Real Exchange Rate Response to Inward Foreign Direct Investment in Liberalized India

SREELATA BISWAS[a]* AND BYASDEB DASGUPTA[b]

[a,b]*University of Kalyani, West-Bengal, India*

ABSTRACT

The impact of foreign capital inflows in India on the real exchange rate is examined using quarterly data for the period 1994-95Q_1 to 2009-10Q_4 that is just after the spread of the neo liberal doctrine. The time series under study are found to be non-stationary and integrated of order one. The Johansen multivariate co-integration test is used to establish a link between the real exchange rate and relevant macroeconomic variables. The result suggests that Foreign Direct Investment (FDI) and workers' remittances affect real exchange rate positively in India. Generalized variance decompositions indicate that FDI has more prudent impact on real exchange rate.

Keywords: Real exchange rate, Co-integration, FDI, Remittances, India

JEL classification: F31, C22, F21, F24, O53

INTRODUCTION

FDI is gradually increasing in India since the last two decades. It has affected the gross domestic product, volume of trade, employment (primarily in service sector) and technical progress. The World Investment Prospects Survey 2010-2012 by the United Nations Conference on Trade and Development (UNCTAD) projected that China and India rank first and second respectively as the top priority host economy for FDI over the 2010 to 2012 period for the first time. It demonstrates the prospective potential of India as a preferred destination of FDI in global perspective. At present India is the world's thirteenth largest FDI host economy. This recent wave of FDI inflows could result in some of the unfavorable side effects of foreign capital in the country. One of these effects has been referred to as 'the real exchange rate problem' by Corden (1994) i.e., the possibility that

---

capital inflows give rise to appreciation of the real exchange rate (the relative price of traded to non-traded goods) with adverse consequences for traded goods production in the domestic economy. FDI is an important source of capital financing in capital deficit countries. It can affect equilibrium real exchange rate in both ways i.e., appreciation or depreciation of domestic currency depending on the use of these inflows. If FDI is used to finance imports, it does not affect equilibrium real exchange rate, however, its use for domestic non-tradables will lead to the appreciation of domestic currency (Baffes, 1999). Again, international migrant remittances are becoming an important source of capital in terms of both magnitude and growth rate, exceeding the inflow of foreign aid and private capital in many countries within the last two decades. Remittance received by developing countries, estimated at US $221 billion in 2006, increased by 132 per cent compared with 2001 figures, and in 2008 it represents 1.9 per cent of total income in emerging economies (World Bank, 2008). Remittance inflows currently constitute about one-third of total financial flows to the developing world. These inflows are directly received by the families of remitters, thus has direct impact on poverty reduction and high growth rates (Adams and Page, 2005; Acosta et al., 2008) in receiving countries. Further, remittances curtail the current account deficits of the receiving country as they are treated as unrequited current private transfers in the balance of payments (BOP) accounts. However, remittances have important implications for equilibrium real exchange rate. If these inflows are largely spent on non-tradable goods, it may result in the appreciation of real exchange rate. According to Amuedo-Dorantes and Pozo (2004) and López et al. (2007), rising levels of remittances in recipient economies, like any other massive capital inflow, can appreciate the real exchange rate and therefore generate a resource allocation from the tradable to the non-tradable sector (Acosta et al., 2007). This phenomenon is usually known as the 'Dutch disease effects' in the literature. Rodrik (2007) observed that real exchange rate overvaluation weakens long-term economic growth, particularly for developing countries, in that in those countries, tradable goods production suffers disproportionately from weak institutions and market failures. This emphasizes the importance of the implications of remittances for real exchange rate movements. In fact, exchange rate misalignment is a common feature in most developing countries now. Since early 1980s, real exchange rate misalignment has become a standard concept in international macroeconomic theory and policy (Razin & Collins, 1997) and therefore, exchange rate management is a challenging macroeconomic policy issue in the modern literature on the real exchange rate.

The objective of this paper is to investigate the empirical relationship between FDI inflows and exchange rate misalignment in liberalized India. The rest of the paper is structured as follows. Section II provides an overview of India's inward

FDI followed by a brief outline of its remittance inflows in section III. Section IV presents a review of the existing literature. Section V illustrates the data. Section VI describes methodology and provides the empirical results. Finally the paper is concluded in Section VII.

FDI INFLOWS IN LIBERALIZED INDIA

FDI inflow has started slowly in India following the new economic reform. It was very low after the liberalization process. The inflow was within the range of less than just US $ 1 billion till 1994-95 because of limited and restricted opening up of the economy. After that it has gradually gained its momentum. It has doubled by the year 2002 because of further impetus to the reform process. The enormous growth actually has occurred during the last decade due to the sector specific and target oriented FDI policy intervention by the government. FDI in India has achieved a phenomenal double digit value of 37.2 billion US dollar in 2009-10 (Figure 1).

FDI Inflows in India (US$ billion)
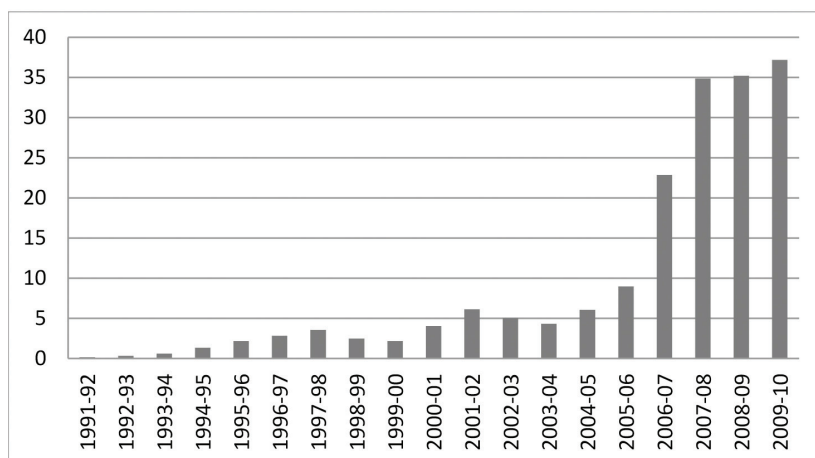

Source: Hand book of Statistics, 2009-10 RBI
Note: Data for 2008-09 and 2009-10 are Provisional.

Figure 1 FDI Inflows in India (US$ billion)

Nowadays foreign investors are playing a robust pro-active role in Indian. Mauritius, as a country, is the largest direct investor in India since August 1991, largely because of India-Mauritius double-taxation treaty, which is recently in news. It is generally argued that Mauritius based investments are nothing but mainly

323

US investments routed via a tax haven. The tax advantage arises because of the double tax avoidance agreement that India has with Mauritius. This agreement means that any foreign investor has the option of paying tax either in India or in Mauritius. Since, the tax rates prevailing in Mauritius are the lowest in the world, many multinational corporations (MNCs) prefer to route their investments to India through Mauritius. After the adaption of the tax treaty, in between August 1991 and March 2002, firms based in Mauritius invested US $ 6.63 billion FDI in India. During the same time period US was the second largest investor with total FDI inflows of US $ 3.19 billion followed by Japan (US $ 1.3 billion), U.K. (US $ 1.12 billion), Netherlands (US $ 986 million), Germany (US $ 908 million), Singapore (US $ 505 million)[*]. From the financial year 2002-03 onwards major sources of FDI in India include Mauritius, Singapore, U.S.A. and U.K. (Figure 2).

