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THE ECONOMICS OF REAL EXCHANGE RATE UNDER FINANCIAL
REPRESSION WITH AN APPLICATION TO KOREA

A DISSERTATION SUBMITTED TO THE GRADUATE DIVISION OF THE
UNIVERSITY OF HAWAII IN PARTIAL FULFILLMENT OF THE
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To My Families
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Needless to say, the errors and omissions in this dissertation are my sole
responsibility.
ABSTRACT

The objectives of this study are to analyze the effects of various government policies and external shocks on the movement of equilibrium real exchange rates under conditions of financial repression. Two main topics are addressed. First, the reaction of the equilibrium real exchange rate to trade and capital market liberalization policies, as well as to changes in government consumption, are examined under the condition of financial repression. This is undertaken in the framework of a general equilibrium intertemporal model. Second, an empirical application is provided using Korean data to test empirical implications of the theoretical model.

The proposed model of the equilibrium real exchange rates is a variant of Edwards’ (1991) model, extended to incorporate financial repression. Various comparative static analyses are undertaken and some important implications are derived. Under financial repression, the effects of government policies, including liberalization policies and expenditure changes, may result in real exchange rate changes that are contrary to the conventional wisdom. Deregulation of interest rates in the presence of other distortions may also generate a result contrary to the traditional wisdom.

Empirical studies using Korean quarterly data over the past 24 years (1970 - 1993) support some implications derived in the comparative static analysis. The empirical model find that in Korea, since 1980, trade liberalization effect on the real exchange
rate has been changed, from real depreciation to ambiguity. This implies that trade liberalization under financial repression may not result in a real depreciation, contrary to the conventional wisdom.

The results of the theoretical work and the empirical estimation suggest a number of policy implications for Korea and other developing countries. First, a developing country under financial repression should anticipate the effect of each economic liberalization measure on the real exchange rate which may be different than that of previous studies. Based on an understanding of this anticipated effect, each developing country should attempt to find a countermeasure in order to avoid an unwanted misalignment of the real exchange rate. Especially, in Korea, it is necessary to analyze the anticipated effects in detail to cope with the accelerated financial liberalization scheduled in the near future.
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CHAPTER 1
INTRODUCTION

Since the advent of the generalized floating exchange rate system in 1973, real exchange rates between major industrial countries have been very volatile. Various structural models based on the recent theoretical framework — the monetary approach (in flexible-price, sticky price, and real interest differential formulations), the macroeconomic model in the tradition of Mundell-Fleming, the new classical approach and the equilibrium approach — have been proposed to explain this exchange rate volatility. However, none of these approaches gives a truly satisfactory explanation of exchange rate volatility under a floating exchange rate system (Dornbusch, 1989). Furthermore, some recent studies argue that the exchange rates in developed countries follow a random walk. In developing countries, given the fluctuations in the exchange rates of major currencies, the authorities have adjusted the nominal exchange rates of their currencies more frequently than in the past to cope with external shocks and higher inflation within these countries. Despite adjustment of nominal exchange rates, many developing countries have also experienced serious fluctuations in real exchange rate due to a variety of adverse external shocks such as oil price swings.

In developing countries, standard exchange rate determination theories under a floating exchange rate system can not be applied directly, because these countries are still using the managed floating exchange rate system or currency peg system. There are two main approaches in the exchange rate policy in developing countries (Corden, 1990). One is the "nominal anchor approach," which used to be known as international monetarism. This
approach is based on the purchasing power parity (PPP) theory that the exchange rate anchors the domestic inflation rate to the inflation rate of trading partner countries.\(^2\) The other is the "real target approach," based on the Keynesian view that the nominal exchange rate can be and should be used together with other policy instruments as an instrument to attain real objectives.\(^3\)

There is theoretical support for each respective approach. However, as the monetary approach lost the ability to explain exchange rate fluctuations due to economic liberalization process of the Southern Cone countries (Argentina, Chile and Uruguay), many developing countries have tried to use the real exchange rate as the important policy variable. Many institutions including the International Monetary Fund (IMF) and the World Bank also suggest a real target approach. In a small open economy, a stable real exchange rate can achieve and maintain international competitiveness and so ensure a viable balance of payments which is essential for economic growth. Recently, Cottani et al. (1990) and Ghura and Grennes (1993) show some empirical evidence that many developing countries that experienced high real exchange rate volatility have suffered from higher levels of macroeconomic instability and lower rates of economic growth. To the extent that for many developing countries, the balance of payments is a binding constraint, their exchange rate policy needs to be aimed at protecting external competitiveness. This competitiveness can best be assessed by the real exchange rate movements. Therefore, many developing countries use the real exchange rate as an important policy variable to achieve macroeconomic goals such as income and employment growth. (Aghevli et al., 1991, Kim, 1992). Accordingly, a growing body of theoretical and empirical studies have attempted to explain the behavior of the real exchange rates in developing
countries since the 1980s, especially since a number of developing countries attempted to alter their economic structure through economic liberalization. Most studies were focused on determination of the real exchange rates and on the effects of monetary and real factors. However, these studies have passed over the condition of the domestic financial market, which might play an important role in real exchange rate determination.

Previous studies have not considered the existence of financial repression (government controls on interest rates in the domestic financial market) which is a typical stylized fact in developing countries. Financial repression exists both in the countries which have failed to complete financial deregulation such as some Southern Cone countries, and also, to a certain degree, in countries which have supposedly been successful in financial deregulation. Financial markets in developing countries are still underdeveloped and their financial prices are distorted by policy-induced restrictions. The World Bank World Development Report (1989) noted that in these financially repressed economies relatively few types of financial assets are available to economic agents. The report also noted that interest rates are controlled or strongly influenced by the government in these countries.

Financial repression and the existence of underdeveloped financial markets in developing countries can play important roles in determining the behavior of real exchange rates. Under the condition of repressed domestic interest rates, the discount rate for consumption should be increased by low deposit rates. On the contrary, the discount rate for production should be decreased by high marginal loan rates. These changes distort the intertemporal allocation of consumption and production. These distortions provide a different channel through which various government policies and external shocks affect the real exchange rate. The mechanism
is different than that which is predicted under the standard model which considers only well-functioning financial markets. Under financial repression, distortions have an additional impact on the equilibrium real exchange rate, which can operate in a direction opposite to the impact which appears in the standard model.

The purpose of this dissertation is to analyze the effects of the various government policies and external shocks on the movement of equilibrium real exchange rates under conditions of financial repression.

In this dissertation, the focus is on how the equilibrium real exchange rate can be affected, theoretically and empirically, by introducing financial repression within an endogenous real exchange rate model based on Edwards (1989, 1991). Two main topics are addressed in this study. First, we examine how the existence of financial repression impacts the equilibrium real exchange rate adjustment to both external shocks and various government policies. These include trade and capital market liberalization policies, as well as fiscal policy. This is all done in the framework of a general equilibrium intertemporal model. Second, we test some of the empirical implications of this theoretical model for the case of Korea.

After rapid growth during the 1960s - 1970s, the Korean economy experienced structural adjustment in the early 1980s. Since then, monetary and fiscal policies have been adopted which are not as expansionary as earlier policies. Tight control has been maintained on money supply growth. The increase in government expenditures and fiscal deficits have also been limited. At the same time, the Korean government has implemented economic liberalization policies, which include relaxation of trade controls, as well as the promotion of capital and domestic financial markets. Most significant has been the substantial relaxation of trade
controls during the past decade. Interest rate deregulation, the main feature of the domestic financial market liberalization, has been slow and delayed. Government control of the domestic interest rates – financial repression – has been maintained. Under financial repression, the Korean economy has been subject to highly volatile fluctuations in real exchange rates even though these fluctuations have not been as severe as those experienced by the Southern Cone countries.

In Korea, the stabilization of the real exchange rate to maintain competitiveness has been the main concern. The Korean economy relies heavily on exports. In the early stage of development, throughout 1960s - 1970s, export-oriented policy was emphasized under the fixed or single peg system. Since the 1980s, the Korean government has adopted a real target approach with the introduction of a managed floating exchange rate system. In spite of the changes in the exchange rate system, stabilization of the real effective exchange rate remains a principal goal of Korea’s foreign exchange rate policy. The authorities have also sought to improve the current account balance. Nam (1993) shows that in Korea there is a close relationship between the movement of real effective exchange rates and the growth rates of real exports over the past thirty years (1962 - 1991). Nam also shows that Korea’s economic growth has been dependent on the rapid growth of exports under an outward orientation.

Here, we shall clearly establish an implication of the model by showing a different channel through which policy changes affect the real exchange rate under financial repression. This finding carries some policy implications which should be communicated to the developing countries that are promoting liberalization policies. We shall proceed as follows: In Chapter 2, we perform a review of the literature on real exchange rate determination. We discuss both
theoretical and empirical studies. In Chapter 3, we present a theoretical framework from which comparative static results are derived. In Chapter 4, we provide the Korean experience, exchange rate movement and policy changes. We also review the financial structure and studies of exchange rate determination in Korea. In Chapter 5, empirical estimation of real exchange rate determinants in the case of Korea is provided. In Chapter 6, concluding remarks are provided.
ENDNOTES


2 That is, the exchange rate is adjusted on the basis of some predetermined scale to affect the inflation differential with trading partner countries, and it constrains domestic monetary policy.

3 Such as an appropriate (non-inflationary) level of demand for home-produced goods and services (internal balance) and desired current account target.
CHAPTER 2

REVIEW OF LITERATURE ON THE REAL EXCHANGE RATE DETERMINATION

2.1 Concepts of the Real Exchange Rate

There have been a number of alternative definitions of the real exchange rate in the economic literature. Although the real exchange rate is always defined as a relative price which indicates the external competitiveness of a country, there are some disagreements on which relative price should be called the real exchange rate. In this section, we review the three important definitions of the real exchange rate.

Traditionally the real exchange rate is based on the concept of purchasing power parity (PPP). In this context, the real exchange rate is basically the nominal exchange rate corrected by the ratio of the foreign and domestic price level. The real exchange rate in the context of PPP is defined as:

\[ RER = E \times \left( \frac{P^*}{P} \right) \]  \hspace{1cm} (2.1)

where

- \( RER \) is the real foreign exchange rate
- \( E \) is the foreign exchange currency price in nominal terms
- \( P \) is the index of domestic price levels
- \( P^* \) is the index of foreign price levels
In the literature, different proxies have been used for \( P^* \) and \( P \). Edwards (1988b) noted that four alternative price indexes have been traditionally suggested as possible candidates for the construction of a PPP-based real exchange rate: (a) consumer price indexes (CPIs) at home and abroad, (b) wholesale price indexes (WPIs), (c) GDP deflators, and (d) wage rate indexes. In most instances it has been suggested to use the same index for the foreign and the domestic country respectively. Edwards (1988b) also noted that the most commonly used index of the real exchange rate based on PPP is that constructed using both foreign and domestic CPIs as the relevant price indices.

Recently many authors including Dornbusch (1974, 1980), Frenkel and Mussa (1984) and Neary and Purvis (1983) have defined the real exchange rate in the context of models of dependent economies, as the relative price ratio between tradable and nontradable goods. Assuming that the law of one price holds for tradables and that there are no taxes on trade, the real exchange rate is defined by these authors as:

\[
\text{RER} = E^*(P^*_t / P_n) \tag{2.2}
\]

where \( P^*_t \) is the world price of tradable goods

\( P_n \) is the domestic price of nontradable goods

The central postulate of this definition is that the relative price ratio \((P^*_t / P_n)\) represents the domestic cost of consuming and producing tradable goods. Thus, the ratio is a summary measure of the incentives guiding allocation between the two major sectors of an economy.
When the price of tradable goods rises in relation to nontradable goods, consumers have less incentive to consume tradable goods while producers have increased incentives to produce tradable goods. The increase in the relative prices results in a decrease in the demand for tradable goods and a rise in the supply of tradable goods. Starting from an equilibrium position, a rise in the real exchange rate means that there is a new incentive to produce more tradable goods in the domestic economy. The real exchange rate in this context then, can be considered as the degree of competitiveness of the tradable goods sector of the domestic economy. An increase in the nominal exchange rate is considered to be an increase in the real exchange rate (real depreciation) if the price of nontradable goods is not immediately brought into line with that of tradable goods. In this case, this country has an advantage of external competitiveness, which leads to an improvement in the current account.

This definition of an alternative real exchange rate has become quite popular recently. However, when we use this definition, we face a more difficult measurement problem. Namely, what are the appropriate proxies for the price of tradables and nontradables. This is because all countries do not formulate price statistics based on this classification, tradables and nontradables. We can not directly measure the price of tradables and nontradables. Some authors such as Harberger (1986) and Diaz-Alejandro (1986) have suggested using the domestic consumer price index (CPI) as a proxy for the price of tradables, and a foreign wholesale or producer price index (WPI or PPI) as a proxy for the world price of tradables.

On the other hand, another definition of the real exchange rate is suggested by Harberger (1986). He employed the real exchange rate as the nominal exchange rate deflated by the general domestic price index.
\[ \text{RER} = \frac{E}{P_d} \]  \hspace{1cm} (2.3)

where \( P_d \) is the general domestic price index.

Harberger argues that when the real exchange rate is defined as \( E/P_d \), identical methods to analyze the effects of disturbances on the real exchange rate can be applied whether a country is operating under a fixed or flexible exchange rate regime. Harberger argues that the concept \( E/P_d \) is exceedingly robust. That is, using it, one can handle essentially all types of disturbances originating in the domestic economy and basically any relevant disturbance originating abroad. And he notes that the only flaw in using \( E/P_d \) as the general and definitive concept of the real exchange rate is the fact that its equilibrium value falls when there is general world inflation.\(^3\)

2.2 Determinants of the Real Exchange Rate

In this section, we review the theoretical models for real exchange rate determination since the adoption of the floating exchange rate system. We also review the empirical studies that focus on recent real exchange rate fluctuations.

2.2.1 Theoretical Models

Recent experience of real exchange rate volatility brought forth some new theoretical explanations of real exchange rate determination. Theoretical models on the determination of the real exchange rate vary with the different concepts of the real exchange rate. The
Monetary Approach with Sticky Prices (so-called disequilibrium approach) is frequently used to explain movements in the real exchange rate based on the PPP concept.

According to this Monetary Approach with Sticky Prices, a change in the real exchange rate occurs in response to changes in the nominal exchange rate because of slow nominal price adjustment. That is, the interaction of monetary shocks and sticky nominal prices creates an implied variability in the real exchange rate. Dornbusch (1976) presents a theoretical model based on this approach. Dornbusch argues that the interaction of nominal shocks with price stickiness in the goods market is a potentially important source of the variation in real exchange rates. Dornbusch explains that initial changes in real exchange rate due to sluggish price adjustment are reversed subsequently as nominal prices reach a new equilibrium level. Mussa (1984) presents a similar model which illustrates the phenomenon of exchange rate overshooting in response to monetary disturbances which induce temporary disturbances from PPP. Frankel (1979) developed a general monetary exchange rate model that accommodates the flexible price and sticky monetarist models as special cases. Hooper and Morton (1982) developed a model of exchange rate determination by extending the Dornbusch - Frankel model to allow for large and sustained changes in real exchange rates. Based on the Sticky Price Monetary Approach, they tried to relate changes in the real exchange rate to changes in the current account through the mechanism of expectations and changes in the risk premium.

The Monetary Approach with Sticky Prices assumes PPP is valid in the long run for nominal shocks, but in the short run, monetary induced deviations from PPP occur. This approach implies that nominal changes, such as changes in the nominal exchange rate, can
change the real exchange rate. By implication, then, the relationship between nominal and real exchange rate changes are exploitable by governments.

In line with this, as the evidence of deviations of the real exchange rate from PPP is widely accepted not only in the short-term but also in the long-term, some of the literature argues that long-term deviation of real exchange rate from PPP is inherently governed by real disturbances. Productivity differentials between the tradable and non tradable sectors have been recognized as a primary factor to induce the change in real exchange rate. That is, if productivity in the tradable sector grows more rapidly than in the non tradable sector, the price of nontradables rises more than the price of tradables. The productivity differential model was formulated first by Balassa (1964) and has been extended by many authors. Bhagwati (1984) provides the theoretical justification for the assumption made in Balassa's model: productivity grows more rapidly in the traded sector than in the non traded sector.

On the other hand, alternative explanations of the real exchange rate behavior were developed. These explanations frame the issue in terms of general equilibrium models in which nominal prices are flexible. This approach is best articulated by Stockman (1980, 1983, 1987).

Stockman objects to the underlying rationale of the disequilibrium theory of real exchange rate determination. He does not see the real exchange rate as an exogenous variable, nor does he see an exploitable relationship between nominal and real exchange rates. He presents an equilibrium approach to explain real exchange rate behavior that explicitly considers the endogenous character of the real exchange rate. His concept differs considerably from the PPP concept used in the disequilibrium approach discussed previously. That is, the real exchange rate is determined in real equilibrium, while the nominal exchange rate is determined as part of
the monetary equilibrium. Stockman employs a real exchange rate concept that defines it as the relative price of foreign goods in terms of domestic goods, which is elsewhere known as the terms of trade. Despite the controversy about the appropriate real exchange rate concept, Stockman's research yields several important implications supporting the hypothesis that the real exchange rate is an endogenous variable.

Neary (1988), assuming optimizing consumer and producer behavior with regard to an objective function, derives the determinants of the equilibrium exchange rate, defined as the relative price of nontradables to tradables. Neary's approach differs from the other concepts in that he explicitly assumes optimizing consumer and producer behavior with regard to an objective function. His model assumes a small open economy producing tradables and nontradables in the context of balance of payments equilibrium. Assuming that prices for tradables are exogenous, the price ratio of nontradables to tradables will increase, i.e., the real exchange rate will appreciate, if any of the following exogenous shocks to the economy's real variables occur: (a) foreign aid is received that is production neutral, (b) a sector-specific boom occurs in an isolated tradables sector (Dutch Disease Effect), (c) terms of trade improves, with tradables being substitutes, (d) higher income is experienced in the home country relative to that in foreign countries, with international productivity differentials being smaller in the production of nontradables compared to the production of tradables.

Edwards (1988a, 1989, 1991) presents a dynamic general equilibrium model of real exchange rate determination. In this model, the real exchange rate is defined as the price ratio between tradables and nontradables. He assumes a small open economy producing import substitutes, exportables and nontradables. He further assumes perfect foresight for optimizing
economic agents and that the current account balance in the long run is zero. Duality theory reveals how changes in economic fundamentals such as the external terms of trade, controls on capital flows, and exchange and trade controls etc., will affect the equilibrium value of the real exchange rate. Edwards distinguishes between temporary and permanent, and also between anticipated and unanticipated shocks. From these studies, Edwards shows that using the intertemporal framework, the equilibrium real exchange rate can exhibit behavior which contradicts the traditional wisdom. Thus, it is not possible to predict the direction of real exchange movements in response to exogenous shocks without further assumptions about substitutability of demand among goods. In line with this, Edwards (1988c) proposed a dynamic model of real exchange rate determination with a dual nominal exchange rate system as the complementary model of the general equilibrium model discussed above. This model allows for both real and nominal factors to play a role in the short-run. In the long-run, however, only real factors – the 'fundamentals' – influence the equilibrium real exchange rate. This model provided a number of important insights regarding the relation between macroeconomic policies, real exchange rate misalignment, and devaluations, and thus, has important testable implications. Khan and Ostry (1992) analyzed the effects of the fundamental exogenous disturbances, mainly terms of trade movements and commercial policy changes on the equilibrium real exchange rate using a simple dependent - economy framework. Using this framework, they presented rough estimates of the magnitude of such effects, which should be relevant in designing real exchange rate policy in general, and in the formulation of real exchange rate rules in particular.
2.2.2 Empirical Studies

The foregoing theories of real exchange rate determination spawned many empirical studies which attempted to explain the real exchange rate behavior. First, Buiter and Miller (1981) tried to analyze the consequences of policy actions of the United Kingdom on international competitiveness and national output by adapting Dornbusch's model. They argued that since the foreign currency market is an efficient market in the short run there will be changes in the real exchange rate as a result of monetary shocks to the system. Hooper and Morton (1982) also attempted to explain real exchange rate movements with the Sticky Price Monetary Approach with another extension of the Dornbusch - Frankel model. They related changes in the equilibrium real exchange rate to the cumulative first difference of the current account balance and a time trend. The result shows that, considering a sample period of 1973:4 - 1978:4, the cumulative first difference of the current account balance is shown to have a significant negative effect on the U.S. effective real exchange rate, and that an increase in the trade or current balances cause a real appreciation of the U.S. dollar.

Some empirical studies to examine the productivity bias in PPP were undertaken by Officer (1976) and Hsieh (1982). Officer (1976) undertook the test for the existence of the bias as well as its magnitude using cross - sectional data for fifteen countries over the period of 1950 - 1973. His study showed no evidence of the bias. On the contrary, Hsieh (1982) examined the productivity bias hypothesis using annual time series data for the major seven developed countries over the period 1954 - 1976, and found supporting results.
In line with this, Huizinga (1987) analyzed the series of monthly bilateral exchange rates of the eleven industrial countries over the period of 1974-1986 by applying spectral analysis. He found evidence that there is in fact a long-run tendency for real exchange rates to revert to a constant value. He suggests PPP is a useful anchor for long term exchange rate expectations. Coughlin and Koedijk (1990) examined bilateral long-run real exchange rate behavior between four major developed countries over the period of June 1973 - June 1988. They attempted to analyze the real exchange rate with three different approaches, two real approaches and a monetary approach. The first real approach is concerned with movements in the real exchange rate that arise from incorporating the difference between tradable and non tradable goods prices. The other real approach deals with the implications of incorporating a balance of payment constraints. The monetary approach, in contrast, focuses on the relationship between real exchange rates and real interest rates. Their systematic survey of the potential explanatory variables suggests that no approach to this issue is satisfactory; they conclude that little is known about the determinants of the real exchange rate in the long run.

Many empirical studies on real exchange rate behavior in developing countries were also undertaken. Wood (1988) presented an extensive explanation of long term trend in the real exchange rate for selected countries over the period 1960-84. Wood explained the trend in the real exchange rate by: the black market exchange rate discount ratio (an explanation for the difference between world market prices and domestic prices for traded goods, a consequence of commercial policy), the export volumes as share in GDP (measure of openness), the relative labor productivity, per-capita income, and the ratio of demand for non traded goods to traded goods. Wood ran an OLS regression for seventy nine countries applying alternative subsets of
the explanatory variables listed in the previous paragraph. His results suggest that any increase in any of the explanatory variables results in a real exchange rate appreciation. Though Wood's estimations achieve a respectable degree of significance, his explanatory variables do not serve as appropriate proxies for underlying real economic conditions.

Most of the empirical work on the developing countries has concentrated on examining the relative importance of two types of variations, monetary factors and real factors. The monetary variables have included an index of money supply growth, growth of domestic credit, an index of domestic inflation, and an index of the volatility of nominal exchange rate policy. The real or structural variables include an openness index, which reflects capital mobility, terms of trade, and real growth in GNP.

Yuravlivker (1982) found that, for a group of four developing countries, the real exchange rate was affected positively by the instability of the nominal exchange rate. Melvin and Bernstein (1984) analyzed the role of real factors only on real exchange rate variability. Using cross-country data for eighty seven countries, they regressed a measure of variability of a bilateral real exchange rate against an index of export concentration and a measure of a country's degree of openness. They found that the coefficients of these two variables are significantly positive.

Diaz-Alejandro (1984) regressed the real exchange rate on four variables including the terms of trade, imports over exports (a proxy for capital flows), a maxi dummy (for nominal devaluations) and a maxi dummy lagged. The regressions were estimated for Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela. Edwards (1986a) attempted to explain the behavior of the real exchange rate in Chile 1973-1983 by running reduced form regressions
using quarterly data. The main variables involved were the net capital flows, terms of trade, and devaluations. In these regressions, the net capital inflow was the only variable that was significant and had a negative impact on the real exchange rate. Calvo (1986) explained the appreciation of the real exchange rate in Argentina during 1976-80 as resulting from monetary and banking reforms rather than the tablita type policies.

Edwards (1987, 1988c, 1991) attempted to explain the behavior of the real exchange rate with monetary and real factors. Edwards (1987) has tested the effects of real and monetary variables on the real exchange rate taking into account the short-run effects for a large group of developing economies. The structural factors involved were: an openness index, a measure of variability of the terms of trade, and a proxy for real GDP growth. The monetary variables involved were: an index of money growth instability, an index of domestic credit growth, an index of volatility of domestic inflation, and an index of volatility of nominal exchange rate policy. The test was conducted on thirty countries. The results obtained, using a GLS procedure on cross-sectional data, indicate that real exchange rate variability was affected by both real and monetary factors. Later he (1988c, 1991) analyzed the real exchange rate with a dynamic model of real exchange rates in developing countries. In this paper, he incorporated the government sector (government consumption and fiscal deficit ratio) and capital inflows in addition to the variables he considered in his previous studies. The dynamic equations were estimated using pooled data for a group of twelve countries. The results obtained provide broad support for his theoretical model. That is, in these countries, short-run real exchange rate movements have responded to both nominal and real disturbances. In particular,
expansive and inconsistent macroeconomic policies have inevitably generated forces towards real overvaluation.

In a separate paper, Edwards (1986b) tested the effect of an export boom, caused by an increase in coffee prices, on the real exchange rate for Colombia. A rise in the price of coffee is expected to increase the money supply, through increasing the trade surplus, the inflation rate, and the rate of devaluation. This, in turn, will cause the real exchange rate to appreciate. The system was tested using two- and three-stage least squares for the years 1952-80. The results for the exchange rate adjustment equation were less than satisfactory. The estimation, however, indicates that, other things equal, a change in coffee prices will result in substantial changes in inflation, the rate of devaluation, and will cause real appreciation. The resulting real appreciation will materialize through the money creation and inflation channels. Matin (1992) examined the effect of changes in public expenditure composition on the real exchange rate using annual data for Bangladesh. The estimation result shows that the propensity to spend on nontradables is greater for Bangladesh’s public expenditure relative to private expenditure and for government’s current expenditure relative to capital expenditure. They also show that cuts in capital expenditure in the face of rising current expenditure shifts the composition of total public expenditure towards nontradables and tends to appreciate Bangladesh’s real exchange rate.

Cottani, Carvallo and Khan (1990) analyzed the real exchange rate behavior of two groups of twelve low and high income developing countries. The model is similar to that of Edwards (1988c), but they do not consider government expenditure on nontradables in their estimations. They also proxy a time trend to capture the contribution of technological change to growth.
With regard to the results obtained by Cottani, Cavallo and Khan (1990), some coefficients have unexpected signs. Most of these are insignificant, however.

Krumm (1993) analyzed the role of structural factors that include terms of trade, external capital flows, trade policy, and other factors relevant to the circumstances of individual countries such as import intensity of the industry, to explain the variability of the real exchange rate. Krumm also considered short-run monetary and exchange rate factors. The regressions were estimated for Philippines and Tanzania. In these regressions, in the case of the Philippines, terms of trade, trade liberalization, capital flows and short-run monetary variables were all significant. However, in the case of Tanzania, only external capital flows were significant.
Table 2.1 Previous Major Empirical Studies of Real Exchange Rate Determinants

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Notes: The sign in parenthesis suggests the sign of the coefficient derived in estimation.

a: Domestic credit growth - GDP growth - devaluation - foreign inflation.
b: Use GDP/(exports + imports).
c: Use exports/GDP.
ENDNOTES

1 A key element underpinning relative PPP is that commodity arbitrage will, at any given level of the exchange rate, equalize over time, the price of traded goods across countries after due allowance is made for transactions costs and tariffs.

