where a free nominal exchange rate prevails for the capital account transactions, the balance of payments, i.e., the rate of change of international reserves, i.e., R, will be equal to the current account (CA). However, it has been assumed that there exists an initial stock of international reserves, which might be denoted by R_0. It should be noted that the balance of payments is composed of the balance in the current account and the capital account, and since the balance in the capital account is presumed to be zero, therefore, the only channel through which the government can accumulate the international reserve is through a surplus in the current account. Finally, equation (26) establishes a link between the changes in the domestic credit (D), changes in the domestic stock of money (M), and changes in the stock of international reserves in terms of domestic currency (ER).

VI. Long-Run Sustainable Equilibrium

The long-run sustainable equilibrium is defined to be a state where there exists a simultaneous equilibrium in both the external sector and the nontradables market. The external sector is represented by the current account and the balance of payments. If the

long-run sustainable equilibrium has to prevail in this economy, then it follows that the current account needs to be in equilibrium in every period. If there is a departure that takes place from this equilibrium in the current account in the short or even in the medium run, then it will imply an accumulation or a decumulation of the international reserves. However, there are the following four conditions that are required for the attainability of a steady state long-run equilibrium. These conditions will have to be simultaneously held true.

Four conditions for a steady-state long-run equilibrium exist for the capital market in an economy where there exists a government sector along with a private sector while there is no foreign capital mobility and a free nominal exchange rate, and a predetermined rate exists for the commercial transactions.

1. Equilibrium is attained in the nontradables market, i.e., the nontradable market clears. In terms of the equations of this model, equilibrium in the nontradables market is attained when $C_N = Q_N$, where $C_N = C_N(e,a)$ and $Q_N = Q_N(e)$, i.e., when the sum of private sector and government sector demands for nontradables becomes equal to the supply of these goods. In terms of equation, it can be expressed as follows:

(27) $$C_N(e,a) + eg_N = Q_N(e)$$

where $eg_N = e\dfrac{G_N}{e} = G_N$.

In the above equation, g_N indicates the real government consumption of nontradables in terms of tradable goods.

2. Equilibrium is attained in the external sector, which implies that the current

account is in balance, i.e., $CA = 0$ or $Q_T(e) - C_T(e,a) - G_T = 0$ or $Q_T = C_T(e,a) + G_T$, where there is neither overproduction nor underproduction in the tradables market or, in other words, whatever is produced of tradables is either consumed by the private consumers or by the government sector. It also implies that $R^{\cdot} = 0$ since $R^{\cdot} = CA$. Finally, equilibrium in the external sector implies that $R^{\cdot} = 0 = CA = m^{\cdot}$. In terms of verbal expressions, it can be stated that an equilibrium in the external sector neither necessitates an accumulation nor a decumulation of internal reserves, and, in the absence of a domestic credit creation in a fixed nominal exchange rate for the commercial transactions, it also implies an absence of a positive growth in the domestic real money.

3. The third condition of a long-run sustainable equilibrium requires that domestic fiscal policy be consistent with the existing exchange rate regime, so it happens to be sustainable in the long run. In the present model, it implies that the total government consumption expenditure will be wholly financed by the nondistortionary taxes and, consequently, the growth rate of domestic credit turns to be zero. In terms of notations used in this model, it can be restated as follows:

(28) $$G = t \text{ and } D^{\cdot} = 0.$$

4. Condition four requires that equilibrium holds true in the portfolio decision making.

Finally, the long-run equilibrium real exchange rate is defined to be that particular real exchange rate which prevails under the above-mentioned steady state

conditions. However, Edwards [1991] derived the following equilibrium relation between the real exchange rate (e), total real assets in terms of tradables (a), and the real government consumption of nontradables (g_N).

(29) $$e = v(a, g_N),$$

where $\frac{\partial v}{\partial a} < 0$, $\frac{\partial v}{\partial g_N} < 0$.

The above expression suggests that the real exchange rate has a negative relationship with respect to the total real assets and the government consumption of nontradables, while both of the latter terms have been expressed in terms of tradables. More precisely, equation (29) denotes that an increase in the total real assets will also enhance the real income of the consumers, leading them to spend a higher proportion of that on nontradables given that they have a higher propensity to consume these goods than the tradables. As they increase their consumption of nontradables, the relative price of these goods increases or, in other words, the RER falls more than previously to maintain the overall equilibrium in the economy. On the other hand, a higher consumption of nontradables by the government sector will raise the relative price of these goods or, in other words, it causes an appreciation of the RER. However, it should be noted that equation (29) refers to the RER required to attain the equilibrium in the nontradables sector without any reference to the external sector. But in order to deduce the long-run equilibrium RER, we have to consider the balance in the current account and equilibrium in the balance of payments as well.

Equation (14) denotes the desired demand for domestic and foreign real money, both expressed in terms of tradables. However, since the foreign exchange rate relevant

to the commercial transactions (E) is predetermined, it can be assumed to be a fixed entity and, consequently, the term $\frac{\dot{\delta}}{\delta}$ can be replaced by $\frac{\dot{\rho}}{\rho}$ in the money demand equation as follows, where $\rho = \frac{\delta}{E}$,

(30) $$\frac{m}{\rho F} = \sigma \frac{\dot{\delta}}{\delta} \text{ or } \frac{m}{\rho F} = \frac{\dot{\rho}}{\rho}$$

where $\frac{\dot{\rho}}{\rho} = \frac{\dot{\delta}}{\delta}$.

However, it should be remembered that $\rho = \frac{\delta}{E}$ is equal to the spread between the foreign exchange rates relevant to the financial and commercial transactions, respectively. Now, inverting the above equation and solving for $\dot{\rho}$, we get the following equation:

(31) $$\dot{\rho} = \rho L\left(\frac{m}{\rho F}\right)$$

where $L'\left(\frac{1}{\sigma}\right) < 0$, since $\sigma' < 0$.

According to Edwards [1991], in order to attain a steady-state equilibrium in this hypothetical small open economy, it is required that the growth rate of the spread between the officially determined commercial exchange rate (E) and the free market determined capital account exchange rate (δ) be zero, i.e., $\dot{\rho} = 0$. However, the $\dot{\rho} = 0$ schedule is expected to be upward sloping in nature, since in order for the public to hold a higher proportion of domestic real money, the spread between the fixed and free rates should be growing at a higher rate, i.e., the higher the growth rate of the spread between the free and fixed rates, the lower will be the public expectation that it will grow further in the future. Consequently, they will tend to hold a higher proportion of domestic real money in their portfolio. Now, with the help of equations (21), (23), (24), (25), and

(26), an equation describing the behavior of the growth rate of the real money (m) can be deduced as follows:

$$
\begin{aligned}
& M^{\cdot} = D^{\cdot} + ER^{\cdot} \\
\text{or } & M^{\cdot} = D^{\cdot} + E\left[Q_T(e) - C_T(e,a) - G_T\right] \\
\text{or } & \frac{M^{\cdot}}{E} = \frac{D^{\cdot}}{E} + Q_T(e) - C_T(e,a) - G_T \\
\text{or } & m^{\cdot} = Q_T(e) - C_T(e,a) - G_T + \frac{G-t}{E} \\
\text{or } & m^{\cdot} = Q_T(e) - C_T(e,a) + g - g_T - \frac{t}{E} \\
\text{or } & m^{\cdot} = Q_T(e) - C_T(e,a) + g_N - \frac{t}{E} \\
\text{or } & m^{\cdot} = Q_T(e) - C_T(e,a) + \frac{G_N}{e} - \frac{t}{E}.
\end{aligned}
\tag{32}
$$

Equation (31) depicts the portfolio equilibrium condition since it determines the public portfolio decision making. More precisely, the schedule $\rho^{\cdot} = 0$ stands for the portfolio equilibrium condition. On the other hand, the external sector equilibrium is attained when $m^{\cdot} = 0$. The rationale behind this assertion can be described as follows.

Equilibrium in the external sector implies that the current account balance is equal to zero, i.e., $CA = 0$, and since the only way there can be an accumulation in the stock of international reserve money is through a positive balance in the current account, an equilibrium in the current account obviously implies a zero accumulation of the international reserve money, i.e., $CA = R^{\cdot} = 0$. On the other hand, a steady-state long-run equilibrium of this system implies that the government expenditure is wholly financed by the extraction of nondistortionary taxes (t), i.e., $G = t$ or $D^{\cdot} = 0$. Now, substituting $D^{\cdot} = R^{\cdot} = 0$ in equation (26), we get $M^{\cdot} = 0$ or $m^{\cdot} = 0$, since E (exchange rate relevant to the commercial transactions) is fixed. Therefore, a steady-state long-run

equilibrium of this hypothetical economy also requires that $\dot{m} = 0$. The $\dot{m} = 0$ schedule is downward sloping, implying that a higher level of domestic real money (m) will increase the total real assets, which, in turn, enhances the real income of those consumers who spend more on the nontradables, a situation that subsequently leads to a higher relative price of these goods, i.e., $\uparrow m \Rightarrow \uparrow a = (m + \rho F) \Rightarrow \downarrow CA$. In order to regain equilibrium in the current account, the real wealth (a) should go down via a decline in δ (free market financial exchange rate). The overall long-run sustainable equilibrium of this system is attained through an intersection of $\dot{m} = \dot{R} = 0$ and $\dot{\rho} = 0$ schedules. The former one depicts the external sector equilibrium with a sustainable fiscal policy, and the latter one describes the portfolio equilibrium. However, the long-run sustainable equilibrium implies a steady state of initial real balance (m_0) along with a steady-state initial spread between the fixed and free rate (ρ_0). Given the steady-state initial level of government consumption of nontradables, i.e., g_{N_0}, the steady-state equilibrium values of ρ and m can be utilized to obtain the long-run sustainable equilibrium RER, i.e., $e_{LR} = v\left(m_0 + \rho_0 F_0,\ g_{N_0}\right)$. On the other hand, it should also be recognized that changes in the fundamental real determinants of the RER will also change the long-run equilibrium RER. For instance, a change in the proportion of nominal government expenditure on the tradables, i.e., an increase in $\lambda = \frac{EG_T}{G}$, will also increase the tradables relative price, i.e., an increase in $e = \frac{E}{P_N}$ will take place, provided that the total amount of nominal government expenditure remains the same and the increase in the government consumption of tradables takes place at the cost of its lower level of consumption of the nontradables. This decline in

the RER will be described as an equilibrium real depreciation. The new steady-state equilibrium condition is characterized by a decline in the real money balance and the free market financial nominal exchange rate.

VII. RER Misalignment and Expansionary Macroeconomic Policy

As mentioned before, equations (31) and (32) describe the portfolio and external sector equilibrium conditions, respectively. Now, let us consider how the monetary disturbances will cause a misalignment in the RER and affect the external sector. More precisely, we would like to investigate in which way the monetary disturbances will affect the actual RER in contrast to the equilibrium RER. The most simple way of examining the working mechanism of the model under this situation is to consider a once and for all increase in the domestic credit (D), as shown below. Since

$$
\begin{aligned}
M^{\cdot} &= D^{\cdot} + ER^{\cdot} \\
\text{or } \int M^{\cdot} &= \int D^{\cdot} + E\int R^{\cdot} \\
\text{or } M &= D + ER \\
\text{or } \frac{M}{E} &= \frac{D}{E} + R,
\end{aligned}
\tag{33}
$$

or $m = \frac{D}{E} + R$. Hence, $\uparrow D \Rightarrow \uparrow m$, i.e., the domestic real money balance increases as more domestic credit has been created by the government. On the other hand, the spread between the free market financial exchange rate and the predetermined commercial exchange rate, i.e., $\rho = \frac{\delta}{E}$, has to be increased in order to induce the public to hold a higher volume of domestic real money balance. From equation (13) we know that as $m\uparrow$ and $\rho\uparrow$, $a\uparrow$, since $a = m + \rho F$. Consequently, as the total real wealth increases, so does the people's real income, and since $C_N = C_N(e, a)$,

$\frac{\partial C_N}{\partial A} > 0$, and $\frac{\partial C_N}{\partial e} > 0$, there arises an excess demand for nontradable goods, driving up the relative price of these goods or causing a decline in the RER in order to reestablish the equilibrium in the nontradables market. Now, from equation (29) we know that $e = v(a, g_N)$ where $\frac{\partial v}{\partial a} < 0$ and $\frac{\partial v}{\partial g_N} < 0$. It has been derived from equation (27), and it describes an equilibrium relationship between (e), (a), and (g_N). Now, by taking the total derivative of equation (29) we end up with the following expression:

(34) $$de = \left[\left(\frac{\partial v}{\partial a}\right) dm + \left(\frac{\partial v}{\partial a}\right) F_0 d\rho\right] < 0, \text{ since } a = m + \rho F_0.$$

Equation (34) states that starting from an initial equilibrium position, an increase in the total real wealth (a) initiated by an increase in the public holding of the real money balance (m) and the spread between the free and the fixed rate (ρ) will cause an appreciation of the actual RER vis-à-vis the long-run equilibrium RER, which, in other words, may be called the overvaluation of RER or the misalignment of RER. Obviously, in order to come true, this short-run appreciation of the actual RER should experience an appreciation of the free financial exchange rate, i.e., $\frac{\delta}{\delta} < 0$. However, in the presence of a sufficient central bank possession of international reserve, this discrepancy between the actual and the long-run equilibrium RER , i.e., RER overvaluation will be short lived.

VIII. The Adjustment of the Actual RER Towards Its Long-Run Equilibrium Level

Henceforth, it has been observed that how an expansionary government

macroeconomic policy initiated by a once-and-for-all increase in the domestic credit component of the money supply results in an increase in the domestic real money balance (m), the spread ($\rho = \frac{\delta}{E}$), and the total real wealth ($a = m + \rho F$), and subsequently results in an overvaluation of the actual RER. However, if the system is left on its own, it will go back to its initial position and the actual RER will coincide to its long-run equilibrium level, provided that the central bank has a sufficient stock of international reserve. The adjustment process is initiated by an excess supply of domestic real money balance, and, as the public wants to get rid of this excess domestic money balance, they will transform their excess domestic currency denominated financial assets into the foreign currency denominated ones and, consequently, the government confronts a loss of international reserve as this transformation in the public portfolio position goes on. During this adjustment process, the domestic money balance (m) goes down and so does the spread between the free market and the predetermined nominal exchange rate ($\rho = \frac{\delta}{E}$), since, as the public wants to get rid of the domestic real money balance, it is obvious for them to expect a depreciation of the free rate in the current period.

