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Equilibrium Real Effective Exchange Rate and Exchange Rate Misalignment in Pakistan

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This paper estimates equilibrium real effective exchange rate (EREER) and exchange rate misalignment for Pakistan. Using the annual data from FY78 to FY05, Engle Granger co-integration technique is used to estimate the EREER based on various macroeconomic fundamentals suggested in economic literature by Edwards (1988, 1989, 1994), Elbadawi (1994), and Montiel (1997). The results indicate that EREER is determined by terms of trade, trade openness, net capital inflows, relative productivity differential, government consumption, and workers' remittances. Trade openness, the increase in government consumption and capital inflows depreciate the REER, while, the increase in workers' remittances and the improvement in terms of trade and total factor productivity relative to trading partners appreciate REER. The coefficients of the error correction term indicate the gradual convergence of the exchange rate toward long-run equilibrium. The estimated long run EREER and degree of exchange rate misalignment reveal that exchange rate misalignment ranged between -11.1 percent to 20.1 percent with zero reversion mean from FY78 to FY05 reflecting the long-term convergence tendency of actual REER toward EREER in Pakistan. Furthermore, the actual REER of FY05 is slightly depreciated in the range of 1.8-2.4 percent on the basis of two estimated regressions while one equation reflects an appreciation of 2.0 percent relative to EREER. This suggests that the current exchange rate is not too far away from the EREER and more or less reflects the underlying macroeconomic fundamentals. The result also reflects that the exchange rate misalignment and its volatility in REER measured by standard deviation tend to be smaller in the flexible exchange rate regime as compared to others.

1. Introduction

Real effective exchange rate (REER) is a key macroeconomic relative price, which plays an important role in the broad allocation of resources in production

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and spending behavior in the economy. REER, as a measure of competitiveness, also determines and influences the performance of the export sector [Caballero and Corbo (1989)]. It is because of these allocative and competitive roles of REER that developing and emerging economies are encouraged by IMF to keep the actual REER close to the equilibrium real exchange rate (EREER henceforth), which is defined as the value of the REER consistent with a simultaneous attainment of internal and external equilibrium.[1]

The sustained departure of actual REER from its EREER is called exchange rate misalignment. In case of misaligned exchange rate, REER fails to perform the allocative role and does not provide the appropriate signals to guide the allocation of resources [Montiel (2003) and Edwards (1988)]. This would have detrimental consequences for economic growth as it impairs the efficiency of capital and discourages capital accumulation [Corbo and Rojas (1995) Servin and Solimano (1991)]. Real exchange rate overvaluation can also undermine export competitiveness and weaken the external position, while an undervalued exchange rate may create inflationary pressures. In addition, the maintenance of real exchange rate close to the equilibrium level also prevents countries from currency and banking crises and its huge cost to real economy emanating from balance sheet effect. There is a consensus in economic literature that the substantial misalignment of real exchange rate was one of the major factors behind the Asian crises of 1998.

Exchange rate misalignment can arise in fixed exchange rate regime, flexible exchange rate regime or any hybrid of these two regimes. Market determined exchange rates may deviate substantially from their "equilibrium values" implied by fundamentals in the short term due to: (i) foreign exchange market failure arising from herding and feedback trading which is based on price movements rather than fundamentals and in turn leads to unwarranted changes in exchange rate; (ii) the transitory shocks may lead to a high degree of volatility in exchange rate due to shallow and thin foreign exchange markets in developing countries like Pakistan. Although there is no mandatory obligation for the central bank to intervene in foreign exchange market under flexible exchange rate regime, however, the large divergence of REER from its equilibrium can prompt the central bank to intervene in the foreign exchange market due to the aforementioned cost associated with exchange rate misalignment.

[1] Internal equilibrium refers to a situation that clears the non-tradable goods market. External equilibrium, on the other hand, is attained when the current account is sustainable. Simultaneous attainment of internal and external equilibrium refers to the situation in which present and future current account balances are compatible with sustainable capital flows.

Similarly, under fixed exchange rate regime if real shocks occur and exchange rate parity is not adjusted accordingly, it can appreciate the exchange rate and thus increase the likelihood of a currency crisis as substantially overvalued exchange rates may lead to the expectation that a large adjustment may occur. Therefore, this raises various policy related questions: what is the equilibrium level of real exchange rate, how much is the degree of exchange rate misalignment, which factors are causing misalignment between the actual and equilibrium exchange rate and when is it appropriate for the central bank to act for corrective measures?

Exchange rate misalignments, however, are difficult to detect as there is no consensus on the methodology to estimate the equilibrium exchange rate [Hinkel and Montiel (1999)]. Frequently used indicators include nominal and real effective exchange rates, productivity and other competitiveness measures, terms of trade, current external account and balance of payments outlook, interest rate differentials, and parallel market exchange rates. A problem is that these indicators may not always allow policy-makers to identify the degree of misalignment precisely enough to pinpoint the appropriate timing and amount of intervention. Edwards' (1989, 2000) seminal work was the first substantial endeavor to build an equilibrium exchange rate specifically for developing countries based on reduced-form single equation approach. He finds that only real (fundamental) variables influence the equilibrium real exchange rate in the long run but in the short run changes in monetary shocks can be important determinants. Elbadawi (1994), Montiel (1997, 1999) and Baffes (1999) use co-integration techniques to estimate the equilibrium exchange rate. Montiel (1997) suggests that co-integration is a superior method of estimating the real exchange rate over the PPP methodology.

There have been a few attempts from various economists to estimate EREER for Pakistan. However, none of the studies have tried to quantify the degree of misalignment for Pakistan over the course of time [Chishiti and Hasan (1993), Afridi (1995), and Siddiqui, Afridi and Mahmood (1996)]. In addition, these studies also suffer from various weaknesses such as (i) no study has satisfied or checked the stationary properties of data; (ii) these studies do not provide any evidence about exchange rate misalignment. Therefore, the objectives of this paper are: (i) to estimate the equation of equilibrium real effective exchange rate; (ii) to measures the degree of exchange rate misalignment; and (iii) to provide guidance to policy-makers in implementing exchange rate policy.

The rest of the paper is organized as follows. The next section presents the evolution of exchange rate policies in Pakistan. It also traces out the underlying factors responsible for the actual REER fluctuations. Section 3 presents a brief overview of the main existing approaches to equilibrium real exchange rate and

also describes the existing literature on Pakistan. Section 4 describes the empirical framework that includes the analytical model, discusses preliminary statistical properties of data and presents empirical results. Section 5 explains exchange rate misalignment derived from the empirical models, which are subsequently used to identify various episodes of exchange rate undervaluation and overvaluation for Pakistan. Section 6 goes one step beyond and examines the degree of exchange rate misalignment under the different exchange rate regimes adopted by Pakistan and section 7 concludes.

2. Exchange Rate Policies in Pakistan

Pakistan's exchange rate policy evolves through fixed exchange rate (FY73-FY81) to managed float (FY82-FY99), managed float to multiple exchange rates for a brief period following the nuclear test in May 1998, multiple exchange rate to dirty float in FY99 and then to fully flexible exchange rate (since July 2000).