2 Wickham (1993) noted that the popularity of this concept can be traced to the fact that for most small open economies, the price of tradable goods can be considered to be exogenously given in foreign currency terms (with the nominal exchange rate translating these prices into domestic currency terms). In addition, in the analysis of certain policy issues, such as the repercussions of domestic policy for internal and external balance, the two sector framework is extremely useful.

3 This is because the only channels through which foreign disturbances would enter the picture are movements of capital and changes in the world prices of tradable goods and services.

4 They used the following five variables, all of which are differences between countries: the ratios of wholesale to consumer prices (\(PW/PC - PW*/PC*\)), the real per capita gross national products (\(GNP - GNP*\)), the cumulated current account (TB -TB*), short-term interest rates (RS -RS*), and long-term interest rates (RL -RL*). However, results are not satisfactory because most of the real exchange measures are nonstationary, and because the real exchange rate and most of its measures are not cointegrated.
CHAPTER 3
THEORETICAL FRAMEWORK

3.1 Overview

The theoretical framework to be analyzed here is based on an approach that explains the real exchange rate determination in terms of general equilibrium models in which nominal prices are flexible. The real exchange rate, which is treated as a relative price, is determined in the real equilibrium. The nominal exchange rate, on the other hand, is determined as part of the monetary equilibrium.

Based on the existing intertemporal real model of real exchange rate determination, we extended the analysis to reflect the actual situation of domestic financial markets in developing countries.

This chapter is organized as follows: In section 3.2, the model which will be used for analyzing real exchange rate behavior in the subsequent section is derived. Starting with a simplified basic model based on Edwards’ model (1991), we derive a small open economy general equilibrium intertemporal model incorporating a number of real distortions, including financial repression, controls on capital flows, and trade. Government consumption is also considered. In this section, the concept of equilibrium real exchange rate and the modeling strategy for simplified analyses are also discussed. In section 3.3, comparative static analyses that focus on the reaction of the equilibrium real exchange rates to financial repression and to various government policies under financial repression is provided.
3.2 The Model

The model to be presented is primarily based on Edwards' (1991) model, an optimizing intertemporal real model of a small open economy. Using duality theory, we have incorporated Kähkönen's (1987) analysis, with some extensions to reflect financial repression. We also extend the government sector, when combining these two models, in consideration of the governments' tendency to play an important role in developing countries.

3.2.1 Basic Model

Using Edwards' (1991) model, we assume no distortion and composite tradable goods to derive equilibrium conditions in a distortionless world. Consider a two-period, small open economy comprised of a large number of profit maximizing firms that produce three goods: exportables (X), importables (M), and nontradables (N). All sectors use standard technology under perfect competition. It is assumed that there are more factors than tradable goods so that factor price equalization does not hold. It is assumed that each sector uses capital, labor and natural resources. The economy invests in physical capital in the first period (the short-run) and this investment enhances productive capacity in the second period (the long-run). Other factors are supplied inelastically in both periods.

With respect to preferences, it is assumed that the utility function is weakly separable, with the subutility function in each period being identically homothetic.
There are only two agents in the economy: households and firms. Households live two periods and consume traded goods and nontraded goods in both periods. Households spend their entire income in periods 1 and 2 by consuming both tradable and nontradable goods, in order to maximize the households’ utility in both periods.

Here we assume that there are no import tariffs, and that the international prices of $X$ and $M$ do not change. These two goods, thus, can be aggregated into a composite tradable good ($T$). The price of tradables is taken as numeraire.

Households face a lifetime budget constraint of the form:

$$c_{1T} + f_i c_{1N} + \delta (c_{2T} + f_i c_{2N}) = y^{1} + \delta y^{2} = y$$  \hspace{1cm} (3.1)

where

$c_{ij} =$ consumption of good $j$ in period $i$, with $i = 1, 2, j = T, N$

$f_i =$ the price of nontradables relative to tradables in period $i$

( inverse of the real exchange rate)

$\delta = 1/(1+r)$, the consumers' discount factor

$y^{i} =$ households' income in period $i$

$y =$ the present value of lifetime income

Consumer behavior is described with the expenditure function, defined as the minimum expenditure required to attain the target level of utility at given prices. Following Edwards (1991), we derive the expenditure function which is dual to the utility function. That is, any concept defined in terms of the properties of the expenditure function has a "dual" definition in
terms of the properties of the utility function and vice versa. This expenditure function can be written as a function of prices and utility. (see Varian, 1992, Dixit and Norman, 1980):

\[ E = E \left[ 1, f_1, \delta^*1, \delta^*f_1; w \right] \quad (3.2) \]

With the assumption of a weakly separable intertemporal welfare function, and with each period's subutility homothetic, the expenditure function can be written as:

\[ E = E \left[ \pi^1(1, f_1), \delta \pi^2(1, f_2), w \right] \quad (3.3) \]

where \( \pi^1 \) and \( \pi^2 \) are the exact price indices for period 1 and 2, and are interpreted as unit expenditure functions. (For a derivation of this expenditure function, see Svensson and Razin, 1983.)

The expenditure function has several convenient properties. It is increasing in prices, concave and homogeneous of degree one in prices. The partial derivatives of the expenditure function with respect to prices are equal to the respective compensated (Hicksian) demand functions, \( c^*_j \):

\[ E_1^1 = E_m \pi^1_1 = c^*_T [\pi^1(1, f_1), \delta \pi^2(1, f_2), w] \]
\[ E_1^2 = E_m \pi^2_1 = c^*_N [\pi^1(1, f_1), \delta \pi^2(1, f_2), w] \]
\[ E_2^1 = E_m \pi^1_2 = c^*_T [\pi^1(1, f_1), \delta \pi^2(1, f_2), w] \]
\[ E_2^2 = E_m \pi^2_2 = c^*_N [\pi^1(1, f_1), \delta \pi^2(1, f_2), w] \]
where each subscript represents the partial derivative with respect to its argument, and each superscript represents the period. The derivatives of $\pi_1^i$ and $\pi_2^i$ can be interpreted as expenditure shares of tradables and nontradables in period $i$ ($i = 1, 2$), because the $\pi$'s are unit expenditure functions. By concavity, the second derivatives of $E$ are negative ($E_{nn}, E_{nn} < 0$), reflecting the fact that the demand curves slope downward. Given the assumption of a time separable utility function, expenditures in period 1 and 2 are substitutes, implying that all intertemporal cross elasticities are positive.

Firms produce tradable and nontradable goods in both periods and invest in the first period. For simplicity it is assumed that only tradables are used in investment.

The production side of the model is characterized by revenue functions that give us the maximum revenue that optimizing firms obtain from producing tradables and nontradables subject to given prices, factors production and technology. The revenue functions can then be written in the following way:

\begin{equation}
R^1 (1, f_1) \quad \text{and} \quad R^2 (1, f_2; K + I)
\end{equation}

This is the maximized value of revenue in each period in terms of tradables where the exogenous supplies of labor and natural resources have been omitted. $K$ is the initial capital stock, and $I$ is investment. The revenue functions are dual to the production technology, which has a number of convenient properties. First, their derivatives with respect to prices yield the corresponding supply functions. (see Dixit and Norman, 1980).
\[ R^1_i = Q^i_T(1, f_i) \quad \text{and} \quad R^2_i = Q^i_N(1, f_i) \]

\[ R^1_1 = Q^1_T(1, f_1) \quad \text{and} \quad R^{2_1} = Q^2_N(1, f_1; K+I) \]

\[ R^2_1 = Q^2_T(1, f_2; K+I) \quad \text{and} \quad R^{2_2} = Q^2_N(1, f_2; K+I) \]

where \( Q^i_T \) and \( Q^i_N \) represent the supply function for tradables and nontradables in period \( i (i = 1, 2) \) respectively. Second, under the assumption of convex technology, the revenue functions are convex, which implies that \( R^1_{1i} = \frac{\partial Q^1_N}{\partial f_i} > 0, \quad R^1_{11} > 0, \quad R^2_{11} > 0, \quad R^{2_2} > 0 \). That is, supply curves slope upward.

Investment decisions are governed by the condition that in equilibrium, the Tobin “q” equals 1. Investment is an increasing function of \( q \), the shadow price of capital. In equilibrium, the rate of investment is zero, the shadow price of capital must therefore be equal to its replacement cost, that is \( q = 1 \).

\[ \delta R^2_K (1, f_2; K+I) = 1 \]  \hspace{1cm} (3.5)

The investment function can then be defined implicitly as

\[ I = I(1/\delta) \quad I_{1i} < 0 \]  \hspace{1cm} (3.6)

In general equilibrium, it must be that the present value of the households’ expenditure equals the present value of the households’ lifetime income.

\[ E [\pi^i(1, f_i), \delta \pi^2(1, f_2), w] = y^1 + \delta y^2 = y \]  \hspace{1cm} (3.7)
The households' budget constraint can be written as

\[ E[(\pi(1, f_1), \delta \pi(1, f_2), w)] = R^1(1, f_1) + \delta R^2(1, f_2; K + I) - I(1/\delta) \]  

(3.8)

In addition to the households' budget constraint, internal equilibrium also requires that the nontradable goods market clears in each period. That is, in each period, the quantity supplied of nontradables has to equal the quantity demanded.

\[ E_n[\pi(1, f_1), \delta \pi(1, f_2), w] = R^1_n(1, f_1) \]  

(3.9)

\[ E_\delta[\pi(1, f_1), \delta \pi(1, f_2), w] = R^2_\delta(1, f_2; K + I) \]  

(3.10)

Equations (3.8) - (3.10) summarize the behavior of all the agents in this simple model.

3.2.2 General Model

The simplified basic model discussed above assumed a distortionless world. However, in an actual economy, there are many distortions. We will now introduce some distortions into the above basic intertemporal model.

As in Edwards' (1991) work, controls on trade and capital flows, and changes in the composition of government expenditures are considered. In addition, domestic interest rate control (financial repression) is introduced.
In order to keep the exposition tractable a number of further assumptions are made. Here we consider four agents in the economy: households, firms, banks, and the government. Households live two periods and consume importables, which are subject to specific tax (tariff), exportables, and nontraded goods in both periods. It is assumed that bank deposits are the only form of saving available to households and that the interest rate on deposits ($r_D$) is below the world market level ($r^*$). The marginal domestic loan rate ($r_L$) is above the world market interest rate ($r^*$) because of capital controls, represented by a tax on transactions in the world capital market. The government also consumes both tradables and nontradables. Government consumption is financed from the proceeds of import tariffs, non distortionary lump sum taxes, and the taxation of foreign borrowing by the private sector. It is assumed that the government is not subject to the tax on foreign borrowing. We set the price of exportables ($X$) as the numeraire, since there are no taxes on exportables, its price is equal to one both at home and abroad.

Households face a lifetime budget constraint, measured in exportables, of:

$$c_1^X + p_1 c_1^M + q_1 c_1^N + \delta_D (c_2^X + p_2 c_2^M + q_2 c_2^N) = y^1 + \delta_D y^2 = y$$  \hspace{1cm} (3.11)$$

where $p_i$ : the domestic price of importables relative to exportables in period $i$

\begin{align*}
(p_1 &= p_1^* + \tau_1, \quad p_2 = p_2^* + \tau_2 \quad \text{where } p_i^* \text{ is the world market relative price of } M, \text{ and } \tau_i \text{ is the tariff in period } i) \\
q_i : \text{the price of nontradables relative to exportables in period } i
\end{align*}

$\delta_D = 1/(1 + r_D)$: the consumers' discount factor

where $r_D$ is the real interest rate on deposit in terms of exportables
The first period savings are

\[ S = y^1 - c^1_X - p_1c^1_M - q_1c^1_N > 0 \]  \hspace{1cm} (3.12)

The expenditure and revenue functions can be written as

\[ E = E[\pi^1(l, p_1, q_1), \delta_0\pi^2(l, p_2, q_2), w] \]  \hspace{1cm} (3.13)

\[ R^1(l, p_1, q_1) \quad \text{and} \quad R^2(l, p_2, q_2; K+I) \]  \hspace{1cm} (3.14)

These expenditure function and revenue functions have the properties discussed in section 3.2.1 respectively.

In this model, investment is financed entirely by loans, at the interest rate \( r_L \), which is above the world market interest rate, \( r^* \), because of capital controls. Investment will take place until period two marginal productivity of capital discounted by the domestic discount factor equals 1. For simplicity it is also assumed that only exportable goods, \( X \), are used in investment.

The investment function can then be defined as

\[ I = I(1/\delta_L) \quad I_{1/\delta_L} < 0 \]  \hspace{1cm} (3.15)

The banking system, which is controlled by the government, receives deposits from households at the interest rate \( r_D \), borrows abroad at \( r_L \) (the tax on capital movements is thus \( r_L \)).
The bank's profits are, therefore,

$$\pi^B = r_L I - r_D S - r_L (I - S) = (1/\delta_L - 1/\delta_D)S$$  \hspace{1cm} (3.16)

Bank profits are taxed by the government, and these profits are allocated to households in the second period when they are realized.

Households receive income from production and bank profits from the government as lump sum income. However, households must pay a lump sum tax ($T_i$) in each period.

Therefore, the budget constraint of the private sector can be written as:

$$E[\pi^1(1, p_1, q_1), \delta_D \pi^2(1, p_2, q_2), w] = (\delta_D/\delta_L)(R_1 - T_1 - I) + \delta_D(R_2 - T_2) - (\delta_D/\delta_L - 1)C^1$$  \hspace{1cm} (3.17)

where $C^1 = E^1_1 + p_1 E_{p_1} + q_1 E_{q_1}$, the level of first period consumption.

Government's revenue in the first period consists of revenue from tariffs and lump sum taxation as the following:

$$RG^1 = \tau_1(E_{p_1} - R^1_{p_1}) + T_1$$

where $RG^1$ is government's revenue in period 1, $\tau_1(E_{p_1} - R^1_{p_1})$ is tariff revenue in period 1 ($E_{p_1} - R^1_{p_1}$ represents net import of importables), and $T_1$ is lump sum tax in period 1.
In the second period, the government collects revenue, also from tariffs and lump sum taxation. In addition to this, the government collects revenue from capital controls by imposing tax on capital movements. Government revenue in period 2 is written as the following:

\[ RG^2 = \tau_2(E_{p2} - R_{p2}^2) + T_2 + (\tau L - r^*)(I - S) \]

where \( RG^2 \) is government revenue in period 2, \( T_2 \) is lump sum tax in period 2, and \( \tau_2(E_{p2} - R_{p2}^2) \) is tariff revenue in period 2 (\( E_{p2} - R_{p2}^2 \) represents net import of importables in period 2). Revenue from capital controls is be given by \( (\tau L - r^*)(I - S) \), where \( (\tau L - r^*) \), difference in interest rates between marginal loan rate and world market interest rate represents the tax on capital movements, and \( (I - S) \) represents amount of funds borrowed from abroad.

Therefore, government’s budget constraint can be written as

\[
G^1_X + p^*_1G^1_M + q^*_1G^1_N + \delta^*(G^2_X + p^*_2G^2_M + q^*_2G^2_N) \\
= \tau_1(E_{p1} - R_{p1}^1) + T_1 + \tau_2(E_{p2} - R_{p2}^2) + T_2 + (1/\delta L - 1/\delta^*)(I - S) \quad (3.18)
\]

where \( G^i_j = \) government consumption on \( j \) good (\( X, M, N \)) in period \( i \) (\( i = 1, 2 \))

As in the case of the private sector, the government is subject to an intertemporal constraint the discounted value of government expenditure has to equal the discounted value of revenue
from taxation. Here, the use of the world discount factor, $\delta^*$ in (3.18), reflects the assumption that in this model the government is not subject to the tax on foreign borrowing.

By substituting equation (3.12), the definition of savings into equation (3.18), we can rewrite the government budget constraint as

$$G^1_X + p^*_1G^1_M + q_1G^1_N + \delta^*(G^2_X + p^*_2G^2_M + q_2G^2_N) = \tau_1(E_{p^1} - R^1_{p^1}) + \delta^*\tau_2(E_{p^2} - R^2_{p^2})$$

$$- (\delta^*/\delta_L - 1)(R^1 - 1) + (\delta^*/\delta_L - 1)C^1 + (\delta^*/\delta_L)T_1 + \delta^*T_2$$

(3.19)

Combining the budget constraints of the private and government sector yields the economy’s consolidated constraint. This equilibrium condition is obtained by consolidating equation (3.17) and (3.19) as the following: (Derivation of this equation is given in Appendix A).

$$E[\pi^1(1,p^1,q_1), \delta_D\pi^2(1,p^2,q_2), w] + G^1_X + p^*_1G^1_M + q_1G^1_N + \delta^*(G^2_X + p^*_2G^2_M + q_2G^2_N)$$

$$= \tau_1(E_{p^1} - R^1_{p^1}) + \delta^*\tau_2(E_{p^2} - R^2_{p^2}) + (1 + \delta_D/\delta_L - \delta^*/\delta_L)(R^1 - 1)$$

$$- (\delta_D/\delta_L - \delta^*/\delta_L)C^1 - (\delta_D/\delta_L - \delta^*/\delta_L)T_1 + \delta_DR^2 - (\delta_D - \delta^*)T_2$$

(3.20)

In addition to the private sector and government budget constraints, internal equilibrium also requires that the nontradable goods market clears in each period. The quantity supplied of nontradables has to equal the sum of private and public sector demand for these goods.
The behavior of all the agents in this model can be explained by equations (3.20) - (3.22), with relevant assumptions. The endogenous variables of the model are relative prices of nontradables (inverse of the real exchange rate) in each period, $q_1$ and $q_2$ and welfare, $w$. And the exogenous variables of interest are $\tau_t$, $\tau_z$, $\delta_D$, $\delta_L$, $G^1_N$, $G^2_N$. Three endogenous variables can be solved in this three equation system. This solutions will be used for the empirical estimations in Chapter 5.

### 3.2.3 The Concept of Equilibrium Real Exchange Rate and the Modeling Strategy

The concept of the equilibrium real exchange rate in this study follows the definition employed by Edwards: it is defined as the relative price of tradables (exportables) to nontradables that, for given sustainable (equilibrium) values of other relevant variables – such as taxes, international prices, and technology – results in the simultaneous attainment of internal (i.e. nontradables sector) and external equilibrium.²

As Edwards (1991, 1989) indicated, in models with importables and exportables, the real exchange rate becomes "tricky" since the traditional concept of relative price of tradables to nontradables loses some meaning. Since, when the relative price of exportables and importables changes, we can not talk about a tradable goods composite any more. For this reason, and in order to simplify the exposition, we will focus on the relative price of
nontradables to exportables in some analyses. In particular, in the latter part of section 3.3.1, where we analyze the deregulation of the domestic financial market under trade control, and in section 3.3.3, where we discuss trade liberalization, we concentrate on the "exportables real exchange rate" (price of exportables / price of nontradables) concept. However, in the first part of the section 3.3.1 on financial repression, and in sections 3.3.2 and 3.3.4, where we discuss the relaxation of capital controls and changes in the composition of government consumption respectively, we concentrate on the more traditional relative price of tradables to nontradables ("tradable real exchange rate").

In the intertemporal model presented above, there is not one equilibrium value of the real exchange rate, but rather a vector of equilibrium real exchange rates: one for each period. Within this intertemporal framework, the equilibrium real exchange rate in a particular period is defined as the inverse value of the nontradables that, for given values of other variables (such as world prices, technology and tariffs), equilibrates the external and internal (i.e. nontradables) sectors simultaneously.

In terms of the model, the vector of equilibrium relative prices is composed of those nontradable prices that satisfy equations (3.20) through (3.22), for given values of the "fundamental" variables. An important question refers to the way in which the equilibrium real exchange rates react to different shocks including financial deregulation, changes in capital controls, tariffs, and government consumption under financial repression.

Since an analytical solution of the general model given by equations (3.20) - (3.22) is intractable, we prepared simplified versions of the general model by making some simplifying
assumptions in analyzing each case of distortion. This modeling strategy allows us to ignore aspects not essential to the question we are addressing yet will not affect the main results.

3.3 Comparative Static Analysis

In this section, we undertake comparative static analyses based on the intertemporal model developed in the previous section. Comparative static analyses focuses on the reaction of the equilibrium real exchange rates to financial repression and to the various government policies. In order to simplify the exposition, we analyze each case separately, step by step, and we use the two concepts of the real exchange rate, a "tradables" or "exportables" real exchange rate.

3.3.1 Effects of Financial Deregulation on the Real Exchange Rate

In this section, we investigate how controls or deregulation of the domestic financial market affect the equilibrium path of the real exchange rate in an intertemporal model. Financial repression (deregulation) in domestic market can be represented in the form of lowering (raising) the domestic deposit rate, \( d\delta_D > 0 \) (\( d\delta_D < 0 \)). In order to simplify the exposition, we initially assume that there are no distortions except domestic interest rate control, and that there is no government consumption. We relax some constraints in the next step. In particular, we assume there exist trade distortion and capital controls with domestic financial repression. In the first part of this section, we discuss the effects of financial repression, and in the second
part, we discuss the effects of deregulation of the domestic financial market under import tariffs and a tax on foreign borrowings.

**Financial Repression and Equilibrium Real Exchange Rate**

We assume here only one distortion, financial repression, and we also assume a composite tradable good. This is to examine how the financial repression affects the real exchange rate when there are no other distortions. Using the general equilibrium conditions, equations (3.20) - (3.22) and setting \( \tau_i = 0, T_i = 0, G_i = 0 \) (i = 1, 2, j = X, M, N), \( \delta^* = \delta_L \), the simplified model is summarized as follows, where the same notation as in section 3.2 has been used. Here we concentrate on the "tradables real exchange rate."

\[
E[\pi'_1(1, f_1), \delta_D \pi'_2(1, f_2), w] = \delta_D / \delta^* (R^1 - I(1/\delta^*)) - (\delta_D / \delta^* - 1) (E_1 + f_1 E_n) + \delta_D R^2 \tag{3.23}
\]

\[
E_n[\pi'_1(1, f_1), \delta_D \pi'_2(1, f_2), w] = R^1 n(1, f_1) \tag{3.9}
\]

\[
E_D[\pi'_1(1, f_1), \delta_D \pi'_2(1, f_2), w] = R^2 \pi(1, f_2 ; K+1) \tag{3.10}
\]

The endogenous variables of the model are relative prices of nontradables (inverse of 'tradable real exchange rate') in each period, \( f_1 \) and \( f_2 \) and welfare \( w \). The exogenous variable of interest here is \( \delta_D \).

Totally differentiating these equations, we can write
\[ \begin{bmatrix} a_1 & a_2 & a_3 \\ \[E_{nn} - R_{nn}^1] & \delta_D E_{n\Omega} & \pi^1_{n\Omega E_{nw}} \\ E_{\Omega n} & [E_{\Omega \Omega} - R_{\Omega \Omega}^2] & \pi^2_{\Omega \Omega E_{nw}} \end{bmatrix} \begin{bmatrix} df_1 \\ df_2 \\ dw \end{bmatrix} = \begin{bmatrix} b_1 \\ c_1 \\ e_1 \end{bmatrix} d\delta_D \]

(3.24)

where

\[ a_1 = (\delta_D/\delta^* - 1)(E_{1n}^1 + f_1E_{nn}) < 0 \]

\[ a_2 = (\delta_D/\delta^* - 1)(E_{1\Omega}^1 + f_1E_{n\Omega}) > 0 \]

\[ a_3 = [1 + (\delta_D/\delta^* - 1)(MPC_1^1 + MPC_1^N)]E_{n\Omega} > 0 \]

\[ b_1 = -(\delta_D/\delta^* - 1)(E_{1\Omega\Omega}^1 + f_1E_{n\Omega\Omega})\pi^2 < 0 \]

\[ c_1 = -\pi^2E_{n\Omega\Omega} < 0 \]

\[ e_1 = -\pi^2E_{\Omega\Omega\Omega} > 0 \]

\( MPC^i_j \): marginal propensity to consume on good \( j \) in period \( i \) (see Appendix A)

First, we discuss the effects of a financial repression in domestic financial market on the vector of equilibrium real exchange rates where there is no initial financial repression.

From equation (3.24), setting \( \delta_D = \delta^* \), we obtain the following expressions for changes in the equilibrium relative price of nontradables in period 1.

\[ \frac{df_1}{d\delta_D} = (E_{n\Omega}/\Delta) \pi^2 \{ \delta^*E_{1\Omega\Omega} - [E_{\Omega\Omega} - R_{\Omega\Omega}^2]E_{n\Omega\Omega} \} > 0 \]

(3.25)

where

\[ \Delta = E_{n\Omega} \{ [E_{nn} - R_{nn}^1][E_{\Omega\Omega} - R_{\Omega\Omega}^2] - \delta^*E_{n\Omega\Omega} \} > 0 \]

under usual stability condition (see Appendix A)
The channel through which financial repression influences the price of nontradables in period 1 is the substitution effect, captured by the second term, and the income effect, captured by the first term of the RHS equation (3.25). In the situation of no financial repression, an increase in $\delta_D$ (decrease in $r_D$) makes future consumption relatively more expensive. As a result, consumers substitute intertemporally by more consuming nontradables in period 1. That is, the substitution effect exercises an upward pressure on the price of nontradables. On the other hand, the income effect exercises a downward pressure on the price of nontradables. So, the total effect is ambiguous. However, in the most plausible case, where the substitution effect dominates, there will be upward pressure on the price of nontradables, $df_1/d\delta_D > 0$, which generates an equilibrium real appreciation in period 1.

$$\frac{df_2}{d\delta_D} = (E_w / \Delta) \pi^2 \{ E_{2n} E_{1n0} - [E_{nn} - R_{nn}^1]E_{1n0} \} < 0 \quad (3.26)$$

Equation (3.26) indicates that the equilibrium price of nontradables in period 2 will be affected by the financial repression through the same channel as in period 1. The substitution effect which captured by the second term on the RHS equation (3.26). Consuming fewer nontradables in period 2 causes downward pressure on the price of nontradables in period 2. On the contrary, the income effect captured by the first term operates in the opposite direction. Therefore, in the case in which the substitution effect dominates, there will be downward pressure on the price of nontradables, $df_2/d\delta_D < 0$ and a real depreciation in period 2.
Consider now the case of an initial distortion in the domestic financial market \((\delta_D > \delta^*)\). In this case further financial repression will affect the price of nontradables in the following way.

\[
\frac{df}{d\delta_D} = \frac{1}{A'} \left\{ -b_1 \left[ (E_{zz} - R^{2zz}) \text{MPC}_1^N - \delta_D E_{12} \text{MPC}_2^N \right] E_w \\
- a_2 \pi^2 (E_{z0} \text{MPC}_1^N - E_{t0} \text{MPC}_2^N) E_w - a_3 \pi^2 (\delta_D E_{12} E_{t0}) \right\} \gtrless 0
\] (3.27)

\[
\frac{df}{d\delta_D} = \frac{1}{A'} \left\{ -b_1 \left[ (E_{nn} - R^{1nn}) \text{MPC}_1^N - E_{z0} \text{MPC}_2^N \right] E_w \\
- a_1 \pi^2 (E_{n0} \text{MPC}_1^N - E_{z0} \text{MPC}_2^N) E_w - a_3 \pi^2 (E_{z0} E_{n0}) \right\} \gtrless 0
\] (3.28)

where \(A'\) is the determinant of the LHS matrix in (3.24), which under usual stability requirements is positive.

Equation (3.27) and (3.28) show that the results are ambiguous in both periods. This is because combined income effects generally will operate in the opposite direction than the substitution effects.

The substitution effects, captured by the third terms on the RHS of equations (3.27) and (3.28), still generate upward pressure in period 1, and downward pressure in period 2, on the price of nontradables.