Major Sources of FDI Equity Flows in India (US$ billion)
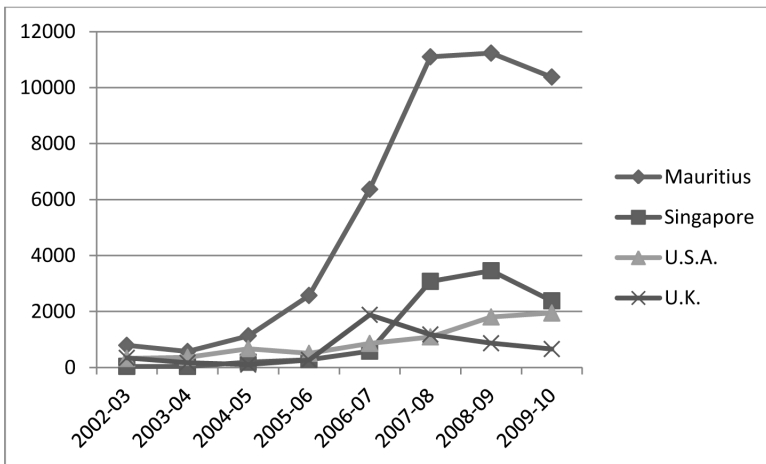
Source: Government of India, Ministry of Commerce & Industry, Department of Industrial Policy and Promotion, FDI Statistics September 2005, March 2008 and January 2011.

Figure 2 Major Sources of FDI Equity Flows in India (US$ billion)

An important aspect of FDI inflows in India is that it is concentrated to a few non-tradable sectors. During August, 1991 to March, 2007, 77.9 per cent of total FDI inflows in India were concentrated to few sectors (Table 1) in which service sector

[*] Government of India, Ministry of Commerce & Industry, Department of Industrial Policy and Promotion, FDI Statistics September 2005.

is the highest recipient. 65 per cent of total FDI inflows have gone to service sector during this period and the sector accounts for slightly more than one third of the total export volume in the same period. FDI into India not only heavily dominated by service sector but also its share in non-traded services has gone up gradually. It is observed in the last decade the share of non-traded services like housing and real estate and construction activities in total inward FDI hiked to more than 7 per cent each, non-financial services, power, hotel and tourism, trading also shows the rising trend (Table 2). Of late, some new sectors including hospital & diagnostic centers, education, petroleum & natural gas, information & broadcasting have started to catch the foreign investors' attention.

Table 1 Sectors Attracting Highest FDI Inflows in India (US $ million)

Rank	Sector	Share of Total FDI Inflows (%) (August1991-March2007)
1.	Electrical Equipments (including computer software & electronics)	18.77
2.	Services Sector (financial & non-financial)	17.84
3.	Telecommunications (radio paging, cellular mobile, basic telephone services)	8.70
4.	Transportation Industry	8.04
5.	Fuels (power + oil refinery)	6.31
6.	Chemicals (other than fertilizers)	4.95
7.	Construction Activities*	3.33
8.	Drugs &Pharmaceuticals	2.75
9.	Food Processing Industries	2.68
10.	Cement and Gypsum Products	2.26
11.	Housing & Real Estate*	2.25
	Total	77.9

Source: Government of India, Ministry of Commerce & Industry, Department of Industrial Policy and Promotion, FDI Statistics March 2007.
Note: * Year-wise/data available from January 2000 onwards only.

Thus it has been noticed that huge FDI inflows are in non-tradable sectors that worsen the current account balance of the country. In contrast comparatively lesser FDI is directed towards major exporting sectors like textiles, chemicals and pharmaceuticals, leather goods, transport, food processing industries etc. FDI in infrastructure development such as the power and telecommunications sector will certainly drive the growth of FDI into other export-oriented manufacturing sectors in India.

Table 2 Sectors Attracting Highest FDI Equity Inflows in India (US $ million)

Rank	Sector	Share of Total FDI Inflows (%) (April12000-March2010)
1.	Services Sector (financial & non-financial)	21.43
2.	Computer Software & Hardware	8.95
3.	Telecommunications (radio paging, cellular mobile, basic telephone services)	8.10
4.	Housing & Real Estate (including cineplex, multiplex, integrated townships & commercial complexes etc.)	7.58
5.	Construction Activities (including roads & highways)	7.31
6.	Power	4.20
7.	Automobile Industry	4.14
8.	Metallurgical Industries	2.84
9.	Petroleum & Natural Gas	2.42
10.	Chemicals (other than fertilizers)	2.26

Source: Government of India, Ministry of Commerce & Industry, Department of Industrial Policy and Promotion, FDI Statistics March 2010.

REMITTANCE INFLOWS IN LIBERALIZED INDIA

Remittances are the major source for financing in developing countries. Remittances from overseas Indians comprise of the inflows towards family maintenance and the funds domestically withdrawn from the Non-Resident Indian (NRI) rupee deposits [NRERA (Non-Resident External Rupee Account) and NRO (Non-Resident Ordinary) deposit schemes]. Such remittances are treated as private unrequited transfers, which are included in the current account of the balance of payments and influence the disposable income of the country. The migrant workers' remittances to India increased steadily during the 1970s, remained more-or-less flat in the 1980s and started picking up sharply with the information technology revolution in the 1990s. Since the beginning of the liberalization era, foreign remittances have become an important component of India's overall balance of payments and within a decade India has placed herself as the world's largest recipient of remittances.

In 1991-1992, for instance, Reserve Bank of India (RBI) reported that remittances from overseas Indians were a modest US $ 3.8 billion. They have risen steadily in the last two decades, vigorously in the last ten years (Figure 3). The figure rose to US $ 12.4 billion in 1996-1997, and then jumped to almost US $ 22 billion in 2003-2004. With a small dip in 2004-2005 (US $ 20.5 billion), it raised to US $ 24.5 billion in 2005-06. Between 2000-2001 and 2005-2006, remittances

almost doubled. In the next two years it has increased consistently. Then remittances grew from US $ 44.6 billion in 2008-09 to US $ 52.1 billion in 2009-10.

Remittances to India   **(US$ billion)**
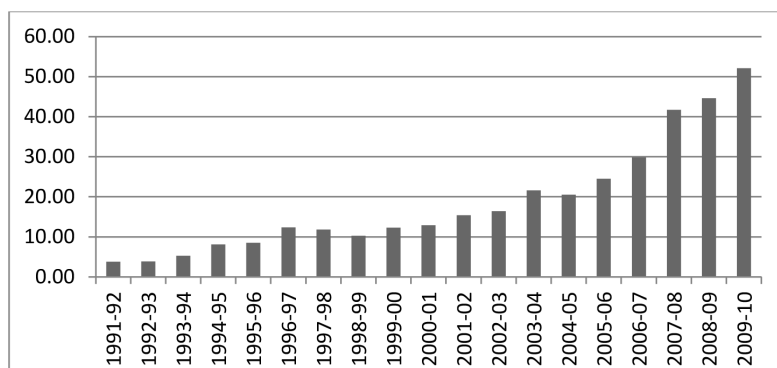
Source: Hand book of Statistics, 2008-09 and 2009-10 RBI
Note: Data for 2008-09 are partially revised and for 2009-10 are preliminary estimates.