Consequently, as the domestic real money balance and the spread between the free and the predetermined rate decline, so do the total real assets, and, since the nontradables demand depends on the total real assets, the demand for these goods goes down too, which in turn gives rise to an excess supply of nontradables. Finally, the relative price of nontradables goes down or a depreciation of the actual RER takes place. However, during this adjustment process, the government will lose its

international reserve and the actual RER will depreciate until it gets back to its long-run equilibrium level. When the actual RER gets back to its long-run equilibrium level, (e), (ρ), and (m) will be the same as they were before the domestic credit expansion. The new composition of domestic nominal money will include a higher level of domestic credit component (D) and a lower level of international reserve component (R), since $\frac{M}{E} = \frac{D}{E} + R$. The time of this adjustment process from a short-run appreciation of the actual RER to a depreciation and its subsequent retreat to its initial long-run equilibrium level will depend on whether the government has undertaken a counter RER misalignment measure or not. If the government undertakes a right amount of nominal devaluation of the predetermined commercial exchange rate, while the system is out of equilibrium, then the real money balance, i.e., $m = \frac{M}{E}$, will go down and, consequently, total real assets (a), nontradables demand (C_N), and relative price of nontradables ($e = \frac{E}{P_N}$) will go down, too, i.e., a depreciation of the actual RER takes place. Hence, the government can prevent the loss of international reserve if it undertakes a right amount of nominal devaluation of the commercial exchange rate in order to counter the effects of an initial expansion of domestic credit. Even under the automatic macroeconomic adjustment process, the government executes a discrete nominal devaluation of the predetermined nominal exchange rate when the reserve position approaches a particular threshold level. Finally, we can enumerate three possible phenomena before the nominal devaluation comes true. First, the actual RER gets appreciated vis-à-vis its long-run equilibrium level. Second, a loss of international reserve takes place. Third, an increase occurs in the dual market spread, i.e., ($\rho = \frac{\delta}{E}$).

CHAPTER 5

EMPIRICAL RESULTS

I. Purchasing Power Parity Measure of RER Misalignment

Recently, an inflation-adjusted exchange rate, more precisely known as the RER, is getting more attention in research works. There are many alternative definitions of RER. In this study, two closely related definitions of RER are used to analyze the evolution of RER misalignment in Bangladesh during the period under study, i.e., 1976-1991. In accordance with one of these definitions, the RER is equal to the nominal exchange rate (E) corrected or adjusted by the ratio of foreign price level (P^*) to the domestic price level (P). This definition has often been called the PPP-adjusted nominal exchange rate or, in other words, PPP real exchange rate, i.e., $RER_{PPP} = \frac{EP^*}{P}$. Since the United States is the largest trading partner of Bangladesh, and the Bangladesh taka is pegged to the U.S. dollar since 1983, thus in order to construct the PPP-adjusted time series of the RER of Bangladesh, the bilateral nominal exchange rate of Bangladesh taka, with respect to the U.S. dollar, is corrected or multiplied by the ratio U.S. price level to the domestic price level of Bangladesh. However, we need to use an operational counterpart of this theoretical construct in order to compute the RER time series of taka. Consumer price indexes of the United States and Bangladesh are used in this context.

Therefore,

(35) $$RER = \frac{E\,CPI_{U.S.}}{CPI_{BD}},$$

where E = bilateral nominal exchange rate of Bangladesh taka in terms of the U.S. dollar; $CPI_{U.S.}$ = consumer price index of the United States; and CPI_{BD} = consumer price index of Bangladesh.

This particular definition of RER also may be called the BRER of Bangladesh taka. In this study, three particular measures are used to identify the RER misalignment of Bangladesh taka. The first one utilizes the PPP theory of RER to indicate the RER misalignment, and it has been defined in the following way:

$$RERMIS_{PP_t} = \frac{\frac{\Sigma_j \max RER_j}{3}}{RER_t} - 1, \tag{36}$$

where $\frac{\Sigma_j \max RER_j}{3}$ $(j = 1,2,3)$ stands for the average of the three highest values of the observed RER_{PPP} of Bangladesh taka over the period 1976-1991.

This measure of RER misalignment is constructed on the basis of the deviation of observed RER_{PPP} from some particular base year when the RER is supposed to be in equilibrium. This chapter uses a procedure adopted by the work of Ghura and Grennes [1993]. Following Cottani et al. [1990], Ghura and Grennes used the average of the three highest values of the observed RER over the period 1976-1991 as a proxy of the equilibrium RER. However, according to this procedure, the RER misalignment is indicated by the deviation of the observed RER from the equilibrium RER, and, in terms of this measure of RER misalignment, it is signified by a decrease in its value. The major demerit of this procedure lies in the fact that it cannot distinguish the short-run monetary variables from the long-run real variables that might affect the long-run RER and, consequently, it might eventually end up with an erroneous

conclusion regarding the RER misalignment. It needs to be mentioned that the long-run real variables, which are frequently referred to as the RER fundamentals, include terms of trade, capital inflow, technological condition, and trade policies.

Figure III is a graphical counterpart of the $RERMIS_{PPP}$ schedule. It signifies that the RER_{PPP} remained misaligned in 1977 and onwards. The extent of RER misalignment attained its peak in 1977, started recovering until 1985, then got worse again. However, it attained its lowest level in 1985.

The second measure of the RER misalignment is suggested by Edwards [1991] in a remarkable study on the misalignment of real exchange rate in the less-developed countries. According to this procedure, four alternative measures of RER indexes have

FIGURE 3. RERMISPP = PURCHASING POWER PARITY MEASURE OF THE RER MISALIGNMENT.

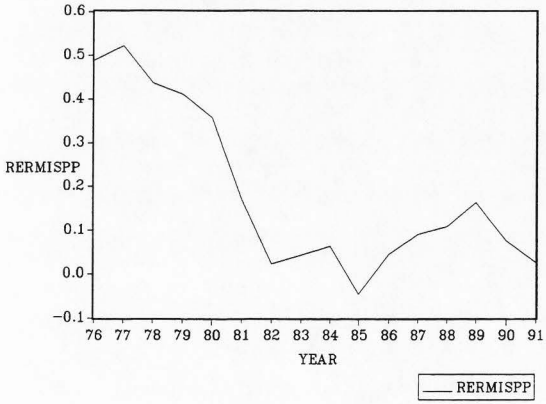

FIGURE III
Purchasing Power Parity Measure of the RER Misalignment

been computed first. RER is defined as the domestic price of tradable goods relative to the domestic price of nontradable goods. However, the computed series of the RER of Bangladesh is also indexed to a base year (1980), which facilitates identifying whether the RER of a particular year gets appreciated or not, relative to the base year. The base year has been selected on the basis of the fact that the RER has attained its maximum value in the year 1980, and thereby it may be used as a proxy of the equilibrium RER. As a result, a fall in the absolute value of the observed RER index compared to its value in the base year indicates a real appreciation, and a rise in the absolute value of the observed RER index compared to its value in the base year reflects a real depreciation. Table I compiles the computed multilateral RER index 1 of Bangladesh taka for the period 1976-1991. Considering the significance of a broad multilateral index of RER in explaining the policy-related issues that can affect the competitiveness of the external sector of an economy, one of the two computed indexes of the multilateral exchange rate indexes will be used in exploring the RER misalignment in the Bangladesh economy. However, since many researchers (Balassa [1990], Cottani et al. [1990], Edwards [1988b, c, 1991]) suggested that the wholesale price index is highly influenced by the tradable goods' prices, the consumer price index is significantly affected by the nontradables' prices, and the MRER1 index incorporates both of these two indexes; hence, the MRER1 index will be used in the empirical analysis to investigate the evolution of RER misalignment in the Bangladesh economy.

Table I shows the actual or observed MRER1 index, which is computed using the trade weights (α_i), official nominal exchange rate (E_i), and the relative price ratio of

TABLE I
MULTILATERAL REAL EXCHANGE RATE INDEX (MRER1)

Year	MRER1 Index (Base 1980 = 100)
1976	64.09791
1977	60.66788
1978	81.41432
1979	85.23723
1980	100.0000
1981	98.54941
1982	99.38048
1983	95.17981
1984	81.00635
1985	97.24992
1986	80.43215
1987	85.79631
1988	79.29888
1989	68.93321
1990	89.28679
1991	82.48716

tradables to nontradable goods ($\frac{P_T^*}{P_N}$). However, there are other measures of RER. Following Edwards [1991], the measures of MRER and BRER are computed in Table II. Table III compiles the indexes of the MRER2, BRER1, BRER2, and black market real exchange rate 1 (BMRER1).

In Table III, various measures of RER indexes have been compiled and the base year in each series of RER is selected by picking up the year when the RER measure in question attained its highest value, and, consequently, it is assumed that it stands as a proxy of the true equilibrium RER. The reason behind picking up the highest value of the RER series in question as a proxy of the true equilibrium lies in the fact that a fall in the RER index indicates a RER appreciation, and a rise in the same reflects a RER

TABLE II

THEORETICAL CONSTRUCTS AND CORRESPONDING EMPIRICAL FORMULAE FOR THE MRER AND BRER INDEXES

Theoretical Constructs	Formulae Used for Empirical Measurements
$MRER = \frac{\Sigma \alpha_i E_{it} P^*_{it}}{P_{jt}}$	$MRER1 = \frac{\Sigma \alpha_i E_{it} WPI_i}{CPI_{BD}}$
	$MRER2 = \frac{\Sigma \alpha_i E_{it} CPI_i}{CPI_{BD}}$
$BRER = \frac{E_{it} P^*_T}{P_N}$	$BRER1 = \frac{E_{it} WPI_{US}}{CPI_{BD}}$, $BRER2 = \frac{E_{it} CPI_{US}}{CPI_{BD}}$
$BMRER = \frac{BME_{it} P^*_T}{P_N}$	$BMRER1 = \frac{BME_{it} WPI_{US}}{CPI_{BD}}$

where $\alpha_i = \frac{X_i + M_i}{X + M}$ is trade weight assigned to the ith trading partner of Bangladesh; X_i and M_i are the values of exports to and imports from the ith trading partner of Bangladesh; X and M stand for the values of total exports and imports of Bangladesh, respectively, both measured in millions of U.S. dollars; E_{it} is the index of the nominal official exchange rate of Bangladesh taka in terms of the foreign currency in question—in the cases of MRER and BRER, it denotes the nominal official exchange rate of Bangladesh taka in terms of U.S. dollars in period t; P^*_{it} is price index of the ith trading partner of Bangladesh in period t, the empirical counterpart of which is the WPI of the ith trading partner in the case of MRER1, and the CPI of the ith trading partner of Bangladesh in the case of MRER2; and P_{jt} is the price index of Bangladesh in period t, the empirical counterpart of which is the CPI of Bangladesh in period t.

TABLE III
ESTIMATED MULTILATERAL AND BILATERAL RER INDEXES OF DIFFERENT CATEGORIES

Year	MRER2 Index Base (1983 = 100)	BRER1 Index Base (1982 = 100)	BRER2 Index Base (1985 = 100)	BMRER1 Index Base (1988 = 100)
1976	55.13381	71.34074	64.11290	36.18542
1977	52.67613	69.53473	62.69677	40.73912
1978	70.38504	73.68792	66.34839	57.42931
1979	73.08848	75.83336	67.58065	62.22274
1980	81.23976	79.24045	70.20323	56.90505
1981	76.26980	90.92830	81.47419	53.41892
1982	82.34571	100.0000	93.25161	47.32827
1983	100.0000	96.12219	91.40323	45.46422
1984	71.36810	92.66067	89.72258	43.61137
1985	87.87548	99.26671	100.0000	72.22073
1986	78.03113	86.27558	91.20968	84.84339
1987	84.06608	81.91425	87.48387	90.16669
1988	79.05516	80.56934	86.01613	100.0000
1989	69.01966	76.84524	81.96774	80.53390
1990	89.54123	81.69650	88.65161	82.72841
1991	86.23703	82.28570	92.95484	82.32289

depreciation. In other words, provided that there is no change in the RER fundamental real variables, this appreciation of the observed RER reflects a RER overvaluation or RER misalignment. On the basis of this argument, it is assumed that in a year, when the observed value of the RER measure in question attains its highest value, it can represent a proxy of the true equilibrium RER. However, the indexes of various measures of RER have been computed with respect to their values in their respective base years. It needs to be mentioned that RER is defined as the domestic relative price of tradables to nontradables goods, i.e., $RER = \frac{EP_T^*}{P_N}$ and it is not possible to find an empirical

counterpart of this theoretical definition; hence P_T^* (world price of tradables) is proxied by the WPI of the trading partners of Bangladesh. Since WPIs contain mainly the tradable goods, they provide a reasonable proxy for P_T^* [Harberger 1986]. On the other hand, since CPIs are heavily influenced by the nontradables goods and activities, they stand as the reasonable proxies for P_N.

II. Graphical Representation of the Evolution of Multilateral and Bilateral RER Indexes

Figure IV shows the behavior of BRER1 and MRER1 indexes of Bangladesh during the whole period of study, i.e., 1976-1991. As mentioned before, a rise in the value of the RER index in question reflects a depreciation, and a fall in its value indicates an appreciation of the RER. However, it can be observed that both indexes move almost in the same direction. Starting from 1976, the BRER1 index appreciates until 1977, as does the MRER1 index, although the BRER1 was above its multilateral counterpart, i.e., MRER1 appreciated more than the BRER1 during this period. However, BRER1 starts depreciating from 1977 onward and so does the MRER1 until 1980, after which MRER1 starts appreciating. But BRER1 is still depreciated, although MRER1 is far more depreciated than BRER1 during this period. However, BRER1 starts appreciating after 1982 and then depreciating again starting after 1984. On the other hand, the MRER1 index starts appreciating from 1980 until 1984 and then it starts depreciating just like BRER1. But one thing comes out from the visual inspection of both Figures IV and V and that is both BRER1 and BRER2 indexes remain above their

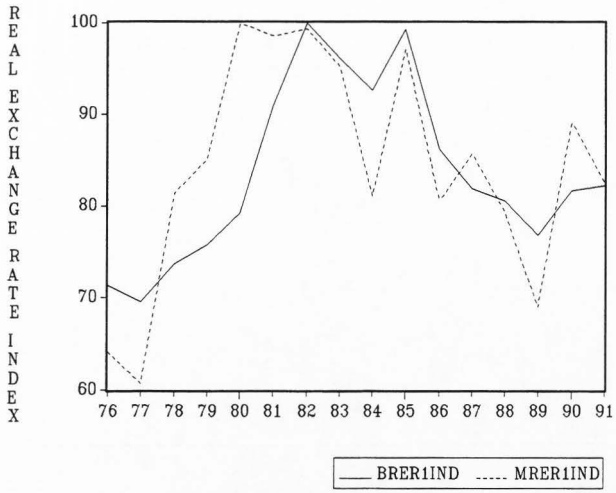

FIGURE IV
BRER1 Index and MRER1 Index

remain above their multilateral counterparts except between mid-1986 to mid-1987 and from mid-1989 to 1991. However, it also can be observed that the BRER2 index is above the MRER2 index starting from 1983 until 1991, except 1990. It needs to be mentioned that the currency of reference of Bangladesh taka has been changed from the pound sterling to the U.S. dollar in 1983. Since the U.S. dollar experienced a steep appreciation against other currencies for most of the 1980s, the BRER indexes, i.e., both BRER1 and BRER2, were above their multilateral counterparts during this period of study. Table IV compiles the computed coefficients of correlation between the alternative measures of RER indexes that are computed on the basis of nominal official

FIGURE V
BRER2 Index and MRER2 Index

exchange rates using the annual data. Some salient features of the alternative measures of the RER indexes have been revealed.