The separation of East Pakistan in December 1972 brought a structural shift in Pakistan's trade structure due to the loss of exports and inter-wings trade. Thus to deal with these problems, multiple exchange rates were introduced on May 11, 1972. In February 1973, the US Dollar was devalued by 10 percent which led to subsequent revaluation of Pakistani Rupee by 10 percent to Rs 9.90 per dollar and it remained fixed at this level until the decision to adopt managed float in 1982. During the fixed exchange rate regime from FY73–82, actual REER moved in tandem with the price differential and the movement of US dollar vis-à-vis major

Figure 1: Nominal Exchange Rate and Devaluation / Appreciation since FY74

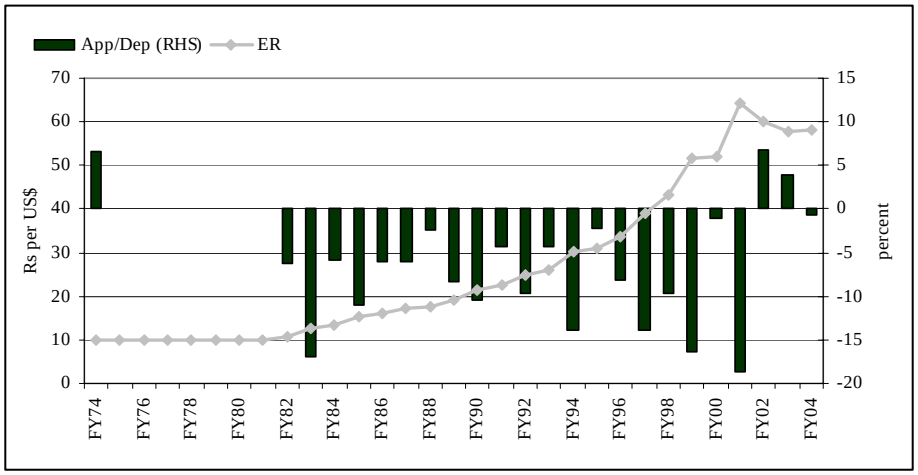
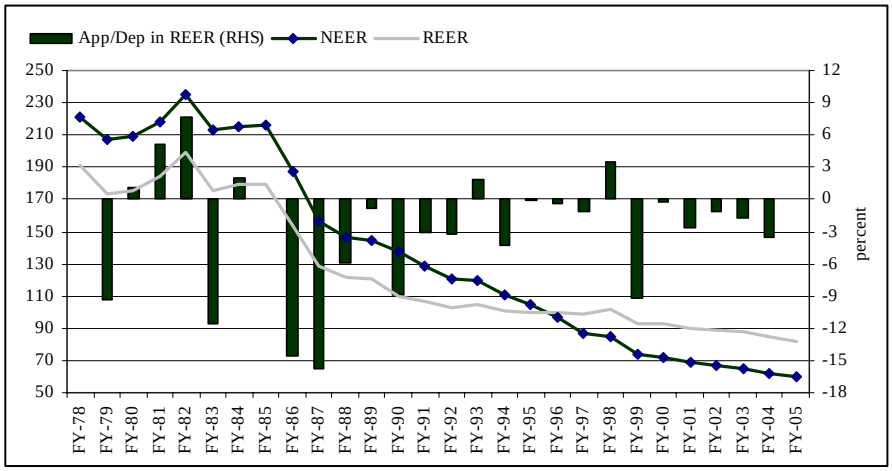


Figure 2: Trend in Nominal and Real Effective Exchange Rates



currencies. The Rupee regained competitiveness in real terms during 1976–79 because of the continued lower inflation differential and US Dollar depreciation vis-à-vis major currencies. During the early 1980s, REER[2] appreciated substantially due to the appreciation of US Dollar against major currencies and higher domestic inflation as compared to trading partners. Keeping in view this sharp appreciation, Pakistan adopted the managed floating exchange rate system on January 8, 1982. The period thereafter characterized with more frequent and small adjustments in rupee against US dollar, keeping in view the relative changes in exchange rates and prices of country's major trading partners/competitors as well as various macroeconomic indicators of Pakistan.

With the transformation of the economy from a semi-closed to a more open or market-oriented economy in the beginning of the 1990s, exchange rate saw much larger devaluation in nominal terms, which was just offset by higher level of inflation in Pakistan as compared to the trading partners. The imposition of economic sanctions following the nuclear tests in May 1998 created a crisis-like situation and SBP introduced a number of measures including the implementation

[2] The REER for Rupee is calculated as a *geometric* weighted average of the level of consumer prices in Pakistan relative to its trade partners/competitors. The currencies included in the basket and the weights assigned to them, are mainly determined by practical considerations, primarily to ensure that these currencies account for a high portion of Pakistan's total trade, where the assigned weights are true representative of their competitive position [Ali, Sajid (2000)].

of a two-tier exchange rate system[3] among others, from July 1998, to steer the economy from the crisis. In FY99, SBP moved from multiple exchange rates to dirty float by defending the exchange rate within narrow band up to May 2000 by channeling the foreign exchange from kerb market to interbank market through kerb purchases. In July 2000, SBP moved away from managed exchange rate to floating exchange rate regime. Initially, the rupee dollar parity witnessed a sharp nominal depreciation of 18.5 percent during FY01, which shows the market correction of the cumulative overvaluation place during FY99 and FY00. In the new exchange rate regime, monetary instruments act as a nominal anchor to curb the anticipated high volatility of the exchange rate. This coupled with the build up of forex reserves led to the stability in nominal exchange rate after the sharp depreciation in FY01. The substantial surge in workers' remittances in the interbank market following the international crackdown on informal channels after the September 11 incidence reversed the downward trend in exchange rate. The excess liquidity in the foreign exchange market, following the surge in workers' remittance into formal banking channel, induced the SBP to purchase US$ 8.2 billion from October 2001–March 2004 to preserve exports' competitiveness from abrupt exchange rate appreciation. The increased demand of foreign exchange from importers dried down the excess liquidity in the interbank market, which not only prompted SBP to scale down its purchases from interbank market; and SBP also had to start providing market support by financing the lumpy oil payments. Interestingly, rupee, in real terms, continued to maintain the compositeness due to the fact that the basket of currencies appreciated against dollar more than the rupee and the relatively higher inflation compared to trading partners.

3. Literature Review

There is voluminous theoretical and empirical literature on the equilibrium exchange rate, which can be broadly demarcated into two strands.

The first strand of literature encompasses models for developed economies. Most of the empirical literature in this group focuses on identifying equilibrium exchange rates for G7 economies that are generally based on methodologies that include: (1) Purchasing Power Parity Approach (PPP) by Ahlers and Hinkle (1998); (2) Trade Equation Approach (TEA) by Devarajan (1998); and (3) Structural Model Approach (SMA) by Devarajan (1998) and Haque and Montiel (1998a). The literature surveyed in MacDonald (1995) and Rogoff (1996) indicates that PPP is not an appropriate model for the determination of equilibrium

[3] The new mechanism was based on: a) official exchange rate, b) floating inter-bank exchange rate, and c) composite rate.

exchange rates because of its slow mean reversion to a constant level implied by the PPP assumption. This criticism on PPP based model resulted in a shift to second strand of literature pertaining to a reduced-form model.

The second strand of literature discussed the reduced-form single equation approach that is extensively used for estimating EREER for developing countries. Edwards' (1989, 1994, 2000) seminal work was the first substantial endeavor to build an equilibrium exchange rate specifically for developing countries. He finds that only real (fundamental) variables influence the EREER in the long run. However, in the short run changes in monetary shocks can be important determinants. Montiel (1997, 1999) and Baffes and others (1999) use co-integration techniques to estimate the equilibrium exchange rate. Montiel (1997) suggests that the co-integration technique is a superior method of estimating the real exchange rate over the PPP methodology.

Razin and Collins (1997) develop their estimation using a reduced form of the real exchange rate equation derived from a Mundell-Fleming model. Williamson (1999) advocated that the usage of reduced-form single equation for developing countries, as large models using the multi-dimensional approach, may not be appropriate for developing countries due to their small economies.