Income effects are captured by the first and second terms on the RHS of both equations;
these terms are related to the intertemporal allocation of consumption (saving) changes and the intratemporal allocation of consumption changes. These two effects may operate in opposite directions. In the initial situation, saving is distorted in that the low deposit rate discourages saving. In this situation, an increase in $\delta_D$ (decrease in $r_D$) will worsen the intertemporal allocation of consumption by decreasing saving. Consequently, this results in ambiguous income effects in period 1 and 2. Therefore, total effects are ambiguous in both periods.

**Deregulation of the Domestic Financial Market and Equilibrium Real Exchange Rates under Tariffs and Capital Controls**

Here we relax the assumptions of the previous case. We assume that import tariffs and a tax on foreign borrowing exist. However, in the long run, trade is assumed to be completely liberalized. This is to examine how the effects of the deregulation of the domestic financial repression on the real exchange rates can be changed in the presence of other distortions. In this analysis, the "exportables real exchange rate" concept will be used.

By setting $\tau_2 = 0$, $T_1 = 0$ and $G_j = 0$ ($i = 1, 2$, $j = X, M, N$) in equation (3.20) - (3.22), the model can be established as the following.

\[
\mathbb{E} [\pi'(1, p_1, q_1), \delta_D\pi^2(1, p_2, q_2), w ] = \left(\delta_D/\delta^*\right) \left[ R_1^1 - I(1/\delta_1) + \tau(E_{p_1} - R_{p_1}^1)\right] + \delta_D R_2^2
- (\delta_D/\delta^* - 1)(E_1^1 + p_1 E_{p_1} + q_1 E_{q_1}) \quad (3.29)
\]

\[
\mathbb{E}_q[\pi'(1, p_1, q_1), \delta_D\pi^2(1, p_2, q_2), w ] = R_1^1 q_1(1, p_1, q_1) \quad (3.21)
\]

\[
\mathbb{E}_q[\pi'(1, p_1, q_1), \delta_D\pi^2(1, p_2, q_2), w ] = R_2^2 q_2(1, p_2, q_2; K+I) \quad (3.22)
\]
From this models, the equilibrium movements of the real exchange rates induced by deregulation of the domestic financial market under trade distortion and capital controls can be analyzed as follows:

\[
\begin{align*}
\frac{dq_1}{d\delta_D} &= \left(\frac{1}{\Delta}\right) \left\{ -b_1 \left[ (E_{q1q2} - R_{q1q2}) \text{MPC}_N \right. \right. \\
& \quad \left. \left. - \delta_0 E_{q1q2} \text{MPC}_N \right] \right\} E_w \\
& \quad - \left[ a_2 \pi^2 (E_{q2q2} \text{MPC}_N \right. \right. \\
& \quad \left. \left. - E_{q1q2} \text{MPC}_N \right] \right\} E_w \\
& \quad - \left[ a_3 \pi^2 \left( E_{q2q2} - R_{q2q2} \right) \right. \\
& \quad \left. \left. E_{q1q2} \right] \right\} \leq 0 \quad (3.30)
\end{align*}
\]

where

\[ a_2 = -(\delta_D/\delta^*) \tau E_{p1q2} + (\delta_D/\delta^* - 1)(E_{1q2} + p_1 E_{p1q2} + q_1 E_{q1q2}) \]

\[ a_3 = [1 + (\delta_D/\delta^* - 1)(\text{MPC}_{1x} + \text{MPC}_{1N}) \right. \right. \\
& \quad \left. \left. + \{ \delta_D/\delta^*(1 - \tau/p_l) - 1 \} \text{MPC}_{1M} \right] > 0 \]

\[ b_1 = \left[ (E_{q1q2} - R_{q1q2}) \right. \\
& \quad \left. \left(\delta_D/\delta^* - 1)(E_{1q2} + p_1 E_{p1q2} + q_1 E_{q1q2}) \right] \pi^2 < 0
\]

\[
\begin{align*}
\frac{dq_2}{d\delta_D} &= \left(\frac{1}{\Delta}\right) \left\{ -b_1 \left[ (E_{q1q1} - R_{q1q1}) \text{MPC}_N \right. \right. \\
& \quad \left. \left. - E_{q2q1} \text{MPC}_N \right] \right\} E_w \\
& \quad - \left[ a_1 \pi^2 \left( E_{q1q1} \text{MPC}_N \right. \right. \\
& \quad \left. \left. - E_{q2q1} \text{MPC}_N \right] \right\} E_w \\
& \quad - \left[ a_3 \pi^2 \left( E_{q1q1} - R_{q1q1} \right) \right. \\
& \quad \left. \left. E_{q2q1} \right] \right\} \geq 0 \quad (3.31)
\end{align*}
\]

where

\[ a_1 = -(\delta_D/\delta^*) \tau E_{p1p1} + (\delta_D/\delta^* - 1)(E_{1q1} + p_1 E_{p1q1} + q_1 E_{q1q1}) < 0 \]
The channels through which financial deregulation affects the real exchange rates are represented by the same terms as in equation (3.27) and (3.28), and, again, give ambiguous results. However, in this case, important policy implications can be derived. In the initial situation, saving is distorted for two reasons: on the one hand, the low deposit rate discourages saving, but, on the other hand, the presence of a tariff in the first period, forces households to postpone consumption and to increase saving. In this situation, a decrease in $\delta_D$ distorts the intertemporal and intratemporal allocation of consumption.

The intertemporal substitution effects, captured by the third terms on the RHS of equations (3.30) and (3.31), generate changes in nontradable prices through the same reasoning as discussed above. A decrease in $\delta_D$ (increase in $r_D$) with deregulation of the domestic financial market puts downward pressure on nontradable good prices in period 1 and upward pressure in period 2.

The other channel, income effects, captured by the first and second terms of the RHS of both equations, depend on the relative magnitude of the tariffs and domestic interest rate controls. In a severe financial repression economy (i.e., financial repression is more important than trade distortion), an increase in $r_D$ will make the intertemporal allocation of consumption interact positively with the price of nontradables by increasing saving. On the other hand, in this economy, with initial import tariffs, an increase in $r_D$ will make the intratemporal allocation of consumption put downward pressure on the price of nontradables. That is, with tariffs in the first period, people tend to postpone consumption for the future. In this situation, an increase in $r_D$ will amplify these distortions. So in this case, the income effects are ambiguous in both
periods. Consequently, the total combined effects on the equilibrium real exchange rates are also ambiguous.

On the other hand, in a high tariff economy (i.e., financial repression is not as severe as trade distortion), the income effects induced by an increase in $r_D$ may operate negatively, which generates decreases in nontradable prices in both periods. Therefore, total effects may result in a decrease in the price of nontradables, generating a real depreciation in period 1, $dq_1/d\delta_D < 0$, and ambiguous results in period 2.

3.3.2 Effects of Relaxing Capital Controls on the Real Exchange Rate

In this section, we analyze the way in which a relaxation of capital controls affect the equilibrium real exchange rates under financial repression. Relaxation of capital controls is represented by an increase in $\delta_L$ (decrease in $\tau_L$). In order to simplify the exposition we first assume that there are no distortions except capital controls, and that there is no government consumption. Later we introduce financial repression and compare the effects of the relaxation of the capital controls on the real exchange rate in both cases, with and without financial repression. In this section, we assume a composite tradable good and concentrate on the "tradables real exchange rate."

No Financial Repression Case

We assume here only a distortion, an capital controls to examine how capital controls affect the real exchange rates when there are no other distortions. In this case, by setting $\tau_i = 0$, $T_i =$
0, \( G_j = 0 \) \((i = 1, 2, j = X, M, N)\) and \( \delta_0 = \delta^* \) in equation (3.20) - (3.22), we derive the equilibrium conditions as follows:

\[
E[\pi^1(1, f_1), \delta^* \pi^2(1, f_2), w] = R^1 + \delta^* R^2 - I(1/\delta_L) \tag{3.32}
\]

\[
E_n[\pi^1(1, f_1), \delta^* \pi^2(1, f_2), w] = R^1_n(1, f_1) \tag{3.9}
\]

\[
E_D[\pi^1(1, f_1), \delta^* \pi^2(1, f_2), w] = R^2_D(1, f_2; K+I) \tag{3.10}
\]

Totally differentiating these three equations, we can write

\[
\begin{bmatrix}
a_1 & a_2 & a_3 \\
[E_{11n} - R^1_{11n}] & \delta^* E_{11} & \pi^1 \pi^2 E_{nw} \\
E_{22n} & [E_{222} - R^2_{222}] & \pi^2 \pi^2 E_{nw}
\end{bmatrix}
\begin{bmatrix}
df_1 \\
df_2 \\
dw
\end{bmatrix}
= 
\begin{bmatrix}
b_1 \\
c_1 \\
e_1
\end{bmatrix}
d\delta_L \tag{3.33}
\]

where \( a_1 = 0, \quad a_2 = 0, \quad a_3 = E_w > 0, \quad b_1 = (1/\delta_L^2)I_{1_{1\times 1}}(1 - \delta^*/\delta_L) > 0 \)

\( c_1 = 0, \quad e_1 = -(1/\delta_L^2)R^2_{222}I_{1_{1\times 1}} \)

From equation (3.33), we can derive following expressions for changes in the equilibrium relative prices of nontradable goods in period 1 and 2.

\[
\frac{df_1}{d\delta_L} = \frac{(1/\Delta)}{\delta_L} \left\{ -b_1 \left( E_{222} - R^2_{222} \right) MPC^1 \delta^* E_{11} - \delta^* E_{11} \delta^* E_{222} + (1/\delta_L^2)R^2_{222}I_{1_{1\times 1}} E_w \delta^* E_{222} \right\} \geq 0 \tag{3.34}
\]
\[
\frac{df_2}{d\delta_L} = \left( \frac{1}{\Delta} \right) \left\{ b_1 \left[ E_{\theta} \text{MPC}_N^1 - (E_{nn} - R_{nn}^1) \text{MPC}_N^2 \right] E_w \\
+ (1/\delta_L^2) R_{\omega x}^2 I_{I\theta x} E_w \left[ E_{nn} - R_{nn}^1 \right] \right\} \geq 0
\] (3.35)

The channel through which relaxation of capital controls influences the real exchange rate consists of income and substitution effects in equations (3.34) and (3.35). The income effects, captured by the first terms on the RHS of both equations, cause upward pressure on the price of nontradables in period 1 and 2. That is, a decrease in \( r_L \) (increase in \( \delta_L \)) toward its world level \( r^*(\delta^*) \) will reduce the only distortion in this economy, generating a positive welfare effect. Consequently, households increase consumption of nontradables putting upward pressure on the price of nontradables. In line with this, a decrease in \( r_L \) improves the intertemporal allocation of production by encouraging investment.

However, substitution effects, captured by the second terms on the RHS of both equations, operate ambiguously. The direction of this substitution effect depends on the factor intensity of the tradable and nontradable goods. Lowering the loan rate (increase in \( \delta_L \)) increases investment, which will enhance productive capacity in period 2. In the case that tradable goods are capital intensive, a decrease in \( r_L \) puts an upward pressure on the price of nontradables in period 2. So, in this case, households substitute intertemporally, and increase consumption of nontradables in period 1. Consequently, the relaxation of capital controls generates upward pressure on the price of nontradables in period 1 and downward pressure in period 2. In the case that nontradable goods are capital intensive, the substitution effects will be opposite to the
case that tradables are capital intensive, and will generate downward pressure on the price of nontradables in period 1 and upward pressure in period 2.

In summary, in the case that tradables are capital intensive, relaxation of the capital controls will result in a higher price of nontradables in period 1, generating a real appreciation in period 1, however, in period 2, the result will be ambiguous. On the other hand, in the case that nontradables are capital intensive, relaxation of the capital controls may result in either a higher or lower price of nontradables in period 1. There is an ambiguous effect on real exchange rates in period 1, however, in period 2, relaxation of the capital controls will result in real appreciation.

**Financial Repression Case**

Here we introduce financial repression to examine how the effects of the relaxation of capital controls on the real exchange rates can be changed under the condition of financial repression. Assuming $\delta_D > \delta^* > \delta_L$, the model can be written as the following.

$$E[\pi'(1, f_1), \delta_D\pi^2(1, f_2), w] = \delta_D R^2 + (\delta_D/\delta^*)(R^1 - I(1/\delta)) + (1 - \delta_D/\delta^*)(E_{1T} + f_2E_{1n})$$  \hspace{1cm} (3.36)

$$E_{n}[\pi'(1, f_1), \delta\pi^2(1, f_2), w] = R^1_{1T}(1, f_1)$$ \hspace{1cm} (3.9)

$$E_{r}[\pi'(1, f_1), \delta^*\pi^2(1, f_2), w] = R^2_{1T}(1, f_2; K+I)$$ \hspace{1cm} (3.10)

Equation (3.37) and (3.38) represent how relaxation of the capital controls influence the price of nontradables under financial repression.
\[
\frac{df_1}{d\delta_l} = \frac{1}{\delta_l} \left\{ -b_1 \left[ (E_{\delta\delta} - R_{\delta\delta}^2)MPC_{NN} - \delta^*E_{NN} MPC_{NN}^2 \right]E_w \\
- a_2 \left[ (1/\delta_l)^2 R_{\delta\delta}^2 I_{1/\delta} \cdot MPC_{NN} E_w \right] + a_3 \left[ (1/\delta_l)^2 R_{\delta\delta}^2 I_{1/\delta} \cdot \delta^*E_{NN} \right] \right\} > 0 \text{ or } < 0
\]

(3.37)

where \( a_2 = (\delta^*/\delta - 1)(E_{1n} + f_1E_{nn}) > 0 \)

\[ a_3 = [1 + (\delta^*/\delta - 1)(MPC_{NN} + MPC_{NN})]E_w > 0 \]

\[ b_1 = (\delta^*/\delta - 1)(1/\delta_l) > 0 \]

\[
\frac{df_2}{d\delta_l} = \frac{1}{\delta_l} \left\{ b_1 \left[ E_{\delta\delta}MP_{NN} - MPC_{NN}^2(E_{nn} - R_{nn}^1) \right]E_w \\
+ a_1 \left[ (1/\delta_l)^2 R_{\delta\delta}^2 I_{1/\delta} \cdot MPC_{NN} E_w \right] - a_3 \left[ (1/\delta_l)^2 R_{\delta\delta}^2 I_{1/\delta} \cdot \delta^*E_{nn} \right] \right\} > 0 \text{ or } < 0
\]

(3.38)

where \( a_1 = (\delta^*/\delta - 1)(E_{1in} + f_1E_{1nn}) < 0 \)

The results are ambiguous in both periods. However, under financial repression, the channel is quite different from the case of no financial repression. In this case, there are additional income effects that are captured by the second terms on the RHS of equation (3.37) and (3.38). These are indirect income effects, the intertemporal reallocation of consumption induced by further reducing initial undersaving with low deposit rate. The direction of this effect depends on the factor intensity of the goods. In the case that tradables are capital intensive, this effect will cause decrease in the price of nontradables in both periods. On the
other hand, in the case that nontradables are capital intensive, its effect will operate positively on the price of nontradables in both periods.

The other channels, direct income effects, captured by the first terms and substitution effects, captured by the third terms on the RHS of equation (3.37) and (3.38), operate as the same way as in equation (3.34) and (3.35). Therefore, under financial repression, the whole income effect may be ambiguous in both periods in the case in which tradables are capital intensive. However, in the case that nontradables are capital intensive, the combined income effects causes upward pressure on the price of nontradables in period 1 and 2.

Consequently, under financial repression, relaxation of the capital controls affect real exchange rates ambiguously in both periods in the case that tradables are capital intensive. In the case that nontradables are capital intensive, relaxation of capital controls also generate an ambiguous result in period 1, however, in period 2, that will result in a real appreciation.

3.3.3 Effects of Trade Liberalization on the Real Exchange Rate

In this section, we investigate how changes in import tariffs affect the equilibrium path of the real exchange rate under financial repression. In order to simplify the exposition, we first assume that there are no distortions, except import tariffs, in the first period, and that there is no government consumption. In the long run, trade is assumed to be completely liberalized. We introduce financial repression later to compare the effects of a tariff reduction on the equilibrium real exchange rate both with, and without, financial repression. In this section, we concentrate on the “exportables real exchange rate.”
No Financial Repression Case

We assume here that only one distortion, an import tariff in the first period, exists. This is to examine how temporary changes in import tariffs affect the real exchange rates when there are no other distortions. Under this condition, all the discount rates should be same, that is, $\delta_D = \delta_L$. Accordingly, by setting $\tau_2 = 0$, $T_i = 0$, $G_j = 0$ ($i = 1, 2$, $j = X, M, N$) and $\delta_D = \delta_L$ to equation (3.20), the households’ budget constraint is derived as:

\[ E[\pi^1(1, p_1, q_1), \delta^* \pi^2(1, p_2, q_2), w] = R^1 + \tau(E_{p1} - R^{1}_{p1}) + \delta^* R^2 - I(1/\delta^*) \]  

(3.39)

At before, in this case, the equilibrium condition in the nontradable goods market holds as:

\[ E_q[\pi^1(1, p_1, q_1), \delta^* \pi^2(1, p_2, q_2), w] = R^1_{q1}(1, p_1, q_1) \]  

(3.21)

\[ E_q[\pi^1(1, p_1, q_1), \delta^* \pi^2(1, p_2, q_2), w] = R^2_{q2}(1, p_1, q_2; K + I) \]  

(3.22)

Totally differentiating these three equations, we can write

\[
\begin{bmatrix}
E_{q1} & [E_{q1}^1 - R_{q1}^1] & \delta^* E_{q1}^2 & \pi^1_{q1} E_{mw} \\
E_{q2} & [E_{q2}^1 - R_{q2}^1] & \pi^2_{q2} E_{mw}
\end{bmatrix}
\begin{bmatrix}
dq_1 \\
dq_2 \\
dw
\end{bmatrix}
= 
\begin{bmatrix}
b_1 \\
b_2 \\
e_1 \\
e_2
\end{bmatrix}
\begin{bmatrix}
dp_1 \\
d\tau
\end{bmatrix}
\]

(3.40)
where \( a_1 = -\tau(E_{p1q1} - R_{p1q1}) < 0, \quad a_2 = -\tau E_{p1q2} < 0, \)

\[
a_3 = [1 - (\tau/p_1)MPC_{1M} E_{p1}] > 0, \quad b_1 = \tau(E_{p1p1} - R_{p1p1}) + (R_{p1} - E_{p1}),
\]

\[
b_2 = E_{p1} - R_{p1} < 0, \quad c_1 = R_{q1p1} - E_{q1p1} < 0, \quad c_2 = 0, \quad e_1 = -E_{q2p1} < 0, \quad e_2 = 0
\]

First, we discuss the case where initial tariffs are equal to zero and no financial repression exists. From equation (3.40), setting \( dt = dp \) and \( \tau = 0 \), that is, no initial tariffs, we obtain the same expressions for changes in the equilibrium relative prices of nontradables in period 1 and 2 as that of Edwards (1989).

\[
\frac{dq_1}{d\tau} = \left( -\frac{E_{p1}}{\Delta} \right) \left\{ [E_{q1p1} - R_{q1p1}] [E_{q2q2} - R_{q2q2}] - \delta^2 E_{q2p1} E_{q1q2} \right\} > 0
\]

Equation (3.41) reveals that a temporary tariff induces an increase in the price of nontradables, an equilibrium real appreciation in period 1 by the substitution effects captured by the term on the RHS of the equation. Under zero initial tariffs, there is no first order income effect. The result is based on the assumption that importables and nontradables are substitutes in period 1 \((E_{p1q1} > 0)\). This result is comparable with that of the financial repression effects on the real exchange rates without the presence of other distortions, which is represented in equation (3.25). In that case, there are both substitution and income effects which operate in the opposite directions. With no income effect, and substitutability in demand everywhere, the rise in import prices in period 1 generated by the imposition of the import tariff, will result in a
reduction in the demand for importables, and an increase in demand for nontradables in that period.

In the same way, the price of nontradables in period 2 will be affected by the temporary tariff as follows:

\[
\frac{dq_2}{dt} = (-E_w / \Delta) \left\{ E_{q_2|q_1} [E_{q_1|q_1} - R_{q_1|q_1}] - E_{q_2|q_1} [E_{q_1|p_1} - R_{q_1|p_1}] \right\} > 0
\]

Equation (3.42) indicates that a temporary tariff in period 1 will result in an equilibrium real appreciation in period 2 by the substitution effect under the assumption of intratemporal and intertemporal substitutability. That is, by the tariff imposition in period 1, households substitute away from period 1 consumption and into period 2 consumption. Some of this additional demand in period 2 falls on nontradables, causing upward pressure on the price of nontradables, generating a real appreciation.

Here, we assume temporary changes in tariffs. When we consider the case of an anticipated change in future import tariffs, a future expected tariff increase will also appreciate the equilibrium real exchange rate in period 1 and 2. (see Edwards, 1989). The mechanism via which this takes place is also intertemporal substitution in consumption. Consider now the case in which tariffs are initially greater than zero. In this case, a temporary tariff change will affect the price of nontradables as follows:
\[ dq_1 \]
\[ \frac{d q_1}{d \tau} = \left( \frac{1}{\Delta} \right) \left\{ - \beta_1 (E_{q_2q_2} - R^2 q_{q_2}^2) \text{MPC}^1_N + \beta_1 \delta^* E_{q_1q_2} E_w \right. \]
\[ + a_2 (E_{q_1p_1} - R^1 q_{p_1}) \text{MPC}^2_N - a_2 E_{q_1p_1} \text{MPC}^1_N E_w \]
\[ - a_3 [(E_{q_1p_1} - R^1 q_{p_1}) (E_{q_2q_2} - R^2 q_{q_2}^2) - \delta^* E_{q_1q_2} E_{q_2p_1}] \} \geq 0 \] (3.43)

\[ dq_2 \]
\[ \frac{d q_2}{d \tau} = \left( \frac{1}{\Delta} \right) \left\{ - \beta_1 (E_{q_1q_1} - R^1 q_{q_1}^1) - \beta_1 E_{q_2q_1} \text{MPC}^1_N \right. E_w \]
\[ + a_1 (E_{p_1q_1} - R^1 q_{p_1}) \text{MPC}^2_N + a_1 E_{q_2q_1} \text{MPC}^1_N E_w \]
\[ - a_3 [(E_{q_2p_1} (E_{q_1q_1} - R^1 q_{q_1}^1) - E_{q_2q_1} (E_{q_1p_1} - R^1 q_{p_1}))] \} \geq 0 \] (3.44)

where \( \beta_1 = b_1 + b_2 = \tau (E_{p_1q_1} - R^1 q_{p_1}) < 0 \)

In this case, a temporary tariff change generates ambiguous results in both periods, even if all goods are substitutes in demand. This is because under the assumption of intratemporal and intertemporal substitutability, the income effects associated with the tariff change may operate negatively to the prices of nontradables, even though the substitution effect operates positively in both periods.

Income effects are composed of the two expressions that are captured by the first and second terms on the RHS of equation (3.43) and (3.44). The first term in both equations puts downward pressure on the price of nontradables. However, the second terms operate ambiguously in both periods. Thus, the combined income effects are ambiguous in both
periods. The importance of the income effects depend on the level of tariffs and on the marginal propensity to consume in both periods.

On the other hand, the substitution effects that are captured by the third terms on the RHS of equations (3.43) and (3.44) exercises a positive pressure on the price of nontradables in both periods. Therefore, in this setting, the effect of import tariffs on the real exchange rate will depend on the relative forces of the income and substitution effects. In the case in which the substitution effects dominate the income effects, a temporary tariff imposition will generate an equilibrium real appreciation in both periods. Therefore, in this case, trade liberalization, a reduction in tariffs, will generate an equilibrium real depreciation in both periods. When we consider the case of an anticipated change in future import tariffs, with positive initial tariffs, there will be a first-order welfare effect that will operate in a way similar to that discussed above for the case of temporary tariffs.

Financial Repression Case

Here, we introduce financial repression to examine how the effect of temporary changes in tariffs on the real exchange rate can be changed under the condition of financial repression. By introducing financial repression ($\delta_D > \delta^* = \delta_L$), the model is summarized as follows:

\[
E_p(\pi^1(1, p_1, q_1), \delta_D, \pi^2(1, p_2, q_2), w) = (\delta_D \delta^*)[R_1^1 - I(1/\delta^*) + \tau(E_{p_1} - R_{p_1}^1)] + \delta_D R^2 - (\delta_D / \delta^* - 1)(E_{p_1}^1 + p_1 E_{p_1} + q_1 E_{q_1})
\]

(3.45)

\[
E_{q_1}[\pi^1(1, p_1, q_1), \delta^* \pi^2(1, p_2, q_2), w] = R_{q_1}^1(1, p_1, q_1)
\]

(3.21)

\[
E_{q_2}[\pi^1(1, p_1, q_1), \delta^* \pi^2(1, p_2, q_2), w] = R_{q_2}^2(1, p_1, q_2; K + I)
\]

(3.22)
Using these three equations, we can analyze how the equilibrium real exchange rates react to a change in tariffs under financial repression.

First, we discuss the case of no initial tariffs under financial repression. Setting $dt = dp_1$ and $\tau = 0$, we obtain the following expressions for changes in the price of nontradables.

\[
\frac{dq_1}{\Delta} = \frac{1}{\delta} \left\{ -\beta_1 \left[ \left( E_{q2q2} - R^2_{q2q2} \right) \text{MPC}_N^1 - \delta_D E_{q1q2} \text{MPC}_N^2 \right] E_w 
\right. \\
- a_2 \left[ \left( E_{q1lp1} \text{MPC}_N^1 - \left( E_{q1lp1} - R^1_{q1lp1} \right) \text{MPC}_N^2 \right) E_w 
\right. \\
- a_3 \left[ \left( E_{q1lp1} - R_{q1lp1} \right) \left( E_{q2q2} - R^2_{q2q2} \right) - \delta_D E_{q1q2} E_{q2q1} \right] \right\} \\ \frac{\Delta}{\Delta} 0
\]

where \( \beta_1 = (1 - \delta_D / \delta^*) (E^1_{lp1} + p_1 E_{q1lp1} + q_1 E_{q1lp1}) > 0 \)

\( a_2 = (\delta_D / \delta^* - 1) (E^1_{q2q2} + p_1 E_{q2q2} + q_1 E_{q2q2}) > 0 \)

\( a_3 = [1 + (\delta_D / \delta^* - 1) (\text{MPC}_X^1 + \text{MPC}_M^1 + \text{MPC}_N^1)] E_w > 0 \)

\[
\frac{dq_2}{\Delta} = \frac{1}{\delta} \left\{ \beta_1 \left[ E_{q2q1} \text{MPC}_N^1 - \left( E_{q1ql1} - R^1_{q1ql1} \right) \text{MPC}_N^2 \right] E_w 
\right. \\
+ a_1 \left[ E_{q2q1} \text{MPC}_N^1 - \left( E_{q1ql1} - R_{q1ql1} \right) \text{MPC}_N^2 \right] E_w \\
- a_3 \left[ E_{q2q1} \left( E_{q1ql1} - R^1_{q1ql1} \right) - E_{q2q1} \left( E_{q1ql1} - R_{q1ql1} \right) \right] \right\} \frac{\Delta}{\Delta} 0
\]

where \( a_1 = (\delta_D / \delta^* - 1) (E^1_{ql1} + p_1 E_{ql1} + q_1 E_{ql1}) < 0 \)
This result is different from the case of no financial repression and no initial tariff, as determined in equations (3.41) and (3.42). In this case there are income effects, captured by the first and second terms on the RHS of equation (3.46) and (3.47) besides the substitution effects captured by the third terms. These two income effects result from the existence of financial repression.