Figure 3 Remittances to India (US$ billion)

India, thus, continues to retain its position as the leading recipient of remittances in the world. Major source of remittances inflows in India are North America, Gulf States in Middle East and Europe. According to the RBI estimation (2006), North America contributes 44 per cent of remittance to India; 24 per cent comes from Gulf States and 13 per cent from Europe. But in the pre-liberalization period, Middle East was the largest source of workers' remittances in India. During 1990-1991, 40 per cent of the remittances came from Gulf countries and 24 per cent from North America. North America has replaced Gulf States as the leading source of Indian inward remittances since 2002. In fact, the number of Indian software engineers migrated to North America increased rapidly since the 1990s and it is one of the main reasons why foreign inward remittance to India increased.

LITERATURE REVIEW

The dependent economy model, also known as the 'Salter-Swan-Corden-Dornbusch paradigm' (Salter, 1959; Swan, 1961; Corden, 1960; and Dornbusch, 1980), provides a theoretical base of empirical analysis regarding the impact of foreign capital on the real exchange rate in developing economies. Within this theoretical model, an increase in capital inflows to a sector of the economy increases the marginal

product of labor, and hence the real wage, in the sector, drawing resources out of other tradable sectors (resource movement effect). A higher real household income triggers an expansion in aggregate demand, which for exogenously given prices of tradable goods, culminates in higher relative prices of non-tradable goods (spending effect) which causes further movement of resources toward this sector. A rise in the relative price of non-tradable goods corresponds to a real exchange rate appreciation. Acosta et al. (2007) developed a dynamic stochastic general equilibrium model considering an additional mechanism as an increase in household income results in a decrease in the labor supply. A shrinking labor supply is associated with higher wages (in terms of the price of tradable output), that in turn leads to higher production costs and a further contraction of the tradable sector. Both the real exchange rate and the ratio of tradable to non-tradable output therefore serve as summary indicators of the outcome of macroeconomic adjustments that occur following an increase in capital inflow i.e., Dutch disease effects viz. the spending effect and resource movement effect.

There are two text-books methods to analyze the equilibrium real exchange rate. The first is strict purchasing power parity (PPP), which posits that the equilibrium real exchange rate for an economy is constant over time, as nominal exchange rates are supposed to adjust rapidly to any price differentials between the economy and its trading partners. Using this approach a number of empirical attempts have been made. Benassy-Quere et al. (2001) advocated the benefits of depreciation that may be offset by excessive volatility of the exchange rate. Blonigen (1997) illustrated how currency depreciation induces foreign firm to acquire firm-specific assets when markets are segmented. Hasnat (1999) studied the impact of misalignment on FDI for five developed nations on annual data ranging from 1976-1995. All of these studies use misalignment as a control variable or a counterpart for exchange rate variability and is measured by a deviation from the PPP values. On the other hand, rejecting the PPP approach and adopting the approach based on fundamentals Elbadawi and Soto (1997) estimated equilibrium real exchange rate for seven developing countries. They used co-integration technique for empirical testing of annual data spanning from 1966 to 1999. Actually they extended the model of the determinants of real exchange rate of Rodriguez (1989) and Edwards (1989) by including two more elements, the effect of financial flows and role of the country risk. Their finding has led to a general consensus that absolute PPP does not hold constant over time and thus the equilibrium exchange rate cannot be constant over time. The second approach is more widely used approach postulating the real exchange rate as a function of several fundamental variables including the Balassa-Samuelson effect, trade openness, net foreign assets and government spending and it also states that the equilibrium real exchange rate follows a path

upon which an economy maintains internal and external balance (Edwards, 1994; Williamson, 1994).

The real exchange rate may change if the economy is shocked by dynamic forces that affect equilibrium. The long-run equilibrium real exchange rate is one which is compatible with steady-state equilibrium for the economy's net international creditor position, conditioned on the permanent values of a variety of policy and exogenous variables. The internal balance is defined as the condition where the non-tradable goods market clears in the current period and is expected to be in equilibrium in the future (Edwards, 1989; Montiel, 1999). The internal balance is inversely related to consumption. If we start from initial internal balance equilibrium, then an increase in private spending results in an excess demand for non-tradable goods at the initial real exchange rate. To restore equilibrium, a real appreciation is required, promoting supply of non-tradable goods and increasing demand for tradable goods. Montiel (1999) defined the external balance as the current account balance that is compatible with long-run sustainable capital inflows. The external balance is given by the trade balance (i.e., domestic output of traded goods net of local consumption of these goods) plus net capital inflows, less costs on foreign debt. In equilibrium, there is a positive relationship between consumption and the real exchange rate. Given initial external balance, an increase in private spending would generate a current account deficit at the original real exchange rate. To restore equilibrium, the real exchange rate must increase (depreciate). The depreciation would then switch demand towards non-traded goods and supply towards traded goods. The steady state for the equilibrium real exchange rate was solved by Montiel (1999), by assuming that the economy faces an upward sloping supply curve of net external funds and that households optimize over an infinite time horizon. The long-run equilibrium real exchange rate is determined by government spending (on tradables and non-tradables), capital inflows, the world real interest rate and the rate of inflation in the domestic price of traded goods. The nominal exchange rate does not appear as part of the fundamentals, as it would mainly have a transitory effect on the real exchange rate.

Various studies have attempted to estimate the determinants of the real exchange rate and the effects of real exchange rate misalignment in developing countries. White and Wignaraja (1992) provided an econometric model of real exchange rate behavior in Sri Lanka using a general to specific modeling procedure. The model specifies the following variables: lagged real exchange rate, total aid and remittances lagged one period, terms of trade, nominal exchange rate and the nominal exchange rate lagged two periods. A major finding from the study is that the substantial rise in total aid and remittances has caused a real appreciation. Younger (1992), Olofsgard and Olausson (1993) have all supported the hypothesis of capital inflows leading to

real exchange rate appreciation like White and Wignaraja (1992). Athukorala and Rajapatirana (2003) conducted a comparative analysis on real exchange rate and capital inflows of emerging market economies in Asian and Latin America during the period 1985-2000. This paper focuses on the behavior of the real exchange rate in terms of private capital inflows, disaggregated into FDI and 'other capital flows', and a set of macroeconomic indicators. The econometric evidence suggests that the composition of capital flow matters in determining their impact on the real exchange rate. They found that the real exchange rate appreciates with rising levels of 'other capital flows' whereas increases in FDI lead to a depreciation of the real exchange rate. Further, their results showed that the degree of appreciation in real exchange rate associated with capital inflows is uniformly much higher in Latin American countries compared to their Asian counterparts, though the latter received far greater foreign capital inflows relative to their sizes of the economy.