Literature related to Pakistan

There are few attempts aimed at estimating the equilibrium exchange rate for Pakistan such as Chishiti and Hasan (1993), Afridi (1995), and Siddiqui, Afridi and Mahmood (1996). Chishiti and Hasan (1993) examined the relevance of PPP in Pakistan through the Engle and Granger co-integration test on quarterly data from 1957.1–1992.2. Then they used the VAR approach to investigate the monetary and real channels for the determination of real exchange rate. Their results show that simple PPP model is not appropriate for Pakistan while VAR analysis shows that monetary expansion (proxied by domestic credit creation) and deficit financing led to a medium term disturbance in the equilibrium level of real exchange rate coupled with the impact of real variables i.e., terms of trade, tariff revenue, nominal devaluation, technical progress and capital inflows in the long-term. Afridi (1995) re-examined the determinants of the real exchange rate using annual data during 1960–1990. The results suggested that excess demand of domestic credit and capital flows are inversely related to the real effective exchange rate while the impact of terms of trade is insignificant. Siddiqui, Afridi and Mahmood (1996) explored the determinants of the real exchange rate by estimating the behavioral relationship between monetary and real variables and REER by using simultaneous equation model. The estimated coefficients reveal

that changes in both monetary and real variables affect the equilibrium path of real exchange rate. These studies have neither checked the time series properties of the data nor computed the misalignment of real exchange rate over the course of time which motivated us to revisit these issues by providing some estimates of exchange rate misalignment.

4. Empirical Framework

4.1 Methodology

This paper estimates the degree of real exchange rate misalignment based on the theoretical model of equilibrium real exchange rate determination developed by Edwards (1988, 1989, 1994), Elbadawi (1994), and Montiel (1997). The reduced form REER equation utilized in this study is presented as follows:

$$\underset{\substack{(-) \quad (+/-) \quad (+/-) \quad (-) \quad (+) \quad (-) \quad (+)}}{\textbf{lreer} = f\,(\textbf{ ltrop, ltot, lgovc, lrigdp, lremg, capinf, tfpd/t})}$$

The variables included in the analysis are: real effective exchange rate index (reer), trade openness (trop), terms of trade (tot), real investment to GDP ratio (rigdp), government consumption as percent of GDP (govc), workers' remittances as percent of GDP (remg), long-term capital to gross domestic product (capinf), and total factor productivity differentials (tfpd) or time trend (t) representing Harrod-Balassa Samuelson effect. All variables except capinf and tfpd are expressed in natural log.

Theoretical models and empirical studies such as Elbadwai (1994), Edwards (1989), Montiel (1997), and Baffes and others (1999) have proposed and ascertained the following signs for each fundamental variable in determining the behavior of REER:

- An increase in trade openness depreciates REER because trade liberalization and trade opening makes future consumption of importable very cheap; this in turn makes consumers to substitute from non-tradable to tradable goods.
- The impact of terms of trade on REER is theoretically ambiguous and can take either sign depending on the substitution and income effect. More specifically, the worsening of trade terms has a positive substitution effect on REER due to increase in import prices. On the other hand, the terms of trade worsening will also have a negative income effect on REER, which in turn may lead to downward pressures on the prices of all goods. If the substitution effect

dominates income effect, then the impact of terms of trade deterioration will be negative, otherwise it will be positive.

- Similarly, the impact of government consumption on REER depends not only on government inter-temporal budget constraints but also on the composition of government consumption. If government consumption contains a larger share of tradable goods then the increase in government consumption will worsen the current account thus leading to depreciation of REER.
- The sign of rigdp would be negative as the rise in rigdp means higher spending on tradable (imported machinery and raw materials). However, as described by Edwards (1994), when investment is included in the theoretical model, the inter-temporal analysis includes supply-side effects that depend on the relative ordering of factor intensities across sectors. Therefore, the sign on the exchange rate in response to increased investment is ambiguous.
- Workers' remittances receipts provide bulk of trade and services account deficits in Pakistan. The sign of workers' remittance to GDP ratio on real exchange rate is positive which reflects that the rise in workers' remittance to GDP ratio, remg, lead to appreciation of real exchange rate as shown by [Haque and Montiel (1998b)].
- As far as the impact of net *capital inflows* on REER is concerned, it depends on the magnitude of capital flows. The capital inflows over and above the current account deficit will appreciate REER while the capital inflows matching or lower than the current account will depreciate REER. Baffes and others (1999) also justified the negative sign of capital inflows on the basis of its associated increases in domestic absorption particularly in non-tradable. Montiel (1997) also argues that when net capital inflows exceed debt-services obligations, then the real exchange rate may appreciate as in the case of large foreign direct investment flows.
- The inclusion of the TFPD or time trend (t) in REER equation represents well-known Balassa-Samuelson effect, which contends that productivity improvements will be, generally, concentrated in the tradable sector and thus lead to an appreciation.[4]

We used the Engle-Granger two-step co-integration approach to estimate a single equation REER model for Pakistan. The following steps are involved in the implementation of this technique: (i) In the first step, OLS technique is used to estimate the different versions of the above relationship using non-stationary

[4] Balassa-Samuelson effect can come from two sources; (i) productivity differential between the domestic tradable and non-tradable sectors; and (ii) productivity growth differentials relative to trading partners. Montiel (1997) advocated the use of time trend (t) to capture the impact of productivity growth.

variables; (ii) In the second step, the residuals obtained from the OLS regression are tested for stationarity. If the residuals of the OLS equation are stationary then it shows that there is a long-run co-integrating relationship between REER and economic fundamentals. In this case, the error correction model (ECM) is used to study the short-run dynamics of REER.

The coefficients from the estimated models and sustainable values of the economic fundamentals are then used to compute the EREER, while the misalignment of exchange rate are computed by taking the percentage deviations of actual REER from EREER.

4.2 Data and Preliminarily Statistical Properties

We have used the annual data from FY78 to FY05 in this study. We have utilized the SBP trade-weighted REER index while the rest of the data is constructed and collected from various secondary data sources such as *SBP's Statistical Bulletin, Economic Survey*, and *Economic Report of the President* on the US economy for the year 2005. Trade openness, trop, is constructed by scaling the summation of exports and imports by GDP and TFPD is the productivity differential between Pakistan and US (approximation of Pakistan's trading partners) while other variables are self explanatory.

First of all, we have checked the time series properties by testing the stationarity of the fundamental variables. A unit root test was undertaken using the augmented Dickey-Fuller (ADF) criterion. The results presented in Table 1 suggest that all the variables are integrated of order one, i.e. *I(1)*, which fulfills the criteria for estimating any long run relations.

Table 1. Unit Root Test

	Level#		**First Difference#**		
	Constant & No Trend	Constant & Trend	Constant & No Trend	Constant & Trend	Level of Integration
lreer	-0.537	-1.585	-4.40***	-4.305***	I(1)
ltrop	-0.531(2)	-0.531(2)	-5.508(1)***	-5.398(1)***	I(1)
ltot	-1.683(2)	-1.683(2)	-5.137***	-4.999***	I(1)
lrigdp	-2.253(2)	-2.778(2)	-4.601(2)***	-4.571(2)***	I(1)
lgovc	-2.120(2)	-2.120(2)	-6.098***	-6.117***	I(1)
lremg	-1.537(1)	-2.041(1)	-3.617**	-3.613**	I(1)
Capinf	-2.234	-2.234	-8.456***	-8.706***	I(1)
tfpd	0.205(3)	0.205(3)	-2.872(1)*	-5.51(1)***	I(1)

4.3 Empirical Results

We begin our analysis by estimating three equations by Ordinary Least Square (OLS). The results are reported in Table 2. The results are quite encouraging as coefficients and signs in all regressions except rigdp in Reg. I and Reg. II coincide with the earlier theoretical and empirical studies. In Reg. I, five macroeconomic fundamentals [trade openness (trop), current government consumption to GDP ratio (govc), net capital inflows as percent of GDP, real investment to real GDP ratio (rigdp), and total factor productivity differential (tfpd)] determine the REER.[5] Trop, and the increase in govc and capinf[6] caused depreciation in REER while increase in rigdp lead to appreciation of REER. The improvement in tfpd leads to REER appreciation. The coefficient of tfpd is small in all three regressions, which is in line with the recent empirical work.