Under initial financial repression, the low deposit rate discourages saving. This exercises upward pressure in the first period and downward pressure in the second period on the price of nontradables. In this initial undersaving situation, a temporary tariff changes the allocation of consumption (saving). That is, with tariff imposition, households are willing to postpone consumption and to increase saving, which puts downward and upward pressure on the price of nontradables in the first and second periods, respectively. Therefore, the combined income effects are ambiguous in both periods.

On the other hand, the substitution effects that are captured by the third terms on the RHS of equation (3.46) and (3.47) puts upward pressure on the price of nontradables in period 1 and 2. Therefore, under financial repression, a temporary tariff will affect equilibrium real exchange rates ambiguously in period 1 and period 2. However, when the combined income effects are positive, or when the substitution effect dominates the income effect even though the combined income effects are negative, tariff imposition will generate a rise in the price of nontradables, that is, a real appreciation in period 1 and 2.

Consider now the case of initial tariffs with financial repression. In this case, the results are also ambiguous and the channels are represented by the same terms as in equation (3.46) and (3.47). However, different policy implications can be derived from equation (3.48) and (3.49).
\[
\frac{dq_1}{dt} = \left(\frac{1}{\Delta'} \right) \left\{ -\beta_1'' [E_{q2q2} - R^2_{q2q2}] Mpc^1_N - \delta D_{q1q2} Mpc^2_N \right\} E_w \\
- a_2'' [E_{q1q1} Mpc^1_N - (E_{q1q1} - R^1_{q1q1}) Mpc^2_N] E_w \\
- a_3'' [(E_{q1q1} - R^1_{q1q1})(E_{q2q2} - R^2_{q2q2}) - \delta D_{q1q2} E_{q2q2}] \right\} \leq 0 \quad (3.48)
\]

\[
\frac{dq_2}{dt} = \left(\frac{1}{\Delta'} \right) \left\{ \beta_1'' [E_{q2q1} Mpc^1_N - (E_{q1q1} - R^1_{q1q1}) Mpc^2_N] E_w \\
+ a_1'' [E_{q2q1} Mpc^1_N - (E_{q1q1} - R^1_{q1q1}) Mpc^2_N] E_w \\
- a_3'' [E_{q2q1}(E_{q1q1} - R^1_{q1q1}) - E_{q2q1}(E_{q1q1} - R^1_{q1q1})] \right\} \leq 0 \quad (3.49)
\]

where \( \beta_1'' = (\delta_D/\delta^*)\tau (E_{plp1} - R^1_{plp1}) + \beta_1' \)

\( a_1'' = -(\delta_D/\delta^*)\tau (E_{plq1} - R^1_{plq1}) + a_1' \)

\( a_2'' = -\tau (\delta_D/\delta^*) E_{plq2} + a_2' \)

\( a_3'' = \{ 1 + (\delta_D/\delta^* -1)(Mpc^1_X + Mpc^1_N) + [ \delta_D/\delta^* (1 - \tau/p_1) - 1] Mpc^1_M \} E_w \)

As we discussed in section (3.3.1), the effects of tariff changes on equilibrium real exchange rates may be changed by the relative importance of the financial repression and trade controls (level of import tariffs). That is, the income effect can be changed to operate in opposite directions in two different cases. When financial repression is more severe than the trade controls (i.e., low import tariffs), the effects of tariff imposition may operate in the same direction as in equations (3.46) and (3.47). However, in a high tariff economy
under small financial repression, the income effects may operate in the opposite direction as in the former case. This can be explained as follows: In the case that the tariff rate is high and the financial repression is not severe, a tariff rate increase will deepen the initial oversaving by postponing the consumption, which may results in a combined negative income effect in the first period and a positive income effect in the second period.

On the other hand, substitution effects that are captured by the third terms on the RHS of equation (3.48) and (3.49) exercise upward pressure on the price of nontradables in both periods. Therefore, if the income effects are negative in the first period and this income effect dominates the substitution effect, a tariff rate increase may result in a real depreciation in the first period. In this case, in the second period, the income effect will be positive, and the result will be a real appreciation. Following this rationale, trade liberalization (tariff reduction) may result in real a appreciation in the short-run.

3.3.4 Effects of Changes in Government Consumption on the Real Exchange Rate

In this section, we analyze how changes in the level of government consumption affect the equilibrium real exchange rate under financial repression. To simplify the exposition, we first assume that there are no distortions. It is assumed that all taxes are the nondistortionary. We introduce the financial repression later to compare the effects of changes in government consumption on the real exchange rates both, with and without, financial repression. In this section, we assume a composite tradable good and concentrate on the 'tradables real exchange rate.
No Financial Repression Case

Here we investigate how changes in government consumption affect real exchange rates when there are no distortions. Accordingly, the budget constraint of the private and government sector can be derived as the follows (equation 3.50) by setting $\tau_i = 0$ ($i = 1, 2$), $\delta_D = \delta^* = \delta_L$ in equation (3.20).

\[
E[\pi^1(1, f_1), \delta^* \pi^2(1, f_2), w] + G^1_T + f_1 G^1_N + \delta^* (G^2_T + f_2 G^2_N) = R^1 + \delta^* R^2 - I(1/\delta^*) \quad (3.50)
\]

In line with this, the equilibrium condition for nontradable goods in both periods should hold as follows:

\[
E_n[\pi^1(1, f_1), \delta^* \pi^2(1, f_2)] + G^1_N = R^1_n(1, f_1) \quad (3.51)
\]
\[
E_2[\pi^1(1, f_1), \delta^* \pi^2(1, f_2)] + G^2_N = R^2_2(1, f_2; K + I) \quad (3.52)
\]

From equations (3.50) - (3.52), we derive the following equation.

\[
\begin{bmatrix}
    a_1 & a_2 & a_3 \\
    [E_{nn} - R^1_{nn}] & \delta^* E_{n2} & \pi^1 E_{nw} \\
    E_{2n} & [E_{22} - R^2_{22}] & \pi^2 E_{2w}
\end{bmatrix}
\begin{bmatrix}
df_1 \\
df_2 \\
dw
\end{bmatrix}
= 
\begin{bmatrix}
b_1 & b_2 \\
c_1 & c_2 \\
e_1 & e_2
\end{bmatrix}
\begin{bmatrix}
dG^1_N \\
dG^2_N
\end{bmatrix}
\quad (3.53)
\]

where $a_1 = 0$, $a_2 = 0$, $a_3 = E_w > 0$, $b_1 = -f_1 < 0$, $b_2 = -\delta^* f_2 < 0$,

$c_1 = -1$, $c_2 = 0$, $e_1 = 0$, $e_2 = -1$
From equation (3.53), we obtain the following expressions for changes in the relative price of nontradables to changes in government consumption of nontradables.

\[
\frac{df_i}{dG_N} = (1/\Delta) \left\{ f_i[(E_{n2} - R_{n2})\text{MPC}_N - \delta E_{n2}\text{MPC}_N]E_w 
- \left[ E_{2n2} - R_{2n2} ]E_w \right\} > 0 \tag{3.54}
\]

Equation (3.54) represents the channel by which an increase in the demand for nontradables by the government affects the price of nontradables in period 1. The channel through which increases in government consumption of nontradables influences the real exchange rate path is composed of two forces: its own direct pressure of the market for nontradables, and indirect pressure via changes in the private sector disposable income. These channels can be explained with the substitution effect, captured by the second term, and the income effect, captured by the first term of the RHS of equation (3.54). The substitution effect, with increased demand for nontradables, causes upward pressure on the price of nontradables, generating a real appreciation.

On the other hand, the income effect exercises downward pressure on the price of nontradables, generating a real depreciation. This is because the higher level of government consumption will require a hike in taxes in period 2, and this will reduce available income. Consequently, there is a reduction in demand for nontradables in period 1 and 2.
The combined effects depend on the relative forces of the substitution and income effects. In the most plausible case, where the substitution effect dominates the income effect, this results in \( \frac{df_1}{dG^1_N} > 0 \), which generates an appreciation in period 1.

\[
\frac{df_2}{dG^1_N} = \left( \frac{1}{\Delta} \right) \left\{ -E_t[E_G^{2\text{N}} \text{MPC}^1_N - (E_{\text{nn}} - R^1_{\text{nn}}) \text{MPC}^2_N]E_w + E_{G^2}E_w \right\} > 0 \tag{3.55}
\]

Equation (3.55) shows the channel by which a temporary increase in government consumption of nontradables in period 1 influences the price of nontradables in period 2. In this case also, the substitution and income effects operate in opposite directions and the result depends on the relative size of the two forces.

The substitution effect captured by the second term on the RHS of equation (3.55) puts upward pressure on the price of nontradables. That is, facing higher government consumption of nontradables, people substitute intertemporally, which generates a positive effect on the price of nontradables.

The income effect captured by the first term on the RHS of equation (3.55) also exercises downward pressure by decreasing private sector available income. Therefore, in the case that the substitution effect dominates the income effect, a temporary increase in government consumption of nontradables in period 1 results in \( \frac{df_2}{dG^1_N} > 0 \), which generates an equilibrium real appreciation in period 2.
Equation (3.56) and (3.57) represent that an anticipated increase in government consumption of nontradables in period 2 will affect the price of nontradables through both, income and substitution channels.

The channels can be explained in the same way as in equations (3.54) and (3.55). In equation (3.56), the intertemporal substitution effect captured by the second term on the RHS causes upward pressure on the price of nontradables. On the other hand, the income effect captured by the first term exercises downward pressure on the price of nontradables in period 1. In equation (3.57), the substitution effect, captured by the second term, and the income effect, captured by the first term also causes upward and downward pressure, respectively, on the price of nontradables in period 2.

Therefore, when the substitution effect dominates the income effect, an anticipated increase in government consumption of nontradables in period 2 will result in an increase in the price of nontradables in period 1 and 2, \( \frac{df_1}{dG^2_N} > 0 \), \( \frac{df_2}{dG^2_N} > 0 \), or, a real appreciation in both periods.
Financial Repression Case

Here we introduce financial repression to examine how the effects of the changes in government consumption on the real exchange rate can be changed under the condition of financial repression. By introducing financial repression \( (\delta_D > \delta^* = \delta_L) \), the model can be written as follows:

\[
E [ \pi'(1, f_1), \delta_D \pi^2(1, f_2), w ] + G^1_T + f_1G^1_N + \delta^* (G^2_T + f_2G^2_N) = (\delta_D / \delta^*) R^1
+ \delta_D (R^2 - T - I / \delta^*) + (\delta_D / \delta^* - 1)(T_1 + C^1) - \delta^* T_2
\]  

(3.58)

\[
E_n[\pi'(1, f_1), \delta^* \pi^2(1, f_2)] + G^1_N = R^1 n(1, f_1)
\]  

(3.51)

\[
E_\pi[\pi'(1, f_1), \delta^* \pi^2(1, f_2)] + G^2_N = R^2 n(1, f_2; K + I)
\]  

(3.52)

From these equations, we can derive the effects of the change in government demand for nontradables under financial repression on the equilibrium real exchange rates as follows:

\[
\frac{df_1}{dG^1_N} = \frac{1}{\Delta^*} \left\{ f_1[(E_{\pi\pi} - R^2_{\pi\pi})\text{MPC}^1_N - \delta_D E_{\pi\pi}\text{MPC}^2_N]E_w
\right. \\
\left. - a_2'\text{MPC}^2_N E_w - a_3'[E_{\pi\pi} - R^2_{\pi\pi}] \right\} \geq 0
\]  

(3.59)

\[
\frac{df_2}{dG^1_N} = \frac{1}{\Delta^*} \left\{ -f_1[E_{\pi\pi}\text{MPC}^1_N - (E_{\pi\pi} - R^1_{\pi\pi})\text{MPC}^2_N]E_w
\right. \\
\left. + a_1'\text{MPC}^2_N E_w + a_3'E_{\pi\pi} \right\} \geq 0
\]  

(3.60)
where 

\[ a_1' = (\delta_y/\delta^* - 1)(E_{1n}^1 + f_1E_{nn}^1 - G_{1n}^1) < 0 \]

\[ a_2' = (\delta_y/\delta^* - 1)(E_{1n}^1 + f_1E_{nn}^1) > 0 \]

\[ a_3' = [(\delta_y/\delta^* - 1)(MPC_{1-T} + MPC_{1-N})]E_{w} > 0 \]

\( \Delta' \) is the determinant of the LHS matrix in (3.53), which under usual stability requirements is positive.

Equations (3.59) and (3.60) represent the channels through which a temporary increase in government consumption of nontradables under financial repression affect the real exchange rate. The channels that affect the price of nontradables are different from the case of no financial repression we reviewed in (3.54) and (3.55). There are additional income effects that are captured by the second terms on the RHS of equation (3.59) and (3.60). These effects are induced by financial repression. There is an initial distortion of undersaving. In this situation, an increase in government consumption of nontradables in period 1 may improve the intertemporal allocation of consumption by increasing saving. This income effect may put downward and upward pressure on the price of nontradables in period 1 and period 2 respectively. Direct income effects that are captured by the first terms operate negatively on the price of nontradables in both periods. Therefore, the combined income effect will be negative in the first period, and will be ambiguous in the second period. On the other hand, the substitution effects, captured by the third terms on the RHS of both equations, operate positively on the price of nontradables in both periods. Therefore, the total effect will be ambiguous in both periods. However, in the first period, because of the additional negative
income effects, the combined income effect may dominate the substitution effect, which generates a real depreciation in period 1.

\[
\frac{df_1}{dG^N} = \left(\frac{1}{\Delta^\lambda}\right) \left\{ \delta \delta^\omega (E_{2R} - R^2_{2R}) \text{MPC}^N - \delta \eta \text{MPC}^N \right\} E_w \\
+ a_2 \gamma \text{MPC}^N E_w + a_3 \delta \eta E_{2R} \right\} \geq 0
\]  \hspace{1cm} (3.61)

\[
\frac{df_2}{dG^N} = \left(\frac{1}{\Delta^\lambda}\right) \left\{ -\delta \delta^\omega (E_{2R} \text{MPC}^N - (E_{2R} - R^2_{2R}) \text{MPC}^N) E_w \\
+ a_1 \gamma \text{MPC}^N E_w - a_3 [E_{2R} - R^2_{2R}] \right\} \leq 0
\]  \hspace{1cm} (3.62)

Equations (3.61) and (3.62) represent the channel through which anticipated increases in government consumption of nontradables in period 2 affect the price of nontradables. The channels can be explained with the same logic as in equations (3.59) and (3.60). The substitution effects that are captured by the third terms on the RHS of equations (3.61) and (3.62) generate a positive effect on the price of nontradables in both periods. The direct income effects captured by the first term of both equations also operate negatively on the price of nontradables in both periods, as in the previous cases.

On the other hand, another income effect induced by the financial repression, captured by the second terms on the RHS of equation (3.61) and (3.62) may influence positively the price of nontradables in period 1, and negatively in period 2. The combined income effects, then will
be ambiguous in period 1 and will be negative in period 2. Therefore, the total effect will be ambiguous in both periods. However, in the second period, the income effect may dominate the substitution effect, which will result in a decrease in the price of nontradables, a real depreciation in period 2.

3.3.5 Summary

In the previous sections, we undertook various comparative static analyses using the intertemporal model. The major findings of these analyses are summarized as follows. (1) In the most plausible case, when there is no initial distortion of financial repression and substitution effects dominate income effects, financial repression generates a real appreciation in the first period and then generates a real depreciation in the second period. However, when there is an initial distortion of financial repression, these effects can be changed. This is because additional income effects are induced by the initial financial repression which may generate ambiguous results in both periods. In line with this, under other distortions such as trade controls, the effect of the financial repression on the real exchange rates may also be changed. The effect of financial repression on the real exchange rate depends on the relative importance of the preexisting financial repression and trade controls. In an economy in which trade controls are more severe (high tariffs) than financial repression, financial deregulation may generate a real depreciation.

(2) The effect of the relaxation of the capital controls on the real exchange rate depends on the factor intensity of the tradables and nontradables. In the case in which tradables are capital
intensive, relaxation of the capital controls will result in a real appreciation in period 1, and have an ambiguous effect in period 2. In the case in which nontradables are capital intensive, relaxation of the capital controls generate an ambiguous result in period 1, however, that will generate a real appreciation in period 2. The effect can be changed in the presence of financial repression. Under financial repression, indirect income effects are induced, and this additional income effect may change the effects from those expected without financial repression. Therefore, under financial repression, relaxation of capital controls affects real exchange rates ambiguously in both periods if tradables are capital intensive. In the case that nontradables are capital intensive, relaxation of capital controls also generates an ambiguous result in period 1.

In period 2, however, there will be a real appreciation.

(3) When there is no initial tariff, tariff imposition results in a real appreciation due to the substitution effect in both periods. When there are initial tariffs, the effects of a hike in import tariffs on the real exchange rate may be changed with the income effects. However, in the plausible case that there is substitutability in consumption everywhere and that the substitution effect dominates the income effects, a temporary tariff hike (reduction) will generate an equilibrium real appreciation (depreciation) in both periods. This is the conventional wisdom that has been argued in the traditional policy literature. Under the condition of financial repression, this traditional wisdom can be changed. Under financial repression, a tariff reduction will not necessarily result in an equilibrium real depreciation because of the additional income effects induced. The effects of tariff changes on the equilibrium real exchange rate will be influenced by the relative importance of financial repression and the level of the tariff rate.
(4) When there are no distortions, and in the most plausible case in which the substitution effect dominates the income effect, an increase in government consumption of nontradables will generate a real appreciation in both periods. An anticipated increase in government consumption of nontradables in period 2 will generate the same results, a real appreciation in both periods. However, when we consider financial repression these results can be changed. That is, under financial repression, an increase in government consumption of nontradables may result in a real depreciation. This is because with the initial distortion of financial repression, additional income effects are induced, which may generate movements in the opposite direction as the substitution effect.

Analyses of the above results provide important implications. Under financial repression, some government policies sometimes may generate unwanted real exchange rate misalignments that contradict the conventional wisdom. Edwards (1989, 1991) showed that changes in the level of import tariffs and taxes on foreign borrowing can generate different impacts on the path of equilibrium real exchange rates than the result of previous studies using his intertemporal framework. However, he assumed well-functioning domestic financial markets in developing countries. The above reveals that financial repression may play an important role in the channel through which various government policies affect the real exchange rate. In this respect, an empirical study to examine these relationships is necessary.
ENDNOTES

1 Kähkönen analyzed the welfare effects of three types of liberalization policies - financial deregulation, relaxation of capital controls, and trade liberalization. However, he did not consider nontradable goods.

2 Internal equilibrium means that the nontradable goods market clears in the current period, and is expected to be in equilibrium in future periods. In this definition of equilibrium real exchange rate, it is implicit that this equilibrium takes place with unemployment at the 'natural level'. External equilibrium, on the other hand, is attained when the intertemporal budget constraint, that states that the discounted sum of a country's current account has to be equal to zero, is satisfied. In other words, external equilibrium means that the current account balances (current and future) are compatible with long-run sustainable capital flows.

3 This assumption of gross substitutability in period 1 requires that $E_{m1}\pi^1_{p1q1} > 0$ and $|\pi^1_{p1}E_{m1}| < E_{m1}\pi^1_{p1q1}$. Edwards (1989) argues that only in this case, the presumption found in traditional policy literature regarding the relation between tariffs and real exchange rates (a tariff hike will require a real exchange rate appreciation) will hold.

4 $E_{q2q1} > 0$, $E_{q2p1} > 0$. This result is possible only in a model with foreign borrowing where agents borrow from the rest of the world to smooth the effects of foreign shocks through time. In this case, if there is no intertemporal substitution, $E_{q2q1} = 0$, $E_{q2p1} = 0$, then $dE_{q2}/d\tau = 0$.

5 Edwards (1989) indicates that this ambiguous result is in contradiction to the more traditional, and generally accepted policy oriented literature on tariff regimes. Edwards also indicates that if we assume that there is substitutability in consumption everywhere, and that substitution effects dominate income effects, a temporary tariff will generate an equilibrium real appreciation in both periods.
Chapter 4
Exchange Rate Movement and Policy: The Korean Experience

4.1 Economic Development and Policy Changes

In this section, we review the economic policy changes in Korea over the past three decades. There have been two fundamentally different regimes since the early 1960s. Beginning in 1962, policy makers adopted a highly regulated expansionary and export-oriented economic policy. This policy promoted high economic growth until the end of the 1970s. In the early 1980s, policy makers adopted a regime of economic stabilization, and have promoted deregulation policies since then.

4.1.1 Expansionary and Export-Oriented Policy

Korea launched its first five year economic development plan in 1962. From this time, Korea pursued expansionary monetary and fiscal policies to promote high economic growth until the end of the 1970s. In line with this, Korea chose an outward oriented strategy as the means to economic development.¹

During the 1960s and 1970s, the priority of economic policies was high economic growth and the creation of new employment opportunities. Thus the main aim of monetary policy in these periods was to help finance economic plans. Given the low level of capital accumulation and lack of well-organized money markets, funds were short and, typically, had to be typically
provided by expanding the money supply or by inducing an inflow of foreign capital. Furthermore, during this period, as the government adopted an expansionary fiscal policy, a substantial fiscal deficit was maintained. Monetary policy during the period was also expansionary. As a consequence of these expansionary policies, chronic inflation persisted alongside rapid economic growth. At the same time, foreign debt had been accumulated with sustained large investments exceeding domestic savings. During the 1970s, especially, the ambitious development plan led to an overheated economy in spite of a difficult competitive environment in world markets for newly developing countries. Experiencing the first oil crisis, Korean policy makers feared that its comparative advantage was shifting away from light industry. In response, the Korean government initiated a massive investment program in heavy and chemical industries. During this period, policy instruments for monetary control, both orthodox instruments and direct controls of bank credit, could not function effectively because of factors such as the immaturity of the financial structure, the existence of persistent excess demand for banking funds, commercial banks’ heavy borrowings from the central bank, and large government deficits.

On the other hand, to pursue the outward development policy, the Korean government initiated an intensive series of financial reforms. First, the authorities strengthened the controls over financial institutions. In 1962, at the launch of the first five year economic development plan, the Korean government revised the “Bank of Korea Act” and the “General Banking Act.” Since then, the financial sector in Korea has been under strict government controls. Government has been directly or indirectly involved in formulating some of the policies which failed. Second, the authorities changed the interest rates. In 1965, the Korean government
undertook monetary reform to substantially raise the interest rates for lending and borrowing (especially for borrowing). The purpose of the reform was to supply funds to industries by monetizing the non-monetary sector, and expanding the fund-raising scale in the financial market through the parametric function of the interest rates, even though there were some financial distortions. This reform was suggested by Gurley, Patrick and Shaw. The high level of interest rates was maintained for about three years. From 1968, however, as the financial structure of firms deteriorated, interest rates began to fall steadily until August 1972, when the high interest rate period was terminated by a Presidential Emergency Decree. Third, the authorities changed the exchange rate system. In 1964, the government adopted a single currency peg (crawling peg) system. These financial reforms helped outward-oriented policy to work well and contributed to economic growth.

4.1.2 Stabilization and Deregulation Policies since the 1980s

In the early 1980s, the Korean authorities shifted to a policy of economic stabilization. This was followed by economic liberalization policies.

Economic Stabilization in the Early 1980s

Toward the end of the 1970s, the Korean economy began to experience widening structural imbalances associated with a prolonged period of rapid growth and high inflation brought on by the expansionary policies. Kim (1986) noted that the accelerated inflation was considered
to undermine the sustained economic growth seriously: weakening export competitiveness, unproductive activities of business preoccupied with inflationary gains, and the growing frustration of workers confronting a widening disparity in the distribution of income and wealth. Coping with this situation, the Korean government announced a comprehensive stabilization program in 1979, which became a landmark in Korean macroeconomic management. This program included restrictive fiscal and monetary management, investment adjustment in the heavy and chemical industries, improvement in the government price control and commodity distribution system, and proposals for institutional changes to stabilize real estate prices.

Figure 4.1 Increase Rates of Money Supply (M2) and Consumer Price
Source: Bank of Korea, Monthly Bulletin, various issues
During the subsequent years, as the economic situation continued to deteriorate, the government relaxed the original restrictive policy stance somewhat to stimulate the economy. However, with this stabilization effort as momentum, the Korean authorities have continued to maintain tight monetary and fiscal policies.²

Figure 4.1 shows that since 1980, money supply growth has decreased remarkably and that prices have been largely stabilized.³ In line with this, as we see in Figure 4.2, the ratio of government consumption has decreased remarkably since the 1980s, reflecting the tight fiscal policy stance, especially since the latter half of the 1980s. The government consumption to GDP ratio declined from 0.155 during the 1970s to 0.128 during 1980 - 1985, to 0.103 during 1986 - 1993.

![Figure 4.2 Ratio of Government Consumption to GDP](image)

Promotion of Deregulation Policies

The successful implementation of a series of economic development plans contributed greatly to Korea's achievement of remarkable economic development in the 1960s and 1970s. However, as the Korean economy grew much larger and more complex, it reached a stage where entrusting the management of the economy to government initiative was believed to be less efficient than entrusting it to the market mechanism. (Bank of Korea, 1990).

Therefore, the government shifted its policy stance to market-oriented management of the economy as of the early 1980s, to enhance the efficiency of the entire economic system. First, to introduce greater competition from abroad, the government has accelerated import liberalization, progressively reducing the number of items whose import is subject to restriction. As a result, by the early 1990s, import liberalization has been almost accomplished. The import liberalization ratio (number of automatic approval item / total number of item) has been raised from around 50 - 60%, during the second half of the 1970s, to 95.4% in 1988. (Ministry of Finance, 1992). Together with the reduced quantitative import restrictions, the average nominal tariff rate has been gradually lowered from 24.9% in 1979, to 18.1% in 1988, and to 10.1% in 1992.

In the financial sector, also, a number of measures have been taken to encourage financial reform since the early 1980s. This effort started with the lifting of many restrictions on bank management in order to promote competition and efficiency. Subsequently, various measures of reform have been promoted. Reforms in financial system, and monetary policy reforms such as interest rate deregulation and relaxation in credit controls have been enacted. In addition, there has been a relaxation of capital and foreign exchange controls. Among these
various measures, interest rate deregulation and the relaxation of capital and foreign exchange controls are particularly correlated to the changes in exchange rates. As such, we shall narrow our focus down to an analysis of just these policies.

The Korean experience is in contrast to that of the Southern Cone countries, with regard to the implementation of the liberalization policies. The Southern Cone countries carried out extensive reforms, including the elimination of direct programs, interest rate controls, and exchange rate controls. In Korea, by contrast, reforms have been introduced step by step, and have been much less comprehensive. Korea initially tried to liberalize only trade transactions and to promote the domestic financial market and capital markets. Korean monetary authorities have been very conservative in promoting the liberalization of the interest rate and the capital account. They were very much preoccupied with the unfortunate consequences resulting from the appreciation of the local currencies after capital liberalization during late 1970s, and early 1980s, in the Southern Cone countries.

**Interest Rate Deregulation**

Early efforts at interest rate deregulation in Korea, during the first half of the 1980s, adopted the strategy of introducing new financial products, with relatively high interest rates, that were closer to market rates, instead of deregulating the rates on existing products. (see Appendix B).

In the latter half of the 1980s, price stability and a current account surplus enabled the Korean economy to proceed further along the road of interest rate liberalization. With a major deregulation of the interest rates charged by banks and non-banks, which took place in
December 1988. Unfortunately, however, the timing of this move proved somewhat inopportune, forcing the monetary authorities to resume control of interest rates several months later. Economic conditions promptly deteriorated from early 1989. As the market-determined interest rates soared, the failed reform was criticized from the viewpoint that high interest rates would erode the international competitiveness of Korean exports, along with the hikes in wages and appreciation of the Korean won.