First, the two alternative measures of BRER indexes exhibit a tendency of moving together, which is supported by their high degree of correlation, i.e., the computed coefficient of correlation between LOG(BRER1) and LOG(BRER2) is more than 0.83. Second, the two alternative measures of MRER indexes also show a high degree of positive correlation, i.e., the computed coefficient of correlation between LOG(MRER1) and LOG(MRER2) exceeds 0.82. Third, different measures of the computed indexes of BRER and MRER have shown a lower degree of tendency of moving together. For instance, the computed coefficient of correlation between

TABLE IV
COEFFICIENTS OF CORRELATION BETWEEN THE ALTERNATIVE MEASURES OF RER INDEXES

Series of the Log of RER	Coefficients of Correlation
LOG(BRER1), LOG(BRER2)	0.8321635
LOG(MRER1), LOG(MRER2)	0.8263887
LOG(BRER1), LOG(MRER1)	0.7380782
LOG(BRER2), LOG(MRER2)	0.7641684

LOG(BRER1) and LOG(MRER1) appears to be a little more than 0.73, while, on the other hand, the computed coefficient of correlation between LOG(BRER2) and LOG(MRER2) is 0.76. It should be mentioned that a specific measure of the RER index in a particular category, whether bilateral or multilateral, differs from its variant due to different kinds of price indexes used in their construction. For instance, BRER1 and BRER2 differ since the wholesale price index of the United States is used to construct the former while the LOG(MRER2) is 0.76. It should be mentioned that a specific measure of the RER index in a particular category, whether bilateral or multilateral, differs from its variant due to different kinds of price indexes used in their construction. For instance, BRER1 and BRER2 differ since the wholesale price index of the United States is used to construct the former, while the consumer price index of the United States is used to construct the latter. On the other hand, in the case of MRER1 and MRER2, the difference comes out because the wholesale price index of the

ith major trading partner is used to construct the former, and the CPI of the ith major trading partner is used to construct the latter. Therefore, it can be concluded that choosing the price indexes in constructing a specific measure of RER index under a particular category is not a significant empirical problem. It matters little if BRER1 is used in the empirical analysis instead of BRER2 or if MRER1 is used instead of MRER2 since BRER1 shows a high degree of correlation with BRER2, and MRER1 shows a high degree of correlation with MRER2. It is also apparent from the following graphs.

Figure VI shows that the BRER1 index almost moves together with the BRER2 index and even coincides with the latter in the year 1985. As a result, either of them can be used to explain the RER behavior in Bangladesh. But the BRER2 index proves to be the one that is most widely used in explaining the policy-related issues. Moreover, it is also used as a measure of the PPP version of the RER index.

On the other hand, Figure VII shows that the MRER1 index also moves together with the MRER2 index and even coincides with the latter in several occasions. Hence, either of them can be used to explain the RER behavior of Bangladesh. But the MRER1 index involves the wholesale price index of the major trading partners of Bangladesh, and the extent to which it is influenced by the tradable goods' prices helps it stand as a good proxy of the tradable goods price. Consequently, it stands as a better alternative to the MRER2 index as it reflects the theoretical definition of RER more proficiently than the former. Now, considering the significance of a broad multilateral RER index in explaining the competitiveness of the external trading sector, the MRER1

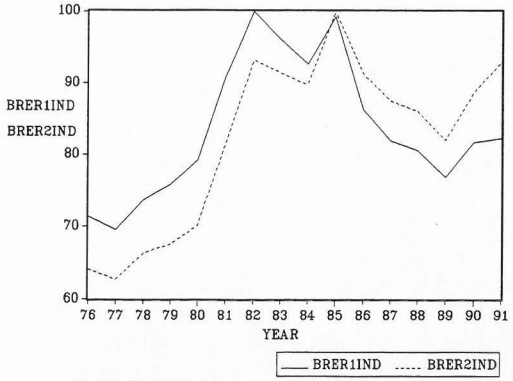

FIGURE VI
BRER1 Index and BRER2 Index

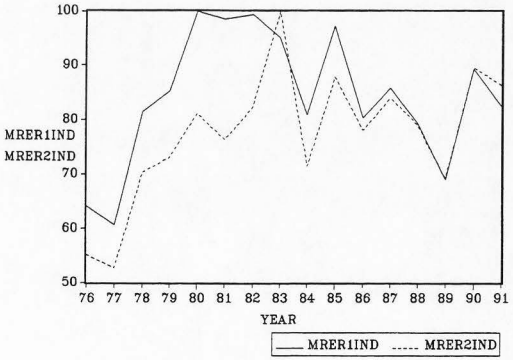

FIGURE VII
MRER1 Index and MRER2 Index

index is used to analyze the evolution of RER and the effects of its misalignment on the macroeconomic performance of Bangladesh. However, it should also be noted that although the alternative measures of MRER show a tendency of moving together, nevertheless they have a little similarity with their bilateral counterparts. Consequently, if someone even gets tempted to explain the competitiveness of the external trading sector with the aid of BRER indexes, he should be very cautious about this as the explanation might end up with inaccurate conclusions regarding the competitiveness of the external trading sector of domestic economy [Edwards 1991, p. 100]. Finally, the merit of using the MRER1 index in the present study lies in the fact that it involves the trade weights, which are computed by using the trade shares of Bangladesh with its major trading partners in its total annual volume of trade. The construction of MRER2 index also involves the task of computing the trade weights; nevertheless, the MRER1 index more closely reflects the theoretical definition of the RER.

III. Basic Statistical Properties of the MRER1 Index of RER

Table V compiles the major statistical properties of the MRER1 index of Bangladesh. However, for the convenience of explaining the RER behavior from the perspective of decisive changes in the domestic and international financial arena, three different time periods are identified: 1976-1991 (the whole period of study), 1976-1983 (a major nominal devaluation took place in 1975 and the currency of reference of Bangladesh taka was changed from pound sterling to the U.S. dollar in 1983), and 1984-1991 (a period when various unprecedented trade-liberalizing enactments were issued).

It can be observed from Table V that the difference between the maximum and the minimum values of the computed series of MRER1 index varies during the three different periods in question. The difference between the maximum and the minimum values of the computed or observed series of the MRER1 index signifies the volatility of RER over time [Edwards 1991, p. 100]. Consequently, it is apparent that the extent of volatility or variability of the MRER1 index differs during the three stated periods in question. The difference between the maximum and the minimum values of the MRER1 index is 39.33212 during the whole period of study, i.e., 1976-1991.

On the other hand, the difference between the maximum and the minimum values of the MRER1 index over the period 1976-1983 appears to be also 39.33212, and, during this period, the currency of reference of Bangladesh taka has been changed from the British pound sterling to the U.S. dollar and a major nominal devaluation took place in the preceding year (1975). Finally, the difference between the maximum and the minimum values of the MRER1 index over the period 1984-1991 is 28.31671 and during this period, various trade-liberalizing measures were undertaken. One important

TABLE V
GENERAL STATISTICAL PROPERTIES OF THE MRER1 INDEX IN DIFFERENT TIME PERIODS UNDER CONSIDERATION

Period	Mean	S.D.	Cff. of Var.	Maximum	Minimum
1976-1991	84.313613	12.264264	141.01141	100.00000	60.667880
1976-1983	85.565879	15.848904	219.78927	100.00000	60.667880
1984-1991	83.061347	8.2182513	59.097197	97.249920	68.933210

Note: S.D. = standard deviation; Cff. of Var. = coefficient of variation.

conclusion can be reached from this observation, which is that the volatility of the MRER1 index over the whole period of study is the same as it is during the period when the currency of reference for the domestic currency is changed from pound sterling to the U.S. dollar (1976-1983), whereas a major nominal devaluation took place just a year ago (1975). It implies that the variability of the RER index in question for the whole period of study is dictated by its variability under the period 1976-1983, i.e., the change in the currency of reference from one internationally powerful country to another and the incidence of a major nominal devaluation have a significant impact on the multilateral RER variability over time. Finally, it can also be deduced that the enactment of various trade-liberalizing policies during the period 1984-1991 has a lower extent of impact on the variability of the MRER1 index than the occurrences like a nominal devaluation in 1975 and a change in the currency of reference from the British pound sterling to the U.S. dollar in 1983. The same conclusion can also be reached by observing the computed coefficients of variation for the three different periods in question, which is 219.78927 over 1976-1983, 141.01141 during 1976-1991, and 59.097197 during 1984-1991. Clearly, again the variability of the MRER1 index for the overall period of study is dictated by its variability prevailing during 1976-1983, whereas it seems comparatively low during 1984-1991, i.e., the trade-liberalizing policies have a lower extent of impact on the RER variability in question.

Table VI compiles the estimates of the trend coefficients of the multilateral real exchange rate index MRER1. As before, trend regressions are estimated for the three periods 1976-1991, 1976-1983, and 1984-1991.

TABLE VI
ESTIMATED TREND COEFFICIENTS OF THE MRER1 INDEX IN DIFFERENT TIME PERIODS UNDER CONSIDERATION

Period	Estimated Trend Coefficients
1976-1991	-0.6947248 (-0.5384058)
1976-1983	4.6531547 (1.2895425)
1984-1991	-1.4441490 (-1.1733809)

Cochrane-Orcutt's [Lilien 1989] estimation procedure is adopted to estimate the trend coefficients of the MRER1 index due to a high degree of autocorrelation among the current and lagged values of the stochastic disturbance terms [Gujarati 1988, pp. 383-4]. As before, the observed series of the MRER1 index has been decomposed into three different categories according to three different periods identified by the various changes in the domestic financial arena. As can be seen from Table VI, neither of the trend coefficients is significant at a high level of significance (even at the 10 percent level of significance) for the three different periods in question. However, the negative sign of the estimated trend coefficient for the overall period of study (1976-1991) indicates a weak tendency of the RER appreciation as the absolute value of the estimated trend coefficient for the MRER1 index is not large enough. On the other hand, a negative sign is also attained for the estimated trend coefficient for the period (1984-1991), which might be the impact of various trade-liberalization policies undertaken during this time. But the positive sign of the estimated trend coefficient for the period (1976-1983) indicates a strong tendency of real depreciation of the MRER1

index since the absolute value of the estimated trend coefficient for this period is large enough to support this finding (although it is not significant at the required level of significance). The reason for real depreciation of the MRER1 index during this period can be explained with the aid of two opposing forces for the real depreciation. As mentioned before, a major nominal devaluation of Bangladesh taka took place in 1975 and the currency of reference was changed from the British pound sterling to the U.S. dollar in 1983. It should be mentioned that a nominal devaluation results in a depreciation of the RER and nominal appreciation ends up with a real appreciation as the nominal exchange rate of Bangladesh taka is expressed as the value of the major trading partners' currency in terms of taka. Also, the U.S. dollar experienced a nominal appreciation against other major currencies of the world during the 1980s, and, since taka was pegged to the dollar in 1983, it was also appreciated against the currencies of the major trading partners of Bangladesh. However, the reasons behind this behavior of the RER will be explained in detail later in the theoretical discussion of the equilibrium RER determination mechanism. The RER depreciation during the period (1976-1983) might have taken place as a result of a higher relative strength of the lagged or "trickle down" effect of the nominal devaluation in 1975 on the series of RER during the same period (1976-1983) vis-à-vis the lower relative strength of nominal appreciation that took place in 1983. But it should be remembered that the estimated trend regressions of the MRER1 index for the periods in question are incapable of capturing the forces for explaining the misalignment of the real exchange rate of a country [Edwards 1991, p. 105].

IV. Instability Measure of RER Misalignment Based on Edwards's Model

As mentioned before, estimating the extent of RER misalignment is contingent upon the estimation of the long-run equilibrium RER since the term RER misalignment" is defined as the sustained deviation of the actual or observed RER from its long-run equilibrium level [Edwards 1991]. Considering the significance of a broad multilateral RER index in evaluating policy-related issues, either MRER1 or MRER2 can be used. However, in this paper, MRER1 is used to serve this purpose, as it accords more with the theoretical definition of the RER since the WPI of the ith major trading partner of Bangladesh and the CPI of Bangladesh are used to construct this measure of RER. Many researchers (Balassa [1990], Cottani et al. [1990], Edwards [1988b, c, 1991]) have used the WPI of the United States as a proxy for tradables price, i.e., P_T^* and the domestic CPI as a proxy of the nontradables price, i.e., P_N for constructing the bilateral measure of the RER. It is noted that measuring the extent or degree of RER misalignment appears to be one of the most significant recent academic issues. Understanding the RER misalignment depends on the identification of the determinants of actual and long-run equilibrium RER. While the actual RER is influenced both by monetary and real variables, the long-run equilibrium RER, on the other hand, depends on the real variables only and these are called the RER fundamentals. However, the second measure of RER misalignment is constructed on the basis of a paper by Ghura and Grennes [1993, p. 158]. This measure is named the "instability measure" of RER misalignment. The term "instability" is justified on the grounds that the "misalignment

index" constructed under this measure in fact indicates the instability of the observed RER around its long-run equilibrium level on average. In short, the instability measure of RER misalignment can be represented as follows:

$$(37) \qquad RERMISINSTA_{BD,\,t} = \frac{ERER_{BD,\,t}}{RER_{BD,\,t}} - 1 = \frac{ERER_{BD,\,t} - RER_{BD,\,t}}{RER_{BD,\,t}}$$

where $RERMISINSTA_{BD,\,t}$ = the index of RER misalignment of Bangladesh in period t, $RER_{BD,\,t}$ = the observed value of RER of Bangladesh in period t, and $ERER_{BD,\,t}$ = the estimated value of the long-run equilibrium RER of Bangladesh in period t. The subscript "*BD*" stands for Bangladesh and "*t*" stands for the time period in question. However, in order to estimate the series of long-run equilibrium RER for the period 1976-1991, an equation developed by Edwards [1991, p. 135] is used, which describes the relationship between the long-run equilibrium RER and its fundamental real determinants as follows:

$$(38) \qquad \begin{aligned} \log e_t^{*} &= \alpha_0 + \alpha_1 \log(TOT)_t + \alpha_2 \log(GCN)_t + \alpha_3 \log(CAPCONTROLS)_t \\ &+ \alpha_4 \log(EXCHCONTROLS)_t + \alpha_5 \log(TECHPRO)_t + \alpha_6 \log(INVGDP)_t + u_t \end{aligned}$$

where e^* = the equilibrium RER, TOT = the external terms of trade defined as $(\frac{P_X^*}{P_M^*})$, i.e., the nominal world price of exportables relative to the nominal world price of importables, *GCN* = the government consumption on nontradables, *CAPCONTROLS* = the measure of the extent of government control over capital flows, *EXCHCONTROLS* = the index of the extent of trade restrictions and exchange controls, *TECHPRO* = the measure of the technological progress, *INVGDP* = the ratio of investment to GDP, and u = the stochastic disturbance term.