Recent research works have used co-integration techniques to determine the existence of a long-run equilibrium model. For instance, Hussain (2008) and Rehman et al. (2010) apply co-integration technique to compute Pakistan's equilibrium real exchange rate and its misalignment. By using annual data from 1970 to 2007, Hussain's study estimates the impacts of real and monetary variables on real exchange rate. The study concludes that equilibrium real exchange rate depends on terms of trade, capital inflows, government consumption and GDP growth. Co-integration technique enables us to estimate the long-run steady state parameters, after confirming the existence of equilibrium. According to Baffes et al. (1999), the co-integration technique gives a clearer picture of how the fundamentals determining the real exchange rate may move permanently, thus altering the equilibrium value.

The rate of growth of FDI has dramatically increased in India compared to that of the early 1990s. This indicates the rising competitiveness of India in attracting FDI which demands empirical research since it would be vital to investigate which factors that contributed to the augmentation of competitiveness. Existing literatures concentrate mainly on cross country panel data analysis. The present study empirically intends to explore exchange rate misalignment as an indicator of FDI inflow competitiveness in case of India.

DATA

In this paper the behavior of equilibrium real exchange rate has been analyzed through co-integration technique to establish a long run relationship between real effective exchange rate (REER) and its fundamental determinants. The variables used as proxies of fundamentals include: log of industrial production index

(LPROD) as a proxy for productivity in tradable goods; log of openness (LOPEN) defined as the quarterly sum of exports and imports of goods and services and taken as a proxy of trade openness; log of foreign direct investment inflow (LFDI) as a proxy of capital inflows and log of workers' remittances (LREMIT) as an important foreign inflow in recent years. We take trade-based REER with the base year of 1993-94. In India, REER is weighted average (36- country) of the bilateral nominal exchange rates of the home country's currency relative to an index or basket of other major foreign currencies adjusted for the effects of inflation. For industrial production index general index with base year of 1993-94 is used. The data such as 'openness', 'FDI inflows' and 'remittances' are taken from India's overall Balance of Payment (BOP). Remittances are included in India's BOP as private transfers in current account. The empirical work uses quarterly data from the first quarter of 1994-95 to fourth quarter of 2009-10 sourced from the Hand book of Statistics (2007-08 and2009-10) published by the Reserve Bank of India. The summary statistics of the data used is appended at the end (*See Table A.1 in the Appendix*).

METHODOLOGY AND EMPIRICAL ANALYSIS

Test of Stationarity and Co-integration Technique

Before implementing the co-integration technique, the stationarity of LREER (log of REER) and fundamentals (LPROD, LOPEN, LFDI, and LREMIT) is checked by applying Augmented Dickey-Fuller (ADF) test, the Phillips-Perron (PP) and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests. The ADF test is based on the following two regressions.

$$\Delta X_t = \beta_1 + \theta X_{t-1} + \gamma_i \sum_{i=1}^{p} \Delta X_{t-i} + \epsilon_t \tag{1}$$

$$\Delta X_t = \beta_1 + \beta_2 t + \theta X_{t-1} + \gamma_i \sum_{i=1}^{p} \Delta X_{t-i} + \epsilon_t \tag{2}$$

Where X is the variable under consideration, Δ is the first difference operator, t is the time or trend variable, ϵ_t is a pure white noise and p is the optimum number of lags on the dependent variable. Since the possibility of the presence of structural breaks makes the ADF test unreliable for testing stationarity, this study also employs the Philip-Perron (PP) test statistics. The regression equations for the PP test is given by the equation (3) and (4) as

$$\Delta X_t = \beta_1 + \theta X_{t-1} + u_t \tag{3}$$

$$\Delta X_t = \beta_1 + \beta_2 t + \theta X_{t-1} + u_t \tag{4}$$

Here u_t is a white noise error term and all other symbols have their usual meanings. Both the ADF and PP tests are carrying out by estimating their respective regressions with just drift as well as both drift and linear time trend. The test for a unit root is conducted on the coefficient of X_{t-1} in the regression. If the coefficient is significantly different from zero (less than zero) then the hypothesis that X contains a unit root is rejected. The null and the alternative hypothesis for the existence of unit root in variable is $H_0: \theta = 0$ versus $H_1: \theta < 0$. Rejection of the null hypothesis denotes stationarity in the series. Finally the KPSS test is conducted on the basis of the following two equations (5) and (6) respectively:

$$X_t = \beta_1 + \mu_t + u_t \tag{5}$$

$$X_t = \beta_1 + \beta_2 + \mu_t + u_t \tag{6}$$

Where μ_t is a pure random walk with innovation variance σ_ϵ^2

$$\mu_t = \mu_{t-1} + \epsilon_t \ , \ \epsilon_t \sim W N (0, \ \sigma_\epsilon^2)$$

The KPSS test statistic is the Lagrange multiplier (LM) or score statistic for testing null hypothesis $H_0: \sigma_\epsilon^2 = 0$ i.e., the time series is stationary, against the alternative hypothesis that $H_1: \sigma_\epsilon^2 > 0$ i.e., the series in non-stationary and in this ground this test differs from ADF and PP tests. We now report the results of the three tests in Table 3 and 4.

Table 3 shows that all the variables under study do not possess the same degree of integration. LREER is stationary at level while the test equation considers only intercept. But in case of constant & linear trend, PP test confirms LREER to non stationary at level. Again LREMIT is stationary (though not for KPSS test) at level only in case of test equation having intercept and trend. The other variables [LPROD, LOPEN, LFDI] are non-stationary i.e., integrated of order one or I(1) at levels and are stationary at first differences (see Table 4). However, it is claimed that in the multivariate case co-integration analysis is applicable for a set of variables with different orders of integration (Enders, 2004 and Asterious & Hall, 2007) and it is known as multi co-integration. In this case long-run equilibrium relationship among the variables could have been achieved if the stochastic trend components of a set of variables offset each other to attain a stationary linear combination of the variables. In this study Johansen (1988) and Johansen and Juselius (1990) method of co-integration technique is used to estimate the long-run relationship between LREER and fundamentals (LPROD, LOPEN, LFDI, LREMIT) as it requires some variables to be non-stationary at level not all. On the basis of standard lag length criteria (*Table A.2 in Appendix*) we have 5 as optimum lag length for co-integration test.