Following this reversal, there was lively debate over how interest rate deregulation should proceed. Finally, a new four-stage interest rate deregulation plan was undertaken in November 1991. In the first stage, most of the short-term lending rates of banks and non-bank financial institutions were liberalized. Deposit rates were partially liberalized with rates on deposits with maturities of more than three years being deregulated. At the same time, interest rates on various money and capital market instruments, including corporate bonds with maturities of over two years, were also freed.

The successful completion of this first phase of interest rate deregulation could be a firm basis for the next, more extensive, round of deregulation. However, it is generally accepted that interest rate deregulation in Korea has been slow, and this delay has proved to be a hurdle for further financial liberalization.5

Relaxation of Capital Controls

The policy toward decontrol of the capital account has been strongly influenced by Korea’s overall macroeconomic situation. In particular, the current account, the debt situation, and liquidities constraints have all played a role. In the early 1980s, Korea faced the problems of a
current account deficit and accumulated foreign debt. The government reacted by restricting capital outflows, resulting in an eventual net capital inflow.

Korea has experienced a constant capital shortage ever since the economic development process began and has relied mainly on foreign borrowing, rather than on foreign direct or portfolio investment, as a method of financing. However, in July 1984, the authorities adopted a negative list system to the effect that all types of foreign direct investment are allowed unless specifically prohibited in the regulation of foreign direct investment. Since the new policy has been adopted, foreign direct investment by non-residents has increased greatly.

In the late 1980s, when Korea recorded a current account surplus, she had difficulties in controlling domestic liquidity with an excessive supply of money in the foreign sector. Korea had concerns about the possibility of changes in the real exchange rate due to capital inflows. For the sake of export competitiveness, the Korean won needed to be held at a relatively competitive level. During this period, however, international pressure began to mount on Korea for greater import liberalization. Given the economic situation of the latter half of the 1980s, the Korean government pushed strongly for policies which induced large capital outflows, and at the same time, placed strong restrictions on capital inflows during the second half of the 1980s and early 1990s. The deregulation of capital inflows during this period has been concentrated on overseas direct and portfolio investments.

As international pressure to open the capital market strengthened, Korea partially opened the domestic stock market to foreign investors beginning in 1992.
Foreign Exchange Liberalization

Liberalization of the Korean foreign exchange market has been gradually pursued since the late 1980s, reflecting the authorities' desire to minimize the adverse effects of abrupt liberalization policies. Since Korea accepted the obligations of Article VIII of the IMF Agreement in November 1988, there has been a considerable relaxation of foreign exchange controls in line with the spirit of the IMF. However, liberalization of the foreign exchange market in Korea is still in the early stages.

Foreign exchange transactions, which had been under strict control because of a chronic current account deficit, turned to surplus in the latter half of the 1980s. Deregulatory changes took place in areas like the foreign exchange rate system, and foreign exchange position management. At the same time, efforts for the internationalization of the Korean won have been carried out consistently.

The market average foreign exchange rate system, which was introduced in March 1990, allows the won/U.S.dollar exchange rate to fluctuate freely, within a band, around a base exchange rate. In 1987, transactions in currency futures and currency options were allowed in addition to forward contracts and currency swaps. Major foreign currency call markets were established during 1989 - 1992.

4.2 Overview of the Financial Structure

In the previous section, we reviewed the major economic policy changes in Korea for the past three decades. During this period, the Korean government played an important role in
economic development. Under the government initiative, the financial sector has made a significant contribution to economic development in Korea by allocating domestic savings to strategically important sectors. The current financial system has been built to support the industrial policies, by supplying a large amount of financial resources at lower interest rates.

With the revision of the "Bank of Korea Act" and the "General Banking Act" in 1962, the financial system in Korea was converted to support the financing of industry, and an economic development program proceeded under the guidance of the new government. Since then, the financial sector in Korea has been lagging behind the real sector.

The financial sector has grown substantially in terms of scale, though, to keep pace with the growth of the economy. Generally, the financial interrelation ratio (the ratio of total financial asset to GNP) is used to measure the scale of the financial sector. The trend of the financial interrelation ratio (FIR) shows an increasing trend in the long-run, especially since the 1980s. Table 4.1 shows that the Goldsmith's FIR (Goldsmith, 1969) rose from 2.13 in 1970 to 2.40 in 1980 to 4.22 in 1991.

Bank of Korea (1993) explains that financial industries in Korea have grown remarkably terms of scale by establishing and extending financial institutions, and by introducing new financial instruments during the 1970s and 1980s. However, this ratio is far lower than those of major advanced countries, and lower than that of Taiwan, a country at a similar stage of economic development. The FIR in U.S.A., U.K., Japan and Taiwan are all in the 5.2 - 6.9 range as of the early 1990s. However, in Korea, this ratio is only 4.2 in 1991. The security and equity markets are also underdeveloped compared to major industrial countries. As we see in Table 4.1, the ratio of primary securities to GNP is in the 1.3 - 1.7 range for the three
Table 4.1 Financial Interrelation Ratio

<table>
<thead>
<tr>
<th>Country</th>
<th>Financial Asset/GNP</th>
<th>Primary Securities/GNP</th>
<th>Indirect Security/GNP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Korea</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1970</td>
<td>2.13</td>
<td>0.59</td>
<td>1.54</td>
</tr>
<tr>
<td>1980</td>
<td>2.40</td>
<td>0.46</td>
<td>1.94</td>
</tr>
<tr>
<td>1987</td>
<td>3.77</td>
<td>0.84</td>
<td>2.93</td>
</tr>
<tr>
<td>1991</td>
<td>4.22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>U. S. A.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1970</td>
<td>4.37</td>
<td>1.65</td>
<td>2.72</td>
</tr>
<tr>
<td>1973</td>
<td>4.28</td>
<td>1.34</td>
<td>2.94</td>
</tr>
<tr>
<td>1986</td>
<td>5.03</td>
<td>1.76</td>
<td>3.27</td>
</tr>
<tr>
<td>1990</td>
<td>5.23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>U. K.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1969</td>
<td>4.46</td>
<td>1.39</td>
<td>3.07</td>
</tr>
<tr>
<td>1972</td>
<td>5.02</td>
<td>1.63</td>
<td>3.39</td>
</tr>
<tr>
<td>1986</td>
<td>6.32</td>
<td>1.30</td>
<td>5.02</td>
</tr>
<tr>
<td>Japan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1970</td>
<td>3.74</td>
<td>0.55</td>
<td>3.19</td>
</tr>
<tr>
<td>1977</td>
<td>4.48</td>
<td>0.77</td>
<td>3.71</td>
</tr>
<tr>
<td>1987</td>
<td>6.81</td>
<td>1.76</td>
<td>5.05</td>
</tr>
<tr>
<td>1991</td>
<td>6.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taiwan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1970</td>
<td>2.14</td>
<td>0.51</td>
<td>1.63</td>
</tr>
<tr>
<td>1986</td>
<td>4.20</td>
<td>1.02</td>
<td>3.18</td>
</tr>
<tr>
<td>1988</td>
<td>4.23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1991</td>
<td>5.10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

advanced countries in 1986 or 1987. However, the ratio in Korea stood at 0.84. This level is lower than that of Taiwan in the same year.

At the same time, Bank of Korea (1993) noted that financial industries in Korea have generally lagged behind in terms of quality. That is, the banking institutions in Korea do not carry out the fundamental roles of intermediation of savings and investments because the market mechanism is distorted in the financial markets by excessive government controls. Bank of Korea (1993) also noted that the lag in the financial sector in Korea has been the result of the sustained financial repression implemented to pursue the export-led growth strategy during the past three decades. Financial markets have been controlled for most of the period, with the monetary authorities allocating scarce domestic savings to export-oriented industries, the priority sector for economic development in Korea. Amsden and Euh (1993) note that despite the longer-than-a decade effort at financial liberalization, the financial system continues to operate within the context of industrial policy.

The Korean monetary authorities have especially controlled domestic interest rates to maintain a low cost of capital to encourage economic development. Amsden and Euh (1993) also note that the monetary authorities in Korea maintain the policy of intervention to prevent excessively high costs of capital that might discourage investment. Therefore, most of the interest rates including lending and borrowing rates of the financial institutions, have been restricted below the market level of rates. Figure 4.3 compares the regulated interest rate paid on deposits with the curb market rate, and corporate bond yields that represent the market rate, since the 1970s. During the whole period, the interest rate paid on deposits is far below the rate of the curb market and corporate bond yields.\(^7\) During a period of the 1970s, the real
interest rates paid on deposits even showed a negative trend. This negative real interest rates was an adverse consequence of an artificially low interest rate on deposits and of high inflation. However, during the 1980s, the real interest rate for deposits maintained a positive trend thanks to a lower inflation rate.

Figure 4.3 Trends of Real Interest Rates
Source: Bank of Korea

4.3 Review of the Exchange Rate System and Exchange Rate Behavior

In this section, we review the exchange rate system in Korea over the past three decades. We also review the Korean won exchange rates movements since the 1970s.
4.3.1 Exchange Rate System

In Korea, four different exchange rate systems have been used since the end of World War II. From August 1945 to March 1965, the fixed parity system tying the won to the U.S. dollar was adopted. During this period, the parity was changed frequently. The exchange rate was set rather arbitrarily by government officials and stayed unchanged until the next official change.

From May 1965 to December 1974, a single currency peg (crawling peg) system, pegged to the U.S. dollar was adopted. This was done because Korea faced continuous high inflation during this period and wanted to maintain competitiveness by adjusting the exchange rates to reflect the differential between domestic and foreign inflation rates. This crawling peg system encouraged foreign capital inflows because expectations were more stable than in the case of a one-time substantial depreciation. However, it was found that the changes made under the crawling peg were not large enough and Korea depreciated the won sharply in 1969, 1971, and 1974. These successive rounds of devaluation were carried out to support the export-led economic growth policy. Price competitiveness, through devaluation, was a high priority in achieving the goal of export promotion. At the same time, the monetary and fiscal expansion necessary to carry out an ambitious economic plan accelerated inflation.

Therefore, from 1975 to 1979 Korea went back to a fixed exchange rate linked to the U.S. dollar, at 484 won per dollar. In addition, the improved balance of payments situation, due to the booming exports and increased remittances from laborers in the Middle East, increased reserves and allowed Korea to more easily adopt a fixed exchange rate regime. Korea also
tried to halt imported inflation by fixing the exchange rate. However, this U.S. dollar peg or fixed system revealed some problems. One observer (Kim, 1992) has noted a number of problems with the policy: first, since the value of the won was linked only to the value of the U.S. dollar, the won exchange rates vis-à-vis other currencies was often misaligned and no corrections were made in a timely basis. Second, the exchange rate was changed in a highly discrete manner. Devaluation came only after substantial pressure of devaluation had mounted and, when it did, it came in big ways. This pattern of change misdirected the allocation of resources. Third, the high domestic inflation rate was not properly incorporated in the exchange rate, and this hampered the price competitiveness of Korean exports.

To deal with these problems, the government of Korea depreciated the won 20% in January 1980. Subsequently, in February 1980, the Korean government changed its exchange rate system to a multiple currency basket, managed floating system. This was a system of pegging the Korean currency's value to the average of both the SDR basket value of the U.S. dollar and a Korean trade-weighted basket value of five foreign currencies. This basket approach was introduced in the belief that market forces should play a more active role in improving the flexibility of the exchange rate, while stability should be maintained at the same time. Under this system, the won-U.S. dollar rate was the exchange rate the monetary authority used to set the appropriate level of Korean external value against foreign currencies.

The announced formula was as the following.

\[ E = \beta \text{SDR} + (1-\beta)\text{KOR} + \text{ADJ} \quad 0 < \beta < 1 \]

where \( E \): nominal exchange rate of the won to the U.S. dollar
The rule did not allow the exchange rate to be set freely but provided a simple mechanistic formula for the monetary authority to set a “center rate”. Adjustments of the exchange rate were easier both operationally and politically. This was because Korea was accused of “manipulating” the foreign exchange rate by the U.S. government. What is more, the weights between the SDR basket and the won basket were not announced by the authorities. Under this dual basket system, the nominal won - U.S.dollar exchange rate depreciated 84% from 1980 to 1985. In response, the trade balance began to improve, and, in 1986, the trade balance shifted into surplus. However, during 1986-1989, the nominal won - U.S.dollar exchange rate appreciated by 22%, a result which was influenced by the Plaza and Louvre agreements. During this period, the U.S. government mounted pressure on Korea to open up its financial markets. In line with this, the multiple basket pegged system revealed some limitations, particularly in regard to its inability to take fully into account economic fundamentals and the supply and demand situation of the domestic foreign exchange market.

Accordingly, in March 1990, the authorities adopted a new exchange rate system (the Market Average Exchange Rate System) as part of an effort to move to a full-fledged system of market-based determination of the exchange rate. Reflecting the immature exchange
market in Korea, the government introduced this system as a transitional stage toward the free floating exchange rate system being used in major advanced countries. Under this new regime, the market average rate of the won against the U.S. dollar is calculated by taking a weighted average of the exchange rates, with the weight being the transaction volume at each rate. The exchange rates against other currencies are determined by an arbitrage relationship, with the exchange rate between the U.S. dollar and any third currency being determined in the international foreign exchange market. The market average rate, thus determined, becomes the basic rate of the next day, and this rate is initially allowed to fluctuate within a band, which has frequently been expanded. The band, originally set to 0.4% above or below the base exchange rate, was expanded to 0.6% either way in September 1991, to 0.8% in July 1992, and then 1.0% in October 1993. Eventually, this gradual expansion of the daily fluctuation band is expected to bring about what is virtually a free-floating exchange rate system.

In reviewing exchange rate management over the past three decades, we can say that it was based on a nominal anchor approach during the 1960s-1970s, in the respect that the monetary authorities tried to fix the exchange rates. On the other hand, since the 1980s, the monetary authorities have adopted a real target approach by introducing a managed floating exchange rate system.

4.3.2 Exchange Rate Behavior

Examining the trend of the won/U.S. dollar nominal exchange rate, there are three sharp depreciations and two turning points in the period from 1970 to the early 1990s. The first
sharp depreciation occurred in June 1971 (21.8%) under the single currency peg system. The second substantial depreciation took place in December 1974 (30.5%), mainly due to the first oil shock. Subsequently, the exchange rate system went back to a fixed exchange rate system.

The third big depreciation was implemented in January 1980 (20%), due to the second oil shock. Soon after, the monetary authorities changed the exchange rate system to the multiple basket pegged system. In line with this, two turning points are evident since the 1980s: In 1986, the depreciation trend was reversed, and an appreciation followed from 1987 to 1989. In 1990, this rate peaked and, since then, the won has been depreciating.
Examining the real exchange rate of the won vis-à-vis the U.S. dollar, since 1980, it shows a similar pattern as the nominal won exchange rate. Figure 4.4 depicts the trend of these bilateral nominal and real exchange rates since 1970.

![Graph showing trends of Real Effective Exchange Rates and Real Exchange Rate (won/U.S. dollar)](image)

**Figure 4.5** Trends of Real Effective Exchange Rates and Real Exchange Rate (won/U.S. dollar)


The real effective exchange rate (REER) for the Korean won which is measured by using trade volume and prices of seven major trading partners (U.S.A., Japan, Canada, United Kingdom, Germany, France, Netherlands), shows a similar trend to the real won exchange rate (see Figure 4.5). In the early 1970s, the REER depreciated. However as of 1973, the REER appreciated until the end of the 1970s. Beginning in the 1980s, with the adoption of a multiple
basket system, the REER started to depreciate rapidly, with a 42.39% real depreciation by the end of 1986. The REER then had a 23.6% appreciation, which continued until the end of the 1980s. However, beginning the 1990s, it has reversed to a trend of depreciation, with an 11.46% real depreciation from 1990 to 1993.

![Figure 4.6 Trends of Real Effective Exchange Rates and Nominal Exchange Rate (won/U.S.dollar)](source: IMF, International Financial Statistics, various issues)

In comparing the trend of the REER with that of the nominal won exchange rate, we see that these two exchange rates, as a whole, seem to have moved systematically since the 1980s. However, from time to time, the REER and the nominal exchange rate have diverged. The asynchronous movement of these two exchange rates reflects exchange rate misalignments.
among major currencies. During 1986, the nominal exchange rate stayed almost unchanged (appreciating slightly), while the REER decreased sharply, reflecting the strength of the U.S. dollar against the Japanese yen and the Deutsche mark. In this particular period, the exchange rate policy stance in Korea could be characterized as having been too cautious and conservative. The Korean monetary authorities adjusted slowly to maintain international competitiveness against the U.S. dollar.

4.4 Studies of Exchange Rate Determination in Korea

Many studies on the determination and the appropriate level of the Korean exchange rate have been done by Korean economists since the adoption of multiple currency basket peg system in 1980. These studies, including Kim (1984), Oum (1990), and Kwack and Kim (1990), attempt to reveal whether the authorities manage the basket system properly, and whether the weights of the major currencies are appropriate.

Some studies considered structural factors, such as the current account balance and external debts. These studies, however, focused on the mechanism of the multiple currency basket peg system. Kwack (1988), examined whether the exchange rate policy targets are related to Korea's PPP or external debt position, and found that Korea's authorities adjusted their exchange rate in response to change in the external debt, but not to deviations from the PPP during 1973-1986. According to these results, the possible targets of exchange rate policy were PPP, inflation differentials, the real exchange rate, the balance of payments, external debt and interest rate differentials. Kwack and Kim (1990) also showed that the exchange rate over
the managed floating period of 1980 - 1989 is explained by the movements of the U.S. dollar, relative prices, and the external liability relative to Korean income.

Kim (1990a) reviewed Korean exchange rate behavior from the viewpoint of the exchange rate determination theories. He applied the flexible price monetary model (Frenkel - Bilson model), the rational expectations model, the sticky price monetary model (Dornbusch - Frankel Model), and the sticky price asset model (Hooper - Morton model) under the assumption of PPP theory, over the period 1980-1989, using quarterly data. However, the result shows that any model based on PPP theory, the monetary approach, or the portfolio balance approach, does not explain Korean exchange rate satisfactorily. Lee (1992a) argues that the monetary approach model and the Hooper - Morton model have certain limitations in explaining exchange rate behavior in less developed countries. This is because these models are based on the Mundell - Flemming model, which only considers demand. It is necessary to consider supply in less developed countries, such as Korea. Paying attention to this, he compared the monetary approach model, and the Hooper - Morton model, with his “labor market disequilibrium model” which considers the supply side estimating the Korean exchange rate using U.S. and Korean data. From this study, Lee derived some important implications. The model is applicable in explaining the exchange rate behavior between developing and advanced countries.

There are some other studies that discuss purchasing power parity of the Korean exchange rate, and deviations from it. Bahmani-Oskoosee and Rhee (1992) tested the absolute PPP theory between the Korean won and nineteen other currencies of the effective exchange rate concept using cointegration over the period of 1980 - 1989. This provided empirical evidence
rejecting the long-run PPP. Lee (1991) examined whether the Korean exchange rate deviates systematically from PPP. He found some evidence that the Korean exchange rate against the U.S. dollar and the Japanese yen deviates systematically over the period of 1980 - 1990, and that these deviations could be explained by productivity differences between the countries.

Some studies analyzed the exchange rate behavior by estimating the authorities' reaction functions. Kim (1990b) analyzed the exchange rate policy behavior in Korea by estimating both nominal and real exchange rate reaction functions over the period of the third quarter 1980, to the third quarter 1988. His results are that the authorities appear to have targeted the overall current account and bilateral trade balance for the won/U.S. dollar and won/yen exchange rates. His results also shows that they did not target either PPP, or real exchange rate misalignment for the won/U.S. dollar exchange rate determination. Lee (1990) also estimated the nominal won/U.S. dollar exchange rate over the period of 1980 - 1989 using quarterly data. His results also imply that Korean monetary authorities may target the current account rather than PPP. The result implies that authorities are concerned with overall economic characteristics rather than the bilateral economic determination of the won/U.S. dollar exchange rate.

On the other hand, Park (1989) attempted to explain Korean exchange rate behavior from the viewpoint of macroeconomic stability, changes in wages, productivity and profit margins, and the political economy of exchange rate policy instead of using specific exchange rate theory. From this study, he found that in Korea, in relation to the experience of Southern Cone countries, sound fiscal and financial policies accompanied by capital controls provided the macroeconomic stability that prevented massive movements in real exchange rates. In a
separate paper, Park (1987) analyzed the linkages between the real exchange rate and real wages. He showed that the linkages are influenced by the magnitude of changes in terms of trade, productivity in nontraded goods, wages in terms of importables, effective real capital cost and import liberalization among others.

Park (1991) analyzed the determinants of the Korean real exchange rate by applying the Calvo and Rodriguez's (1977) simple two-sector model. The estimation was performed over the period of 1980-89, using quarterly data. The results reveal some interesting phenomena. First, the monetary and fiscal expansion led to a real appreciation. Second, the improvement in the terms of trade led to a real depreciation. This experience is in the contrast to the popular view that an improvement in the terms of trade will result in a real appreciation. Third, productivity growth led to a real appreciation, but this effect of the Ricardo-Balassa type was not significant. Finally, the nominal devaluation was quite effective in producing a real depreciation. Lee (1992b) investigated the empirical relationship between the real exchange rate and interest rate differentials for Korea-U.S as well as for Korea-Japan, over the periods 1973.5-1990.6. The result showed that monetary disturbances do not explain much of the exchange rate behavior. It is expected that real factors affected the exchange rates over the sample period. The result also noted that long run equilibrium relations do not exist between both series.

As we reviewed above, most studies on the Korean exchange rate have concentrated on the behavior of the nominal exchange rate. There are only limited studies on real exchange rate determination, and these studies do not consider the effects of a repressed domestic financial market in Korea. In Korea, the monetary authorities have controlled domestic interest rates to
maintain a low cost of capital to encourage economic development. As we examined in Chapter 3, in a financially repressed economy, the real exchange rate can be affected by its condition of financial repression, and under this condition, the effects of government policies on the real exchange rates also can be changed. In this respect, it is quite necessary to investigate real exchange rate determination considering a repressed domestic financial market in Korea. Furthermore, we can say that it is timely to analyze the effects of the various policies on the real exchange rate in Korea by considering the financial repression. This is because the Korean monetary authorities plan to accelerate the interest rate liberalization in the near future.
ENDNOTES

1 The first of a series of Five-Year Plans, initiated in 1962, identified investment and export-led economic growth as the number one priority. One of the premises of this development strategy was that foreign capital inflows and imports must be used primarily to build up the productive capacity of the economy to increase export performance.

2 The IMF (1985) evaluated Korea's experience following the second wave of oil price increases as an excellent example of how orthodox stabilization policies, effectively implemented, can help a country adjust to domestic and external shocks.

3 By the policy changes, the annual growth rate of money supply (M2), which had averaged over 30% in the 1970s, has decreased to well below 20 percent since 1983.

4 According to the Bank of Korea (1994), the measures enacted since the early 1980s are summarized as follows: 1) interest rate deregulation 2) relaxation of the regulations on the internal management 3) lowering entry barriers to the financial markets 4) enlargement of business scope 5) national treatment of foreign banks 6) capital market opening 7) foreign exchange and capital account liberalization 8) introduction of the real name system for financial transactions.

5 Jwa (1992) attempted to measure the degree of financial liberalization in Korea by looking at the response of regulated interest rates to the market interest rate over time and by analyzing the trend of the interest rate margin in the banking sector. According to these results, Korea's overall financial deregulation seems to have been slightly set back since the late 1980s.

6 Mobilization and allocation of domestic savings in the financial markets have been a priority of the Korean government since the early 1950s. Moser (1989) argues that Korea has been very successful in allocating domestic savings to priority sectors, but mobilization of domestic savings has not been as effective as in many other Asian countries.

7 Even in the period of high interest rates (1965 - 1972), the level of official interest rates had been below the market interest rates.

8 Korean monetary authorities, devalued the Korean won 18.6% on November 3, 1969, 21.8% on June 28, 1971, and 30.5% on December 7, 1974.

9 The weights given in the SDR basket represent, approximately, the role of the five countries (U.S., West Germany, Japan, France, and U.K.) in world exports of goods and services. While the SDR basket serves as a proxy for the global weights, it may not adequately represent the weights appropriate for Korea. Thus, a dual basket scheme was adopted.
However, the IMF still classifies Korea’s exchange rate system as a managed floating system. This is because the new system introduced a band within which exchange rate fluctuation is allowed.
5.1 Empirical Model Specification

The empirical model is based on the theoretical framework presented in Chapter 3. According to this framework, financial repression (or deregulation of the domestic financial market), capital controls, the composition of government consumption, investment, productivity, and the external terms of trade, are the important "fundamentals" in determining the behavior of equilibrium real exchange rates.

The simplest possible way of writing down the equilibrium real exchange rate is as follows: (Refer to Edwards, 1991).

$$
\log(e^*) = \beta_0 + \beta_1 \log(KC) + \beta_2 \log(TC) + \beta_3 \log(GNC) + \beta_4 \log(INV) + \beta_5 \log(PDT) + \beta_6 \log(TOT) + \beta_7 \log(RID) + u_t
$$

where the following notation has been used:
- $e^*$: equilibrium real exchange rate
- KC: measure of controls over capital flows
- TC: measure of controls over trade
- GNC: government consumption on nontradables
- INV: ratio of investment of GDP
- PDT: index of productivity
- TOT: external terms of trade
- RID: measure of financial repression
However, as discussed in Chapter 3, the actual real exchange rate generally deviates from the long run equilibrium real exchange rate. That is, in the short-run, the real exchange rate is also affected by monetary factors. In the long-run, equilibrium real exchange rate movements will depend on real variables only. Therefore, the dynamic behavior of the actual real exchange rate can be presented as follows:

\[
\log(e)_t - \log(e)_{t-1} = \theta [ \log(e')_t - \log(e)_{t-1} ] + \mu \text{IMPACT} \tag{5.2}
\]

where \( e_i \): actual real exchange rate, \( \text{IMPACT} \): disturbances

Based on Edwards' specification (1988c, 1991), the following equation for the dynamics of real exchange rate behavior can capture the actual real exchange rates.

\[
\Delta \log(e)_t = \theta [ \log(e')_t - \log(e)_{t-1} ] - \lambda [ Z_t - Z^*_t ] + \Phi [ \log(E)_t - \log(E)_{t-1} ] \tag{5.3}
\]

where \( Z_t \) is an index of macroeconomic policies, \( Z^*_t \) is the sustainable level of macroeconomic policies. \( E \) is the nominal exchange rate. And \( \theta, \lambda, \Phi \) are positive parameters that capture the dynamic adjustment process.

Equation (5.3) establishes that actual movements of the real exchange rate respond to three forces. First, there will be an autonomous tendency for the actual real exchange rate to correct existing misalignments. This force is represented by the partial adjustment term, \( \theta[\log(e)_t - \log(e)_{t-1}] \). The speed of self adjustment is captured by the parameter \( \theta \). The smaller is \( \theta \) (i.e., the closer it is to zero), the slower will be the speed at which the real exchange rate
misalignment will be corrected. According to Edwards, the value of $\theta$ will depend on a number of institutional factors, including the extent of capital mobility, and the existence of wage indexation rules.

The second determinant of real exchange rate movements is related to macroeconomic policies, given by $- \lambda [ Z_t - Z^*_t ]$. This term states that if the macroeconomic policies are unsustainable in the medium to longer run, and are inconsistent with a pegged rate (i.e; $Z_t > Z^*_t$), there will be pressures toward a real appreciation.

The third determinant of real exchange rate movements is related to changes in the nominal exchange rate and is given by the term $\Phi [ \log(E)_t - \log(E)_{t-1} ]$. A nominal devaluation will have a positive effect on the real exchange rate on impact, generating a short run depreciation; the actual magnitude of this real depreciation will depend on parameter $\Phi$.