In order to estimate the above-mentioned equation, time-series data on the relevant fundamental real variables have to be found. However, except for the external *TOT* and the ratio of gross domestic investment to the GDP, i.e., (*INVGDP*), reliable time-series data on the other fundamental real variables are impossible to obtain. Consequently, appropriate proxies are used in place of the fundamental real variables for which time-series data are not available. A bunch of proxy variables are used here as suggested by Edwards [1991], which replaced the actual fundamental real variables mentioned before. The ratio of general government consumption to the GDP (*GCGDP*) is used instead of the government consumption on nontradables (*GCN*). On the other hand, the measure of the extent of government control over the capital flows (*CAPCONTROLS*) is proxied by the lagged ratio of net inflow of long-term capital to GDP. Instead of the index of government controls over the trade and exchange controls (*EXCHCONTROLS*), the percentage of the spread between the black market and the official nominal exchange rate of Bangladesh taka is used. Finally, technological progress (*TECHPRO*) is proxied by the growth rate of the real GDP of Bangladesh.

It needs to be mentioned that in the present study, the trade weighted measure of the RER of Bangladesh taka is used as the dependent variable in order to estimate the time series of long-run equilibrium RER where the WPI of the ith major trading partner stands as a proxy for the world price of tradables (WPI_i) and the CPI of Bangladesh (CPI_{BD}) signifies a proxy for the domestic price of nontradables in the computation of this measure. Obviously, the relevant MRER1IND (multilateral real exchange rate index 1) is indexed to a base year for being used in the regression. Before estimating

the long-run equilibrium RER of Bangladesh taka, the augmented Dickey Fuller (ADF) test is executed to examine whether the dependent variable (MRER1 index) is stationary or not, as the nonstationarity in the dependent variable creates many inferential problems. However, in order to get rid of the nonlinearity problem in the data, the logarithm of all the variables involved in the regression, dependent and independent, is computed first. Hence, the ADF test is executed to the log of MRER1IND series. Table VII is a compilation of the results of the ADF test of the log (*MRER1IND*) series.

From Table VII, we can see that the series MRER1IND proves to be stationary, when the ADF test is undertaken with the appropriate number of lags. Without going

TABLE VII
AUGMENTED DICKEY-FULLER TEST RESULTS FOR THE SERIES OF MRER1 INDEX

Test	Test Results	Corresponding ADF Regression Results: Variable	Corresponding ADF Regression Results: Coefficient	Corresponding ADF Regression Results: "t" Statistic
ADF test UROOT(T,2) Y	Dickey-Fuller "t" statistic = -2.8423 MacKinnon Critical values: 1% = -4.8870 5% = -3.8288 10% = -3.3588	D(Y(-1)) D(Y(-2)) Y(-1) C TREND	-0.1863108 0.0278848 -0.9026974 4.2145356 -0.0173446	-0.7206376 0.0932734 -2.8423254 2.8966804 -1.5656569
ADF test UROOT(T,0) Y	D-F statistic = -4.0331 MacKinnon Critical values: 1% = -4.8025 5% = -3.7921 10% = -3.3393	Y(-1) C TREND	-0.7716749 3.5615770 -0.0116447	-4.0331047 4.1798694 -1.7478962

into the details of intricate econometric theories, which are supposed to determine how many lags to be taken when the ADF test of time-series data is executed, in the present case, a lag of two periods is adopted to run the ADF test of the series MRER1IND as a rule of thumb. Since there are only 16 observations in the series MRER1IND, such an act is not expected to create much of a problem. However, from the first test, the series in question appears to be nonstationary as the computed "t" statistic value falls short of the MacKinnon [Hall et al. 1994] critical values at either the 1 percent, 5 percent, or even 10 percent level of significance. However, the ADF regression results for the first test indicate that the lagged differenced terms can be dropped as they proved to be insignificant and did not contribute anything to the test. Consequently, the ADF test is run again, this time without the lagged differenced terms, and, as a result, the second ADF test indicates that the computed "t" statistic value result by the ADF test exceeds the MacKinnon critical values at the 5 percent and 10 percent levels of significance. The findings of the second ADF test are also supported by the corresponding ADF regression results as the estimated coefficients of the ADF regression appear to be significant. Consequently, the series MRER1IND proves to be stationary. Equation (38) is estimated using the OLS method. The regression results are compiled in Table VIII. In Table VIII, results are compiled of the OLS regression of the log of MRER1IND on the logarithm of other fundamental real variables. Although all of the fundamental real variables are replaced by their appropriate proxy variables except for terms of trade and the ratio of gross domestic investment to the GDP, the original code names are retained in the OLS regression for notational convenience. It should be noted

TABLE VIII

MULTIVARIATE REGRESSION RESULTS FOR THE OLD MODEL DESCRIBED IN EQUATION (25) (DEPENDENT VARIABLE = LOG(MRER1IND) = Y)

Independent Variables	Expected Signs	Estimated Coefficients	
C (the constant term)		5.5667512	(3.2638103)
X1 = log(TOT)	(-)	0.0390823	(0.0854243)
X2 = log(GCN)	(-)	-0.0214154	(-0.2772568)
X3 = log(CAPCONTROLS)	(-)	-0.0387864	(-0.4649575)
X4 = log(EXCHCONTROLS)	(-)	0.0289366	(0.2955284)
X5 = log(TECHPRO)	(-)	0.0936962	(1.7772256)
X6 = log(INVGDP)	(+)	0.8311873	(2.1718760)

R squared = 0.669128
Adjusted R squared = 0.448547
Number of observations = 16
F statistic = 3.033481
Durbin-Watson stat = 1.883895
N.B. = Numbers in parentheses are "t" stats.

that an increase in the ratio of investment to the GDP is expected to result in a depreciation of the long-run equilibrium RER as follows from Balassa's [1964] interpretation of the effects of technological progress on the long-run equilibrium RER, which states that the tradables sector of an economy is expected to be the first recipient of technological progress and, consequently, as the technological progress proceeds, the investment to the GDP ratio goes up and most of this new investment is channeled off to the tradables sector. But due to government protection, these domestic export industries are able to purchase required imported inputs at a subsidized price. As a result, they appear to be cost inefficient, and the domestic prices of these export goods become higher than the world price of the same. Consequently, the domestic relative price of tradables will go up, resulting in a depreciation of equilibrium RER. However,

from Table VIII, it is apparent that three of the estimated coefficients attained their expected signs while the other three did not. The adjusted R-squared value is low enough to ignore this regression. Moreover, most of the estimated coefficients are insignificant. Probably, the autocorrelation problem is responsible for this insignificant regression. Let d, d_U, and d_L be the computed value, the upper limit value, and the lower limit value, respectively, of the Durbin-Watson statistic. For the given number of observations and the number of independent variables, except for the constant term, it was found that $d = 1.8838$, $d_U = 2.388$, and $d_L = 0.502$, where the upper and the lower limit values of the D-W statistic are obtained at the 5 percent level of significance. On the basis of the usual D-W test, a conclusion cannot be reached about the positive or negative autocorrelation since the estimated D-W statistic value lies in the indecisive range. However, on the basis of a modified D-W test [Gujarati 1988, p. 379], we fail to reject the null hypothesis of a significant first-order autocorrelation, positive or negative, since $d < d_U$ and $4 - d < d_U$.

However, since this is an intertemporal dynamic equilibrium model, the lagged values of the relevant RER fundamentals are expected to have significant effects on the equilibrium RER. According to Edwards [1991], the long-run equilibrium RER is significantly affected by the terms of trade prevailing in the previous periods. Moreover, whether the equilibrium RER will appreciate or depreciate as a result of an improvement or deterioration of the terms of trade will depend on the substitution and income effects created by these changes in the terms of trade. Consequently, the net effect of the change in the terms of trade on the equilibrium RER is ambiguous. For

instance, if the intertemporal income effect dominates the substitution effect, an improvement in the terms of trade will appreciate the equilibrium RER. Otherwise, a different effect might be observed on the equilibrium RER due to the same improvement in the terms of trade. In like manner, changes in government expenditure and in government controls over the capital flows in the previous periods are expected to exert significant effects on the current equilibrium RER. On the basis of these presumptions, most of which are elaborately explained in the theoretical part of this chapter, a diagonistic test is undertaken to examine whether adding the lagged values of the logarithm of terms of trade, government expenditure, and the government extent of capital control have expected significant effects on the equilibrium RER. Moreover, in order to get rid of the autocorrelation problem, the Cochrane-Orcutt [Lilien 1989] iterative estimation procedure is also adopted. The new and the old regression models, under the econometric diagonistic test, are listed below.

The new model:

$$(39) \qquad Y_t = \beta_0 + \beta_1 X1_t + \beta_2 X1_{t-1} + \beta_3 X1_{t-2} + \beta_4 X2_t + \beta_5 X2_{t-1} + \beta_6 X3_t + \beta_7 X3_{t-1} + \beta_8 X4_t + \beta_9 X5_t + \beta_{10} X6_t + u_t.$$

The old model:

$$(40) \qquad Y_t = \gamma_0 + \gamma_1 X1_t + \gamma_2 X2_t + \gamma_3 X3_t + \gamma_4 X4_t + \gamma_5 X5_t + \gamma_6 X6_t + u_t.$$

The results of this econometric diagnostic test, which examines the incremental contribution of the above-mentioned lagged fundamental real variables to the original OLS regression, are listed below in Table IX. However, the null hypothesis may be stated as, $H_0: \beta_2 = \beta_3 = \beta_5 = \beta_7 = 0$, or in terms of the "TSP" output,

TABLE IX
DIAGNOSTIC TEST RESULTS FOR THE NEW MODEL DESCRIBED IN EQUATION (39)

F-statistic	16.5570	Likelihood ratio	54.7052
Probability	0.1820	Probability	0.0000

add: X1(-1) X1(-2) X2(-1) X3(-1).

From Table IX, it is apparent that the null hypothesis fails to be accepted at almost the 18 percent level of significance. Although the level of significance of this hypothesis testing is a bit higher than it conventionally should be, nevertheless, it results in a satisfactory OLS regression output, which yields the theoretically expected signs of a higher number of estimated coefficients of the RER fundamental real variables than the previous OLS regression. Moreover, it can be stated that the addition of the previously mentioned lagged fundamental real variables to the old model significantly increases the ESS (explained sum of squares) and thus the R-square value as shown in Table X.

The regression results compiled in Table X indicate that the lagged values of some of the RER fundamental real variables affect the observed RER in the current period which might have been brought about by the intertemporal interaction between the RER and its fundamental real determinants. But the main purpose of including the lagged values of some of the RER fundamentals in the new regression model is to examine whether it enhances the explanatory power of the independent variables, i.e., if their inclusion to the old regression model facilitates the estimated coefficients to attain their theoretically expected signs and if they prove to be statistically significant. It can

TABLE X
MULTIVARIATE REGRESSION RESULTS FOR THE NEW MODEL DESCRIBED IN EQUATION (39)

Independent Variables	Expected Signs	Estimated Coefficients	
Intercept term		-5.0640915	(-2.0642103)*
$X1_t$	(-)	2.3467564	(4.0828417)**
$X1_{t-1}$		-1.4082873	(-3.8292777)**
$X1_{t-2}$		2.2261092	(3.6065084)**
$X2_t$	(-)	-0.7330937	(-3.4761569)**
$X2_{t-1}$		1.3601397	(4.0604907)**
$X3_t$	(-)	0.2311925	(4.7959015)**
$X3_{t-1}$		0.0466626	(1.2580529)°
$X4_t$	(-)	-0.1432338	(-0.9058961)
$X5_t$	(-)	-0.0433343	(-0.3789422)
$X6_t$	(+)	0.6462990	(4.6551152)**

$R^2 = 0.994421$, Adj. $R^2 = 0.933051$, F-stat. = 16.20361, D-W stat. = 3.019166

* = significant at 5% level. ** = significant at 1% level.
° = significant at more than 10% level.
Number of observations = 13. The numbers in parentheses are the t-statistics value. However, the number of observations has been reduced from the previous regression due to the use of lagged values of a couple of variables.

be observed from Table X that this objective is partially achieved. Although most of the estimated coefficients are significant at the 5 percent level of significance, three of them appear to be significant at even more than the 10 percent level of significance or, in other words, they may be considered insignificant. However, most of the estimated coefficients attained their expected theoretical signs except $X1_t$ (log of the terms of trade) and $X3_t$ (log of the variable representing the government controls over capital flows). However, in order to estimate long-run equilibrium RER, the estimated

coefficients of the current real variables are considered only. Using these estimated coefficients of the RER fundamentals, which signify the partial elasticities of the observed RER due to changes in the fundamental real variables, a series of long-run equilibrium RER is estimated for the period of study in question, i.e., 1976-1991, using equation (39).

Table XI compiles this estimated series of long-run equilibrium RER along with the series log(*MRER1 INDEX*) = *Y*. As mentioned before, RER misalignment is defined to be the sustained deviation of the observed RER from its long-run equilibrium level. Conceptually, this deviation of the observed RER from its long-run equilibrium level can assume either an upward or a downward direction, i.e., the observed RER can either fall short of or outstrip the equilibrium RER. It is noted that an increase in the observed RER denotes a RER depreciation, and a decrease in the same reflects an appreciation of the RER. For this empirical study, the RER misalignment is reported when the observed RER falls short of its long-run equilibrium level, i.e., when the observed RER appreciates more than its long-run equilibrium level. The phenomenon of RER misalignment can be observed in Figure VIII, where the estimated long-run equilibrium and the observed RER indexes are plotted in the same diagram in order to show their discrepancy. As shown, the observed RER index falls short of the long-run equilibrium RER in 1977, and this downfall persists until 1986. In other words, the RER is misaligned in 1977, and this misalignment persists until 1986. However, it is also observed that the long-run equilibrium RER falls short of the observed RER in 1976 and later in 1987, and this downfall in the equilibrium RER persists until 1991. In other words, there is an undervaluation of the RER.