Table 3 Test of stationarity in levels

Series	ADF	PP	KPSS
		Intercept	
LREER	-4.248 [2]	-3.090 [2]	0.096 [5]
	(0.0012)***	(0.0324)**	
LPROD	1.881 [6]	0.696 [15]	1.027 [6]***
	(0.9998)	(0.9912)	
LOPEN	0.094 [0]	0.239 [11]	0.972 [6]***
	(0.9628)	(0.9730)	
LFDI	-0.969 [1]	-1.455 [4]	0.914 [6]***
	(0.7590)	(0.5495)	
LREMIT	-0.737 [1]	-0.667 [2]	0.973 [6]***
	(0.8292)	(0.8472)	
		Intercept & trend	
LREER	-4.198 [2]	-3.040 [2]	0.096 [5]
	(0.0079)***	(0.1298)	
LPROD	0.247 [6]	-3.605 [8]	0.500 [5]***
	(0.9979)	(0.0373)**	
LOPEN	-1.663 [0]	-1.611 [7]	0.212 [6]**
	(0.7559)	(0.7775)	
LFDI	-3.099 [0]	-3.001 [2]	0.168 [5]**
	(0.1155)	(0.1403)	
LREMIT	-4.780 [0]	-4.963 [4]	0.197 [5]**
	(0.0014)***	(0.0008)***	

Unlike Engel Granger (1987), the Johansen and Juselius technique for estimating co-integration is said to be superior because it is based on maximum likelihood procedure that provides test statistics to determine number of co-integrating vectors as well as their estimates. Johansen (1990, 1995) suggested two test statistics, namely the trace test statistics (λ trace) and the maximum eigenvalue test statistics (λ max). The trace statistic tests the null hypothesis that the number of distinct co-integrating vector is less than or equal to q against a general unrestricted alternatives q = r. The test is calculated as follows:

$$\lambda \text{ trace } (r) = -T \sum_{i = r + 1} \ln\left(1 - \widetilde{\lambda}t\right) \tag{7}$$

Where T is the number of usable observations, and the λ_t, s are the estimated eigenvalue from the matrix. The Second statistical test is the maximum eigenvalue test (λ max) and it tests the null hypothesis that there is r of co-integrating vectors

Table 4 Test of stationarity in first differences

Series	ADF	PP	KPSS
	Intercept		
LREER	-5.844 [0] (0.0000)***	-5.827 [1] (0.0000)***	0.055 [2]
LPROD	-2.283 [4] (0.1809)	-9.988 [17] (0.0000)***	0.232 [15]
LOPEN	-5.617 [2] (0.0000)***	-8.929 [6] (0.0000)***	0.146 [10]
LFDI	-10.931 [0] (0.0000)***	-11.142 [6] (0.0000)***	0.088 [9]
LREMIT	-8.611 [1] (0.0000)***	-17.428 [8] (0.0000)***	0.107 [8]
	Intercept & trend		
LREER	-5.806 [0] (0.0000)***	-5.790 [1] (0.0000)***	0.046 [2]
LPROD	-3.108 [5] (0.1144)	-10.397 [17] (0.0000)***	0.181 [13]**
LOPEN	-5.715 [2] (0.0001)***	-8.999 [7] (0.0000)***	0.092 [11]
LFDI	-10.839 [0] (0.0000)***	-11.028 [6] (0.0000)***	0.085 [8]
LREMIT	-8.587 [1] (0.0000)***	-17.392 [8] (0.0000)***	0.076 [9]

Notes: [.] denotes the lag(s) suggested by Schwarz Information Criterion (SIC) for ADF tests and by Newy-west using Bartlett Kernel for PP and KPSS tests. (.) is p-value. ***, **, and * denote the rejection of the null hypothesis of a unit root at 1%, 5%, and 10%, respectively.

against the alternative r+1 co-integrating vectors. It is calculated according to the following formula:

$$\lambda \max (r, r+1) = -T \ln (1 - \lambda_{r+1}) \quad (8)$$

The results of Johansen's test for co-integration rank are presented in Table 5 and it confirms that under 5% significant level the number of statistically significant co-integration vectors is equal to three for trace statistics and two co-integrating vector for maximal eigenvalue. This implies that there exists a significant co-integrating relationship connecting the five variables and we can conclude that there is a long run relationship among the variables under study. The long-run

relationship can be obtained by normalizing the co-integrating vector on LREER. In equation form, the normalized vector can be expressed as follows:

$$LREER = 4.71795 + 0.148644 \ LPROD - 0.108235 \ LOPEN + 0.028102 \ LFDI + 0.006915 \ LREMIT$$

Table 5 Johansen's Co-integration Test (Assuming intercept (no trend) in co-integration equation)

Hypothesized No. of CE(s)			5 per cent critical value	Probability**
$\lambda_{\text{trace test}}$	Eigen values	λ_{trace} values		
None*	0.504644	105.9000	69.81889	0.0000
At most 1*	0.448275	65.15623	47.85613	0.0005
At most 2*	0.236650	30.66328	29.79707	0.0397
At most 3	0.148416	15.00101	15.49471	0.0592
At most 4*	0.093334	5.682914	3.841466	0.0171
$\lambda_{\text{max test}}$	Eigen values	λ_{max} values		
None*	0.504644	40.74374	33.87687	0.0065
At most 1*	0.448275	34.49295	27.58434	0.0055
At most 2	0.236650	15.66226	21.13162	0.2452
At most 3	0.148416	9.318100	14.26460	0.2606
At most 4*	0.093334	5.682914	3.841466	0.0171

Note: Trace statistic (λtrace) test indicates three co-integrating equations and Maximum-Eigen Statistic (λmax) test indicates two co-integrating equations at the 0.05 level. * denotes rejection of the hypothesis at the 0.05 level. ** MacKinnon-Haug-Michelis (1999) p-values.

With exception of LREMIT, the other three estimated coefficients are statistically significant. LPROD and LFDI are significant at 10% level and LOPEN is significant at 1% level. In this long run relationship, LPROD, LFDI, and LREMIT have positive (appreciating) effect whereas LOPEN has negative (depreciating) effect on real effective exchange rate. The implication of positive sign of LPROD is the productivity rise in tradable goods sector. This is the fundamental of Balassa-Samuelson theory (1964). According to the theory productivity rise in tradable goods sector will increase real wages and demand for non-tradables, and thus ultimately real exchange rate appreciates. The impacts of LFDI and LREMIT on LREER are also positive and show that increase in long-run foreign capital inflows appreciate real exchange rate. FDI can affect equilibrium real exchange rate through both supply side and demand side. From the supply side, FDI inflows augment the existing capital stock and bring technology spillovers which initially lead to an increase in output and fall in prices of non-tradables thus depreciating the real

exchange rate. But in the next step, the increase in output of non-tradables expands disposable income and thus tends to appreciate the real exchange rate alike 'Dutch disease effect'. Finally, the positive sign of LREMIT indicates that the usage of remittances is basically for consumption of non-tradables. Then, combining long run parameters of the co-integrating equation with their respective determinants we derive the equilibrium real effective exchange rate (LEREER) by computing Hodrick-Prescott Filter (HP Filter).

$$LEREER = 4.71795 + 0.148644\ LPROD* - 0.108235\ LOPEN* + 0.028102\ LFDI* + 0.006915\ LREMIT*$$

Real exchange rate misalignment is then calculated as the difference between actual and equilibrium real effective exchange rates.

$$Misalignment = LREER - LEREER$$

Figure 4 shows the actual and equilibrium real effective exchange rates. When actual real effective exchange rate (LREER) is above the equilibrium real effective exchange rate (LEREER), it shows over-valuation and vice versa. Our findings reject the PPP school of thought of fixed equilibrium real exchange rate and support Edwards and Elbadawi and Soto's view of fundamentals approach that equilibrium real exchange rate is not constant over time. Figure 4 shows that equilibrium real exchange rate is a path instead of a single value and thus equilibrium real exchange rates can change over time, as a result of change in fundamentals like productivity and capital inflows.
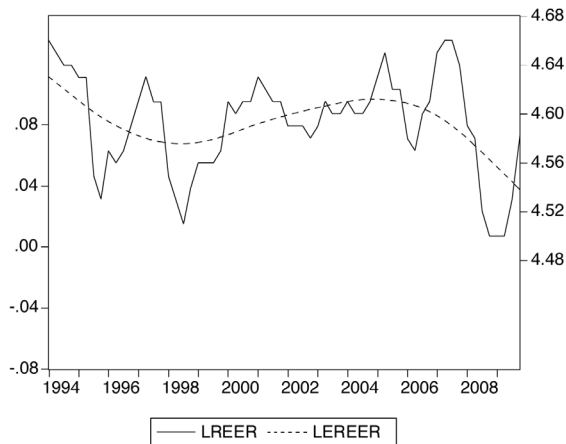