By replacing equation (5.1) and the expression for $[ Z_t - Z^*_t ]$ in equation (5.3), we obtain an equation that could, in principle, be estimated using conventional methods. Here we consider the excess supply of domestic credit (EXDC) and the ratio of fiscal deficit (RDEH) as the components of a macroeconomic policies vector. In this case the equation to be estimated is as follows:

$$
\log(e)_t = \gamma_0 + \gamma_1 \log(KC)_t + \gamma_2 \log(TC)_t + \gamma_3 \log(GNC)_t + \gamma_4 \log(INV)_t + \gamma_5 \log(PDT)_t \\
+ \gamma_6 \log(TOT)_t + \gamma_7 \log(RID)_t + (1 - \theta) \log(e)_{t-1} - \lambda \text{EXDC} + \Phi \text{RNE}X + \varepsilon_t \quad (5.4)
$$

where $\gamma_i = 0 \beta_i (i = 0 \text{ to } 7)$, $\varepsilon_t = \theta u_t$. 
5.2 Specification of the Variables and Data

In this section, we discuss the variables and related data to be used for estimation. After defining the variables, we undertake stationary (unit root) and cointegration tests. We also discuss some econometric issues, such as endogeneity, and the power of the cointegration test.

5.2.1 Definition of the Variables and the Source of Data

Here, we discuss the definitions of both dependent and explanatory variables. We choose some appropriate proxies for the variables that are not available.

**Dependent Variables: Real Exchange Rates**

From the theoretical framework, the real exchange rate is defined as the relative price of tradables to nontradables \((E * P^*_T / P_N)\) or the relative price of exportables to nontradables \((E^* P^*_X / P_N)\). However, it is difficult to measure the exact real exchange rates corresponding to the definition, as was discussed in Chapter 2.

For this reason, we use the proxy that is commonly used for empirical studies: foreign country’s producer price index (PPI) in the numerator and the domestic consumer price index (CPI) in the denominator.\(^2\)

\[
\text{RER} = \left( \frac{E^* P^*_T}{CPI} \right) \quad (5.5)
\]
The main arguments in its favor are that the foreign country's WPIs or PPIs can be considered as fair proxies for the whole price of tradables, and the domestic CPI contains a very high proportion of nontradable commodities.

Using these proxies, we constructed the bilateral real exchange rate against the U.S. dollar as follows:

\[
\text{RER} = \frac{E * \text{PPI}_{US}}{\text{CPI}_K}
\]

where \( E \) is the nominal Korean won exchange rate (average) against the U.S. dollar.

In line with this, we constructed a real effective exchange rate (REER) using the following method:

\[
\text{REER} = \pi \left( \frac{E_{it}}{E_{i0}} \right)^{w_i} / \pi \left( \frac{P^K_t}{P^K_0} \right)^{w_i}
\]

where
- \( E_{it} \) : won exchange rate against currency \( i \) at time \( t \)
- \( E_{i0} \) : won exchange rate against currency \( i \) at base period
- \( P^i_t \) : price levels in country \( i \) at time \( t \)
- \( P^K_t \) : price levels in Korea at time \( t \)
- \( P^i_0 \) : price levels in country \( i \) at base period
- \( P^K_0 \) : price levels in Korea at base period
- \( w_i \) : weight of the trade

In calculating the REER, we consider seven major trading partners of Korea: U.S.A., Japan, Canada, Germany, United Kingdom, France and the Netherlands. In this study, we use two
real exchange rates, the bilateral real exchange rate against the U.S. dollar and the real effective exchange rate. This is due to the presence of financial repression, one of the most important variables in this study, which is obtained from the real interest rates in U.S. and Korea. In addition, we also use another proxy for financial repression, the spread between the market oriented interest rate and the government controlled deposit rates.

Both variables, bilateral and multilateral real exchange rate will be used in log form. The quarterly data for the bilateral and real effective exchange rates are from IMF's International Financial Statistics and Direction of Trade Statistics and Bank of Korea's Monthly Bulletins. All the data cover from 1970 to 1993. (see Appendix C)

**Explanatory Variables**

Here, we discuss the explanatory variables for real exchange rate equation. As equation (5.4) specifies, explanatory variables consists of both real and nominal variables. Some variables that are not available are proxied by the appropriate terms that best represent the theory.

**Controls over Capital Flows (KC):** A perfect proxy for capital controls is not available. In the theoretical framework, changes in capital controls is represented by changes in the marginal loan rate ($r_L$). However, the series of marginal loan rates is not available. Therefore, we replace controls on capital flows by net capital flows. This is because capital controls will affect the flow of capital moving in and out of the country. In the balance of payments, long-term and short-term capital balances reflect capital flows. So, we use long-term and short-term
capital balances as the proxy for capital controls. It is the conventional wisdom that relaxation of capital controls will result in a real appreciation, a negative sign for this variable. However, the theoretical framework shows that this effect depends on the factor intensity of the tradables and nontradables, and the condition of financial repression.

**Trade Controls (TC):** Trade controls generally consist of tariff barriers and nontariff barriers. However, it is difficult to measure the nontariff trade controls. In this study, we only consider the changes in tariff rates even though it does not reflect the whole effect of trade controls. However, changes in the tariff rate is the most important policy tool in trade policy, and it is directly related to the comparative static analysis in the theoretical framework. We use the ratio of import duties to GDP as the measure of changes in import tariffs. Traditional policy literature argues that relaxation of trade controls will result in a real depreciation, a negative sign for this variable. However, we can expect different results under the condition of financial repression, following the theory developed in Chapter 3.

**Government Consumption of Nontradables (GNC):** Data on government consumption of nontradables is not easily available. As Edwards (1991) suggests, this is proxied by the ratio of total government consumption to GDP. This is because it is considered that in Korea, government consumption is mostly composed of nontradables. However, this is not a perfect proxy, and, therefore, the results obtained should be interpreted with care. It is the popular view that increases in government consumption will result in a real appreciation, a negative sign for this variable. The theoretical framework in Chapter 3 notes that this effect can be changed under financial repression.
Investment (INV): Investment is represented by the increase in capital stock. Capital stock can be captured by the gross fixed capital formation in the national accounts. And changes in investment can be represented by the changes in the ratio of capital stock to GDP. Therefore, we use the ratio of the gross fixed capital formation to GDP. This is one of the fundamentals that are reliable in time series data.

Productivity (PDT): Measuring productivity change is not easy. Edwards (1991) used GDP growth rates as a measure of productivity change (technological progress). This type of proxy was used under the implicit assumption that growth is taking place in the tradable sector. However, Edwards mentions the shortcomings of the proxy. Cottani et al. (1990) used a time variable, in their regressions, as the proxy for technological factors to capture the residual trend in the real exchange rate. In this study, we use two other proxies. First, a labor productivity index from the Korea Productivity Center, and, second, self-constructed proxy (RLPTY) that are obtained by dividing GDP by employment. In Korea, it is expected that productivity increase will generate a real appreciation, a negative sign for this variable which represents the Ricardo - Balassa effect. This is because Korea has pursued an export-oriented policies.

External Terms of Trade (TOT): Terms of trade are represented by the external relative price of exportables ($P^*_X$) to importables ($P^*_M$). Following this definition, we use a calculated index using unit price of exports and unit price of imports, in U.S.dollar terms. This is one of the reliable fundamentals that exist in time series data. It is the popular view that improvements in the terms of trade – an increase in TOT – will result in an equilibrium real appreciation, a negative sign for this variable.
Financial Repression (RID): It is very difficult to measure the level of financial repression exactly. It is closely related to the financial system that which is peculiar to each country. In this study, financial repression can be measured by the difference in real interest rates between the world market and Korean deposits (RID). We use the treasury bill rate in the U.S. as the world market real interest rate, and the 1 - 2 year time deposit interest rate in Korea as the representative domestic deposit interest rate. In calculating real interest rates, we deduct the inflation rate using the CPI in each country. In line with this, considering the difference in financial structure between the two countries, such as preexisting chronic excess demand of funds in Korea, we construct another proxy (RIDD), to measure the financial repression that could represent the progress of the financial deregulation in domestic market. This is calculated as the difference (spread) between the market oriented interest rate (corporate bond yields) and the government controlled deposit rates in Korea. As reviewed in Chapter 4, in Korea, the government controlled deposit rates have been far below the market oriented corporate bond yields. It can, then, be explained that, as the deregulation in the domestic financial market progresses, the spread between the two interest rates narrows. Following the results of the theoretical analysis in Chapter 3, we expect a negative sign for these two variables. This is because we can say that in the Korean economy, financial repression has been more severe than trade controls.

Excess Supply of Domestic Credit (EXDC): As one of the measures of macroeconomic policy consistency, we measure this term by the growth rate of domestic credit minus the lagged rate of growth of real GDP, as Edwards (1991) suggests. This is based on an assumption that the demand for domestic credit has unitary elasticity with respect to real income. Following the
definition of this variable, we would expect a negative sign, which indicates that as the excess supply of domestic credit increases, the real exchange rate will appreciate.

**Growth Rate of Domestic Credit or Monetary Aggregate (RDC or RMON):** Following Edwards (1991), we also use the growth rate of domestic credit, or a monetary aggregate, as the substitute for excess supply of domestic credit.

**Fiscal Deficit Ratio (RDEH):** As another measure of the macroeconomic policy consistency, we use the ratio of the fiscal deficit to lagged high powered money as a measure of fiscal policy. We would expect this variable to negatively affect the real exchange rate. An increase in the ratio would cause an appreciation of the real exchange rate, given that all other variables are stationary.

**Changes in Nominal Exchange Rates (RNEX):** To measure changes in the nominal exchange rate, we use changes in the Korean nominal won exchange rate against the U.S. dollar. This is because the Korean won has either been explicitly pegged to the U.S. dollar, or has been pegged to a basket which has been dominated by the U.S. dollar. We would expect a positive sign for this variable, that is, a nominal devaluation will generate a short-run real exchange rate depreciation.

Some of the data discussed above such as TC, GNC, INV, TOT will be used in log form. The quarterly data for explanatory variables are from various issues of the Monthly Bulletin and the National Accounts from the Bank of Korea. The productivity index is from Korea Productivity Center, and the U.S. treasury bill rate is from the International Financial Statistics. (see Appendix C). All Korean data (except government controlled deposit rate) were seasonally adjusted using RATS EZ - X11 program.
5.2.2 Unit Root and Cointegration Tests

Before estimating, it is necessary to check whether the series of each variable in the empirical model are stationary. Phillips (1986) notes that the usual procedures of traditional OLS analysis, using non-stationary series that generate an integrated process, results in "spurious" correlations. In this situation, the usual significance tests about the regression coefficients are misleading.

The first step involves testing the variables to see if they are integrated. We use the Augmented Dickey - Fuller (ADF) Test (Engle and Granger, 1987). For each variable, the ADF test is conducted by running an OLS regression on the following equation.

\[
\Delta Y_t = \gamma + \delta t + (\Phi - 1)Y_{t-1} + \sum_{j=1}^{k} (\beta_j \Delta Y_{t-j}) + \varepsilon_t
\]  

(5.7)

where \(\gamma\): constant, \(t\): trend, \(Y\): data to be tested

To select the proper \(k\), we started with some upper bound on \(k\), say \(k_{\text{max}}\). \(k_{\text{max}} = \text{Int} \{4(T/100)^{1/4}\}\) where \(T\) is the number of the observations. We followed the following rules: If the last included lag is significant, we select \(k\). If not, we reduce the order of the estimated autoregression by one until the coefficient on the last included lag is significant. If none is significant, select \(k = 0\). In the last case, the ADF test is equivalent to the standard DF test.
The null hypothesis to be tested is that series has a unit root, that is, \((\Phi - 1) = 0\). Using this method, for some variables, we can not reject the null hypothesis of unit root. Two dependent variables, bilateral and multilateral real exchange rates (RER, REER) are non-stationary in levels. Six explanatory variables including TC, GNC, INV, TOT, RIDD, RMON are also non-stationary. We also checked that the first difference of these series are stationary using the same ADF test. Results show that all the mentioned non-stationary series are stationary in first difference form. (see Table 5.1). This conclusion is supported by casual diagramatic evidence provided by the time series plots shown in Figure 5.1.1

The second step is to test whether the non-stationary variables in the real exchange rate equations are cointegrated. If the non-stationary variables in the system are cointegrated, the regressions are not spurious and a genuine relationship between dependent and explanatory variables exist. In this case, for better estimation, the dependent and explanatory variables may be considered to be generated by an error correction model. Engle and Granger (1991) note that when the non-stationary variables are cointegrated, the model will include both differences and error correction terms. They also noted that when the non-stationary variables are not cointegrated, the model will include only differences by forcing the error correction terms to have zero coefficients.

For the cointegration test, we use two procedures following the Engle – Granger two step estimation method (Engle and Granger, 1991). First, the cointegrating regressions that include non-stationary variables are estimated. Second, using the residuals from the cointegrating regression, ADF tests are conducted to test the null hypothesis that the variables are not cointegrated.
Table 5.1 Augmented Dickey - Fuller Test (1970.1 - 1993.3)

\[ \Delta Y_t = \gamma + \delta t + (\Phi - 1)Y_{t-1} + \sum_{j=1}^{k} (\beta_j \Delta Y_{t-j}) + \varepsilon_t \]

<table>
<thead>
<tr>
<th>k</th>
<th>( H_0: \Phi - 1 = 0 ) (t value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RER</td>
<td>1</td>
</tr>
<tr>
<td>REER</td>
<td>1</td>
</tr>
<tr>
<td>EXMON</td>
<td>3</td>
</tr>
<tr>
<td>EXDC</td>
<td>3</td>
</tr>
<tr>
<td>RMON</td>
<td>4</td>
</tr>
<tr>
<td>RDC</td>
<td>1</td>
</tr>
<tr>
<td>RDEH</td>
<td>0</td>
</tr>
<tr>
<td>RNEX</td>
<td>0</td>
</tr>
<tr>
<td>KC</td>
<td>1</td>
</tr>
<tr>
<td>TC</td>
<td>0</td>
</tr>
<tr>
<td>GNC</td>
<td>1</td>
</tr>
<tr>
<td>INV</td>
<td>0</td>
</tr>
<tr>
<td>TOT</td>
<td>1</td>
</tr>
<tr>
<td>RPDT</td>
<td>3</td>
</tr>
<tr>
<td>RLPTY</td>
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<tr>
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<tr>
<td>RIDD</td>
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</tr>
<tr>
<td>( \Delta RER )</td>
<td>1</td>
</tr>
<tr>
<td>( \Delta REER )</td>
<td>1</td>
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<tr>
<td>( \Delta RMON )</td>
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<td>( \Delta TC )</td>
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<tr>
<td>( \Delta GNC )</td>
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<td>1</td>
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<td>( \Delta TOT )</td>
<td>1</td>
</tr>
<tr>
<td>( \Delta RIDD )</td>
<td>1</td>
</tr>
</tbody>
</table>

Notes: *(**) indicates that the null hypothesis of unit root is rejected at 5% (1%) significance level. The critical value at the 5% and 1% significance level is -3.45 and -4.04 respectively for 100 observations (Harvey, 1991). \( \Delta \) denotes the first difference.
Figure 5.1
Plot of Series: Dependent and Explanatory Variables
Figure 5.1 (Continued)
Plot of Series: Dependent and Explanatory Variables
Figure 5.1 (Continued)
Plot of Series: Dependent and Explanatory Variables
Figure 5.1 (Continued)
Plot of Series: Dependent and Explanatory Variables
Figure 5.1 (Continued)
Plot of Series: Dependent and Explanatory Variables
Figure 5.1 (Continued)
Plot of Series: Dependent and Explanatory Variables
Figure 5.1 (Continued)
Plot of Series: Dependent and Explanatory Variables
The ADF test involves using the residuals from the cointegrating regression in the following regression:

\[ \Delta U_t = \gamma + \pi U_{t-1} + \sum (\beta_j \Delta U_{t-j}) + \varepsilon_t \]  \hspace{1cm} (5.8)

where \( \gamma \): constant  \( U \): residuals

Using the same criteria as in equation (5.7), if the calculated t value on \( \pi \) exceeds the critical value, the null hypothesis that there is a unit root in the residuals (i.e., there is a non-cointegration), can be rejected.

We estimated cointegrating regressions based on seven different combinations of non-stationary variables. Using two dependent variables and six explanatory variables that are integrated, we chose seven cointegrating regressions to be tested that include up to six important integrated variables. The result of all the cointegration tests shows that the null hypothesis can not be rejected. That is, cointegrating relations do not exist among the series of non-stationary variables. (see Table 5.2). This result can be confirmed by the distributions and correlograms of these residuals in Appendix D. Therefore, the empirical model for estimation can be specified using the differences of the non-stationary variables.

5.2.3 Some Econometric Issues

Most of major explanatory variables in the empirical model were derived from the theoretical framework. Theory does not note possible endogeneity bias, however. To be on
Table 5.2 Cointegration Test

<table>
<thead>
<tr>
<th>Regression</th>
<th>k</th>
<th>$H_0: \pi = 0$ (t value)</th>
<th>Critical Value (t value)</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression 1 (RER, TC, GNC INV, TOT)</td>
<td>0</td>
<td>-3.8385</td>
<td>-4.5644 (-4.2453)</td>
<td>Can not be Rejected</td>
</tr>
<tr>
<td>Regression 2 (REER, TC, GNC INV, TOT)</td>
<td>0</td>
<td>-3.2022</td>
<td>-4.5644 (-4.2453)</td>
<td>Can not be Rejected</td>
</tr>
<tr>
<td>Regression 3 (RER, TC, GNC INV, TOT, RIDD)</td>
<td>0</td>
<td>-3.3587</td>
<td>-4.9054 (-4.5794)</td>
<td>Can not be Rejected</td>
</tr>
<tr>
<td>Regression 4 (REER, TC, GNC INV, TOT, RIDD)</td>
<td>1</td>
<td>-3.6759</td>
<td>-4.9054 (-4.5794)</td>
<td>Can not be Rejected</td>
</tr>
<tr>
<td>Regression 5 (REER, RMON TC, GNC INV, RIDD)</td>
<td>1</td>
<td>-3.5277</td>
<td>-4.9054 (-4.5794)</td>
<td>Can not be Rejected</td>
</tr>
<tr>
<td>Regression 6 (REER, RMON TC, GNC INV, TOT)</td>
<td>0</td>
<td>-3.7469</td>
<td>-4.9054 (-4.5794)</td>
<td>Can not be Rejected</td>
</tr>
<tr>
<td>Regression 7 (REER, RMON TC, GNC TOT, RIDD)</td>
<td>0</td>
<td>-3.6453</td>
<td>-4.9054 (-4.5794)</td>
<td>Can not be Rejected</td>
</tr>
</tbody>
</table>

Notes: 5%(10%) significance level.
We calculated the critical values using the method provided by Mackinnon(1991). Using his method, we can test cointegration relations with more than two variables up to six variables. Based on a repeated, millions of experiments, Mackinnon derived a specific equation to calculate the critical value for cointegration test. 8

Engle and Yoo (1987) also established the critical value for the cointegrated test with more than two variables (maximum five variables). According to this, the critical value at a 5%(10%) significance level is -4.58(- 4.26) for 5 variables and 100 observations.
the safe side, it is necessary to test to see whether some explanatory variables have an endogeneity bias problem.

We used the methods of Granger-Causality test, and the Hausman specification test, to check for the possible endogeneity bias. First, using the Granger-Causality method, for each explanatory variable, we tested the null hypothesis that the dependent variable (here real exchange rate) causes an explanatory variable. However, since there are some weaknesses of this causality test, we used the Hausman specification test at the same time. That is, first, we chose the explanatory variable which is regarded to have an endogeneity bias according to the Granger-Causality test, then we undertook the Hausman test by substituting for this variable with the appropriate instrument variable.

The result of this test suggest that most of the explanatory variables have no endogeneity bias. In the case of the bilateral exchange rate equation, two variables, financial repression (RID) and the productivity index (RPDT), are concerned with endogeneity bias. In the case of the multilateral exchange rate, also two variables, nominal exchange rate changes (RNEX) and the productivity index (RPDT), are concerned. Accordingly, we will estimate the real exchange rate equations using instrumental technique. (see Appendix E).

Related to the result of the cointegration test, it is meaningful to remind ourselves of the limitations of the power of cointegration tests. This limited power, results to the extent that the data series used does not cover enough periods (around 90 quarters). In addition, we should keep in mind that during this period, the Korean economy experienced some structural changes. Campbell and Perron (1991) noted that every cointegration process can be arbitrarily well approximated, in a finite sample, by a non- cointegrated process and vice versa. Kremers
et al. (1992) argues that with cointegration, the error correction model statistic can generate more powerful tests than those based upon the Dicky-Fuller statistic applied to the residuals of a static cointegrating relationship. In this respect, we will consider the error correction model additionally by assuming a cointegration relationship between non-stationary variables.

5.3 Empirical Estimation of the Real Exchange Rate Equation

Based on the results of the unit root and cointegration tests in section 5.2, we can now set up the model for the real exchange rate equation. This model includes first differences of the I(1) variables and the I(0) variables in the level form. So, the real exchange rate equation estimated is:

\[
\Delta RER_t = \alpha + \sum_{i=1}^{n_1} \beta_{1i} EXDC_{t-i} + \sum_{i=1}^{n_2} \beta_{2i} RDEH_{t-i} + \sum_{i=1}^{n_3} \beta_{3i} RNX_{t-i} + \sum_{i=1}^{n_4} \beta_{4i} Kc_{t-i} + \sum_{i=1}^{n_5} \beta_{5i} \Delta GC_{t-i} + \sum_{i=1}^{n_6} \beta_{6i} \Delta TC_{t-i} + \sum_{i=1}^{n_7} \beta_{7i} \Delta TOT_{t-i} + \sum_{i=1}^{n_8} \beta_{8i} \Delta INV_{t-i} + \sum_{i=1}^{n_9} \beta_{9i} RPDT_{t-i} + \sum_{i=1}^{n_{10}} \beta_{10i} RID_{t-i} + \sum_{i=1}^{n_{10}} \beta_{10i} RID_{t-i} + u_t
\]

(5.9)
In specifying a model’s lag structure, we considered the Schwartz and Akaike Information Criteria.\(^\text{11}\) (Schwarz, 1978, Judge et al., 1988).

A number of versions of equation (5.9) considering both, bilateral and multilateral real exchange rates, were estimated using the variables with different proxies as mentioned in section 5.2. The estimations were performed using instrumental variable techniques based on the endogeneity bias test. The dummy variables were also used to test the constancy of the parameters of the major policy variables.

5.3.1 Instrumental Variable Technique

Here, we estimate the real exchange rate equations using some instrumental variable techniques. Variables that have potential endogeneity bias are replaced with instrumental variables. The estimation results of the two cases, bilateral and multilateral real exchange rates are slightly different. Here, we explain the results separately.

Bilateral Real Exchange Rate Estimation

In the bilateral real exchange rate estimation, we use a instrumental variable instead of the financial repression variable (RID). The results of three regressions, summarized in Table 5.3, shows that the Korean won real exchange rate against the U.S.dollar was affected by real variables (economic fundamentals) and also by monetary (nominal) variables.
The coefficients for capital flows (KC), and trade controls (ΔTC) are significantly negative. This indicates that relaxation of the capital controls resulted in an equilibrium real appreciation and relaxation of trade controls resulted in a real depreciation. These results generally support the conventional wisdom that can are derived in the theoretical static model. The coefficient of government consumption (ΔGNC) shows a mixed insignificant sign, which does not support the traditional wisdom.

The coefficients of the domestic interest rate control variables (RID), which were substituted out by the instrumental variables are all negative, yet not significant. From this result, it is difficult to argue that government interest rate controls in the domestic financial market resulted in a real appreciation of the won real exchange rate against the U.S. dollar. With regard to productivity, the coefficient shows insignificant mixed signs. Using the growth rate of GDP per employee (RLPTY), the result shows mixed insignificant signs, and using the GDP growth rate, the coefficient has an insignificant negative sign. It is different from the expectation. To the extent that these proxies represent the productivity changes in Korea, we can say that the Ricardo-Ballasa effect is not found in Korea.

The coefficients of the macroeconomic policies, the excess supply of domestic credit (EXDC), or the increased rate of domestic credit (RDC), and the ratio of fiscal deficit (RDEH), are significantly negative. This result supports the view that unsustainable (inconsistent) macroeconomic policies results in a real exchange rate disequilibrium. That is, expansionary monetary and fiscal policies resulted in a real appreciation in the short run through the increase in the price of nontradables.
Table 5.3 Bilateral Real Exchange Rate Equations (Instrumental Variables)

<table>
<thead>
<tr>
<th>Variable</th>
<th>$\Delta RER$</th>
<th>$\Delta RER$</th>
<th>$\Delta RER$</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONSTANT</td>
<td>0.0016</td>
<td>0.0062</td>
<td>0.0041</td>
</tr>
<tr>
<td></td>
<td>(0.2543)</td>
<td>(0.8896)</td>
<td>(0.628)</td>
</tr>
<tr>
<td>EXDC</td>
<td>-0.0641***</td>
<td></td>
<td>-0.0618***</td>
</tr>
<tr>
<td></td>
<td>(-2.9186)</td>
<td></td>
<td>(-3.0242)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-0.0697***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-3.3703)</td>
<td></td>
</tr>
<tr>
<td>RDC</td>
<td></td>
<td>-0.0618&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-1.9149)</td>
<td></td>
</tr>
<tr>
<td>RDEH$_{(t+4)}$</td>
<td>-0.119&quot;</td>
<td>-0.1279&quot;</td>
<td>-0.0992&quot;</td>
</tr>
<tr>
<td></td>
<td>(-2.111)</td>
<td>(-2.3382)</td>
<td>(-1.9149)</td>
</tr>
<tr>
<td>RNX</td>
<td>0.9020***</td>
<td>0.8939***</td>
<td>0.8688***</td>
</tr>
<tr>
<td></td>
<td>(13.6401)</td>
<td>(13.8812)</td>
<td>(13.0056)</td>
</tr>
<tr>
<td>$\Delta TOT_{(t+2)}$</td>
<td>-0.0171</td>
<td>-0.0338</td>
<td>-0.0196</td>
</tr>
<tr>
<td></td>
<td>(-0.1854)</td>
<td>(-0.3723)</td>
<td>(-0.2109)</td>
</tr>
<tr>
<td>$\Delta C_{(t+1)}$</td>
<td>-0.0044&quot;</td>
<td>-0.0052&quot;</td>
<td>-0.0041</td>
</tr>
<tr>
<td></td>
<td>(-1.6949)</td>
<td>(-2.0172)</td>
<td>(-1.4807)</td>
</tr>
<tr>
<td>$\Delta GNC_{(t+4)}$</td>
<td>-0.0542</td>
<td>-0.0477</td>
<td>0.0015</td>
</tr>
<tr>
<td></td>
<td>(-0.6408)</td>
<td>(-0.5775)</td>
<td>(0.0191)</td>
</tr>
<tr>
<td>$\Delta TC$</td>
<td>-0.0902***</td>
<td>-0.0874***</td>
<td>-0.0758***</td>
</tr>
<tr>
<td></td>
<td>(-3.9202)</td>
<td>(-3.8718)</td>
<td>(-3.333)</td>
</tr>
<tr>
<td>$\Delta INV$</td>
<td>0.022</td>
<td>0.0243</td>
<td>0.012</td>
</tr>
<tr>
<td></td>
<td>(0.6045)</td>
<td>(0.6817)</td>
<td>(0.333)</td>
</tr>
<tr>
<td>RLPTY$_{(t+5)}$</td>
<td>-0.0203</td>
<td>0.0306</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(-0.2421)</td>
<td>(0.3765)</td>
<td></td>
</tr>
<tr>
<td>RGDP</td>
<td>-</td>
<td>-</td>
<td>-0.0421</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(-0.7829)</td>
</tr>
<tr>
<td>RID$_{(t+1-3)}$</td>
<td>-0.0922</td>
<td>-0.0987</td>
<td>-0.0886</td>
</tr>
<tr>
<td></td>
<td>(-1.4136)</td>
<td>(-1.5826)</td>
<td>(-1.4868)</td>
</tr>
</tbody>
</table>
Table 5.3 (Continued)
Bilateral Real Exchange Rate Equations (Instrumental Variables)

<table>
<thead>
<tr>
<th></th>
<th>ΔRER</th>
<th>ΔRER</th>
<th>ΔRER</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>79</td>
<td>79</td>
<td>79</td>
</tr>
<tr>
<td>R²</td>
<td>0.858</td>
<td>0.865</td>
<td>0.836</td>
</tr>
<tr>
<td>D.W</td>
<td>2.139</td>
<td>2.139</td>
<td>2.148</td>
</tr>
<tr>
<td>Q / Sig. Level</td>
<td>15.48/0.692</td>
<td>13.25/0.825</td>
<td>15.7/0.677</td>
</tr>
</tbody>
</table>

Notes:
*: The following variables were used as instruments:
   constant, lagged variables (1 to 5) of EXDC, RDEH, ΔTOT, ΔINV, RPDT and RID.