TABLE XI
ESTIMATED INDEX OF LONG-RUN EQUILIBRIUM RER AND THE ACTUAL OR OBSERVED RER

Year	Estimated Equilibrium Real Exchange Rate	log(MRER1 INDEX) = Y
1976	3.5889658827455	4.160412
1977	5.4295511984997	4.105414
1978	5.0478063778585	4.399551
1979	4.7990072676408	4.445438
1980	4.7191545759427	4.605170
1981	4.6065215978554	4.590558
1982	4.7418704846627	4.598956
1983	4.8355740683522	4.555768
1984	4.8539228457766	4.394527
1985	4.9279149271384	4.577284
1986	4.6128369616110	4.387414
1987	4.1094761967207	4.451976
1988	4.2771366435998	4.373224
1989	3.7336041543905	4.233138
1990	4.2493317543851	4.491854
1991	4.1894236408203	4.412642

However, in the present study, the main concentration of discussion is focused on the overvaluation or the misalignment of RER. On the other hand, using the formula mentioned before, an index of RER misalignment is also computed, which is also referred to as the instability measure of RER misalignment. The term "instability" is justified on the grounds that it measures the degree of instability of the observed RER around its long-run equilibrium level, and this instability can assume either direction, whether upward or downward, from the long-run equilibrium RER. But the current chapter concentrates on the downward movement of the observed RER from its

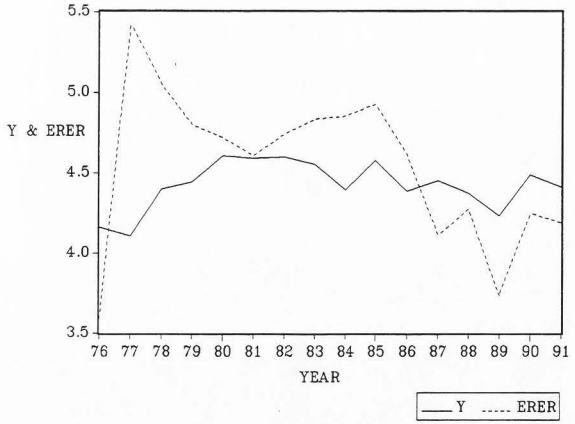

FIGURE VIII
Observed and Estimated Long-Run Equilibrium Multilateral RER Index 1

long-run equilibrium level exclusively, which is also called the RER misalignment, and hence the term "instability" indicates the degree of downward movement of observed RER from its point of reference, i.e., the long-run equilibrium RER. Table XII reports the RER misalignment index for the period under the present study, 1976-1991.

Table XII compiles the index of RER misalignment in terms of percentage. An increase in the RER misalignment index indicates the growing extent of RER misalignment. However, it can be observed from Table XII that the extent of RER misalignment is the highest in 1977, i.e., the extent of RER misalignment is more than 32 percent, after which it goes down by more than 14 percent in 1978 and later it is even less than that. The extent of RER misalignment is the lowest in 1981, only 0.35

TABLE XII
RER MISALIGNMENT INDEX

Year	RER Misalignment Index (%)	Year	RER Misalignment Index (%)
1976	-13.74	1984	10.45
1977	32.25	1985	7.66
1978	14.73	1986	5.14
1979	7.95	1987	-7.69
1980	2.48	1988	-2.20
1981	0.35	1989	-11.80
1982	3.11	1990	-5.40
1983	6.14	1991	-5.06

percent. However, there is no misalignment in the RER during 1976 and in 1987 and later until the end of the period of study, i.e., 1991. It is noted that the RER misalignment index keeps an accord with Figure VIII, which showed the discrepancy between the observed and the long-run equilibrium RER. Figure IX plots the RER misalignment index in terms of percentage for the whole period of study, 1976-1991.

V. Black Market Measure of RER Misalignment

The third measure of RER misalignment is constructed on the basis of a premium of the nominal black market exchange rate of Bangladesh taka (B) over the nominal official exchange rate (E). This measure appears to be a proxy for the RER misalignment [Ghura and Grennes 1993, p. 165], and this is computed using the following equation:

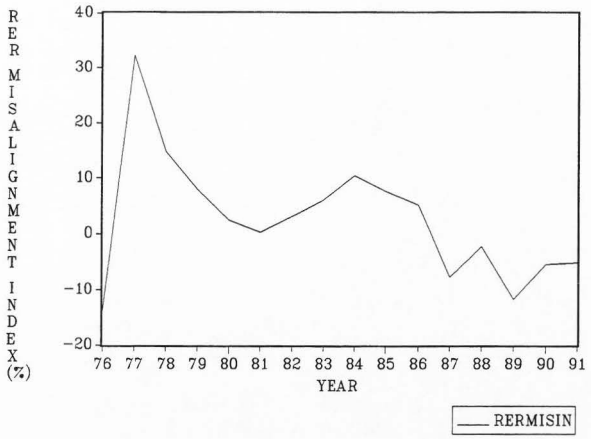

FIGURE IX
Percentage of RER Misalignment Index

(41) $$RERMISBLK_{BD,t} = \frac{B_{BD,t}}{E_{BD,t}} - 1$$

where $RERMISBLK_{BD,t}$ = black market measure of the RER misalignment for Bangladesh in period t; $B_{BD,t}$ = premium of the nominal black market exchange rate of Bangladesh taka (B) over the official rate (E) in period t; and $E_{BD,t}$ = nominal official exchange rate of Bangladesh taka in period t.

This proxy of RER misalignment is supposed to reflect (i) misalignment in the RER, (ii) distortion in the foreign exchange market, and (iii) degree of exchange control and import rationing in the economy. It needs to be mentioned that the officially fixed exchange rate system that is prevailing in Bangladesh economy keeps the official rate of exchange of Bangladesh taka below the market equilibrium rate and necessitates an

excess demand for foreign exchange. Consequently, it appears to be a common practice on behalf of the government to use various forms of exchange controls in order to ration the scarce foreign exchange among the traders and travellers. It seems obvious that the stricter the exchange control becomes, the higher will be the black market premia measured by equation (26). Table XIII compiles the computed index of the black market measure of RER misalignment or the black market premia, and the corresponding Figure X below renders a plot of this index for the whole period of the present study, 1976-1991.

Table XIII shows, and it is also apparent from Figure X, that except for six years, the computed index of the black market measure of RER misalignment is positive for the rest of the period of the present study, i.e., 1976-1991. In the first year of the study period, i.e., 1976, the black market premia is very low, -0.550120, indicating that

TABLE XIII
INDEX OF THE BLACK MARKET MEASURE OF RER MISALIGNMENT

Year	RERMISBK	Year	RERMISBK
1976	-0.550120	1984	-0.654620
1977	-0.325230	1985	0.079677
1978	0.227802	1986	0.811039
1979	0.345458	1987	1.146474
1980	0.052797	1988	1.547877
1981	-0.320650	1989	0.995662
1982	-0.647090	1990	0.894663
1983	-0.648000	1991	0.859772

N.B. RERMISBK = black market measure of the RER misalignment.

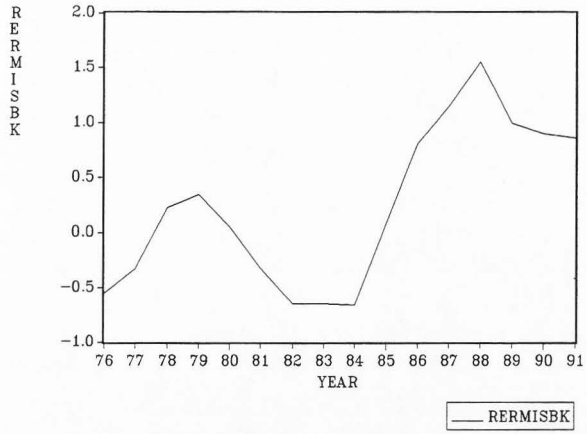

FIGURE X
Black Market Measure of the RER Misalignment

the distortion in the foreign exchange market, created by government restrictions, is substantially lower in this year.

It should be noted that the black market premia measures the average rate of discrepancy of the nominal official exchange rate from its free market counterpart and in a country like Bangladesh, where the government restrictions in the foreign exchange market are very high, the free market exchange rate assumes the form of the black market exchange rate. As a result, any phenomenon that reduces the discrepancy between the officially determined and the black market nominal exchange rate will also reduce the black market premia. A major devaluation of the nominal official exchange rate took place in 1975 and, consequently, the discrepancy between the nominal official exchange rate and its black market counterpart is reduced too, which might be the

probable reason behind a low black market premia during 1976—a lagged effect of the nominal devaluation. However, the black market premia is still low in 1977, and thereafter it increases gradually. It signifies that the lagged effects of the nominal devaluation on the black market premia will gradually die off in the course of time. However, Table XIII and the corresponding Figure X show that, although the black market premia is always in existence for the whole period of study, it is a little lower for six years. Starting from 1980, the black market premia experienced a downfall, not always at the same rate, but substantially lower compared to 1988, when it attained its peak (1.55 approx.), and it remained quite high even in the next year. On the other hand, this black market premia was the lowest in 1984, which is perhaps brought about by the various trade liberalization policies undertaken during the period 1984-1991. One abrupt change in the behavior of this black market premia is noticed when it suddenly drops from its peak value in 1988 to a meager value of 0.995662 in 1989 (a more than 35 percent decrease). In the latter years, Bangladesh experienced a systematic decrease in this black market premia until the end of the study period, i.e., 1991. A couple of significant changes in the government policy in the foreign exchange regime of Bangladesh can be identified for this unprecedented downfall in the black market premia during this time. On September 12, 1989, a trade-liberalization enactment was issued, which increased the foreign exchange allowances for business travel abroad by the exporters to the range of $4,000-$15,000, depending on the size of the export companies. On October 18, 1989, a liberalization policy was issued, which eliminated a ceiling of 200 pounds sterling a month on the remittances for family

maintenance purposes by the foreign nationals working in Bangladesh [IMF 1992]. These empirical findings provide support for the theoretical hypothesis, which states that the lower the extent of government exchange control, the lower will be the black market premia. Since the black market premia is an indirect measure of the government exchange control, the lower the exchange control becomes because the excess demand for foreign exchange is lower. Consequently, the black market nominal exchange rate comes more in line with the nominal official exchange rate, i.e., their discrepancy goes down and, as a result, the black market premia goes down, too.

The fourth procedure of testing the RER misalignment in Bangladesh involves the task of testing the strict absolute version of PPP. According to this strict absolute version of PPP theory, traded goods will have the same price when measured in the same currency. This is also called the "law of one price" [Appleyard and Field 1995, p. 506]. Although there exists much controversy regarding the validity of the strict absolute version of PPP theory, since transportation costs and trade barriers do not let this theory hold true empirically, nevertheless it has some important implications for the misalignment of RER. The strict absolute version of PPP theory asserts that the logarithm of the observed RER series will exhibit a "white noise" process [Edwards 1991, p. 118], i.e., any deviation of the log of observed RER series from its constant equilibrium level will be purely random. Consequently, if the RER behaves according to the PPP theory, then any large deviation of the actual RER from its PPP level will signify a misalignment.

VI. Box-Pierce Statistic Test of the Strict Absolute Version of the PPP Theory

In order to test the strict absolute version of the PPP theory, the Box-Pierce statistic test is executed for the log of the observed series of multilateral and bilateral RER indexes using 15 lags. The Box-Pierce statistic can be used to test the null hypothesis that all the autocorrelations of the observed series log (RER_t), either multilateral or bilateral, are zero or, in other words, the series log (RER_t) is a "white noise" process. If the null hypothesis of log (RER_t), being a "white noise" process, is rejected or failed to be accepted at the corresponding level of significance, then it will imply that the observed variability of log (RER_t), around its trend or mean value, cannot be described as a "white noise" process, and, consequently, it will signify a failure of the strict absolute version of the PPP theory. Table XIV compiles computed Box-Pierce statistic values for the log of observed series of MRER and BRER indexes.

Right below Table XIV, the critical values of the χ^2 statistic and the corresponding probabilities are listed. Q, or the Box-Pierce statistic value, is normally used to test whether a series is a "white noise" process. However, under the null hypothesis of the Box-Pierce statistic test, the statistic Q is asymptotically distributed as chi-squared with the certain degrees of freedom. The degrees of freedom are equal to the number of lags used in computing the autocorrelation of a series in question, assuming that it has not been subjected to the ARIMA analysis. For the present study, a modified version of the Box-Pierce statistic is used, which is known as the Ljung-Box Q-statistic, since the latter has a better finite sample property [Greene 1993].

TABLE XIV
RESULTS OF THE LJUNG BOX Q-STATISTIC TEST FOR THE MULTILATERAL AND BILATERAL REAL EXCHANGE RATE INDEXES

Observed RER Index	Ljung Box Q-Statistic Value	Probability
log(MRER1 index)	19.26	0.2023
log(MRER2 index)	19.58	0.1885
log(BRER1 index)	44.90	0.0001
log(BRER2 index)	44.22	0.0001
log(BMRER1 index)	40.73	0.0004

χ^2(df) critical values,	Probability
$\chi^2(15) = 24.9958$,	0.05
$\chi^2(15) = 30.5779$,	0.01
$\chi^2(15) = 22.3072$,	0.10

Under the null hypothesis, log (RER_t) is a "white noise" process, i.e., its deviation from its constant equilibrium level is expected to be totally random. Table XIV shows that in the case of both log(MRER1 index) and log(MRER2 index), the null hypothesis has failed to be rejected, as the computed values of the Ljung-Box Q-statistic fall short of their corresponding critical values of the χ^2 statistics at 5 percent, 1 percent, and 10 percent levels of significance with 15 degrees of freedom. The same conclusion can also be reached by comparing the probability values of the Ljung-Box Q-statistic for which it is significant relevant to log(MRER1 index) and log(MRER2 index) with the corresponding probability values of the critical values of the χ^2 statistic. Since the probability values of the computed Ljung-Box Q-statistic are greater than 5 percent, 1 percent, and 10 percent (probability values of the critical values of the χ^2 statistic), it can be stated that it has failed to reject the null hypothesis of log(MRER1

index) and log(MRER2 index) being a "white noise" process. Therefore, the strict absolute version of PPP theory holds true in the case of the multilateral RER index of either variant. This observation is in sharp contrast to Edwards [1991], who found strong evidence against the strict absolute version of the PPP theory in the case of log(MRER1 index).