Figure 4 Actual and Equilibrium Real Exchange Rates

Table 6 Normalized co-integrating coefficients

LREER	LPROD	LOPEN	LFDI	LREMIT	C
1.000000	-0.148644	0.108235	-0.028102	-0.006915	-4.717950
	(0.07671)	(0.03639)	(0.01457)	(0.03536)	

Note: standard errors are in parentheses

As we have seen that the deviation of actual REER from the fitted or estimated value in the co-integration equation represents the misalignment from its equilibrium value, there may exist specification error in the co-integration equation. So it is important to check the precision of the estimated REER. The results of three diagnostic tests of residuals are reported in Figure 6 and Table 7 & 8. The outcomes assure that the residuals are normally distributed, serially uncorrelated and no heteroskedasticity is found at all.
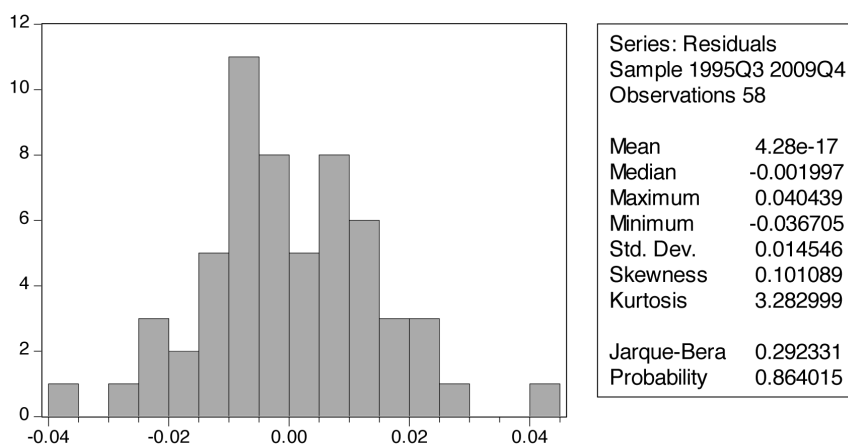

Series: Residuals	
Sample 1995Q3 2009Q4	
Observations 58	
Mean	4.28e-17
Median	-0.001997
Maximum	0.040439
Minimum	-0.036705
Std. Dev.	0.014546
Skewness	0.101089
Kurtosis	3.282999
Jarque-Bera	0.292331
Probability	0.864015

Figure 6 Residuals normality test

Table 7 Residuals serial correlation test

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.360690	Prob. F(2,29)	0.7003
Obs*R-squared	1.407741	Prob. Chi-Square(2)	0.4947

Table 8 Residuals heteroskedasticity test

Heteroskedasticity Test: ARCH			
F-statistic	2.291002	Prob. F(1,55)	0.1359
Obs*R-squared	2.279366	Prob. Chi-Square(1)	0.1311

We have also verified the stationarity of the misalignment series to examine whether the specified model is unbiased or not. Tests reveal that the series is stationary (Table 9) having no specification error.

Table 9 Test of stationarity of misalignment series in levels

Series	ADF	PP	KPSS
	Intercept		
Misallignment	-4.970 [2]	-3.384 [1]	0.042 [4]
	(0.0001)***	(0.0152)**	
	Intercept & trend		
Misallignment	-4.994 [2]	-3.60 [1]	0.038 [4]
	(0.0007)***	(0.0662)*	

Notes: [.] denotes the lag(s) suggested by Schwarz Information Criterion (SIC) for ADF tests and by Newy-west using Bartlett Kernel for PP and KPSS tests. (.) is p-value. ***, **, and * denote the rejection of the null hypothesis of a unit root at 1%, 5%, and 10%, respectively.

Generalized Variance Decompositions and Impulse Response Analysis

Further we use generalized variance decompositions and impulse response function to study the dynamic characteristics of every endogenous variable in the system. Variance decompositions give the proportion of the n-periods-ahead forecast error variance of a variable that can be attributed to another variable. Here we measure the proportion of the forecast error variance of LREER that can be explained by shocks given to its determinants. Again the basic idea of the impulse response function is to measure the time profile of the effect of shocks at a given point in time on the future values of endogenous variables of a dynamic system. The result of variance decomposition of LREER for a 10-quarter time horizon is provided by Table 10. For our model at the end of the 10-quarter forecast horizon, around 47.1 per cent of the forecast error variance of LREER is explained by its own innovations. LPROD, LOPEN, LFDI and LREMIT explain about 15.6 per cent, 16.3 per cent, 18.6 per cent and 2.4 per cent of the total variation after 10 quarters respectively. Thus, the relationship between FDI inflows and REER is more prominent.

Table 10 Variance decomposition of LREER

Period	S.E.	LREER	LPROD	LOPEN	LFDI	LREMIT
1	0.019724	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.029200	94.16272	2.451224	0.108290	2.385780	0.891985
3	0.039500	80.65024	5.620040	0.067278	10.41566	3.246784
4	0.047437	73.20051	5.848603	0.128624	17.40265	3.419614
5	0.051723	64.65911	8.060855	0.504080	23.75413	3.021821
6	0.055070	57.55738	11.19384	1.545263	27.03257	2.670954
7	0.058271	52.14442	15.44481	5.361348	24.44228	2.607139
8	0.061257	49.85574	17.09792	8.454296	22.18321	2.408835
9	0.064513	48.56191	16.71656	12.39886	20.04952	2.273146
10	0.067275	47.09330	15.60991	16.25314	18.64433	2.399319

As the forecast error variance decompositions only give us the proportion of the forecast error variance of LREER that is explained by its determinants. They do not indicate the direction (positive or negative) or the nature (temporary or permanent) of the variation. Thus, the impulse response analysis is used to analyze the dynamic relationship among variable. Impulse responses of LREER are shown in Figure 5. In this figure, the horizontal axis denotes the lag period of impulse (Unit: quarter) and the vertical axis denotes the response of impulse. The direction of change observed in the impulse response in each graph conforms to the sign obtained earlier in the co-integrating vector. Now, for LREER, through the analysis of Figure 5 we can get: LREER itself is almost unchanged in the short term (within three quarters); after that in the long term (up to nine quarters) it will decrease steadily and in between nine and ten quarters it will maintain moderate increase. The immediate and permanent effect on LREER of a one standard deviation shock to LPROD is positive. The impact of a one standard deviation shock to LOPEN on LREER is positive in the short term (within four quarters) and in the long term it is negative. A one standard deviation shock to LFDI has a long term positive impact on LREER, though it is slightly negative in some of the ending periods. Again the immediate and permanent effect of a one standard deviation shock to LREMIT is positive towards LREER.