Data in parentheses are t statistics. N: Number of observations. R²: The Coefficient of determination.
*: 1% significance level. **: 5% significance level. ***: 10% significance level.
The coefficient of nominal exchange rate changes (RNEX), as expected, shows a significantly positive sign with a large value, which provides evidence supporting the view that nominal depreciation can be a powerful device to reestablish real exchange rate equilibrium.

On the other hand, the coefficient sign of the terms of trade ($\Delta TOT$) is insignificantly negative. Therefore, in this case, the result does not support the popular view that improvements in the terms of trade – an increase in $\Delta TOT$ – will result in an equilibrium real appreciation. The coefficient of investment ($\Delta INV$) is insignificant and positive, which suggests that, in Korea, investment (capital accumulation) has no obvious effect on the real exchange rate.

**Multilateral Real Exchange Rate Estimation**

In the multilateral real exchange rate estimation, we use the instrumental variable instead of changes in nominal exchange rate (RNEX). The results, summarized in Table 5.4, show that the real effective exchange rate was affected by both real and nominal variables, though some coefficients are not significant. Some variables, however, have different results from that of the bilateral exchange rate case, especially, financial repression variables show significant result.

The coefficients of capital flows (KC) and government consumption ($\Delta GNC$) show insignificant mixed signs, which indicates that the effects of capital flows and changes in government consumption on the real effective exchange rate is ambiguous. The variables of macroeconomic policy show contradictory results to those of the bilateral exchange rate case. The increase rate of money supply ($\Delta RMON$) and the ratio of fiscal deficit (RDEH), both have
Table 5.4 Multilateral Real Exchange Rate Equations (Instrumental Variables)

<table>
<thead>
<tr>
<th></th>
<th>Δlog(REER)</th>
<th>Δlog(REER)</th>
<th>Δlog(REER)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONSTANT</td>
<td>0.0068</td>
<td>-0.0408***</td>
<td>-0.0467***</td>
</tr>
<tr>
<td></td>
<td>(0.5128)</td>
<td>(-4.4824)</td>
<td>(-3.9632)</td>
</tr>
<tr>
<td>EXDC</td>
<td>-0.0479</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(-1.0572)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ΔRMON_{ltol-1}</td>
<td>-</td>
<td>1.0874***</td>
<td>0.7484***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(5.6533)</td>
<td>(4.5597)</td>
</tr>
<tr>
<td>RDEH_{ltol-2}</td>
<td>-0.042</td>
<td>0.1141</td>
<td>0.1693**</td>
</tr>
<tr>
<td></td>
<td>(-0.44)</td>
<td>(1.456)</td>
<td>(2.1641)</td>
</tr>
<tr>
<td>RNEX</td>
<td>1.0801***</td>
<td>1.0428***</td>
<td>1.1447***</td>
</tr>
<tr>
<td></td>
<td>(7.0478)</td>
<td>(6.982)</td>
<td>(7.1138)</td>
</tr>
<tr>
<td>Δlog(TOT)</td>
<td>-0.0235</td>
<td>-0.1967</td>
<td>-0.0997</td>
</tr>
<tr>
<td></td>
<td>(-0.1975)</td>
<td>(-1.6359)</td>
<td>(-0.8611)</td>
</tr>
<tr>
<td>KC_{ltol-3}</td>
<td>-0.0069</td>
<td>-0.0023</td>
<td>0.0024</td>
</tr>
<tr>
<td></td>
<td>(-1.0431)</td>
<td>(-0.3444)</td>
<td>(0.3581)</td>
</tr>
<tr>
<td>Δlog(GNC)_{ltol-3}</td>
<td>0.0816</td>
<td>-0.1481</td>
<td>-0.2108</td>
</tr>
<tr>
<td></td>
<td>(0.2552)</td>
<td>(-0.5022)</td>
<td>(-0.7164)</td>
</tr>
<tr>
<td>Δlog(TC)_{ltol-1}</td>
<td>-0.0316</td>
<td>-0.1243**</td>
<td>-0.1281***</td>
</tr>
<tr>
<td></td>
<td>(-0.5351)</td>
<td>(-2.1454)</td>
<td>(-2.1599)</td>
</tr>
<tr>
<td>Δlog(INV)</td>
<td>0.091</td>
<td>0.113</td>
<td>0.1187</td>
</tr>
<tr>
<td></td>
<td>(1.2797)</td>
<td>(1.4628)</td>
<td>(1.1474)</td>
</tr>
<tr>
<td>RLPTY_{ltol-2}</td>
<td>-0.0542</td>
<td>0.6398***</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(-0.3242)</td>
<td>(3.704)</td>
<td></td>
</tr>
<tr>
<td>RGDP</td>
<td>-</td>
<td>-</td>
<td>0.4273***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(3.2316)</td>
</tr>
<tr>
<td>RID_{ltol-3}</td>
<td>-0.3585***</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(-3.6614)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 5.4 (Continued)
Multilateral Real Exchange Rate Equations (Instrumental Variables)

<table>
<thead>
<tr>
<th></th>
<th>Δlog(REER)</th>
<th>Δlog(REER)</th>
<th>Δlog(REER)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΔRIDD_{t+1:2}</td>
<td>-</td>
<td>-0.0157***</td>
<td>-0.0136***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-2.991)</td>
<td>(-2.6038)</td>
</tr>
<tr>
<td>N</td>
<td>80</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>R²</td>
<td>0.674</td>
<td>0.685</td>
<td>0.666</td>
</tr>
<tr>
<td>D.W</td>
<td>1.45</td>
<td>1.699</td>
<td>1.573</td>
</tr>
<tr>
<td>Q / Sig. Level</td>
<td>19.01/0.521</td>
<td>14.16/0.822</td>
<td>16.58/0.68</td>
</tr>
</tbody>
</table>

Notes: *: The following variables were used as instruments:
constant, lagged variables (1 to 4) of EXDC, RDEH, RNEX, ATOT, KC, AGNC, ATC, AINV and RPDT, current and lagged variables (1) of consumer prices of the major seven countries: U.S., Japan, Canada, Germany, United Kingdom, France, Netherlands, and bilateral exchange rates of these countries against U.S. dollar.

* : 1% significance level. **: 5% significance level. ***: 10% significance level.
significant positive signs. The coefficient of productivity, has a significant positive sign. However, trade controls (ΔTC) is significantly negative, which implies that relaxation of trade controls resulted in a real effective exchange rate depreciation, as in the previous bilateral real exchange rate case.

On the other hand, the coefficients of domestic interest rate controls (RID, ΔRIDD) all have significant negative signs. This suggests that interest rate controls in the domestic financial market (financial repression), in Korea, resulted in an equilibrium real appreciation, weakening international competitiveness. The coefficient of changes in the nominal exchange rate (RNEX), which was replaced with an instrumental variable has a significant positive sign with a large value. This also provides evidence that, in Korea, changes in nominal exchange rate can be a powerful device to maintain a stable real effective real exchange rate.

5.3.2 The Use of Dummy Variables

As discussed in Chapter 4, since the 1980s, the Korean economy experienced structural adjustment and the Korean government promoted various deregulation measures. Especially, there was a substantial relaxation of trade controls during the 1980s and early 1990s. At the same time, monetary and fiscal policies have been tightened since the 1980s. In line with this, controls over domestic financial markets and capital markets have also been relaxed gradually since the 1980s even though it is not as intensive as the relaxation of trade controls. Considering these policy changes, the parameter estimates in the model may not be constant over time.
In this section, therefore, we introduce some dummy variables to test whether there were some changes in the effects of major policy variables on the real exchange rates since the 1980s. In estimation, we used four dummy variables for the major policy variables; capital controls (KC), trade controls (ATC), government consumption (AGNC), and financial repression (RID). Here, we omitted the insignificant variables of the previous estimation (ΔTOT, ΔINV), to preserve sufficient degrees of freedom.

In this case, the real exchange rate equation is specified as follows:

\[
\Delta RER_t = \alpha + \sum_{i=1}^{n1} \beta_{1i} \text{EXDC}_{t_i} + \sum_{i=2}^{n2} \beta_{2i} \text{RDEH}_{t_i} \\
+ \sum_{i=3}^{n3} \beta_{3i} \text{RNEX}_{t_i} + \sum_{i=4}^{n4} \beta_{4i} \text{KC}_{t_i} + \sum_{i=4}^{n4} \beta_{4i}(\text{DM}\times\text{KC})_{t_i} \\
+ \sum_{i=5}^{n5} \beta_{5i} \text{AGNC}_{t_i} + \sum_{i=5}^{n5} \beta_{5i}(\text{DM}\times\text{AGNC})_{t_i} + \sum_{i=6}^{n6} \beta_{6i} \text{ATC}_{t_i} \\
+ \sum_{i=6}^{n6} \beta_{6i}(\text{DM}\times\text{ATC})_{t_i} + \sum_{i=7}^{n7} \beta_{7i} \text{RID}_{t_i} + \sum_{i=7}^{n7} \beta_{7i}(\text{DM}\times\text{RID})_{t_i} + u_t \tag{5.10}
\]

where DM = 0 during 1970 - 1979
1 during 1980 - 1993

A number of versions of equation (5.10) concentrated on the bilateral real exchange rate were estimated using the same instrumental variable technique.
In this estimation, we also use an instrumental variable instead of the financial repression variable (RID). The estimation results using dummy variables are summarized in Table 5.5. From this result, some important implications can be derived. First of all, the coefficient of the dummy variable for trade control (DM*ΔTC) changed to a positive sign, among which, one is significant. This is contrary to the sign of trade controls (ΔTC), which implies that the effect of the relaxation of trade control (trade liberalization) on the real exchange rate have changed since the 1980s. This result indicates that trade liberalization, under the repressed domestic financial market, will not necessarily result in an equilibrium real depreciation in the short-run. This supports the result, derived in Chapter 3. That is, in an economy where financial repression is more severe than the trade controls, as in the Korean economy, the effects of tariff reduction may not result in a real depreciation. This is because the income effects are induced by the financial repression can operate in the opposite direction (i.e., negative effect) and dominate the positive substitution effect. The coefficients of the dummy variables for government consumption (DM*ΔGNC) has an insignificant negative sign. On the other hand, all the dummy variables of financial repression show insignificant positive signs.

5.3.3 Using Ordinary Least Squares and the Error Correction Model

In section 5.3.1 and 5.3.2, we estimated the real exchange rate equations using instrumental variables and dummy variables. This is based on the result of the endogeneity test. However, considering that there may be some weakness of the endogeneity test we have taken, we additionally estimated the real exchange rate using Ordinary Least Squares. The results of
these estimations using OLS show almost the same results as those of the estimations using an instrument variable technique, with some difference in significance in some variables. (see Appendix F, Table F.1 through F.3). In the case of the bilateral real exchange rate equations, changes in government consumption (ΔGNC) and financial repression (RID) show significant negative signs in the Ordinary Least Squares estimations. In the case of multilateral real exchange rate estimations, OLS results in the coefficients of trade controls (ΔTC), and the ratio of fiscal deficit (RDEH), having insignificant mixed signs. Using dummy variables, OLS results give all dummy variables for trade controls (DM*ΔTC) significant positive signs. This seems to strongly support the argument, in section 5.3.2, that trade liberalization under a repressed domestic financial market may not result in a real depreciation.

As Kremers et al. (1992) suggests, we also estimated the real exchange rate equation using an error correction model by assuming a cointegration relationship between non-stationary variables. The result of these estimations are the same as those of the estimations using the OLS method. There is no difference in signs and significance, and the error correction terms are all insignificant. (see Appendix Tables F.4 and F.5).
Table 5.5 Bilateral Real Exchange Rate Equations (Dummy variables)

<table>
<thead>
<tr>
<th></th>
<th>ΔRER</th>
<th>ΔRER</th>
<th>ΔRER</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONSTANT</td>
<td>-0.0032</td>
<td>0.0097</td>
<td>-0.0095***</td>
</tr>
<tr>
<td></td>
<td>(-0.7815)</td>
<td>(1.2948)</td>
<td>(-4.0512)</td>
</tr>
<tr>
<td>EXDC</td>
<td>-0.0483***</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(-2.028)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RDC</td>
<td>-</td>
<td>-0.0773</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-3.0483)</td>
<td></td>
</tr>
<tr>
<td>ΔRMON_{t,tot-1}</td>
<td></td>
<td>-0.0776</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-0.684)</td>
<td></td>
</tr>
<tr>
<td>RDEH_{t,tot-4}</td>
<td>-0.0509</td>
<td>-0.0873</td>
<td>-0.0038</td>
</tr>
<tr>
<td></td>
<td>(-0.8672)</td>
<td>(-1.4814)</td>
<td>(-0.0719)</td>
</tr>
<tr>
<td>RNEX</td>
<td>0.8692***</td>
<td>0.8984***</td>
<td>0.7933***</td>
</tr>
<tr>
<td></td>
<td>(11.9017)</td>
<td>(12.4151)</td>
<td>(11.0119)</td>
</tr>
<tr>
<td>KC_{t,tot-1}</td>
<td>0.0034</td>
<td>0.0052</td>
<td>-0.0069</td>
</tr>
<tr>
<td></td>
<td>(0.4407)</td>
<td>(0.5573)</td>
<td>(-0.9105)</td>
</tr>
<tr>
<td>DM*KC_{t,tot+1}</td>
<td>-0.0055</td>
<td>-0.0087</td>
<td>-0.005</td>
</tr>
<tr>
<td></td>
<td>(-0.7266)</td>
<td>(-0.8698)</td>
<td>(0.6904)</td>
</tr>
<tr>
<td>ΔGNC_{t,tot-1}</td>
<td>-0.0877</td>
<td>0.0973</td>
<td>0.1452</td>
</tr>
<tr>
<td></td>
<td>(0.8095)</td>
<td>(0.9195)</td>
<td>(1.2829)</td>
</tr>
<tr>
<td>DM*ΔGNC_{t,tot-1}</td>
<td>-0.1495</td>
<td>-0.145</td>
<td>-0.2338</td>
</tr>
<tr>
<td></td>
<td>(-1.0379)</td>
<td>(-1.0909)</td>
<td>(-1.6161)</td>
</tr>
<tr>
<td>ΔTC</td>
<td>-0.0896***</td>
<td>-0.0997***</td>
<td>-0.0665</td>
</tr>
<tr>
<td></td>
<td>(-2.8809)</td>
<td>(-3.1917)</td>
<td>(-1.8354)</td>
</tr>
<tr>
<td>DM*ΔTC</td>
<td>0.0596</td>
<td>0.0719      *</td>
<td>0.0393</td>
</tr>
<tr>
<td></td>
<td>(1.3685)</td>
<td>(1.6417)</td>
<td>(0.8352)</td>
</tr>
<tr>
<td>RID^*_{t,tot-3}</td>
<td>-0.1222</td>
<td>-0.1198</td>
<td>-0.1816</td>
</tr>
<tr>
<td></td>
<td>(-1.5966)</td>
<td>(-1.6641)</td>
<td>(2.4158)</td>
</tr>
</tbody>
</table>
### Table 5.5 (Continued)
Bilateral Real Exchange Rate Equations (Dummy Variables)

<table>
<thead>
<tr>
<th></th>
<th>ΔRER</th>
<th>ΔRER</th>
<th>ΔRER</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM* RID(_{t=1-3})</td>
<td>0.0795</td>
<td>0.0907</td>
<td>0.0912</td>
</tr>
<tr>
<td></td>
<td>(0.9137)</td>
<td>(0.9852)</td>
<td>(0.9942)</td>
</tr>
<tr>
<td>N</td>
<td>79</td>
<td>79</td>
<td>79</td>
</tr>
<tr>
<td>R(^2)</td>
<td>0.861</td>
<td>0.873</td>
<td>0.856</td>
</tr>
<tr>
<td>D.W</td>
<td>2.186</td>
<td>2.265</td>
<td>2.066</td>
</tr>
<tr>
<td>Q / Sig. Level</td>
<td>20.35/0.374</td>
<td>22.97/0.239</td>
<td>19.99 /0.395</td>
</tr>
</tbody>
</table>

**Notes**: * Use instrumental variable used in Table 5.3.


***: 1% Significance level. **: 5% significance level. *: 10% significance level.

ENDNOTES

1 Edwards suggests to the terms such as excess supply of domestic credit (or the growth rate of domestic credit) and ratio of fiscal deficit as the measure of \(Z_t - Z'_t\).

2 This index of the real exchange rate has been strongly recommended by Harberger (1986) and Diaz-Alejandro (1986). A number of researchers use these proxies for the (bilateral) real exchange rate.

3 We consider the weight of Korean exports to the major trading partners and the export weights of these countries to the world market.

4 The weights of these countries are as follows: U.S.A; 0.36726, Japan; 0.23277, Canada; 0.06370, U.K.; 0.07617, Germany; 0.13964, France; 0.06889, Netherlands; 0.05156.

5 This is the effect that a real appreciation is induced by high productivity in the tradable sector. If productivity in the tradable sector is higher than in the non-tradable sector, the high productivity in the tradable sector lowers the price of tradables, inducing a real appreciation. In addition, with high productivity in the tradable sector, domestic wages increase, which leads to an increase in the price of nontradables, which results in additional real appreciation.

6 According to Engle and Granger (1987), the variables will be cointegrated if: (a) All the variables are integrated of order 1, I(1). (b) There exists a linear combination of the I(1) variables which is stationary (i.e., I(0)).

7 This cointegration tests were undertaken using I(1) variables among the variables specified in section (5.2.1). However, considering that there have been policy changes during the period for this test, it is meaningful to incorporate policy change variables additionally in the cointegrating regressions. This is because considering this additional variable, the result of cointegration tests could be different. Therefore, we considered a dummy variable for trade controls, which was used in the empirical estimation of the cointegration tests. This dummy variable for trade controls is also I(1), which supposedly reflects the comprehensive policy changes in trade control since the 1980s. The tests, however, give the same result, non-cointegration between the I(1) variables.

8 Estimated Critical values: \(\hat{\beta}_0 + \beta_1 / T + \beta_2 / T^2\)

where: \(\hat{\beta}_0\): Estimated asymptotic critical values.
\(\beta_1\): Coefficient on \(T^1\) in response surface regression.
\(\beta_2\): Coefficient on \(T^2\) in response surface regression.
\(T\): number of observations in the unit root test regression
Granger-Causality test is undertaken using the following equation:

\[ X_t = \sum_{i=1}^{m} (\alpha_i X_{t-i}) + \sum_{i=1}^{m} (\beta_i \varepsilon_{t-i}) + \varepsilon_t \]

where \( X_t \): explanatory variable  
\( \varepsilon_t \): real exchange rate

The null hypothesis of this test is that the coefficients \( \alpha_i \) for \( i = 1, 2, ..., m \) are jointly insignificant. Accordingly, if the null hypothesis is rejected, we can conclude that \( \varepsilon \) causes \( y \), and that in this case, endogeneity bias exists.

This is to test for the presence of endogeneity. The idea of this method is as follows: In a simple equation, \( Y_t = \alpha X_t + \varepsilon_t \) if there is no endogeneity in \( X \), then \( X \) and \( \varepsilon \) are uncorrelated. Related to the weakness to of the endogeneity test, Pindyck and Rubinfeld (1991) note that there is a weakness of the causality test that a third variable might in fact be causing the dependent variables. Jacob et. al (1979) argues that it is not possible to infer the direction of causation from observed correlations. This is because the null hypothesis tested is necessary but not sufficient to imply causality, and any specification error renders the causality test results uninterpretable.

Yoshida (1990) notes that in the case of quarterly data, 4 - 6 lags is said to be sufficient unless important explanatory variables are omitted.
CHAPTER 6
CONCLUDING REMARKS

Since the collapse of the Bretton-Woods system in the early 1970s, real exchange rates both in developed and developing countries have shown substantial variation. In particular, some countries, such as the Southern Cone countries, have suffered from high real exchange rate volatility, which has led to higher levels of macroeconomic instability and lower rates of economic growth. With this recent experience in mind, developing countries have frequently tried to adopt a real target approach. Many developing countries use the real exchange rate as an important policy variable which measures external competitiveness to achieve macroeconomic goals, such as income and employment growth.

These experiences of real exchange rate volatility called forth two major new theoretical explanations of real exchange rate determination, the Monetary Approach with Sticky - Prices, and the general equilibrium approach. Accordingly, the issue of real exchange rate determination based on the foregoing theories has been given much attention in the literature. This attention has resulted in some empirical studies being performed. Studies on real exchange rate variations are closely related to the stabilization and liberalization policies. Most of these studies focused on determination of the real exchange rates, and on the effects of monetary and real factors.

In this dissertation, we concentrate on the issue of real exchange rate determination paying particular attention to the case of financially repressed developing countries. This study analyzes how the equilibrium real exchange rate reacts to external shocks and to various
government monetary and fiscal policies, and trade and capital market liberalization policies, under conditions of financial repression. Our analysis makes use of the framework of a general equilibrium intertemporal model. We then apply our theoretical results to generate some empirical implications for the case of the Korean economy.

In Chapter 2, we reviewed various real exchange rate concepts. We also reviewed studies of real exchange rate determinants. We focused on the theoretical models and empirical studies.

In Chapter 3, we established a theoretical framework that can be used to analyze real exchange rate determinants. First, we developed an intertemporal real model of a small open economy. This is an extension of Edwards' (1991) model, introducing financial repression, one of the typical structural factors that affect the real exchange rates in developing countries. The concept of equilibrium real exchange rate and the modeling strategy were also discussed. Second, using an established intertemporal model, we undertook various comparative static analyses, considering the effects on the real exchange rates of various government policies, deregulation of the financial market, relaxation of the capital and trade controls, and changes in government consumption.

The major findings are as follows. First, in the most plausible case, when there is no initial distortion of financial repression, financial repression generates a real appreciation in the short-run. However, when there is an initial distortion of financial repression, this effect can be changed. In line with this, under trade controls, this effect can also be changed. The effect on the real exchange rate depends on the relative importance of the preexisting financial repression and the preexisting trade controls. In a high tariff economy, financial deregulation may
generate a real depreciation. We also noted that these results are valid both in the absence and in the presence of capital controls. Second, the effect of the relaxation of the capital controls on the real exchange rate depends on the factor intensity of the tradables and nontradables. And these effect can be changed in the presence of financial repression. Under financial repression, indirect income effects are induced. This additional income effect may change the results which are expected without the financial repression. Third, conventional wisdom notes that a tariff reduction (hike) will generate a real exchange rate depreciation (appreciation). However, under financial repression, contrary to this traditional wisdom, a tariff reduction will not necessarily result in an equilibrium real depreciation. And the effects of tariff changes on the equilibrium real exchange rate may be changed by the relative importance of the financial repression and the level of the tariff rate. Fourth, contrary to both the recent study by Edwards (1991) and to the traditional literature, under financial repression, an increase in government consumption may result in a real depreciation. This is because with the initial distortion of financial repression, additional income effects are induced, which may operate in the opposite direction as the substitution effect.

In Chapter 4, we reviewed the economic policy changes in Korea over the past three decades centering on recent stabilization and deregulation policies. Related to these policy changes, we reviewed the financial structure in Korea, which can be characterized as repressive and lagged behind the real sector. We reviewed the exchange rate system and exchange rate behavior over the past three decades. We also reviewed the studies of real exchange rate determination in Korea. The Korean experience is a good example for the other developing countries.
In Chapter 5, based on the theoretical framework, we analyzed empirically how the real exchange rates (both bilateral and multilateral) respond to various government policies and external shocks. Using Korean quarterly data, we derived some empirical implications which supports the results derived in Chapter 3. The Korean won real exchange rates were affected by the real variables (economic fundamentals) and also by monetary variables. Interest rate controls in the domestic financial market in Korea resulted in an equilibrium real appreciation. We also found an important implication that, in Korea, since the 1980s, the effect of trade liberalization (tariff reduction) on the real exchange rate has changed, which implies that trade liberalization under financial repression may not result in a real depreciation, contrary to conventional wisdom.

The results of the theoretical analysis and empirical estimation suggest a number of policy implications for Korea and other developing countries. First, the authorities in these countries are advised to take measures to cope with the expected effects of economic liberalization policy on the real exchange rates. Now, many developing countries, including Korea, are promoting economic liberalization policies intensively. In particular, in Korea, financial liberalization is scheduled to be completed by 1997. Most importantly, the deregulation in domestic financial market is suggested to be taken considering the relative importance of trade controls, and vice versa. Abrupt deregulation of interest rates may result in a real depreciation. Relaxation of the capital controls is to be taken considering capital intensity and also considering financial repression. Second, related to government consumption changes, the authorities should also be advised to consider the impact of controlled domestic interest rates.
Third, it can be strongly suggested that in developing countries, changes in the nominal exchange rate can be a powerful device to adjust real exchange rates.

In addition, this study suggests that it is necessary to be more careful when doing empirical estimation to analyze the specific policy cases. This is because the results are frequently ambiguous for highly-distorted economies.