On the other hand, Table XIV also shows that the log of bilateral RER indexes of all categories, computed using the official and black market nominal exchange rates and different combinations of price indexes, proves to strongly reject the strict absolute version of PPP theory. Consequently, the computed Ljung-Box statistics for log(BRER1 index), log(BRER2 index), and log(BMRER1 index) with 15 degrees of freedom are high enough compared to their respective critical values of the χ^2 statistic at 5 percent, 1 percent, and 10 percent levels of significance. As a result, the null hypothesis of the log of bilateral RERs, either based on official or black market nominal exchange rates, of being a "white noise" process, has failed to have been accepted at 5 percent, 1 percent, and 10 percent levels of significance. This same conclusion is also reached by comparing the probability values associated with the critical values of the χ^2 statistic with the probability values of the computed Ljung-Box statistic for the log of bilateral official and black market RERs. Hence, the deviations of these RER indexes from their respective equilibrium values cannot be described as completely random. However, this observation is in line with Edwards's [1991] study that found that the parallel market RER did not follow the prediction of the strict absolute version of the PPP theory.

The unit root test is also performed to examine whether the logs of observed multilateral and bilateral RER indexes of different categories are stationary or not. Whether the RER indexes in question are stationary or not is very important in the sense that nonstationarity in the observed RER indexes is supposed to create serious problems in interpreting the standard regression results as the test statistics such as "t," R^2, and Durbin-Watson lose their standard properties in the presence of nonstationarity in data. Consequently, if the logs of multilateral and bilateral RER indexes turn out to be nonstationary, then there will be serious problems regarding interpreting the standard regression results, which are used to explain the behavior of log of RER series in question. Table XV compiles the results of the unit root test for the observed series of log(RER) of different categories. Table XV shows that the multilateral RER indexes of both kinds prove to be stationary. While the computed value of the Dickey-Fuller statistic is -4.0331 in the case of the log(MRER1I), it is -4.6454 for log(MRER2I). Consequently, the absolute values of this statistic outweigh their respective MacKinnon [Hall et al. 1994] critical values at 5 and 1 percent levels of significance for the log(MRER1I) and log(MRER2I) series, respectively. As a result, both series of RER are stationary. The ADF test is executed first by adopting two periods of lags. But as the testing procedure suggests, the number of lags has been dropped to zero in each case as the estimated coefficients of the lagged differenced terms appear to be insignificant in the corresponding Dickey-Fuller regressions.

Similarly, initially both trends and intercept terms are added to each series in question. But as their estimated coefficients prove to be insignificant in the

TABLE XV
UNIT ROOT TEST FOR THE LOGARITHM OF VARIOUS BILATERAL AND MULTILATERAL RER INDEXES

Augmented Dickey-Fuller Test		Dickey-Fuller *t*-Statistic	Mackinnon Critical Values	
UROOT(T,0)	LGMRER1I	-4.03311	1%	-4.8025
			5%	-3.7921
			10%	-3.3393
UROOT(C,0)	LGMRER2I	-4.6454	1%	-4.0113
			5%	-3.1003
			10%	-2.6927
UROOT(C,0)	D(LGBRER1I)	-2.7985	1%	-4.0681
			5%	-3.1222
			10%	-2.7042
UROOT(C,0)	D(LGBRER2I)	-2.8895	1%	-4.0681
			5%	-3.1222
			10%	-2.7042
UROOT(N,0)	D(LGBMRER1)	-3.3318	1%	-2.7760
			5%	-1.9699
			10%	-1.6295

LGMRER1I = log(MRER1 index), LGMRER2I = log(MRER2 index)
LGBRER1I = log(BRER1 index) , LGBRER2I = log(BRER2 index)
LGBMRER1 = log(BMRER1 index).

corresponding Dickey-Fuller regressions, they are retained as in log(MRER1I), and, in the rest of the test series, only the intercept term is retained except for the log(BMRER1 index), where neither trend nor intercept term is added in the Dickey-Fuller test since both of their estimated coefficients are insignificant in the corresponding Dickey-Fuller regression. However, all of the BRER indexes prove to be nonstationary, either computed using the nominal official exchange rate or the black market nominal exchange rate. As Table XV shows, both the log of bilateral official RER indexes and

the log of bilateral black market RER indexes are integrated of order 1, i.e., they are I(1) or the "random walks" in other words, since all of them are needed to be differenced once to attain their stationarity.

VII. Effects of the RER Misalignment on Macroeconomic Performance of Bangladesh

RER misalignment, or the overvaluation of RER, inflicts harmful effects on the macroeconomic performance of a country. There may be various indicators of macroeconomic performance, but one of the most important indicators is the growth rate of real GDP, which is expected to be brought about by the growth of a vital leading sector of an economy, such as the export sector, which is supplemented by the growth of domestic savings and investment. But the RER misalignment is observed to result in a misallocation of resources, thereby channeling resources from the growth initiating sectors to the less productive lagging sectors. However, this hypothesis will be tested by estimating the effects of three computed measures of RER misalignment on the log of growth rate of real GDP, log of total exports to the GDP ratio, log of total exports to the GDP ratio, log of investment to the GDP ratio, and log of savings to the GDP ratio. There might be other indicators of macroeconomic performance, but for the convenience of analysis, these five broad indicators of macroeconomic performance are considered in this analysis. However, the three measures of RER misalignment are (i) instability measure of RER misalignment, (ii) PPP measure of RER misalignment, and (iii) black market proxy of RER misalignment. The following tables compile the

results of these regression estimates of the aforementioned RER misalignment measures on the five macroeconomic indicators. However, the regressions numbered (1) for each indicator show the effect of the instability measure. As already mentioned, the term "instability" is defined as the instability of the observed RER from its long-run equilibrium level. An instability of this kind can assume either an upward or a downward direction. But since the downward direction of observed RER from its long-run equilibrium level is considered to be a misalignment of RER, the "instability" measure of RER misalignment is expected to indicate the extent of downward movement of the observed RER from its long-run equilibrium level. As a result, misalignment in the RER is reported when the observed RER falls short of the equilibrium RER, i.e., when the observed RER gets appreciated compared to its long-run equilibrium level. On the other hand, regressions (2), (3), and (4) indicate the effects of the PPP measure of RER misalignment, the effects of the black market proxy of RER misalignment, and the joint effects of the instability and PPP measure on each indicator of macroeconomic performance, respectively.

Now, the effects of various measures of RER misalignment on the different indicators of macroeconomic performance will be discussed in light of regression results compiled in the tables below.

Economic Growth

Growth rate of real GDP is one of the most important indicators of macroeconomic performance of a less-developed country like Bangladesh, where the rate of inflation is substantially high. Table XVI compiles the regression results

obtained by regressing the computed measures of RER misalignment on the growth rate real GDP of Bangladesh for the period in question, 1976-1991. However, the table indicates that the growth rate of real GDP is adversely affected by all measures of RER misalignment, i.e., the level of real GDP goes down along with an increasing extent of RER misalignment of all categories in question, although some of the estimated coefficients appear to be statistically insignificant. This observation signifies that the adverse effects on the growth rate real GDP is attributable to RER misalignment, which is most often brought about by domestic economic mismanagement, and this finding is in accord with previously committed studies (Agarwala [1983], Cottani et al. [1990], Dollar [1992], Edwards [1988b]) pertaining to a diverse group of LDCs. Finally, Table XVI also incorporates the probable joint effects of two alternative measures of RER misalignment on the growth rate of real GDP. These measures of RER misalignment have been selected due to their historical significance in the empirical studies. The "RERINSTA" measure of RER misalignment is basically constructed in light of a model developed by Edwards [1991], and the "RERMISPP" measure is an empirical counterpart of the PPP theory. But this table indicates that, although both of these measures have deleterious effects on the real GDP growth rate individually, they fail to demonstrate a joint adverse effect on the same. As a result, regression (4) in Table XVI indicates that the estimated coefficient of the PPP measure of RER misalignment attained the expected algebraic sign and proved statistically significant, while the estimated coefficient of the "instability" measure neither attained its expected sign nor proved statistically significant. Consequently, it can be deduced that these two

TABLE XVI
EFFECTS OF DIFFERENT MEASURES OF RER MISALIGNMENT ON THE GROWTH RATE OF REAL GDP OF BANGLADESH

Dependent Var.	Rg. No.	Inter.	RER INSTA	RERMIS PP	RERMIS BK	R^2	F Value	N
LGGRRGDP	(1)	1.37**	-0.535°			0.23	1.81°	15
			(12.52)	(-0.449)				
LGGRRGDP	(2)	1.49**		-0.804***		0.35	3.265***	15
		(7.31)		(-1.596)				
LGGRRGDP	(3)	1.36**			-0.047	0.23	1.75	15
		(12.92)			(-0.325)			
LGGRRGDP	(4)	1.50**	0.823	-1.027***		0.38	2.20	15
		(11.90)	(0.632)	(-1.647)				

measures of RER misalignment are not two separate empirical variables as far as their influence on the growth rate of real GDP is concerned.

Exports and Imports

Table XVII reports the effects of RER misalignment on exports. It can be observed that exports have been adversely affected by all of the existing measures of RER misalignment in question. Moreover, it is also jointly affected by the "instability" and PPP measures of RER misalignment. The estimated coefficients are significant at different levels of significance except for the black market measure of RER misalignment. Besides, the estimated coefficient of this measure of RER misalignment appears to be the lowest in comparison with other measures. This observation is in accord with the findings of Ghura and Grennes [1993], who ended up with the conclusion that the black market premia overstated the degree of misalignment and

TABLE XVII
EFFECTS OF THE DIFFERENT MEASURES OF RER MISALIGNMENT ON THE EXPORTS OF BANGLADESH

Dependent Var.	Rg. No.	Inter.	RER INSTA	RERMIS PP	RERMIS BK	R^2	F Value	N
LGXGDP	(1)	-1.733** (-26.81)	-0.745** (-4.204)			0.63	10.379**	15
LGXGDP	(2)	-1.69** (-47.166)		-0.361** (-2.637)		0.33	6.956*	16
LGXGDP	(3)	-1.748** (-31.141)			-0.0403° (-0.614)	0.19	1.396°	15
LGXGDP	(4)	-1.775** (-5.753)	-0.684** (-4.292)	-0.509*** (-1.709)		0.702	8.647**	15

understated the magnitude of its effects on macroeconomic performance. However, the estimated coefficients have minus signs, indicating that as the RER misalignment goes up, the exports share of GDP goes down. However, adverse effects of RER misalignment on the exports have been reported by almost all empirical studies performed henceforth. RER misalignment lowers the international competitiveness of the domestic trading sector. Consequently, imports are artificially underpriced and exports are overpriced. As mentioned before, most of the time RER misalignment is brought about by an expansionary macroeconomic policy, which is undertaken in an officially fixed exchange rate regime. As the selection of a particular exchange rate regime always imposes some restrictions on the chosen macroeconomic policy, a fixed exchange rate system demands a more or less conservative macroeconomic policy. Otherwise, RER misalignment shows up almost certainly, which reveals itself as an

increase in the relative price of nontradable goods as the consumption expenditure on these goods goes up. In other words, the relative price of tradable goods goes down as the RER is defined as the domestic relative price of tradables to nontradables. This is a typical situation of RER overvaluation. However, more resources are allocated to the nontradables sector, causing a higher labor demand. Wage rate and cost of other material inputs go up in the nontradables sector and the trade unions' claim of an equal national wage rate may result in a wage hike, even in the exports sector. But, at the same time, the relative price of exportables does not experience an equivalent increase. Therefore, production costs of exportables exceed the price of the same, leading to an increase in the domestic price of export goods vis-à-vis the competitor's export price. As a result, export revenue falls.

Table XVIII compiles the empirical results of the effects of RER misalignment on the ratio of total imports to GDP of Bangladesh. Theoretically, it is argued that a misalignment of RER lowers the competitiveness of the domestic trading sector as it reduces the relative price of tradable goods below its long-run equilibrium level, where the price of tradables is a weighted average of exportables and importables. More precisely, imports seem artificially underpriced and exports overpriced due to an occurrence of RER misalignment. Exports are overpriced due to cost ineffectiveness in the export goods producing sector. On the other hand, imports become cheaper due to a decline in their relative prices. Consequently, export revenues decline and import expenditures increase, leading to a worsening trade balance. This hypothesis is partially supported by the empirical findings compiled in Table XVIII. While the ratio of

TABLE XVIII
EFFECTS OF THE DIFFERENT MEASURES OF RER MISALIGNMENT
ON THE IMPORTS OF BANGLADESH

Dependent Var.	Rg. No.	Inter.	RER INSTA	RERMIS PP	RERMIS BK	R^2	F Value	N
LGMGDP	(1)	-2.140*	0.731**			0.608	9.303**	15
		(1.974)	(4.016)					
LGMGDP	(2)	-2.565**		-0.604**		0.476	12.710**	16
		(-57.859)		(-3.565)				
LGMGDP	(3)	-2.627**			0.024°	0.312	2.719°	15
		(-34.428)			(0.314)			
LGMGDP	(4)	-2.563**	0.227°	-0.647**		0.497	6.427*	16
		(-56.825)	(0.742)	(-3.563)				

imports to GDP increases due to increases in the instability and black market measures of RER misalignment (although the estimated coefficient of the latter is insignificant), the ratio declines due to an increase in the PPP measure of RER misalignment. Therefore, the empirical findings pertaining to the effects of instability and black market measures of RER misalignment seem to support the theoretical hypothesis in question. On the other hand, the estimated coefficient of the PPP measure of RER misalignment is negative and significant, too, indicating that imports are adversely affected by an increase in the extent of this measure of RER misalignment. This can be explained with the aid of indirect reasoning, which indicates a channel through which imports can be affected due to such an occurrence. As mentioned before, the export sector loses its competitiveness due to an RER misalignment and import expenditures increase, an occurrence that eventually ends up with an increasing current account deficit. If external financing for imports is not available, then the government will

enhance restrictions on imports (through tariff and quotas) in order to save the scarce foreign exchange. As a result, imports may decline due to an RER misalignment because of the government policy response. Empirical studies show that African countries could maintain overvalued RER for a long period, even in the presence of a declining export earning by imposing quantitative restrictions on the cheap imports [African Development Bank 1990].