Table 2. Determinants of Real Effective Exchange Rate

	Reg. I	Reg. II	Reg. III
Constant	9.977***	6.348***	7.713***
	(0.971)	(1.720)	(0.885)
Ltrop	-0.999***	-0.542**	-0.609***
	(0.206)	(0.232)	(0.132)
Ltot		0.377**	0.336**
		(0.151)	(0.096)
Lgovc	-1.112***	-0.903***	-0.927***
	(0.148)	(0.139)	(0.122)
Capinf	-0.027**	-0.021**	-0.023**
	(0.013)	(0.009)	(0.007)
Lrigdp	0.479**	0.315	
	(0.226)	(0.232)	
Lremg		0.143***	0.156***
		(0.035)	(0.026)
Tfpd	0.012**	0.010***	0.011***
	(0.004)	(0.003)	(0.002)
DW-stat	1.636	1.517	1.599
Adjusted R-Sq.	0.901	0.945	0.943
S.E. of regression	0.092	0.069	0.070
Residuals Unit Root Test	3.955[1]***	3.779***	4.057[1]***

Where figures in parenthesis are standard errors. Figures in squared brackets reflect optimal level of lags in ADF test.
***, **, and * reflect the significance at 1 %, 5 % and 10 % respectively.

[5] Terms of trade variable turn out to be insignificant and Wald Test also supports the exclusion of tot from the regression.
[6] The rise in capinf which hardly finance the current account deficit depreciates the REER while the capital inflows over and above the current account deficit appreciate the REER [(Monteil (1997) and Baffes and others (1999)].

Table 3. Diagnostic Tests

	Reg. I	Reg. II	Reg. III
Correlogram of residuals			
Q-stat (2)	2.07	2.22	2.96
Probability	0.36	0.33	0.23
Q-stat (5)	4.57	5.69	5.61
Probability	0.47	0.34	0.35
Correlogram of residual squared			
Q-stat (2)	1.01	0.87	1.28
Probability	0.60	0.65	0.53
Normality Test			
Jarque-Bera	1.33	0.71	0.58
Probability	0.52	0.70	0.75
Breusch-Godfrey Serial Correlation LM Test			
F-stat	1.12	1.06	1.37
Probability	0.35	0.37	0.28
ARCH Test			
F-stat	0.37	0.17	0.05
Probability	0.55	0.68	0.82
White Heteroskedasticity Test			
F-stat	0.32	0.54	0.58
Probability	0.96	0.86	0.82

In Pakistan's case, workers' remittance is an important source of foreign exchange earnings and finances a large portion of trade and services deficits in the current account balance. Motivated by this fact and following Haque and Montiel (1998), we have included remittances as percent of GDP (remg) in the determination of REER as shown by Reg. II and Reg. III. Workers' remittance turns out to be significant and has a positive sign, which reflects that the increase in the remittances inflows appreciates the real exchange rate. Furthermore, the inclusion of the relevant variable, remg, positively affects the overall performance of the regression and causes tot (an important macroeconomic fundamental) to significantly explain the real exchange rate. The positive sign of tot shows that the improvement of tot appreciates real exchange. However, rigap becomes insignificant with the inclusion of remg and Wald Test supports the exclusion of rigdp from Reg. II. Therefore, we have dropped rigdp from Reg. II and re-estimated the model in Reg. III.[7]

[7] We have also tried to use time trend, t, as suggested by Montiel (1997), as an alternative to tfpd for Balassa-Sameuleson effect. However, tot and trop become insignificant with the inclusion of t in the regression accompanied by serial correlation in the model. Although the inclusion of ldsr (ratio of debt servicing to exports) corrected the serial correlation problem, the sign of ldsr was positive which is theoretically incorrect as to why regression was dropped.

The residuals generated from these regressions are tested for unit root to establish long-run co-integrating relationship. These residuals are stationary, as reflected by the results of unit root test reported in the bottom panel of Table 2, confirming that the above regression is showing a long-run co-integrating relationship between REER and economic fundamentals.

As exhibited in Table 2, the long-run relationship between REER and the key economic fundamentals reported in Reg. III can be summarized as follows:

- An increase in trade openness of one percentage point of GDP is associated with a depreciation of REER by 0.6 percent.
- One percent improvement in terms of trade leads to 0.34 percent appreciation of REER.
- An increase in government expenditure of one percentage point of GDP is associated with a depreciation of REER by 0.93 percent.
- An increase in net capital inflows of one percentage point of GDP is associated with a depreciation of REER by 0.02 percent.
- An increase in workers' remittances of one percentage point of GDP is associated with an appreciation of REER by 0.16 percent.
- One unit reduction in total factor productivity differential relative to trading partners (i.e. US) leads to 0.01 percent appreciation in REER.

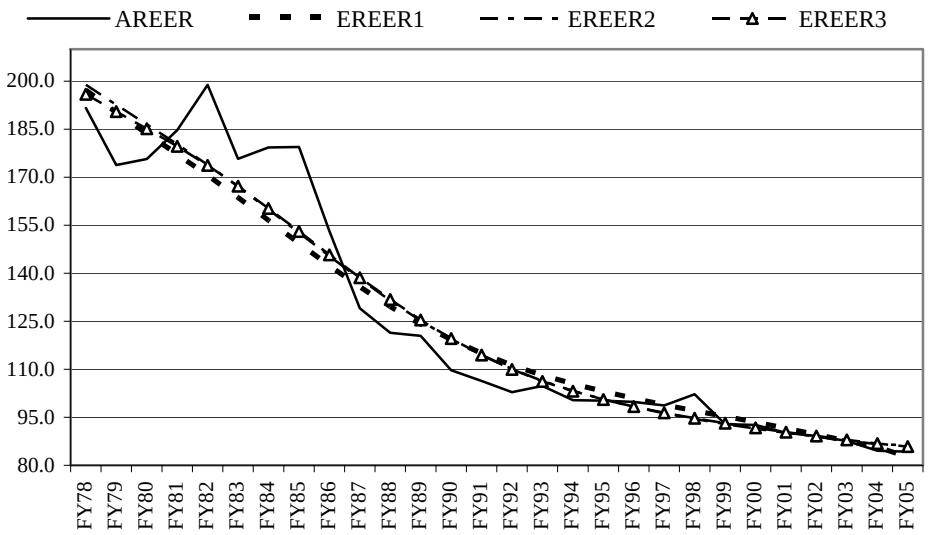
The estimated regressions also satisfied post diagnostic tests such as no autocorrelation, homoskedasticy, normality of the residuals and parameters stability. The results of various diagnostic tests are reported in Table 3. Specifically, the Ljung-Box Q-stat for residuals and squared residuals up to 5 lags are not significant at the 5 percent significance level in all three regressions. Moreover, LM test (with 2 lags), ARCH test and White test are not significant in all regressions, which reflect that there is no serial correlation, ARCH effect or heteroskedasticity. In addition, Jarque-Bera stats is also not significant in all regressions, which shows that residuals are normal. Various stability tests suggest that coefficients are stable. Specifically, Chow breakpoint and forecast tests are insignificant in all regression; the CUSUM test statistics stay within the 5 percent significance lines throughout the sample period; and the squared CUSUM test stat stay within the 5 percent significance lines which indicate that coefficients are stable (Appendix: Figure A1).

The above long-term relationships can be used to compute the EREERs by evaluating these coefficients at sustainable values of macroeconomic fundamentals. The rationale of using sustainable economic fundamentals is to eliminate short run fluctuations in explanatory variables and only use long-term

equilibrium values of the variables. Hodrick-Prescott filter is used to remove the short-term variations from the explanatory variables.

Figure 3 presents the actual REER and EREERs derived by evaluating the coefficient at HP filter series of economic fundamentals. As exhibited by Figure 3, three estimated EREERs reflect prolonged divergence in both directions from actual REER in the first part of the sample while these estimates track the behavior of actual REER closely in the latter part of the sample. Specifically, the rupee was undervalued from FY78 to FY80 relative to EREER due to lower price differential and depreciation of US dollar vis-à-vis others major currencies. During FY81-86, the behavior of actual REER and EREERs suggest that rupee were overvalued mainly due to the appreciation of US dollar vis-à-vis others major currencies. Following the adoption of managed exchange rate regime in 1982, SBP to some extent was succeeded in offsetting the effect of US appreciation with periodic adjustments in nominal exchange rate as shown by Figure 3. This figure also reflects that the actual REER appears to have been close to its estimated equilibrium REER during the last five years.

Figure 3. Actual Vs Equilibrium Real Effective Exchange Rates (1992=100)



Short-term dynamics of REER

Short-term Dynamics of REER are examined through the estimation of error correction models (ECMs). The results of ECMs are reported in Table 4, which shows that some of the long-term fundamentals such as trop, capinf, and govc are statistically significant and affect the short-run dynamics of the real exchange rate in the same direction as these variable did in case of long run. The estimated regressions also satisfied post-diagnostic tests such as of no autocorrelation, homoskedasticy, normality of the residuals and parameters stability (appendix Table A2 and Figure A2).

Table 4. Short-run Dynamics of Real Effective Exchange Rate

	Reg. I	**Reg. II**	**Reg. III**
Dependent Variable is dlreer			
Constant	0.022	0.122**	0.117**
	(0.036)	(0.050)	(0.055)
dltrop	-0.542***	-0.452**	-0.424**
	(0.160)	(0.179)	(0.198)
dcapinf		-0.008	-0.007
		(0.005)	(0.005)
dlgovc	-0.267*	0.337**	
	(0.146)	(0.163)	
dltot		0.148	0.159
		(0.119)	(0.132)
dlremg(-1)		-0.090*	-0.086*
		(0.046)	(0.051)
fisdef	-0.003	-0.018**	-0.017*
	(0.006)	(0.007)	(0.008)
ndev	-0.004**	-0.004*	-0.004*
	(0.002)	(0.002)	(0.002)
D85	0.111***	0.107**	0.094*
	(0.026)	(0.044)	(0.047)
D87	-0.108***	-0.125**	-0.128**
	(0.023)	(0.044)	(0.048)
ECM	-0.406**	-0.541***	-0.418**
	(0.155)	(0.174)	(0.179)
DW-stat	1.938	1.993	1.615
Adjusted R-Sq.	0.516	0.479	0.509
S.E. of regression	0.042	0.043	0.042

Where figures in parenthesis are standard errors.
***, **, and * reflect the significance at 1 %, 5 % and 10 % respectively.

As described by the literature on real exchange rate, macroeconomics policies such as exchange rate policy, fiscal policy and monetary policy might affect the behavior of REER in the short run. We also investigated the impact of these macroeconomic polices and found out that excess domestic credit (proxy of monetary policy) is insignificant while the rise in fiscal deficit as percent of GDP (fisdef, a proxy for fiscal policy) and depreciation of nominal exchange rate (ndev) depreciate the REER in the short run. According to the Mundell-Flemming framework, higher fiscal deficit leads to current account deficit,[8] which necessitates adjustment in nominal exchange rate and thus real exchange rate depreciation/devaluation in the presence of flexible/managed float exchange rate regime. The proxy of monetary policy (excess domestic credit) is statistically insignificant in all the short-run dynamics regression which may reinforce the established view that monetary policy in Pakistan was subservient to fiscal policy. However, the recent monetary expansion is driven by private sector credit where preliminary data suggests indicating higher inflationary pressures in Pakistan but its impact on the REER has yet to be strengthened up due to short space of time. Therefore, it is expected that the monetary and especially private credit channel would also affect REER in the short run. Since monetary policy remained subservient to fiscal policy due to the heavy reliance of the government to finance fiscal deficit from the banking system, the direct impact of monetary policy on short term is statistically insignificant. The impact of net devaluation on EREER turned out to be negative as expected which indicates that nominal devaluation/depreciation of Pak Rupee vis-à-vis Dollar depreciates REER.

The coefficient of the error correction term in all regressions is negative and has absolute values smaller than one. This not only indicates the stability in the long-term EREER but also reflects the gradual convergence of the exchange rate toward long-run equilibrium. More specifically, it indicates that when the fundamentals in the previous period call for a lower (higher) REER than observed, i.e. EC coefficient is positive (negative), the REER in the current period will tend to depreciate (appreciate) toward equilibrium level predicted by the economic fundamentals. The speed of adjustment measured by the EC coefficients is around negative 0.40 in Reg. I and Reg. III that is consistent with the range of values estimated by the Edwards (1989) and Elbadawi (1994) for developing countries.

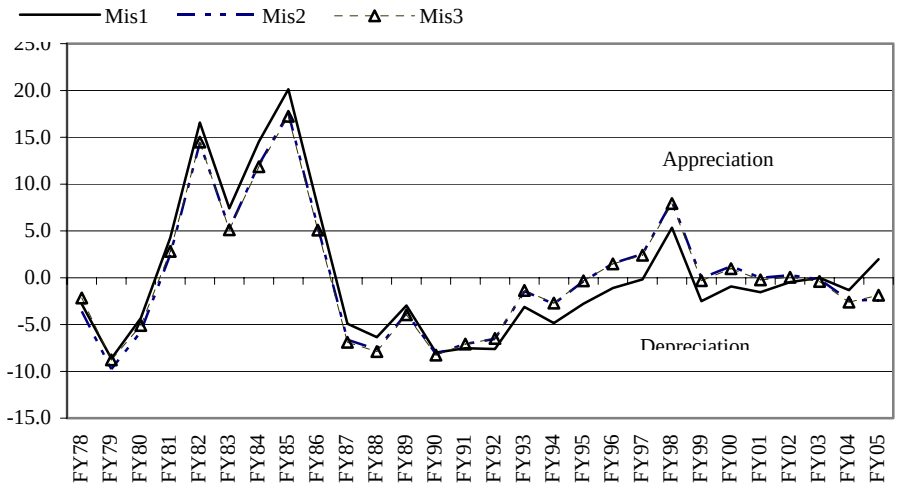
[8] Fiscal deficit financed by printing money would lead to inflation, which in turn appreciates REER due to higher price differential from the trading partners' countries thus resulting into current account deficit.

5. Exchange Rate Misalignment

In the final step, we have computed the degree of misalignment which is simply the percentage deviations of actual REER from equilibrium REER. The misalignments of exchange rate based on three different competing models of EREER are shown in Figure 4. The positive deviations reflect the appreciation of actual REER relative to EREER while negative deviations indicate the depreciation of actual REER. As reflected by Figure 4 and Table A3 in the appendix, exchange rate misalignment ranged between -11.1 percent to 20.1 percent with zero reversion mean from FY78 to FY05. This reflects the long-term convergence tendency of actual REER toward EREER in Pakistan.

Furthermore, the actual REER of FY05 is slightly depreciated in the range of 1.8-2–4 percent on the basis of two estimated regressions while one equation reflects an appreciation of 2.0 percent relative to EREER. This suggests that the current exchange rate is not too far away from the EREER and more or less reflects the underlying macroeconomic fundamentals. As far as the behavior of exchange rate misalignment over the period under review is concerned, our calculations indicate that there are three episodes[9] of undervaluation (from FY78–80, FY87–95, and from FY02–05) and two episodes of overvaluation (from FY81–FY86 and from FY96–FY98).

Figure 4. Misalignment (in percent)



[9] An episode is defined as the three consecutive years of either overvaluation or undervaluation.

Table 5. Contribution of Economic Fundamentals to Actual REER App.(+)/Dep.(-)

		Contributions				
Variables	Elasticities	FY78-80	FY81-86	FY87-95	FY96-98	FY02-05
Actual REER (LREER) App. (+)/Dep. (-)		**-0.087**	**-0.187**	**-0.253**	**0.024**	**-0.057**
Terms of Trade (LTOT)	0.336	22.5	17.2	-0.8	-7.8	103.2
Trade openness (LTROP)	-0.609	20.0	12.7	19.4	-37.9	168.6
Workers' remittances as percent of GDP (LREMG)	0.156	-6.2	10.9	53.4	-31.9	-110.2
Total Factor Productivity Differentials (TFPD)	0.011	-32.7	-25.8	19.5	-202.9	18.9
Current Govt. Expenditure as percent of GDP (LGOVC)	-0.927	54.0	78.9	22.1	26.3	55.8
Net Capital Inflows as percent of GDP (CAPINF)	-0.023	7.2	17.8	13.2	96.7	48.7
Unexplained	-0.036	35.2	-11.6	-26.9	257.5	-184.9
		100.0	100.0	100.0	100.0	100.0

First episode (FY78–80)

The first episode of depreciation or negative misalignment is observed from FY78 to FY80 when the 9.1 percent depreciation of actual REER outpaced the 5.8 percent depreciation in EREER. The main reasons for former were lower inflation differential and the weakening of US Dollar against other major currencies while the latter was depreciated due to rise in current government expenditures, deterioration in the terms of trade and trade liberalization as shown by the contributions of these factors in Table 5.

Second episode (FY81–86)

Exchange rate misalignment posted a sharp reversal from negative misalignment (undervalued exchange rate) to positive misalignment (overvalued exchange rate) in FY81 and remained positive until FY86. During this episode, EREER depreciated by 23.2 percent as compared to the depreciation of 20.6 percent in actual REER and exchange rate misalignment ranged between 2.8 to 17.2 percent. Actual REER started to appreciate after FY80 mainly due to the appreciation of US Dollar vis-à-vis major currencies and higher domestic inflation and peaked at 7.1 percent in FY82 despite the nominal exchange rate depreciation of 6.2 percent following the abandoning of fixed exchange rate regime in the beginning of 1982. On the contrary, EREER witnessed a sharp depreciation despite the increase in

workers' remittances and productivity gains due to trade openness, deterioration in terms of trade and increase in current government expenditure during FY82, which kept the actual REER overvalued by 14.5 percent. The downward adjustments in nominal exchange rate gathered pace in the managed float regime and actual REER witnessed sharp depreciations of 13.1 percent and 17.1 percent in FY83 and FY86 respectively.[10] However, the continued depreciation of EREER on the back of trade openness, increase in current government expenditure and later on the decline in workers' remittances (after a peak in FY83) rendered the real exchange rate overvalued by 5.1 percent at the end of FY86.

Third episode (FY87–95)

The sharp weakening of US Dollar vis-à-vis other major currencies during FY87 put further downward pressures on actual REER and it overtook the declining EREER. As a result, the real exchange rate became undervalued after six years of overvaluation and remained undervalued unti FY95 with noticeable reduction in misalignment magnitude from FY93. It is interesting to note that the implementation of exchange and payment reforms from 1991, to transform the economy toward market-oriented policies, increased the magnitude of nominal exchange rate devaluations. However, these devaluations were offset by higher domestic inflation relative to trading partners that kept the exchange rate close to EREER.

Fourth episode (FY96–98)

During FY96–98, EREER depreciated by 1.3 percent on average as against the appreciation of actual REER by 0.8 percent on average thus leading to positive exchange rate misalignment (overvaluation) of 3.9 percent on average. The rise in the total factor productivity differential, the reduction in the workers' remittances inflows and the increasing trade liberalization contributed toward the depreciation of EREER, offset by reduction in government current consumption expenditure and higher net capital inflows.

Fifth episode (FY02–05)

A major structural shift was observed in the aftermath of September 2001 when large inflows of foreign exchange brought the fundamentals to the convergence of equilibrium real exchange rate. Specifically, the real exchange rate on average

[10] Besides nominal exchange rate depreciation, the weakening of US dollar vis-à-vis major currencies during FY86 also contributed toward the depreciation of actual REER.

reflects a slight undervaluation of real exchange rate by 1.6 percent during FY02–FY05 mainly due to much sharper cumulative depreciation in actual REER (by 2.0 percent during FY02–FY05) than EREER (by 1.3 percent during FY02–FY05). While Rupee was under heavy pressure of appreciation due to excess foreign exchange liquidity in the foreign exchange (interbank) market, it was the conscious intervention policy of SBP to not only build forex reserves but also protect export competitiveness from unwarranted exchange rate appreciation. Despite the appreciation of Rupee, interestingly, real exchange rate continued to maintain the competitiveness due to: (i) the fact that basket of currencies appreciated against Dollar more than the Rupee; (ii) absorbed the negative impact due to the relatively higher inflation compared to trading partners; and (iii) the continued depreciation of EREER slowed down as the surge in workers' remittances, somewhat, offset the depreciations emanating from trade openness and increase in government current expenditures as shown by the contributions of these factors in Table 5.

6. Exchange Rate Misalignment under Different Exchange Rate Regimes

In this section we have analyzed the exchange rate misalignment under different exchange rate regimes adopted by Pakistan during the sample period. As shown in Table 6, the degree of misalignment and its volatility (variation) derived from the actual REER and the three regressions of EREER are much higher under fixed exchange rate regime followed by managed and flexible exchange rate regime. Interestingly, range (difference of maximum and minimum) which measures the degree of dispersion reflects that there is a high degree of variation in exchange rate misalignment under managed exchange rate regime followed by fixed and flexible exchange rate. Standard Deviation (SD), a more refined measure of dispersion relative to range, exhibits a high degree of volatility under managed exchange rate regime as compared to fixed exchange rate regime. As far as the level of exchange rate misalignment is concerned, the real exchange rate on average remained overvalued under fixed and flexible exchange rate regimes contrary to undervaluation of exchange rate under flexible exchange rate regimes. Therefore, we can conclude that exchange rate misalignment and its volatility is much lower under flexible exchange rate regime as compared to fixed and managed exchange rate regimes, which is also consistent with the finding of Calvo and Miskin (2003) showing that exchange rate can adjust more quickly and more smoothly to real shocks under flexible than other exchange rate regimes.

Table 6. Exchange Rate Misalignment (in %) under Different Exchange Rate Regimes

	Fixed Exchange Rate Regime (FY78-82)				Managed Floating Exchange Rate Regime (FY83-98)			
	Reg. I	Reg. II	Reg. III	Average	Reg. I	Reg. II	Reg. III	Average
Mean	1.01	-0.46	0.25	0.27	0.35	0.5	0.38	0.41
Max.	16.58	14.39	14.48	15.15	20.13	17.54	17.23	18.3
Min.	-8.65	-9.76	-8.77	-9.06	-7.99	-8.17	-8.26	-8.14
Range	25.23	24.15	23.25	24.21	28.1	25.71	25.49	26.44
S.D.	9.86	9.4	9.01	9.42	8.36	7.61	7.54	7.84

	Flexible Exchange Rate Regime (FY00-05)			
	Reg. I	Reg. II	Reg. III	Average
Mean	-0.38	-0.58	-0.68	-0.54
Max.	2	1.22	0.97	1.4
Min.	-1.54	-2.4	-2.6	-2.18
Range	3.54	3.62	3.57	3.58
S.D.	1.29	1.49	1.31	1.36

7. Conclusion and Policy Implications

We use Engle Granger co-integration technique to estimate EREER for Pakistan, based on various macroeconomic fundamentals suggested in economic literature by Edwards (1988, 1989, 1994), Elbadawi (1994) and Montiel (1997). The main explanatory variables are found to be terms of trade, trade openness, net capital inflows, relative productivity differential, current consumption government, and workers' remittances. The results of the reduced-form relationship between the real exchange rate and the fundamentals seem to be consistent with empirics. Specifically, trade openness, the increase in current consumption government and net capital inflows depreciate the REER, while, the increase in workers' remittances inflows and the improvement in the total factor productivity appreciates the REER. The estimated long-run EREER and degree of exchange rate misalignment reveal that exchange rate misalignment ranged between -11.1 percent to 20.1 percent with zero reversion mean from FY78 to FY05, reflecting the long-term convergence tendency of actual REER toward EREER in Pakistan. As far as the behavior of exchange rate misalignment over the period under review is concerned, this paper has identified three episodes of undervaluation (from FY78–FY, FY87–FY95, and from FY03–FY05) and two episodes of overvaluation (from FY81–FY86 and from FY96–FY98). This paper also shows that the actual REER of FY05 is slightly depreciated in the range of 1.8–2.4

percent on the basis of two estimated regressions while one equation reflects an appreciation of 2.0 percent relative to EREER. This suggests that the current exchange rate is not too far away from EREER and more or less reflects the underlying macroeconomic fundamentals. The magnitude of the error correction coefficients indicates the gradual convergence of the exchange rate toward long-run equilibrium, which is consistent with the findings for other developing countries. Furthermore, the exchange rate misalignment over the period under review suggests that the degree of misalignment and its volatility is unambiguously much lower under the flexible exchange rate regime than fixed and managed exchange rate regimes. The short-term dynamics of the models suggest that fiscal deficit and nominal exchange rate devaluation/depreciation depreciate the exchange rate in short term while the impact of monetary policy is statistically insignificant. The rationale of insignificant impact of monetary policy is that monetary policy was effectively used to finance government budgetary borrowing in the past. In sharp contrast, the monetary expansion during the last three years was mainly driven by credit expansion to private sector, which has started to create inflationary pressures in Pakistan and there is an emerging sign of real exchange rate appreciation due to increasing inflationary differential relative to trading partners. However, this relationship has yet to be established.

These results yield the following important policy implications for exchange rate policy in Pakistan and other developing countries: Firstly, EREER is not fixed and is subject to variability due to changes in economic fundamentals, hence it requires changes in EREER and actual REER accordingly. Secondly, the continued prudent fiscal policy is crucial for the exchange rate stability for Pakistan. Thirdly, the appreciation of actual REER due to higher price differentials relative to EREER would lead to exchange rate misalignment. Last but not the least, flexible exchange rate regime responds better in case of real shocks than other exchange rate regimes. Therefore, SBP should continue with current stance of flexible exchange rate regime and intervene in the interbank market only to smooth unwarranted movements in exchange rate by keeping in view EREER and exchange rate misalignment.

References

Afridi U. (1995). “Determining Real Exchange Rates.” *Pakistan Development Review*, 34: 263-276.

Ahlers, T. and L. Hinkle (1998). "Estimating the Equilibrium Real Exchange Rate Empirically: Traditional Approaches and Operational Techniques." Washington, D.C.: World Bank,

Ali, S. (2000). "Pakistan's Real Effective Exchange Rate", First quarterly report of SBP for the year 2000-2001, pp. 41-52.

Baffes, J., A. Elbadawi, and A. O'Connell, (1999). "Single Equation Estimation of the Equilibrium Real Exchange Rate." In L. Hinkle and P. Montiel (eds). *Exchange Rate Misalignment, Concepts and Measurements for Developing Countries*. : Oxford University Press.

Caballero, R. and V. Corbo (1989). *How does Uncertainty about the Real Exchange Rate Affects Exports*. Research Policy Series No. 221. Washington DC, World Bank.

Corbo, V. and P. Rojas (1995). *Exchange Rate Volatility, Investment, and Growth: Some New Evidence*. Unpublished Manuscript. Catholic University of Chile.

Devarajan, S. (1998). *Estimates of Real Exchange Rate Misalignment with a Simple General Equilibrium Model*. Washington, D.C.: World Bank.

Edwards, S. (1988). "Real and Monetary Determinants of Real Exchange Behavior: Theory and Evidence from Developing Countries." *Journal of Development Economics*, 29: 311 – 341.

——— (1989). *Real Exchange Rates, Devaluation and Adjustment: Exchange Rate Policy in Developing Countries*. Massachusetts: MIT Press.

——— (1994). "Real and Monetary Determinants of Real Exchange Rate Behavior: Theory and Evidence from Developing Countries." In J. Williamson (eds.). *Estimating Equilibrium Exchange Rates*. Washington, D.C.: IIE. (Chapter 4)

Elbadawai, I. (1994). "Real and Monetary Determinants of Real Exchange Rate Changes." In R.Z. Aliber (eds.). *National Monetary Policies and the International Financial System*. Chicago: University of Chicago Press

Calvo, G. and F. Mishkin (2003). *The Mirage of Exchange Rate Regimes for Emerging Market Countries*. NBER Working Paper No. 9808. Massachusetts: NBER.

Hinkle, L. and P. Montiel (1999) (eds). *Exchange Rate Misalignment, Concept and Measurement for Developing Countries*. London: Oxford University Press.

Haque, N. and P. Montiel (1998a). *Long-Run Real Exchange Rate Changes in Developing Countries: Simulations from an Econometric Model*. Washington, D.C.:World Bank.

——— (1998b). "Exchange Rate Policy in Pakistan: Recent Experience and Prospects." In A. Nasim (eds). *Financing Pakistan's Development in the 1990s*. Karachi: Oxford University Press.

MacDonald, R. (1995). "Long-run Exchange Rate Modeling: A Survey of Recent Evidence." IMF *Staff Papers*, 42: 437-98.

Montiel, P. (1997). "Exchange Rate Policy and Macroeconomic Management in ASEAN Countries." In J. Hicklin et al. (eds.). *Macroeconomic Issues Facing ASEAN Countries*. Washington, D.C.: IMF.

——— (1999). "Determinants of the Long-Run Equilibrium Real Exchange Rate: An Analytical Model." In L. Hinkle and P. Montiel (eds.). *Exchange Rate Misalignment, Concepts and Measurements for Developing Countries*. London: Oxford University Press.

——— (2003). *Macroeconomics in Emerging Markets*. Cambridge: Cambridge University Press.

Razin, O. and S.Collins (1997). *Real Exchange Rate Misalignments and Growth*. NBER Working Paper 6174. Massachusetts: NBER.

Rogoff, K. (1996). "The Purchasing Power Parity Puzzle." *Journal of Economic Literature*, 34: 647-68.

Siddiqui, R., U. Afridi, and Z. Mahmood (1996). "Exchange Rate Determination in Pakistan: A Simultaneous Equation Model." *Pakistan Development Review*, 35: 683-692

Chishti, S. and M. Hasan (1995). "What Determines the Behavior of Real Exchange Rate in Pakistan." *Pakistan Development Review*, 34: 1015-1029

Serven, L. and A. Solimano (1991). *An empirical Macroeconomic model for Policy Design: The case of Chile*. Research Policy Series No. 709, Washington DC, World Bank.

Williamson, J. (1994) (eds.). *Estimating Equilibrium Exchange Rates*. Washington, D.C.: IIE.

Appendix

Table A1. Correlations Matrix

	LRER	LTOT	LTROP	LGOVC	TFPD	CAPINF	LRIGDP
LRER	1.00						
LTOT	**0.53**	1.00					
LTROP	**-0.75**	-0.59	1.00				
LGOVC	**-0.77**	-0.33	0.43	1.00			
TFPD	**0.49**	0.23	-0.49	-0.06	1.00		
CAPINF	**-0.18**	0.05	0.01	0.33	0.55	1.00	
LRIGDP	**0.59**	0.05	-0.45	-0.42	0.23	-0.29	1.00

Table A2. Diagnostic Tests

	Reg. I	Reg. II	Reg. III
Correlogram of residuals			
Q-Stat (2)	2.07	2.22	2.96
Prob	0.36	0.33	0.23
Q-Stat (5)	4.57	5.69	5.61
Prob	0.47	0.34	0.35
Correlogram of residual squared			
Q-Stat (2)	1.01	0.87	1.28
Prob	0.60	0.65	0.53
Normality Test			
Jarque-Bera	1.33	0.71	0.58
Prob	0.52	0.70	0.75
Breusch-Godfrey Serial Correlation LM Test			
F-stat	1.12	1.06	1.37
Prob	0.35	0.37	0.28
ARCH test			
F-stat	0.37	0.17	0.05
Prob	0.55	0.68	0.82
White Heteroskedasticity Test			
F-stat	0.32	0.54	0.58
Prob	0.96	0.86	0.82

Table A3. Actual REER , Equilibrium REER and Exchange Rate Misalignment

	Actual	Equilibrium			Misalignment on the basis of		
	REER	EREER1	EREER2	EREER3	Reg I	Reg II	Reg III
FY78	191.7	197.2	198.8	195.9	-2.8	-3.6	-2.2
FY79	173.8	190.2	192.6	190.5	-8.6	-9.8	-8.8
FY80	175.7	183.6	186.5	185.1	-4.3	-5.8	-5.1
FY81	184.7	177.1	180.3	179.6	4.3	2.5	2.8
FY82	198.9	170.6	173.9	173.7	16.6	14.4	14.5
FY83	175.8	163.6	167	167.2	7.4	5.2	5.1
FY84	179.3	156.5	159.9	160.3	14.5	12.1	11.9
FY85	179.4	149.4	152.7	153.1	20.1	17.5	17.2
FY86	153.2	142.4	145.4	145.8	7.6	5.4	5.1
FY87	129.1	135.7	138.2	138.6	-4.9	-6.6	-6.9
FY88	121.4	129.6	131.5	131.8	-6.3	-7.7	-7.9
FY89	120.4	124.1	125.2	125.4	-3.0	-3.8	-4.0
FY90	109.7	119.2	119.5	119.6	-8.0	-8.2	-8.3
FY91	106.3	115	114.4	114.4	-7.5	-7.1	-7.1
FY92	102.8	111.3	110	110	-7.6	-6.5	-6.5
FY93	104.8	108.1	106.3	106.2	-3.1	-1.5	-1.4
FY94	100.4	105.5	103.2	103.1	-4.8	-2.8	-2.7
FY95	100.2	103.1	100.6	100.6	-2.8	-0.4	-0.3
FY96	99.8	100.9	98.3	98.3	-1.1	1.5	1.5
FY97	98.7	98.9	96.3	96.4	-0.2	2.5	2.4
FY98	102.2	97	94.5	94.7	5.3	8.2	7.9
FY99	92.8	95.2	92.9	93.1	-2.5	-0.1	-0.3
FY00	92.6	93.5	91.5	91.7	-0.9	1.2	1.0
FY01	90.2	91.6	90.2	90.4	-1.5	0.0	-0.2
FY02	89.2	89.6	88.9	89.1	-0.5	0.3	0.0
FY03	87.6	87.6	87.8	87.9	0.0	-0.2	-0.4
FY04	84.5	85.7	86.6	86.8	-1.3	-2.4	-2.6
FY05	84.2	82.6	86.3	85.8	2.0	-2.3	-1.8

Figure A1: Cusum and Cusum Square Tests: Long-Run REER Co-integrating Equations

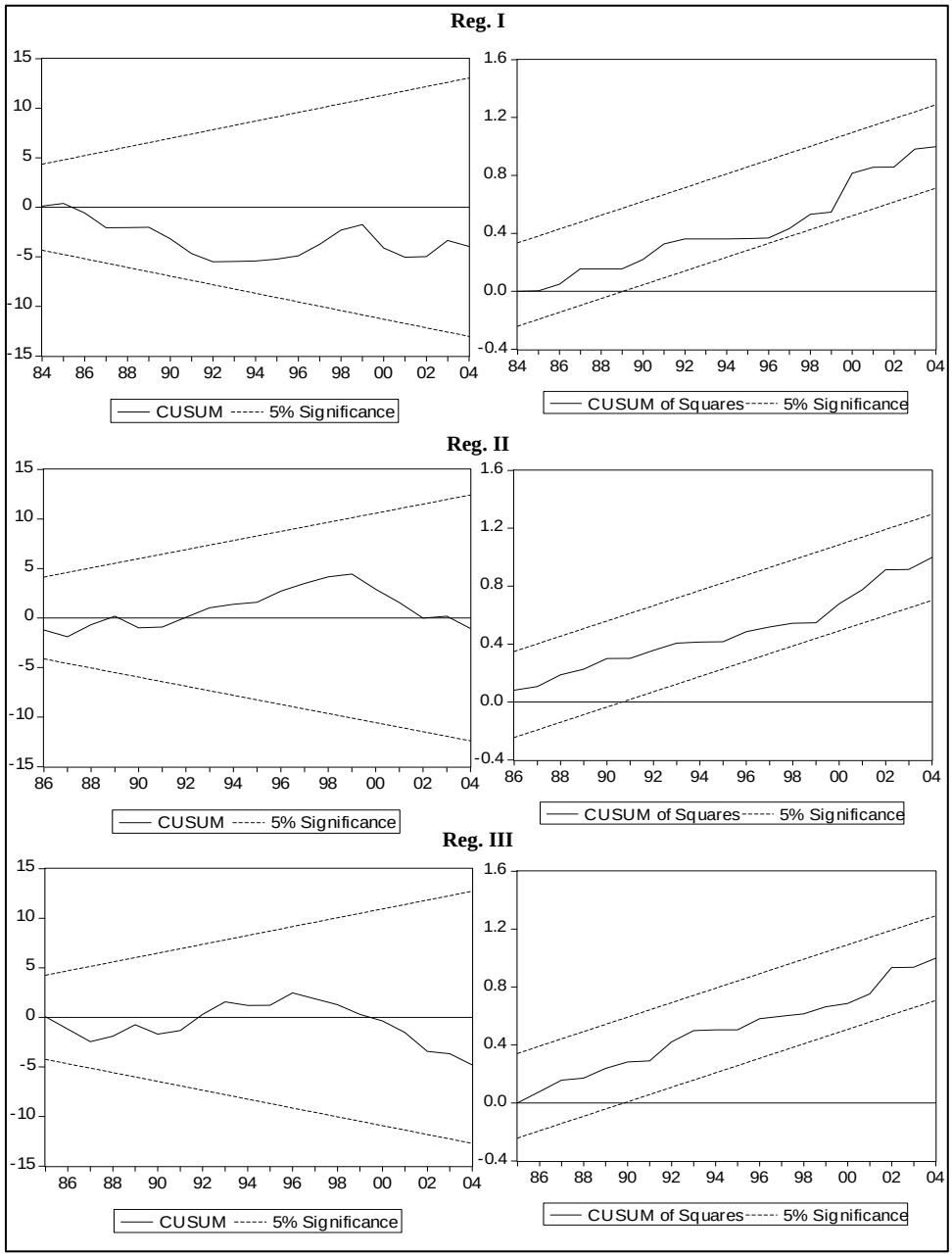


Figure A2: Cusum and Cusum Square Tests: Short-run REER Dynamics Equations