This study attempted to explain the real exchange rate variations by introducing the typical situation in developing countries of a repressed domestic financial market. However, this study has some limitations. First of all, the theoretical model simplified the financial institutions to characterize the financially repressed nature of the economy. In developing countries, a money market also exists even though it is underdeveloped. An unofficial money market plays an important role in developing countries. As Kähkönen suggests, adding an operating unofficial money market would be an interesting extension. Second, related to the empirical estimation, we tried to find the appropriate proxies for each variable. However, in some variables, it is necessary to find the most appropriate proxies that theory suggests, especially, trade control, productivity, and financial repression. Along with the foregoing defect, the short estimation period is another limitation of this study. Lastly, this study does not suggest the optimal sequence of the liberalization policies.
APPENDIX A

SIGN OF THE DETERMINANT AND DERIVATION OF THE MARGINAL PROPENSITY TO CONSUME

1. Sign of the Determinant of Matrix on LHS of equation (3.24)

1.1 Stability Condition

By following Edwards (1991), dynamic behavior of the price of nontradable goods can be depicted by the following equations, (A.6) and (A.7). The intuition for this is that excess demand will generate an increase in price of nontradables.

\[
\begin{align*}
\dot{f}_1 &= \lambda_1 [E_1 - R_1^1] \quad (A.6) \\
\dot{f}_2 &= \lambda_2 [E_2 - R_2^2] \quad (A.7)
\end{align*}
\]

where \(\lambda_1\) and \(\lambda_2\) are speed of adjustment, both greater than 0

Using Taylor expansions of (A.6) and (A.7) around equilibrium prices, and dropping second and higher order terms, we obtain

\[
\begin{bmatrix}
\dot{f}_1 \\
\dot{f}_2
\end{bmatrix}
= 
\begin{bmatrix}
\lambda_1(E_{111} - R_{111}^1) & \lambda_1E_{112} \\
\lambda_2E_{221} & \lambda_2(E_{222} - R_{222}^2)
\end{bmatrix}
\begin{bmatrix}
f_1 - f_1^* \\
f_2 - f_2^*
\end{bmatrix}
\]
Denoting the RHS matrix as $A$, stability of the system requires

$$\text{Det } A > 0\quad \text{tr } A < 0$$

Therefore

$$\text{Det } A = \lambda_1 \lambda_2 (E_{\eta\eta} - R_{1\eta\eta}^1)(E_{\eta\eta} - R_{2\eta\eta}^2) - \lambda_1 \lambda_2 E_{\eta\eta} E_{\eta\eta} > 0$$

which means that

$$(E_{\eta\eta} - R_{1\eta\eta}^1)(E_{\eta\eta} - R_{2\eta\eta}^2) - E_{\eta\eta} E_{\eta\eta} > 0 \quad (A.8)$$

$$\text{tr } A = [ (E_{\eta\eta} - R_{1\eta\eta}^1) + (E_{\eta\eta} - R_{2\eta\eta}^2) ] < 0 \quad (A.9)$$

### 3.2 Sign of the Determinant

Under the assumption of no financial repression, the determinant of the LHS of equation (3.24) is derived as follows:

$$\Delta = E_{\omega} [ (E_{\eta\eta} - R_{1\eta\eta}^1)(E_{\eta\eta} - R_{2\eta\eta}^2) - \delta^* E_{\eta\eta} E_{\eta\eta} ] \quad (A.10)$$

Using the above stability condition (A.8), the sign of this determinant, $\Delta$ can be signed as positive.
Under the assumption of financial repression, the determinant consists of (A.10) and additional terms, which under usual stability requirements is positive.

2. Derivation of the Marginal Propensity to Consume (MPC)

By following Kähkönen (1987), we can establish the following identities.

\[ \Delta = E_w \left[ (E_{nn} - R^1_{nn})(E_{n\Omega} - R^2_{nn}) - \delta^* E_{nn}E_{\Omega n} \right] > 0 \]

where \( \delta^* = 1 / (1 + r^*) \), \( 0 < \delta^* < 1 \)

Under the assumption of financial repression, the determinant consists of (A.10) and additional terms, which under usual stability requirements is positive.

\[ \frac{\partial}{\partial y} \] results in the following:

\[ E_1^1[\pi^1, \delta^D\pi^2, V(\pi^1, \delta^D\pi^2, y)] = D^{1}_X(\pi^1, \delta^D\pi^2, y) \]
\[ E_{pl}[\pi^1, \delta^D\pi^2, V(\pi^1, \delta^D\pi^2, y)] = D^{1}_M(\pi^1, \delta^D\pi^2, y) \]
\[ E_{ql}[\pi^1, \delta^D\pi^2, V(\pi^1, \delta^D\pi^2, y)] = D^{1}_N(\pi^1, \delta^D\pi^2, y) \]
\[ E[\pi^1, \delta^D\pi^2, V(\pi^1, \delta^D\pi^2, y)] = y \]

where \( D^1_X, D^1_M, D^1_N \) are Marshallian (uncompensated) demand functions, and \( V \) is the indirect utility function.

Differentiating with respect to \( y \) results in the following:
\[
\frac{\partial D^1_X}{\partial y} = E_{1w}V_y, \quad \frac{\partial D^1_M}{\partial y} = E_{p1w}V_y \\
\frac{\partial D^1_N}{\partial y} = E_{q1w}V_y \quad E_{w}V_y = 1 \quad \text{(i.e., } V_y = 1/E_w) 
\]

Combining these we derive the marginal propensity to consume on the three goods in period 1 as follows.

\[
\text{MPC}^1_X = E_{1w}/E_w, \quad \text{MPC}^1_M = p_1E_{p1w}/E_w, \quad \text{MPC}^1_N = q_1E_{q1w}/E_w
\]
APPENDIX B

BRIEF HISTORY AND IMPLEMENTATION PLAN FOR FINANCIAL LIBERALIZATION IN KOREA
(Source: Ministry of Finance, Korea, 1993, Bank of Korea, 1994)

1. Major Steps in Interest Rate Deregulation

June 1981: Introduced commercial paper (CP) at unregulated discount rates.

June 1982: Allowed yields on corporate bonds to fluctuate within certain limits.

January 1984: Introduced a bond system for banks’ loan rates.

July 1984: Allowed banks to set interest rates on deposits by maturity, and on loans by type within maxima.

November 1984: Expanded the fluctuation band of banks’ loan rates. Also abolished ceilings on inter-bank call rates, and issue rates of unguaranteed corporate bonds.

March 1986: Freed issue rates on CDs, guaranteed corporate bonds and financial debentures. Linked issue rates on Monetary Stabilization Bonds to market interest rates.

December 1988: Implemented a comprehensive interest rate deregulation. However, they soon backtracked on these measures as macroeconomic conditions turned unfavorable.

November 1991: Implemented the first stage of interest rate deregulation under the four-stage plan announced in August 1991.

November 1993: Launched the second stage of interest rate deregulation.

2. Highlights of Capital Market Opening

- 1981 - 84: Set up international investment trusts.
- 1985 - 87: Allow limited direct securities investment by foreigners.
- Early 1990s: Allow investment in foreign securities by domestic investors.

July 1983: Permission for foreign equity participation in large domestic securities companies

May 1984: Establishment of first closed-end international investment vehicle. (The Korea Fund).

November 1985: Domestic firms allowed to issue convertible bonds to foreigners.


- Capital increase of existing funds for foreign investors.
- Expansion of overseas securities issues by domestic firms.
- Expansion of international business of Korean securities companies.

November 1990: Permission for establishment of foreign securities companies, branches and joint venture companies.

January 1992: Foreigners allowed to invest directly in Korean securities market.

3. Plan for Deregulation of Interest Rates

1. First Stage (November 1991)

Lending Rates

- Bank overdrafts and discounts on commercial bills, apart from loans assisted by Bank of Korea rediscounts.

- Discounts on commercial paper and trade bills of investment and finance companies etc.

- Overdue loans.
Deposit Rates

- Short-term, large denomination deposit instruments such as CDs, trade bills, commercial paper and RPs.

- Long-term time deposits and money-in-trust with a maturity of at least 3 years.

Bond Issue Rates

- Corporate bonds with a maturity of at least 2 years.

2. Second Stage (December 1993)

Lending Rates

- All loans of banks and non-bank financial institutions (excluding government-financed loans and loans rediscounted by Bank of Korea).

Deposit Rates

- Long-term deposits with maturity of over 2 years (time deposits and installment savings of banks, mutual time deposits and installment savings etc.).

Bond Issue Rates

- Corporate bonds with a maturity of less than 2 years and all financial debentures.

- Monetary Stabilization Bonds and all government and public bonds.


Lending Rates

- 1996: Loans from banking funds on which the interest rate short-fall is compensated for from fiscal funds (special equipment loans, etc.)

**Deposit Rates**

- Further deregulation of short term marketable products (Phasing out regulations on issues and maturities).

- Deposits excluding demand deposits (Introduction of financial products linked to market rates such as Money Market Certificates and Money Market Funds).

4. Fourth Stage (during 1997)

**Deposit Rates**

- Setting up plan for gradual deregulation of demand deposits.

- Reviewing the abolition of restrictions on short-term money market instruments.

4. **Plan for Capital Market Opening**

1. First Stage (1993)

**Stock Market**

- Eliminate ceiling on foreigners’ stock investment in companies where over 50% of the equity is held by foreigners.

**Others**

- Allowed foreign investment trusts, and investment consulting companies to participate in the equity of domestic investment trust firms (up to 10%, for all foreign firms, or up to 5% for each).

**Stock Market**

- Raise direct stock investment ceiling for foreigners.
- Accord national treatment in stock investment to residents who are defined as foreigners under the Securities Exchange Act (1994).
- Relax requirements for opening branches by foreign securities companies (1994).

**Bond Market**

- Allow international organizations to issue won-denominated bonds in the domestic market (1995).
- Allow direct purchase of equity-linked securities such as convertible bonds issued by small and medium sized enterprises (1994).
- Allow underwriting of government and public bonds at international interest rates in the primary market (1994).

**Others**

- Permit establishment of domestic representative offices of foreign credit rating firms (1994).
- Raise ceilings on equity participation by foreign investment and trust companies, and investment advisory firms (1995).

3. Third Stage (1996 - 1997)

**Stock Market**

- Continue to raise limits on stock investment by foreigners in individual companies.
Bond Market

- Allow direct investment in small and medium enterprises’ long-term and non-guaranteed bonds (1997).

Others

- Raise the ceiling on equity participation by foreign credit rating firms (1996).

5. Foreign Exchange Liberalization

1. First Stage (1993)

Foreign Exchange Rate

- Expanded range of daily interbank foreign exchange rate fluctuation from 0.8% to 1.0% of the previous day’s market average rate (October 1993).

Foreign Exchange Position

- Raised the ceiling on overall foreign exchange oversold position from 10 to 20 million U.S. dollars (July 1993).

Documentation Requirements

- Raised the ceiling on foreign currency deposits without need to present underlying documents from 200 to 300 million U.S. dollars (July 1993).

- Extended the time limit for submitting underlying documents from 30 days to 45 days (July 1993).

Korean Won Internationalization
- Permitted visible export or import settlement in Korean won up to 100,000 U.S. dollars (October 1993).

- Allowed non-residents to open "free won accounts." (October 1993).


Foreign Exchange Rate

- Further expand range of daily interbank foreign exchange rate fluctuations.

Foreign Exchange Position

- Improved foreign exchange position management system by taking into account both bills bought and net worth (October 1993).

- Adjust the oversold position limit of spot transactions of the foreign exchange market.

Documentation Requirements

- Exempted forward transactions between foreign currencies from underlying documentation requirement (October 1993).

- Abolished ceiling on foreign currency deposits exempted from underlying documentation requirement (October 1993).

- Expanded ceiling on forward transactions between foreign exchange and Korean won (October 1993).

Korean Won Internationalization

- Raised ceiling on settlement in won for visible transactions.
3. Third Stage (1997)

**Foreign Exchange Rate**

- Pursue the settlement of a free-floating foreign exchange rate system.

**Foreign Exchange Position**

- Change the main objective of foreign exchange rate position management toward the promotion of the soundness of foreign exchange banks.

**Documentation Requirements**

- Completely exempt normal transactions from underlying documentation requirements, but maintain the principle of real demand.

**Korean Won Internationalization**

- Gradually expand the scope of external settlements using won currency to include invisible transactions in addition to visible transactions.

6. Capital Account Liberalization

1. First Stage (1993)

**Direct Investment**

- Prepared pre-notification plan for foreign direct investment.

- Simplified application procedures and ease restrictions on overseas direct investment.

**Overseas Funding for Companies**
- Extended deferred payment period for import of raw materials, for export purposes, from 90 days to 120 days (April 1993).

- Introduced a notification system instead of the prior approval system for Korean companies wanting to issue bonds overseas (April 1993).

- Permitted high-tech foreign-invested service companies (July 1993) and high-tech foreign invested manufacturing companies (January 1993), to borrow short-term overseas capital.

**Overseas Stock Investments**

- Permitted individual investors to make indirect overseas portfolio investment through investment companies (April 1993).

- Raised the ceiling on overseas portfolio investment of institutional investors from 50 - 100 to 100 - 200 million U.S. dollars (October 1993).


**Direct Investment**

- Expand the sectors open to foreign direct investment and further simplify the investment procedures.

- Increase minimum investment size of overseas direct investment projects requiring notification to authorities.

**Overseas Funding for Companies**

- Gradually expand scope of short-term overseas borrowings to general manufacturing firms in which foreigners have invested.

- Further ease deferred payment period for imports.

**Overseas Stock Investments**

- Completely lift restrictions on overseas portfolio investment by institutional investors.
- Raise the ceiling on the overseas portfolio investment of individual investors.

3. Third Stage (1997)

**Direct Investment**

- Introduce a full-fledged notification system for foreign direct investment.

- Switch from prior approval system to a notification system in overseas direct investment.

**Overseas Funding for Companies**

- Permit introduction of commercial loans from abroad if economic conditions such as balance of payments, and domestic-international interest rate gap are favorable.

- Extend deferred payment period to international norm.
APPENDIX C
SOURCE OF DATA

   - Domestic Credit (1971-1993)
   - Fiscal Deficit (-) or Surplus (1970-1993)
   - Unit Value Index (Exports and Imports, 1970-1993)
   - Deposit Rate (1970-1993)
   - Corporate Bond Yield (1972.2-1993)

2. National Accounts, Bank of Korea: Korean Data

3. Bank of Korea

4. Korea Productivity Center

5. International Financial Statistics, International Monetary Fund
- Industrial Products Index in Germany (1970-1993)

6. Direction of Trade Statistics Yearbook, International Monetary Fund

- Korean Exports to the major Trading Partners: U.S.A., Japan, Canada, United Kingdom, Germany, France and Netherlands (1970-1993)
- Exports of these Countries to the World Market (1970-1993)
Figure D.1 Plot of Series: Residuals of Cointegrating Regressions
Figure D.1 (Continued)
Plot of Series: Residuals of Cointegrating Regressions
Figure D.1 (Continued)
Plot of Series: Residuals of Cointegrating Regressions
Figure D.1 (Continued)
Plot of Series: Residuals of Cointegrating Regressions
Figure D.1 (Continued)
Plot of Series: Residuals of Cointegrating Regressions
Figure D.1 (Continued)
Plot of Series: Residuals of Cointegrating Regressions
Figure D.1 (Continued)
Plot of Series: Residuals of Cointegrating Regressions
APPENDIX E

RESULT OF CAUSALITY TESTS

1. ARER: Three Lagged Value

Null Hypothesis: ΔARER causes X (here X is each explanatory variable in the model)

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where **: 1% significance level

2. AREER: Four Lagged Value

Null Hypothesis: ΔAREER causes X (here X is each explanatory variable in the model)

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where *: 5% significance level
### APPENDIX F

#### TABLES

Table F.1  Bilateral Real Exchange Rate Equations (OLS)

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Bilateral Real Exchange Rate Equations (OLS)

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Notes: Data in parenthesis are t statistics. N: Number of observations. R²: Coefficient of determination. D.W: Durbin Watson statistic. Q: Q statistic. ***: 1% significance level. **: 5% significance level. *: 10% significance level.
Table F.2 Multilateral Real Exchange Rate Equations (OLS)

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Multilateral Real Exchange Rate Equations (OLS)

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Notes: Data in parenthesis are t statistics. N: Number of observations. R\(^2\): Coefficient of determination. D.W: Durbin Watson statistic. Q: Q statistic. ***: 1% significance level. **: 5% significance level. *: 10% significance level.
Table F.3 Bilateral Real Exchange Rate Equations (OLS, Dummy Variables)

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<tr>
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<td>(-4.049)</td>
<td>(-4.4796)</td>
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<tr>
<td>DM*ΔTC</td>
<td>0.0906**</td>
<td>0.0985***</td>
<td>0.0981***</td>
<td>0.0909**</td>
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<tr>
<td></td>
<td>(2.3614)</td>
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<td>(2.1081)</td>
<td>(1.9249)</td>
</tr>
<tr>
<td>RPDTₜ₋₅</td>
<td>-0.1118***</td>
<td>-0.09**</td>
<td>-</td>
<td>-0.0437</td>
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<td>(-2.2009)</td>
<td>(-2.0288)</td>
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<td>(-0.8766)</td>
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<td>RLPTYₜ₋₅</td>
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Table F.3 (Continued)
Bilateral Real Exchange Rate Equations (OLS, Dummy Variables)

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<tr>
<td>RID_{(t-3)}</td>
<td>-0.1582***</td>
<td>-0.1373**</td>
<td>-0.1732***</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(-2.2016)</td>
<td>(-2.1667)</td>
<td>(-2.5752)</td>
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<td>DM*RID_{(t-3)}</td>
<td>0.0417</td>
<td>0.0345</td>
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<tr>
<td></td>
<td>(0.3327)</td>
<td>(0.3507)</td>
<td>(0.967)</td>
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<tr>
<td>ARJDD_{(t-2)}</td>
<td>-0.0061</td>
<td>-</td>
<td>-</td>
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<tr>
<td></td>
<td>(-1.3966)</td>
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<tr>
<td>DM*ARJDD_{(t-2)}</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>N</td>
<td>86</td>
<td>86</td>
<td>86</td>
<td>83</td>
</tr>
<tr>
<td>R²</td>
<td>0.897</td>
<td>0.914</td>
<td>0.864</td>
<td>0.837</td>
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<tr>
<td>D.W</td>
<td>2.213</td>
<td>2.215</td>
<td>2.215</td>
<td>1.578</td>
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<td>Q / Sig. Level</td>
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<td>20.23/0.567</td>
<td>16.42/0.746</td>
<td>21.72/0.357</td>
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</tbody>
</table>

***: 1% significance level. **: 5% significance level. *: 10% significance level.
<table>
<thead>
<tr>
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<td>0.0233***</td>
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<td>0.0113*</td>
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<td>(3.2394)</td>
<td>(4.6465)</td>
<td>(0.3907)</td>
<td>(1.9378)</td>
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<tr>
<td>EXDC</td>
<td>-0.0689***</td>
<td>-0.0632***</td>
<td>-0.0673***</td>
<td>-0.0743***</td>
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<td>RDC</td>
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<td>-0.087***</td>
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<td>RDEH{t-4}</td>
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<td>-0.2367***</td>
<td>-0.2038***</td>
<td>-0.1934***</td>
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<td></td>
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<td>(-5.3424)</td>
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<tr>
<td>RNEX</td>
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<td>0.8584***</td>
<td>0.908***</td>
<td>0.7927***</td>
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<tr>
<td></td>
<td>(15.76)</td>
<td>(16.778)</td>
<td>(12.9653)</td>
<td>(11.2949)</td>
</tr>
<tr>
<td>ΔTOT{t-2}</td>
<td>-0.0759</td>
<td>-0.0968</td>
<td>-</td>
<td>-0.2487***</td>
</tr>
<tr>
<td></td>
<td>(-0.9008)</td>
<td>(-1.2053)</td>
<td></td>
<td>(-2.2913)</td>
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<tr>
<td>KC{t-1}</td>
<td>-0.0034</td>
<td>-0.0046**</td>
<td>-0.0068**</td>
<td>-0.0016</td>
</tr>
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<td></td>
<td>(-1.5201)</td>
<td>(-2.1958)</td>
<td>(-2.4248)</td>
<td>(-0.548)</td>
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<tr>
<td>ΔGNC{t-1}</td>
<td>-0.2047***</td>
<td>-0.1866***</td>
<td>-0.0717</td>
<td>-0.1448*</td>
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<tr>
<td></td>
<td>(-2.9856)</td>
<td>(-2.8797)</td>
<td>(-0.8157)</td>
<td>(-1.7728)</td>
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<tr>
<td>ΔTC</td>
<td>-0.0848***</td>
<td>-0.0791***</td>
<td>-0.1063***</td>
<td>-0.0714***</td>
</tr>
<tr>
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<td>(-4.5106)</td>
<td>(-4.4156)</td>
<td>(-4.5583)</td>
<td>(-2.9599)</td>
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<tr>
<td>ΔINV</td>
<td>-</td>
<td>-</td>
<td>0.0055</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.1595)</td>
<td></td>
</tr>
<tr>
<td>RPD{t-5}</td>
<td>-0.1613***</td>
<td>-0.1429***</td>
<td>-</td>
<td>-0.138***</td>
</tr>
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<td></td>
<td>(-3.9403)</td>
<td>(-3.6671)</td>
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<td>(-2.5159)</td>
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<tr>
<td>RLPTY{t-5}</td>
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<td>-</td>
<td>-0.0205</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(-0.2328)</td>
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</tr>
<tr>
<td>RID{t-3}</td>
<td>-0.1677**</td>
<td>-0.1741***</td>
<td>-0.137**</td>
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<tr>
<td></td>
<td>(-4.6079)</td>
<td>(-4.5958)</td>
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Table F.4 (Continued)
Bilateral Real Exchange Rate Equations (Error Correction Model)

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<tbody>
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<td>RIDD_{t-2}</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-0.0025 (-0.874)</td>
</tr>
<tr>
<td>ΔRER_{t-2,t-3}</td>
<td>-0.0907 (-0.8057)</td>
<td>-0.1463 (-1.3672)</td>
<td>-0.1488 (-1.1198)</td>
<td>-0.3539** (-2.3065)</td>
</tr>
<tr>
<td>EC_{t-1}</td>
<td>-0.0337 (-1.4416)</td>
<td>-0.0206 (-0.9168)</td>
<td>-0.0112 (-0.3403)</td>
<td>0.0246 (0.7728)</td>
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<tr>
<td>N</td>
<td>86</td>
<td>86</td>
<td>86</td>
<td>83</td>
</tr>
<tr>
<td>R²</td>
<td>0.897</td>
<td>0.908</td>
<td>0.826</td>
<td>0.832</td>
</tr>
<tr>
<td>D.W</td>
<td>1.885</td>
<td>1.831</td>
<td>1.833</td>
<td>1.323</td>
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<tr>
<td>Q / Sig. Level</td>
<td>6.97/0.998</td>
<td>8.2/0.994</td>
<td>18.38/0.625</td>
<td>22.37/0.321</td>
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Notes: Data in parentheses are t statistics. N: number of observations. R²: Coefficient of determination. D.W: Durbin Watson statistic. Q: Q statistic. **: 1% significance level. ***: 5% significance level. ****: 10% significance level.

where in the first three estimations, error correction term (EC) is as follows:

\[ EC_t = RER_t - \left[ 5.6181 - 0.6973 TOT_t - 0.2734 GNC_t \right] \]
\[ (23.1739) (-8.532) (-3.3234) \]
\[ + 0.1371 TC_t - 0.6293 INV_t \]
\[ (3.7405) (-8.329) \]
\[ ( ) : t - statistics \quad N = 95 \quad D.W = 0.649 \quad R² = 0.556 \]

where in the fourth estimation, error correction term (EC) is as follows:

\[ EC_t = RER_t - \left[ 6.0982 - 0.5206 TOT_t - 0.1178 GNC_t \right] \]
\[ (18.669) (-5.1975) (-1.1125) \]
\[ + 0.1395 TC_t - 0.5707 INV_t - 0.0095 RIDD_{t-1} \]
\[ (3.7042) (-6.0363) (-2.1613) \]
\[ ( ) : t - statistics \quad N = 86 \quad D.W = 0.709 \quad R² = 0.444 \]
Table F.5 Multilateral Real Exchange Rate Equations (Error Correction Model)

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<td>0.0031</td>
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<td><strong>EXDC</strong></td>
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<td>-</td>
<td>-0.0406</td>
<td>-</td>
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<td></td>
<td>(-1.1947)</td>
<td>(-0.8904)</td>
<td></td>
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<td>-</td>
<td>0.9504***</td>
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<tr>
<td></td>
<td>(1.6745)</td>
<td></td>
<td></td>
<td>(4.5671)</td>
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<tr>
<td><strong>RDEH</strong></td>
<td>-0.0513</td>
<td>0.1002</td>
<td>0.0204</td>
<td>0.1526**</td>
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<td>(-0.5421)</td>
<td>(1.2592)</td>
<td>(0.2269)</td>
<td>(1.9632)</td>
</tr>
<tr>
<td><strong>RNEX</strong></td>
<td>0.9201***</td>
<td>0.9523***</td>
<td>0.9666***</td>
<td>0.8889***</td>
</tr>
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<td>(7.1292)</td>
<td>(7.6322)</td>
<td>(7.1959)</td>
<td>(6.5815)</td>
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<td><strong>ΔTOT</strong></td>
<td>-0.1477</td>
<td>-0.1417</td>
<td>-</td>
<td>-0.2669**</td>
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<td></td>
<td>(-1.343)</td>
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<td>(-1.329)</td>
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<td><strong>ΔGNCG</strong></td>
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<td>0.0716</td>
<td>-0.1337</td>
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<td>(0.3221)</td>
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<td>(0.2365)</td>
<td>(-0.439)</td>
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<td><strong>ΔTC</strong></td>
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<td>(-1.1472)</td>
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<td>(1.1369)</td>
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<td>(-1.1681)</td>
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<td>0.5419***</td>
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<td>(2.9061)</td>
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<td><strong>RID</strong></td>
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<td>-0.3102***</td>
<td>-0.2912***</td>
<td>-</td>
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<td>(-3.5727)</td>
<td>(-3.2267)</td>
<td>(-2.9599)</td>
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Table F.5 (Continued)
Multilateral Real Exchange Rate Equations (Error Correction Model)

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<td>∆RIDD_{t=1,t-2}</td>
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<td>-0.0154*** (-2.8686)</td>
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<td>∆REER_{t+1,t+3}</td>
<td>0.2658</td>
<td>0.3085*</td>
<td>0.2142</td>
<td>0.1683 (1.644) (1.7957) (1.3468) (0.958)</td>
</tr>
<tr>
<td>EC_{t-1}</td>
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<td>-0.0777</td>
<td>-0.0374</td>
<td>-0.0946 (-0.99) (-1.4256) (-0.6849) (-1.4618)</td>
</tr>
<tr>
<td>N</td>
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<td>87</td>
<td>87</td>
<td>83</td>
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<tr>
<td>R²</td>
<td>0.708</td>
<td>0.731</td>
<td>0.677</td>
<td>0.67</td>
</tr>
<tr>
<td>D.W</td>
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<tr>
<td>Q / Sig. Level</td>
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<td>24.39/10.275</td>
<td>19.14/0.513</td>
</tr>
</tbody>
</table>


*: 1% significance level. **: 5% significance level. ***: 10% significance level.

where in the first and third estimation, error correction term (EC) is as follows:

\[
EC_t = \text{REER}_t - [2.9985 - 0.1876 \text{TOT}_t - 0.5735 \text{GNC}_t - 0.0587 \text{TC}_t - 0.2024 \text{INV}_t ]
\]

\( (j) : t - \text{statistics} \quad N = 95 \quad D.W = 0.442 \quad R^2 = 0.394 \)
where in the second estimation, error correction term (EC) is as follows:

$$EC_t = \text{REER}_t - [2.7011 + 0.2755 \text{ RMON}_t - 0.1641 \text{ TOT}_t \]
\begin{pmatrix}
(8.4517) & (1.9829) \\
(-1.79) & 
\end{pmatrix}
- 0.6604 \text{ GNC}_t - 0.0461 \text{ TC}_t - 0.2555 \text{ INV}_t]$$
\begin{pmatrix}
(-1.1906) & (-1.2545) & (-3.2763)
\end{pmatrix}

( ) : t - statistics
N = 91  D.W = 0.487  $R^2 = 0.389$

where in the fourth estimation, error correction term (EC) is as follows:

$$EC_t = \text{REER}_t - [4.0428 + 0.02 \text{ RMON}_t + 0.1196 \text{ TOT}_t \]
\begin{pmatrix}
(17.4324) & (0.1641) \\
(1.2193)
\end{pmatrix}
- 0.2308 \text{ GNC}_t - 0.0779 \text{ TC}_t - 0.0164 \text{ RIDD}_t]$$
\begin{pmatrix}
(-2.9626) & (-2.7171) & (-4.981)
\end{pmatrix}

( ) : t - statistics
N = 86  D.W = 0.402  $R^2 = 0.431$
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