CONCLUSION AND POLICY MEASURES

The paper empirically finds that the increasing capital inflows in terms of inward FDI and remittances appreciate the equilibrium real exchange rate in India during 1994-95Q_1 to 2009-10Q_4. The productivity rise in tradable goods sector, lesser trade-orientation of inward FDI and usage of remittances for non-tradable consumption

are significantly responsible for such appreciation. Further the study shows that the real exchange rate is mostly influenced by FDI inflows while remittance inflow has the minimum effect. Shocks to each of the determinants of real effective exchange rate have a long run impact on it.
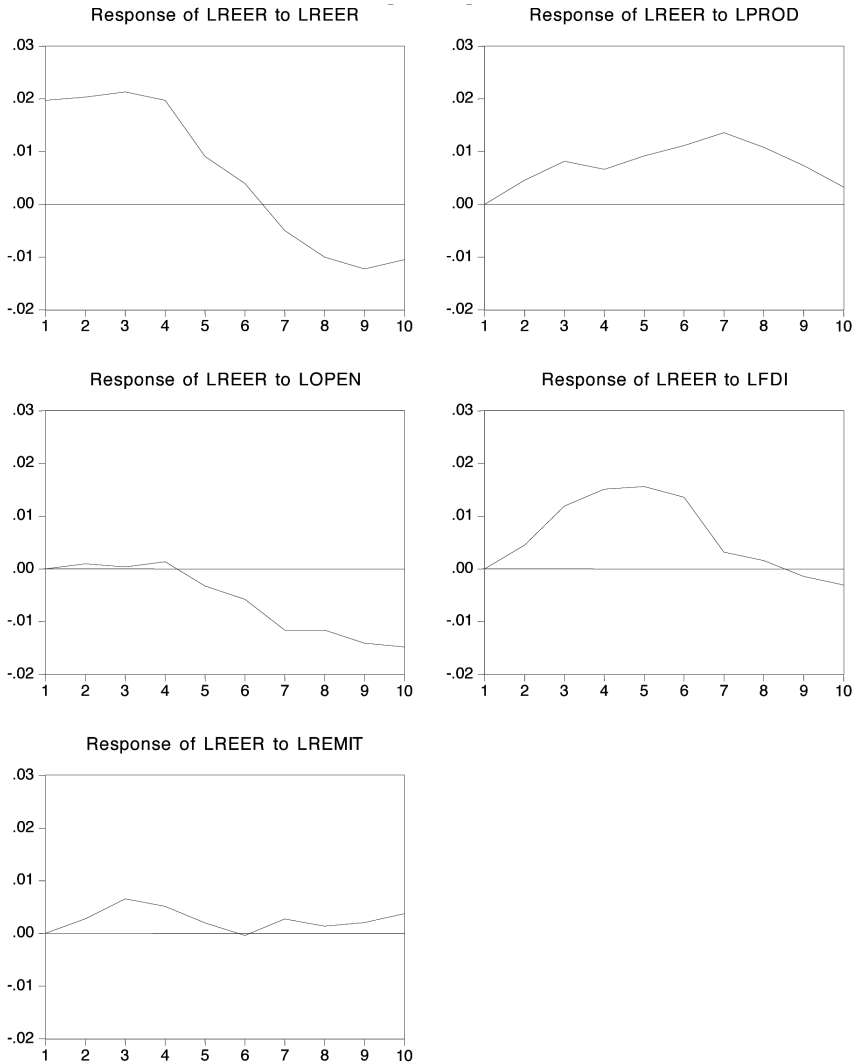
Response to Cholesky One S.D. Innovations

Figure 5 Generalized impulse response function of LREERb

340

As we know that the real exchange rate appreciation reduces the trade competitiveness of an open economy, so it is important to stabilize real exchange rate for internal and external balance of the economy. The study has tried to provide some policy measures to reduce the over-valuation of real exchange rate particularly caused by foreign capital inflows mostly in non-tradables as well as increasing productivity in tradables. Restriction on foreign capital inflows may not be a good one to curb real appreciation as the favourables effects of theses flows for the country like India are unquestionable. Rather it is required to channelize more and more foreign capital into tradable sectors and infrastructure development leading the country with a positive current account balance as well as a potential economic growth. In this regard the government could cut its spending in non-tradable and impose tax on them. The authority may also control import and subsidized exports by suitable tax policy. Further through subsidy and/or via FDI cheaper inputs can be used in domestic production process which leads to a fall in the relative price of both tradable and non-tradable goods.

REFERENCES

Acosta, P. Lartey, E. and Mandelman, F. (2007) Remittances and the Dutch Disease, FederalReserve Bank of Atlanta Working Paper.

Acosta, P. Calderón, C. Fajnzylber, P. and López, H. (2008) What is the Impact of International Migrant Remittances on Poverty and Inequality in Latin America?, *World Development*, **36(1)**, 89-114.

Adams, R. and Page, J. (2005) Do International Migration and Remittances Reduce Poverty in Developing Countries?, *World Development*, **33 (10)**,1645-1669.

Amuedo-Dorantes, C. and Pozo, S. (2004) Workers' Remittances and the Real Exchange Rate: A Paradox of Gifts, *World Development*, **32 (8)**, 1407-1417.

Asterious, D. and Hall, S. (2007) *Applied Econometrics: A Modern Approach*. Palgrave Macmillan: London.

Athukorala, P. C. and Rajapatirana, S. (2003) Capital Inflows and the Real Exchange Rate: A Comparative Study of Asia and Latin America, *The World Economy,* **26(4)**, 613-637.

Baffes, J., Elbadawi, I. A. and Connel, O'S. A. (1999) Single Equation estimation of the Equilibrium Real Exchange Rate, in *Exchange Rate Misalignment: Concepts and measurement for developing countries* (Eds.) P. J. Montiel, L. E. Hinkle, New York: Oxford University Press, pp.405-464.

Balassa, B. (1964) The Purchasing Power Parity Doctrine: A Reappraisal, *Journal of Political Economy*, **72(6)**, 584-596.

Benassy-Quere, A., Fontagne, L. and Lahreche-Revil, A. (2001) Exchange rate strategies in the competition for attracting foreign direct investment, *Journal of Japanese and International Economics,* **15(2)**, 178-198.

Blonigen, B.A. (1997) Firm-Specific Assets and the Link between Exchange Rates and Foreign Direct Investment, American Economic Review, **87(3)**, 447-465.

Corden, W. M. (1960) The Geometric Representation of Policies to Attain Internal and External Balance, Review of Economic Studies, **28(1)**, 1-22.

Corden, W. M. (1994) *Economic Policy, Exchange Rates and the International System*. Oxford: Oxford University Press.

Dornbusch, Rudiger. (1980) *Home Goods and Traded Goods: The Dependent Economy Model*, Chapter 6 in Open Economy Macroeconomics. Basic Books: New York, NY.