Savings and Investment

From the theoretical point of view, RER misalignment is supposed to inflict deleterious effects both on investment and savings. It is argued that when RER misalignment takes place, which is most frequently brought about by an expansionary macroeconomic policy undertaken in a fixed exchange rate regime, an unstable economic atmosphere may show up as domestic money supply exceeds the domestic money demand. This excess supply of domestic money is initiated by the government when it needs to finance the development projects. But private investors tend to transform their domestic currency denominated financial assets into foreign currency-denominated assets. Consequently, the spread between officially fixed and free market exchange rates goes up, capital flights become frequent, and, finally, the government is forced to undertake a nominal devaluation policy in order to save the scarce foreign exchange. On the other hand, speculation in the private sector about the future nominal devaluation goes up and eventually ends up with an unstable atmosphere in the whole economy. As a result, investors will be less willing to invest their funds in the projects, being afraid of their uncertain future returns. Finally, investment goes

down. On the other hand, domestic savings are also expected to experience an undesirable decline to RER misalignment. It is already mentioned that most often RER misalignment takes place when government undertakes expansionary macroeconomic policies in a fixed exchange rate regime and supply of domestic money outweighs the demand for the same. This is a typical situation of monetary inflation. If the exchange rate was allowed to move freely, then it would depreciate as the investors reduced their holding of a domestic money component in their portfolio. But since the exchange rate is kept fixed officially, it cannot adjust itself freely in response to the supply of and demand for domestic money. It can be considered a distortion in the domestic economy, which is initiated by the government in the hope of protecting the vulnerable current account from the exchange rate fluctuations. However, if the government raises these restrictions to protect the domestic economy from the external shocks, it is also expected to impose restrictions on the interest rate and, consequently, the returns to savers go down. But this theoretical proposition of the deleterious effects of RER misalignment on savings and investment is not supported by the empirical investigation of the present study. As can be seen from Table XIX, only the estimated coefficient of the black market measure of RER misalignment attained the minus sign and appears statistically significant. The other measures of RER misalignment failed to capture the adverse effects of RER misalignment on domestic investment. On the other hand, Table XX reports the effects of different measures of RER misalignment on the ratio of gross domestic savings to GDP, and as can be seen, neither of the estimated coefficients attained the expected negative sign nor were they statistically significant. Hence, the

TABLE XIX
EFFECTS OF THE DIFFERENT MEASURES OF RER MISALIGNMENT ON THE INVESTMENTS OF BANGLADESH

Dependent Var.	Rg. No.	Inter.	RER INSTA	RERMIS PP	RERMIS BK	R^2	F Value	N
LGINVGDP	(1)	-2.070**	0.061°			0.365	3.451***	15
		(-32.130)	(0.250)					
LGINVGDP	(2)	-2.073**		0.048°		0.363	3.422***	15
		(-26.129)		(0.109)				
LGINVGDP	(3)	-2.035**			-0.090***	0.475	5.434*	15
		(-41.526)			(-1.689)			
LGINVGDP	(4)	-2.072**	0.054°	0.024°				
		(-24.536)	(0.205)	(0.050)		0.365	2.112°	15

empirical findings on the effects of RER misalignment on domestic savings fail to support the theoretical proposition.

VIII. Effects of Nominal Devaluation on the RER

Nominal devaluation is considered to be one of the measures of realigning the misalignment of RER. It is viewed as a controversial policy measure since it necessitates domestic inflation, which partially wears out the effects of initial devaluation and requires a higher devaluation. As a result, this process may result in a perpetual nonconverging cycle of devaluation and domestic inflation. However, if the nominal devaluation is undertaken when the observed RER is out of its long-run equilibrium level, indicated by a large-scale capital flight that results in a drainage of foreign exchange reserve, and if it is supplemented with appropriate macroeconomic policy, then a realignment of misaligned RER can be expected to be forthcoming.

TABLE XX
EFFECTS OF DIFFERENT MEASURES OF RER MISALIGNMENT
ON THE SAVINGS OF BANGLADESH

Dependent Var.	Rg. No.	Inter.	RER INSTA	RERMIS PP	RERMIS BK	R^2	F Value	N
LGSGDP	(1)	-3.866**	1.349°			0.118	0.800°	15
		(-20.456)	(1.155)					
LGSGDP	(2)	-3.935**		0.756°		0.10	1.557°	16
		(-24.842)		(1.248)				
LGSGDP	(3)	-3.877**			0.216°	0.125	0.855°	15
		(-26.581)			(1.143)			
LGSGDP	(4)	-3.904**	1.119°	0.313°		0.122	0.511°	15
		(-15.898)	(0.796)	(0.259)				

LGGRRGDP = log of the growth rate of real GDP.
LGXGDP = log of the total exports to GDP ratio.
LGMGDP = log of the total imports to GDP ratio.
LGINVGDP = log of the gross domestic investment to GDP ratio.
LGSGDP = log of the gross domestic savings to GDP ratio.
RERINSTA = instability measure of the RER misalignment.
RERMISPP = PPP measure of the RER misalignment.
RERMISBK = black market premia of the nominal exchange rate which is used as a proxy of the RER misalignment.
"t" statistics are in parentheses.
** = significant at the 1% level of significance.
°= not significant at any of the abovementioned levels of significance.
Rg. no. = regression number.
Inter. = estimated intercept term.
N = number of observations, which varies from one regression to an another one due to different methods of estimation used. N = 16, where the simple OLS method of estimation is used. N = 15, where the Cochrane-Orcutt iterative method of estimation is used due to a high degree of positive or negative autocorrelation in the stochastic disturbance term indicated by the Durbin-Watson test.

Initially, Bangladesh taka was pegged to the British pound sterling and later, in 1983, the currency of reference had been changed to the U.S. dollar. But considering the importance of the U.S. dollar in the world exchange market and a considerably high trade share of the United States with Bangladesh, the effectiveness of nominal devaluation in bringing about a real devaluation is discussed with respect to the U.S. dollar. Devaluation is different from depreciation of exchange rate. The former one is a deliberate policy reform and the latter one is the outcome of the demand for and supply of taka vis-à-vis the demand for and supply of its currency of reference, i.e., the U.S. dollar. While the depreciation of the exchange rate is relevant to a floating exchange rate regime, the devaluation, on the other hand, takes place in a fixed exchange rate regime. Since Bangladesh taka was pegged to two major world currencies from the very beginning, any downfall of the value of domestic currency in terms of its currency of reference indicates a nominal devaluation. The first major nominal devaluation of Bangladesh taka took place in 1975. But the occurrence of nominal devaluation is almost a common annual incident in Bangladesh. However, according to a formula devised by Edwards [1991], an effectiveness index (E index) of nominal devaluation episodes for Bangladesh is constructed. The formula can be denoted as follows

$$\text{(42)} \qquad \text{Effectiveness index}_k = \frac{RER_k^{\Delta}}{E_k^{\Delta}}$$

where $\hat{E}_k$ = percentage change in the nominal official exchange rate between one year prior to devaluation and k years after devaluation, where (k = 0, 1, 2, 3). On the other

hand, $\hat{RER_k}$ = percentage change in the observed RER between one year prior to devaluation and k years after devaluation, where (k = 0, 1, 2, 3). Consequently, the ratio of $\hat{RER_k}$ to $\hat{E}_k$ appears to be a cumulative ex post elasticity of the observed RER with respect to nominal exchange rate for the year of devaluation, and 1, 2, and 3 years, respectively, after the devaluation. In other words, this measure of elasticity also reflects the degree of erosion of the effectiveness of nominal devaluation on the observed RER, as it signifies the percentage of nominal devaluation translated into real devaluation in a particular period of study. Therefore, if the value of this E index becomes equal to unity, it will indicate that a nominal devaluation becomes 100 percent successful in translating itself into a real devaluation. A positive but less than unity value of the effectiveness index will indicate a limited success of the nominal devaluation in bringing about a real devaluation. However, if a negative value shows up for this E index, it reflects that more than 100 percent of the nominal devaluation has been eroded and, at any particular period in question, the observed RER is lower than its value even one year before the "crisis of RER misalignment."

However, it is obvious that the effect of nominal devaluation erodes in the course of time after the actual nominal devaluation episode due to the presence of inconsistent macroeconomic policy, especially under the pegged exchange rate regime. Tables XXI and XXII compile the values of E index for the devaluation episodes of Bangladesh taka. However, the year 1986 is omitted because a nominal overevaluation of the officially fixed exchange rate took place in that year. The year 1977 has been omitted for the same reason.

In evaluating the implications of computed effectiveness indexes for the years in question which have been compiled in Table XXI, it seems obvious that the BRER1 index is more relevant than the MRER1 index, since the exchange rate of the U.S. dollar in terms of the Bangladesh taka is used to construct the former, and a weighted exchange rate of the major trading partners of Bangladesh in terms of taka is used to compute the latter. Since 1983, the Bangladesh taka has been pegged to the U.S. dollar, hence, devaluation refers to the officially declared depreciation of taka vis-à-vis the U.S. dollar. However, it needs to be mentioned that the effectiveness index could not be computed for the year 1976 due to the lack of data on variables relevant to the computation of this index. Table XXI indicates that the ex post elasticity of BMRER indexes is substantially high in the year of nominal devaluation with reference to one year prior to devaluation, i.e., in most of the devaluation episodes under consideration, the values of the effectiveness index are positive in the year of devaluation, indicating that the nominal devaluation policy proves to be successful in translating itself into a real devaluation in the year of its occurrence. In the case of the BRER1 index, the computed positive value of this effectiveness index even exceeds unity during 1978 and 1980, signifying that nominal devaluation becomes more than 100 percent successful in translating itself into a real devaluation in the year when it actually takes place. However, most of the time, the extent of this efficacy of nominal devaluation in bringing about a real devaluation erodes in the course of time, and it appears to be the lowest after three years of nominal devaluation. It signifies that in a fixed exchange rate regime, the nominal devaluation policy undertaken in the hope of correcting the

TABLE XXI

EFFECTIVENESS INDEX FOR THE BILATERAL AND MULTILATERAL RER INDEX FOR THE TEN NOMINAL DEVALUATION EPISODES

Year	Effectiveness Index for BRER1 Index	Effectiveness Index for MRER1 Index
1978	for k = 0, E index = 1.598231	for k = 0, E index = 9.150494
	for k = 1, E index = 1.04573	for k = 1, E index = 4.67531
	for k = 2, E index = 1.083238	for k = 2, E index = 5.031373
	for k = 3, E index = 0.812544	for k = 3, E index = 1.649052
1979	for k = 0, E index = 0.613268	for k = 0, E index = 0.98906
	for k = 1, E index = 0.854447	for k = 1, E index = 2.588618
	for k = 2, E index = 0.711181	for k = 2, E index = 0.639757
	for k = 3, E index = 0.58343	for k = 3, E index = 0.360566
1980	for k = 0, E index = 1.155952	for k = 0, E index = 4.4561
	for k = 1, E index = 0.740676	for k = 1, E index = 0.581135
	for k = 2, E index = 0.591285	for k = 2, E index = 0.307865
	for k = 3, E index = 0.447281	for k = 3, E index = 0.195008
1981	for k = 0, E index = 0.666574	for k = 0, E index = -0.06555
	for k = 1, E index = 0.544224	for k = 1, E index = -0.01287
	for k = 2, E index = 0.395724	for k = 2, E index = -0.08953
	for k = 3, E index = 0.282314	for k = 3, E index = -0.31661
1982	for k = 0, E index = 0.468438	for k = 0, E index = 0.039595
	for k = 1, E index = 0.220003	for k = 1, E index = -0.13169
	for k = 2, E index = 0.061454	for k = 2, E index = -0.57419
	for k = 3, E index = 0.163188	for k = 3, E index = -0.02347
1983	for k = 0, E index = -1.00815	for k = 0, E index = -1.09889
	for k = 1, E index = -0.91738	for k = 1, E index = -2.31099
	for k = 2, E index = -0.02549	for k = 2, E index = -0.07452
	for k = 3, E index = -0.49123	for k = 3, E index = -0.68243
1984	for k = 0, E index = -0.900292	for k = 0, E index = -3.722813
	for k = 1, E index = 0.136307	for k = 1, E index = 0.090623
	for k = 2, E index = -0.441545	for k = 2, E index = -0.667867
	for k = 3, E index = -0.596013	for k = 3, E index = -0.397529
1985	for k = 0, E index = 0.370723	for k = 0, E index = 1.042716
	for k = 1, E index = -0.37325	for k = 1, E index = -0.03839
	for k = 2, E index = -0.57988	for k = 2, E index = 0.295654
	for k = 3, E index = -0.54111	for k = 3, E index = -0.08741
1987	for k = 0, E index = -3.89244	for k = 0, E index = 5.135262
	for k = 1, E index = -1.38578	for k = 1, E index = -0.29521
	for k = 2, E index = -2.2902	for k = 2, E index = -2.99545
	for k = 3, E index = -0.3276	for k = 3, E index = 0.679503

TABLE XXI—CONTINUED

Year	Effectiveness Index for BRER1 Index	Effectiveness Index for MRER1 Index
1988	for k = 0, E index = -0.47875 for k = 1, E index = -1.80441 for k = 2, E index = -0.01807 for k = 3, E index = 0.019171	for k = 0, E index = -2.20823 for k = 1, E index = -5.73112 for k = 2, E index = 0.27654 for k = 3, E index = -0.16306

Notes: k = years after the nominal devaluation; E index = effectiveness index for the nominal devaluation episode in question; BRER1 index = bilateral real exchange rate index 1, where WPI_{US} (wholesale price index of the United States) and CPI_{BD} (consumer price index of Bangladesh) are used as the proxies of the tradable and nontradable goods' prices, respectively; MRER1 index = multilateral real exchange rate index 2, where WPI_{US} and CPI_{BD} have been used as the proxies of the tradable and nontradable goods' prices, respectively.

TABLE XXII

EVOLUTION OF BILATERAL RER INDEX AFTER THREE YEARS OF NORMAL DEVALUATION FOR TEN NOMINAL DEVALUATION EPISODES

Year	Year Prior	Year of Development	1 Year After	2 Years After	3 Years After
1978	100	105.97	109.06	113.96	130.77
1979	100	102.91	107.54	123.40	135.71
1980	100	104.49	119.91	131.87	126.75
1981	100	114.75	126.20	121.30	116.94
1982	100	109.98	105.71	101.91	109.17
1983	100	96.12	92.66	99.27	86.28
1984	100	96.40	103.27	89.76	85.22
1985	100	107.13	93.11	88.40	86.95
1987	100	86.91	82.52	81.16	77.41
1988	100	94.94	93.39	89.07	94.69

Year prior = one year prior to the nominal devaluation in question.
Year of development = year of nominal devaluation in question.
1 year after = one year after the nominal devaluation in question.
2 years after = two years after the nominal devaluation in question.
3 years after = three years after the nominal devaluation in question.

RER misalignment, cannot sustain for a long time, most frequently even not for two consecutive years, if it is not supplemented with an appropriate macroeconomic policy. As a result, the E index of nominal devaluation went down in the second year of its occurrence, signifying that an inconsistent macroeconomic policy might be in existence. On the other hand, in the case of the BRER1 index, the E index is negative in the year of nominal devaluation—1983, 1984, 1987, and 1988—signifying that the effects of nominal devaluation on the observed RER are fully eroded even in the year of its occurrence. As a result, the RER is even lower than it was one year before the devaluation. The same kind of phenomenon also is observed from the computed E index for the MRER1 index, except that now it happened in 1981 instead of 1987 (when the effect of nominal devaluation was fully eroded in the year of devaluation for the BRER1 index).

Table XXII compiles the evolution of bilateral RER index of category 1, i.e., the BRER1 index, after each nominal devaluation episode is taken into consideration. Assuming that the BRER1 index was 100 during the year just prior to each devaluation episode, i.e., letting it be the base year for an easy comparison with the following years, this table is expected to show the probable extent of erosion of the RER index in question three years following the devaluation.

Ten nominal devaluation episodes are considered in the present study in order to empirically examine the probable efficacy of nominal devaluation in bringing about a real devaluation, which can also be viewed as a realignment of RER once it is misaligned. As can be seen in Table XXII, the nominal devaluation policy seems quite

successful in the first five years under consideration. In these years, the bilateral RER index 1 is even higher than it was one year before the devaluation crisis. Clearly, this achievement in defending the erosion of the RER index is attained by high rates of further nominal devaluations in latter years. However, in the next five years, starting from 1983, the nominal devaluation policy appeared unsuccessful in bringing about a real devaluation. In these years, the bilateral RER index in question is even lower than it was one year before the devaluation. Except for the year 1985, the effects of nominal devaluation on the bilateral RER prove to be completely gone, i.e., the RER index in these years was even lower than it was one year before the devaluation crisis. This drastic erosion of the RER index for these years might be partly due to highly inconsistent macroeconomic policies pursued in these years and partly because of lower degrees of nominal devaluations undertaken in latter years to encounter the probable decaying effects of the nominal devaluation policy on the RER.

The abovementioned procedure of evaluating the effectiveness of a nominal devaluation episode in bringing about a real devaluation can be viewed as a broad index of measuring the success of that episode. This is "broad" in the sense that it is contingent upon the "before" and "after" behavior of the RER and nominal exchange rate with respect to a certain event (nominal devaluation) and a certain point of time (the year of devaluation) without considering other relevant variables that might affect the RER during the same period under consideration. Consequently, this procedure appears to be unable to separate the effects of nominal devaluation from other policies and exogenous disturbances that may have significant effects in explaining the behavior

of the observed RER [Edwards 1991, p. 259]. For instance, the nominal devaluation cannot curb the RER misalignment alone if it is not supplemented with the elimination of inconsistent macroeconomic policies, the most frequent one of which is the expansionary macroeconomic policy under the pegged exchange rate regime. As a result, the E index reflects only a partial performance of a nominal devaluation episode. Therefore, Edwards [1991] has suggested a procedure of cross-episode regression, where each devaluation episode is considered to be an observation unit and the percentage change in the RER is the dependent variable. Following this procedure, a cross-episode regression is estimated for appraising the efficacy of nominal devaluation episodes under consideration. However, the regression equation to be estimated assumes the following form:

(43) $$RER_k^{\Delta} = \delta_1 \hat{E}_k + \delta_2 \hat{C}_k + \delta_3 FIS_k^{\Delta} + u_t$$

where RER_k^{Δ} = cumulative percentage change in the bilateral RER index 1 between the year prior to nominal devaluation episode in question and k years after that episode; $\hat{E}_k$ = percentage change in the nominal exchange rate between 1 year prior to devaluation and k years after that, where (k = 0, 1, 2, 3); $\hat{C}_k$ = growth rate of domestic credit between one year prior to devaluation and k years after that, where (k = 0, 1, 2, 3); FIS_k^{Δ} = change in the index of fiscal policy between 1 year prior to devaluation and k years after that, where (k = 0, 1, 2, 3). Two indexes of fiscal policy are considered in this study as follows: CPS_k^{Δ} = growth rate of domestic credit to the public sector between 1 year prior to the nominal devaluation episode and k years after that, where (k = 0, 1, 2, 3); and $RPSCR_k^{\Delta}$ = growth rate in the ratio of public sector to total domestic

credit between 1 year prior to devaluation and k years after that, where (k = 0, 1, 2, 3).

Consequently, the estimated coefficients of $\hat{E}_k$ for (k = 0, 1, 2, 3) will reflect a measure of the percentage of nominal devaluation translated on average into a real devaluation, after 0 (year of devaluation), and 1, 2, and 3 years after the nominal devaluation took place for the given values of other macroeconomic variables. An increase in the values of the estimated coefficients of $\hat{E}_k$ for (k = 0, 1, 2, and 3) will reflect whether the nominal devaluation episode in question could sustain the real devaluation 3 years after that episode. Table XXIII contains the estimated regression coefficients of equation (43).

TABLE XXIII
RESULTS OF THE CROSS EPISODE REGRESSION CORRESPONDING TO EQUATION (43)

Episodes	Est. Coeff. of $\hat{E}_k$	Est. Coeff. of $\hat{C}$	Est. Coeff. of CPS_k^{Δ}	Est. Coeff. of $RPSCR_k^{\Delta}$	Estimation Method Used	R^2
I k = 0 years	0.73**	-1.06 •	1.414•	-1.741 •	Cochrane-	0.96
	(7.95)	(-1.04)	(1.144)	(-1.15)	Orcutt iterative	
II k = 1 year	0.60 ***	-0.00292•	0.134•	-0.249 •	Cochrane-	0.91
	(1.70)	(-0.00746)	(0.392)	(-0.497)	Orcutt iterative	
III k = 2 years	0.49 ***	1.513•	-1.353•	2.315 •	OLS	0.82
	(1.91)	(1.51)	(-1.15)	(1.09)		
IV k =3 years	0.69•	-0.197 •	0.0145•	-0.00958 •	Cochrane-	0.93
	(1.00)	(-0.44)	(0.0323)	(-0.00980)	Orcutt iterative	

Episodes = devaluation episodes, est. coeff. = estimated coefficients, t statistics in parentheses, * = significant at the 5% level, ** = significant at the 1% level, *** = significant at the 10% level.

The results obtained from estimating equation (43) are compiled in Table XXIII. It is noted that four different versions of this equation are estimated, signifying the effects of nominal devaluation on the bilateral RER index 1 on the year of devaluation and 1, 2, and 3 years after the devaluation, respectively, assuming that other macroeconomic variables, which are expected to affect the RER, are held constant, i.e., this is a partial elasticity approach of assessing the effects of nominal devaluation on the RER for the ten devaluation episodes under consideration. Version I refers to the regression of percentage change in the BRER index 1 between one year before the devaluation and the year of devaluation ($k = 0$) on the percentage change of nominal exchange rate and other macroeconomic variables in question between the year prior to devaluation and the year of devaluation ($k = 0$) applicable to the ten different devaluation episodes under consideration. As a result, the estimated coefficient of $\hat{E}_k$ for version I regression equation signifies the percentage of nominal devaluation translated into the real devaluation in the very year of devaluation for ten different devaluation episodes, assuming that other macroeconomic variables affecting the RER are held constant. In like manner, versions II, III, and IV of equation (43) refer to the regression of percentage changes in BRER index 1 between one year prior to devaluation and 1, 2, and 3 years after the devaluation episode in question, respectively, on the percentage changes in nominal exchange rate and other relevant macroeconomic variables in question, between one year prior to devaluation and 1, 2, and 3 years after the devaluation episode in question, respectively, for ten devaluation cases. Consequently, the estimated coefficients of $\hat{E}_k$ for versions II, III, and IV of equation

(43) indicate what percentage of nominal devaluation has been translated into real devaluation after 1, 2, and 3 years after the devaluation for the given values of other relevant macroeconomic variables in question for the ten different devaluation episodes under consideration, regarding each devaluation episode as an observation unit. Version I regression of equation (43), which is listed in Table XXIII, indicates that 73 percent of nominal devaluation has been translated into real devaluation in the very year when the devaluation actually took place, assuming that no expansionary macroeconomic policies are in existence, i.e., the partial elasticity of RER_0^{Δ} with respect to $\hat{E}_0$ is 0.73 or, in other words, $(\delta RER_0^{\Delta}/\delta \hat{E}_0) = 0.73$. However, except for the growth rate of domestic credit to the public sector, estimated coefficients of the growth rates of domestic credit and the ratio of public sector to total domestic credit attained the expected negative signs, indicating that all other things being equal, an increase in either domestic credit or in the proportion of total domestic credit allocated to the public sector will cause an erosion of the devaluating effect of nominal exchange rate on the BRER index 1. It can also be observed from Table XXIII that the estimated coefficient of $\hat{E}_k$ is 0.60 in the version II regression of equation (43), while the estimated coefficients of the variables, indicating the expansionary macro policy attained their expected minus signs except one, signify that expansionary macro policy causes the erosion of the devaluating effect of nominal devaluation on the RER. On the other hand, version III regression of equation (43) gives the same kind of qualitative information as the previous two versions, but this time, the estimated coefficient of $\hat{E}_3$ is positive but less than previously. As a matter of fact, the estimated coefficient of $\hat{E}_k$ diminished steadily from the year of nominal devaluation up

to the second year after devaluation. Although it increased up to 69%in the third year since the devaluation took place, nevertheless it is lower than it was in the year of devaluation. This indicates that even if the macroeconomic policies are held constant, there will be some erosion of the devaluating effect of nominal exchange rate on the RER. However, although statistically insignificant most of the time, the estimated coefficients of the components of expansionary macroeconomic policies appear to be negative, signifying that they can cause RER overvaluation, and, unless supplemented by consistent macro policies, the nominal devaluation policy itself cannot have a sustained devaluating effect on the RER.

CHAPTER 6

CONCLUSIONS

The empirical findings of this study exhibit that the RER had been misaligned in Bangladesh during the period of study in question. This observation is in accord with Edwards's [1991] extensive study on the RER behavior in developing countries, some of which are close neighbors of Bangladesh. An attempt is also made to provide an empirical support to the hypothesis linking the RER misalignment and the poor macroeconomic performance of Bangladesh. The empirical findings regarding this issue support that hypothesis.

The results confirm the findings obtained by Agarwala [1983], Cottani et al. [1990], Dollar [1992], Edwards [1988a, 1991], Frenkel [1983], and Khan [1986] that RER misalignment has adversely affected the growth rate of real income and other macroeconomic variables in less-developed countries. Following a significant study performed by Ghura and Grennes [1993], this study applied three different measures of RER misalignment to assess the hypothesized deleterious effects of RER misalignment on the external sector, savings, investment, and real income growth of Bangladesh. The empirical findings in this context supported the presumed hypothesis.

Finally, following Edwards's [1991] study on the RER behavior and exchange rate policy in developing countries, the present study attempted to explore the effectiveness of nominal devaluation as a policy measure in bringing about the RER realignment, both independent of other relevant macroeconomic policies and also in association with these policies.

Both of these procedures emphasized the hypothesis that nominal devaluation turns out to be a rather effective policy in realizing the realignment of RER, especially when supplemented with consistent macroeconomic policies.

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APPENDIX

TRADE WEIGHTS

(Trade weights are assigned to the trading partners according to their proportion of trade shares in the annual total volume of trade of Bangladesh.)

Year	1976	1977	1978	1979	1980	1981	1982	1983
Weight, United States	0.1755	0.1313	0.1405	0.1221	0.1428	0.0691	0.0956	0.1427
Weight, Canada	0.0463	0.0381	0.0490	0.0361	0.0302	0.0190	0.0334	0.0401
Weight, Australia	0.0414	0.0222	0.0150	0.0311	0.0246	0.0330	0.0230	0.0130
Weight, Japan	0.0581	0.0709	0.1142	0.1235	0.1076	0.0925	0.1169	0.0839
Weight, Germany	0.0270	0.0346	0.0350	0.0400	0.0389	0.0377	0.0335	0.0419
Weight, Netherlands	0.0215	0.0162	0.0308	0.0196	0.0263	0.0261	0.0308	0.0270
Weight, United Kingdom	0.0709	0.0553	0.0589	0.0874	0.0617	0.0434	0.0393	0.0562
Weight, Saudi Arabia	####	0.0141	0.0093	0.0363	0.0748	0.1145	0.0804	0.0888
Weight, China	0.0116	0.0207	0.0357	0.0356	0.0432	0.0388	0.0446	0.0292
Weight, India	0.0553	0.0392	0.0234	0.0213	0.0210	0.0247	0.0212	0.0170
Weight, Pakistan	0.0156	0.0265	0.0360	0.0243	0.0298	0.0260	0.0225	0.0261
Weight, Singapore	0.0261	0.0110	0.0255	0.0320	0.0498	0.0381	0.0461	0.0673
Weight, Russia	0.0397	0.0413	0.0437	0.0346	0.0279	0.0215	0.0247	0.0377
Weight, U.A.E.	0.0144	0.0498	0.0327	0.0305	0.0456	0.0576	0.0436	0.0684

TRADE WEIGHTS (Continued)

Year	1984	1985	1986	1987	1988	1989	1990	1991
Weight, United States	0.1137	0.1477	0.1349	0.1470	0.1305	0.1428	0.1454	0.1397
Weight, Canada	0.0395	0.0369	0.0327	0.0448	0.0304	0.0192	0.0306	0.0359
Weight, Australia	0.0404	0.0176	0.0132	0.0196	0.0207	0.0235	0.0188	0.0199
Weight, Japan	0.0951	0.1291	0.1339	0.1273	0.1391	0.1117	0.1143	0.0798
Weight, Germany	0.0289	0.0365	0.0434	0.0356	0.0247	0.0351	0.0482	0.0666
Weight, Nertherlands	0.0328	0.0353	0.0233	0.0235	0.0319	0.0288	0.0377	0.0356
Weight, United Kingdom	0.0686	0.0466	0.0445	0.0411	0.0496	0.0368	0.0496	0.0544
Weight, Saudi Arabia	0.0244	0.0294	0.0215	0.0182	0.0129	0.0153	0.0122	0.0176
Weight, China	0.0350	0.0322	0.0316	0.0309	0.0300	0.0368	0.0312	0.0348
Weight, India	0.0261	0.0319	0.0207	0.0245	0.0249	0.0286	0.0401	0.0476
Weight, Pakistan	0.0242	0.0200	0.0197	0.0187	0.0242	0.0108	0.0195	0.0216
Weight, Singapore	0.0870	0.0803	0.0653	0.0578	0.0469	0.0709	0.0949	0.0728
Weight, Russia	0.0204	0.0238	0.0359	0.0260	0.0207	0.0241	0.0154	0.0109
Weight, U.A.E.	0.0397	0.0466	0.0389	0.0395	0.0372	0.0345	0.0225	0.0282

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