Edwards, S. (1994) Real and Monetary Determinants of Real Exchange Rate Behaviour: Theory and Evidence from Developing Countries, in *Estimating Equilibrium Exchange Rates* (Eds) J. Williamson, pp. 61-91, Washington D.C.: Institute for International Economics.

Edwards, S. (1989) *Real Exchange rates, Devaluation and Adjustment: Exchange rate? Policy in Developing countries*. MIT Press: Cambridge, Massachusetts.

Elbadawi, Ibrahim. A., and Soto, R. (1997) Real Exchange Rates and Macroeconomic Adjustment in Sub-Saharan African and other Developing Countries, *Journal of African Economics*, **6(3)**, 74-120.

Enders, W. (2004) *Applied Econometric Time Series,* 2nd Edition. John Wiley & Sons: New Jersey.

Government of India. Ministry of Commerce and Industry, Department of Industrial Policy & Promotion (2005). *Fact Sheet on Foreign Direct Investment, September 2005.* New Delhi (http://dipp.gov.in/fdi_statistics/india_fdi_sept_2005.pdf) accessed on17[th] June, 2008.

Government of India. Ministry of Commerce and Industry, Department of Industrial Policy & Promotion (2007). *Fact Sheet on Foreign Direct Investment, March 2007.* New Delhi (http://dipp.gov.in/fdi_statistics/india_fdi_mar_2007.pdf) accessed on 17th June, 2008.

Government of India. Ministry of Commerce and Industry, Department of Industrial Policy & Promotion (2008). *Fact Sheet on Foreign Direct Investment, March 2008.* New Delhi (http://dipp.gov.in/fdi_statistics/india_fdi_mar_2008.pdf) accessed on 21st August, 2009.

Government of India. Ministry of Commerce and Industry, Department of Industrial Policy & Promotion (2010). *Fact Sheet on Foreign Direct Investment, March 2010.* New Delhi (http://dipp.gov.in/fdi_statistics/india_fdi_mar_2010.pdf) accessed on 21st August, 2010.

Government of India. Ministry of Commerce and Industry, Department of Industrial Policy & Promotion (2011). *Fact Sheet on Foreign Direct Investment, January 2011.* New Delhi (http://dipp.gov.in/fdi_statistics/india_fdi_jan_20011.pdf) accessed on 31st March, 2011.

Hasnat, B. (1999) Exchange Rate Misalignment and Foreign Direct Investment, *Atlantic Economic Journal,* **27(3),** 235.

Hussain, Shah. (2008) Sources of Real Exchange Rate Misalignment Evidence from Pakistan, State Bank of Pakisthan Working Papers Series, Working Paper No. 26.

Johansen, S. (1988) Statistical analysis of cointegration vectors, *Journal of Economic Dynamics and Control*, **12(2-3)**, 231-254.

Johansen, S. and Juselius, K. (1990) Maximum Likelihood Estimation and Inference on cointegration with Application to the Demand for money, *Oxford Bulletin of Economics and Statistics*, **52(2)**, 169-210.

López, H., Molina, L., and Bussolo, M. (2007) Remittances and the Real Exchange Rate, World Bank Policy Research Working Paper No. 4213.

Montiel, P. J. (1999) Determinants of the Long-Run Equilibrium Real Exchange Rate: An Analytical Model, in *Exchange Rate Misalignment, Concepts and Measurements for Developing Countries* (Eds) L. Hinkle, P. A. Montel, A World Bank Research Publication, Oxford University Press, pp. 219-263.

Olofsgard, A. and Olausson, M. (1993) *Development Assistance and Dutch Disease Evidence from Kenya*. Stockholm: Stockholm University.

Razin, O. and Collins, S. M. (1997) Real Exchange Rate Misalignments and Growth, in *The Economics of Globalization: Policy Perspectives from Public Economics* (Eds) A. Razin, E. Sadka, Cambridge University Press: Cambridge, pp. 59-81.

Rehman, H., Jaffri, A., and Ahmed, I. (2010) Impact of Foreign Direct Investment (FDI) Inflows on Equilibrium Real Exchange Rate of Pakistan, *South Asian studies*, **25(1),** 125-141.

Reserve Bank of India (2006). *RBI Bulletin*, November 2006, India.

Reserve Bank of India (2007-08). *Handbook of Statistics on the Indian Economy*, India.

Reserve Bank of India (2008-09). *Handbook of Statistics on the Indian Economy*, India.

Reserve Bank of India (2009-10). *Handbook of Statistics on the Indian Economy*, India.

Rodriguez, C. A. (1989) Macroeconomic policies for structural adjustment, World Bank Working Paper Series No. 247.

Rodrik, D. (2007). *The Real Exchange Rate and Economic Growth: Theory and Evidence*, Mimeo, Harvard University.

Salter, W.E.G. (1959) Internal and External Balance: The Role of Price and Expenditure Effects, *Economic Record*, **35(71)**, 226-238.

Samuelson, P. (1964) Theoretical Notes on Trade Problems, *Review of Economics and Statistics*, **23**, 1-60.

Swan, Trevor. (1961) Economic Control in a Dependent Economy, *Economic Record*, **36(73)**, 51-66.

UNCTAD (2010). *World Investment Prospects Survey 2010-12*. New York & Geneva: United Nations.

White, H. and Wignaraja, G. (1992) Exchange rates, Trade Liberalisation and Aid: The Sri Lankan Experience, *World Development*, **20(10)**, 1471-1480.

Williamson, J. (1994) *Estimating Equilibrium Exchange Rates*. Washington, D.C: Institute for International Economics.

World Bank (2008) *Migration and Remittances Factbook 2008*, Washington, D.C., World Bank.

Younger, S. D. (1992) Aid and the Dutch Disease: Macroeconomic Management When Everybody Loves You, *World Development*, **20(11)**, 1587-1597.

APPENDIX

Table A.1 Summary statistics, total sample

Variable	No. of observations	Mean	Median	Maximum	Minimum	Standard deviation	Skewness	Kurtosis	Jarque-Bera	Probability
LREER	64	4.593	4.6	4.66	4.5	0.041	-0.537	2.726	3.28	0.193981
LPROD	64	5.199	5.145	5.89	4.61	0.314	0.251	2.18	2.466	0.291434
LOPEN	64	10.796	10.48	12.14	9.69	0.735	0.480	1.792	6.355	0.041695
LFDI	64	7.348	7.1	9.61	5.17	1.088	0.524	2.32	4.161	0.124843
LREMIT	64	8.405	8.3	9.53	7.39	0.592	0.415	2.08	4.097	0.128914

Table A.2 Lag Length Criteria Results

Lag	LogL	LR	FPE	AIC	SC	HQ
0	128.4626	NA	1.05e-08	-4.185174	-4.009112	-4.116447
1	341.6847	383.0769	1.78e-11	-10.56558	-9.509208*	-10.15322*
2	359.8279	29.52106	2.29e-11	-10.33315	-8.396460	-9.577143
3	392.4574	47.56169	1.85e-11	-10.59178	-7.774776	-9.492133
4	421.1902	37.01181	1.79e-11	-10.71831	-7.021001	-9.275032
5	477.5785	63.07834*	7.27e-12*	-11.78232*	-7.204696	-9.995401

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion