Exchange rate misalignment and economic development: the case of Pakistan

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Abstract

Recent findings in the economic growth literature suggest that developing countries need to keep a devalued exchange rate to stimulate their long-run economic growth. In light of this view, we assess the alignment of the real exchange rate of Pakistan, a developing country where sustained economic growth has proved to be elusive during the last two decades. After finding that the Pakistan rupee has been significantly and increasingly overvalued in real terms from 2005 – significantly above the over-valuation detected by International Monetary Fund (IMF) –, we simulate the general equilibrium effects of an eventual re-alignment of the Pakistani real exchange rate with economic fundamentals, and find that realignment would not only lead to a sizable increase in the relative size of the tradable sector - where productivity increases tend to be faster – but also to an associated re-distribution of income in favor of the urban poor and the (relatively disadvantaged) rural households. These findings reinforce recent arguments in the growth literature, and suggest the need for the Pakistani government to achieve – and sustain – a devalued exchange rate to boost its economic development prospects.

Keywords

Real exchange rate, Misalignment, Growth, Pakistan, VAR analysis, Computable General Equilibrium, Income Distribution

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I. Introduction

The Framework for Economic Growth of Pakistan laments that sustained high growth has eluded the country, and recognizes the central role that the real exchange rate policy has in its strategy to generate growth (Planning Commission of Government of Pakistan, 2011). While it is widely acknowledged that the management of the real exchange rate is central for economic growth (Rodrik, 2008), the more traditional line of argument typically emphasizes that overvaluation harms growth and calls for the exchange rate to be at its “equilibrium” level (Easterly 2005). However, more recently, Rodrik (2008) and Bhalla (2012) have argued, and econometrically tested, that undervalued exchange rates are optimal for developing countries, as they lead to periods of economic activity and employment growth. That is, not only would overvaluation be harmful (which is linked to macroeconomic instability, balance of payments crises, stop-go economic growth, rent-seeking and corrupt practices), but undervaluation would be conducive to growth. Rodrik (2008), relying on a panel dataset of 184 countries observed during the 1954-2004 period, regresses per capita GDP growth on an index of undervaluation and GDP per capita and accounts for fixed effects and year-specific dummies, and finds that undervaluation is systematically associated with periods of high growth, an effect that is large and significant for poor countries. Arguably, this is because undervaluation leads production factors to move in the direction of the tradable (export and import-competing) sectors, which tend to have higher productivity growth rates (Cottani et al 1990), and to exhibit larger economies of scale, learning by doing, and knowledge spillovers (Rodrik, 2008); making an economy more competitive, increasing its domestic profitability and investment, and ultimately spurring growth (Bhalla 2012).

A recent report from the International Monetary Fund claims that the Pakistani rupee has been overvalued in recent years (IMF 2012). Widespread symptoms of overvaluation through the Pakistan economy are evident: export growth has been moving in stop-go fashion with hopes remaining pinned on remittances to keep international reserves at sustainable levels rather than on export earnings. IMF assistance has become a regular event in Pakistan, with the country receiving Fund’s assistance in most years since 1978. All these observations lead to the sad conclusion that, with the existing real exchange rate policy, the country is becoming increasingly dependent on the international community.

In the absence of a country-specific, thorough treatment of the Pakistani rupee’s alignment for recent years, the present paper provides a detailed analysis of the real exchange rate of the country. Given the low volatility of the exchange rate of Pakistan in the last three decades, it is on the existence, magnitude and potential effects of misalignment in Pakistan where our study focuses. We investigate the behavior of the Pakistan real exchange rate during the last three decades, finding that it has been systematically overvalued during the last half a decade given observed economic fundamentals. Recently, and in the face of worsening economic fundamentals – rising government deficit, deficit current account – and stagnant growth, a sharp depreciation of the rupee has taken place. While macroeconomic theoretical and empirical evidence presented below suggests that Pakistan needs to continue devaluing its currency to stimulate its growth, we are aware that price changes are never neutral and, as such, real devaluations tend to generate distributional changes by which some groups win and others lose. Reflecting upon this, we analyze the distributional effects that would be generated by the realignment of the real exchange rate in Pakistan. Given the relevant second-round effects generated by a sizable devaluation, this analysis can only be done in a general equilibrium framework. In this framework, we simulate a real devaluation with its size informed by the above econometric analysis of misalignment, and look into the associated general equilibrium changes in the structure of the economy and, in turn, welfare changes that are to be expected for a series of representative household groups, tracing the main transmission channels involved.

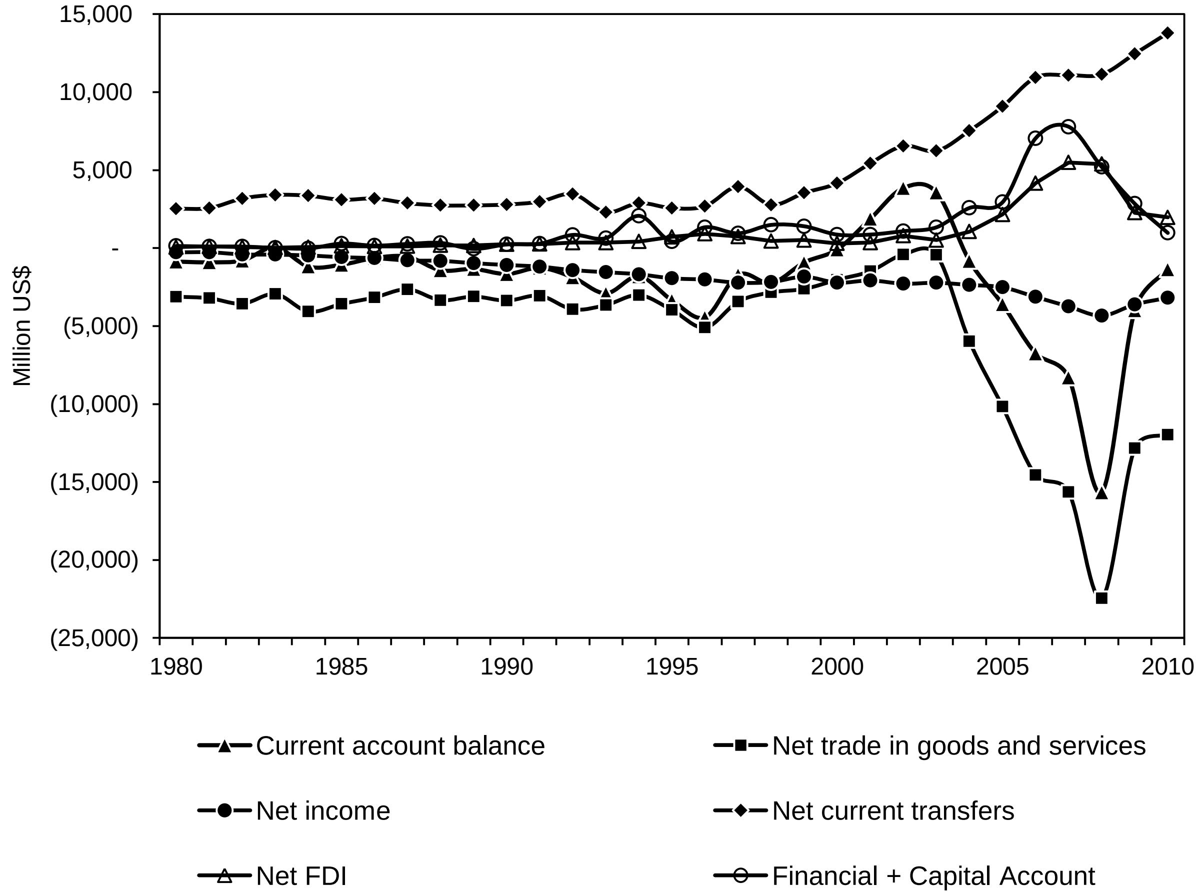
Section II briefly provides necessary background information on the evolution of the external accounts of Pakistan and inspects the association between its exchange rate and domestic economic growth. Section III presents a vector auto-regression econometric approach that assesses the misalignment of the equilibrium exchange rate of Pakistan. Section IV sheds light on the general equilibrium effects of aligning the real exchange rate with Pakistan economic fundamentals, emphasizing the expected change of the relative size of the tradable sector and household income distribution. A final section concludes.

II. The Evolution of Pakistan's Current Account

Excluding the brief period from 2000 to 2004, Pakistan shows a persistent current account deficit from 1980 (Figure 1) that becomes particularly high in the 2006-2009 period. The recent deficits were driven by the sharp deterioration of the trade balance from 2004 to 2008, in turn associated with increasing oil prices – oil being a major import commodity for the country-, and were partially mitigated by the recent relatively good years with abundant cotton harvests that allowed the country to increase its exports of cotton and textiles, major export items for the country. The negative effect of the worsening of the trade deficit on the current account of the balance of payments was offset to some degree by rising current inward transfers (remittances and foreign aid) until 2010. In spite of this, the current account remained in deficit during most years. While foreign direct investment (FDI) and other capital inflows financed part of the current account deficit, Pakistan has had to repeatedly make use of IMF stand-by arrangements (fourteen since 1972) to manage its external finances and avert crisis[1].

[1] Pakistan has had IMF Stand-By Arrangements and other IMF funding in 1972, 1973, 1974, 1980, 1981, 1988, 1993, 1994, 1995, 1997, 2000, 2001, 2004 and 2008.

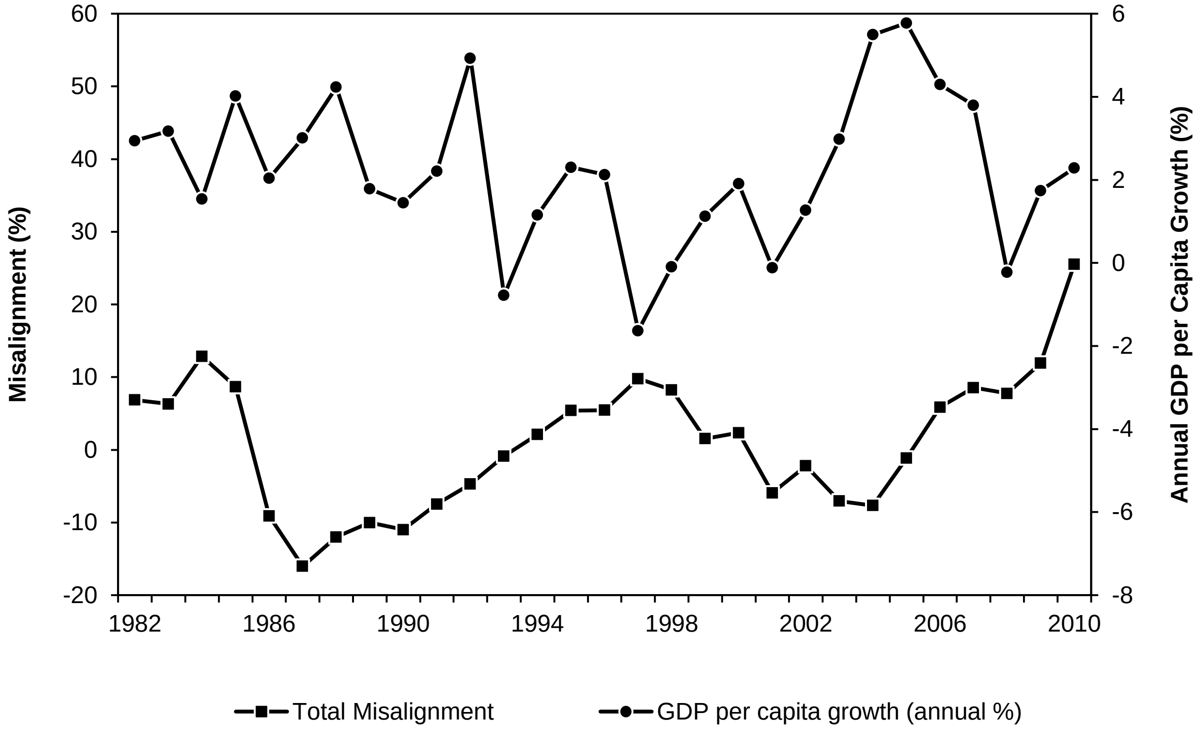
Figure 1: Evolution of the International Balance of Payments of Pakistan



Source – Authors' construction based on World Bank, World Development Indicators. Bézier spline used to smoothen the time-series.

A preliminary look at whether undervaluation is empirically associated with economic growth in Pakistan (Figure 2) suggests that – at least up to 2008 - during periods of undervaluation (negative total misalignment) per capita GDP growth does tend to be higher. While the co-movement is not proof of causation, it provides preliminary evidence in favor of Rodrik's hypothesis, by which a real devaluation in a developing country spurs its growth rate.

Figure 2: Real Exchange Rate Misalignment and Economic Growth in Pakistan



Source – Authors' construction based on econometric estimation of equilibrium exchange rate 1982-2010, actual equilibrium exchange rate 1982-2010, and World Bank World Development Indicators (WDI) for GDP per capita.

Against this backstage of potentially growth-reducing appreciated real exchange rate and probably unsustainable external accounts, we move into the analysis of the Pakistan real exchange rate and its driving forces, assessing if and to what extent the country's real exchange rate has been misaligned with its economic fundamentals.

III. Establishing the Rupee's Equilibrium Exchange Rate

The literature of exchange rate determination contains a range of approaches to measure the equilibrium exchange rate. The approaches vary in how the equilibrium rate is defined, and fall into two broad categories: those that take what is called the internal-external or macro-balance approach, and those that take the equilibrium rate as being directly determined by economic fundamentals. The traditional purchasing power parity (PPP) theory, by which bilateral nominal exchange rates simply adjust to compensate for inflation differentials, can be tested as a by-product of the implementation of these approaches, specifically by testing the stationarity of the real exchange rate in the preliminary inspection of the data.

The macro-balance approach - also called FEER (Fundamental Equilibrium Exchange Rate) – was popularized first by Williamson (1985) and later by Isard and Faruqee (1998). The FEER is identified as the exchange rate that, given full employment in the domestic and foreign economy, leads to a current account balance that can be financed by capital flows considered sustainable in the view of the analyst. More formally, if we call CA and KA the current and capital account of the international balance of payments, q_{FEER} the fundamental equilibrium exchange rate, y_d and y_f the domestic and foreign activity levels, and $\bar{y}_d$ and $\bar{y}_f$ their full-employment levels, the q_{FEER} is identified from the implicit equation $CA(q_{FEER}, \bar{y}_d, \bar{y}_f) + \overline{KA} = 0$, after econometric estimation of the CA function parameters (Edwards (1989), Clark and Mac Donald (1998)). This approach defines then the equilibrium exchange rate as the one that is consistent with an optimal economic state, in the sense that it is consistent with the full employment of production factors and with the net capital inflow that non-residents are willing to provide.

In contrast, the behavioral equilibrium exchange rate approach (BEER) defines the equilibrium in a *behavioral* sense: the behavior that the real effective exchange rate (REER) is expected to follow given a set of observed economic fundamentals. This behavior is assumed to be determined by movements in economic fundamentals that are explicitly considered. The BEER is very general and, by employing it, the analyst is able to avoid the need to define a sustainable capital account position. Besides, she is also free to calibrate the BEER fundamentals imposing the values considered sustainable, estimating hence the sustainable or long run equilibrium exchange rate in a similar way as in the FEER approach. Hence, the BEER, while being positive in its approach, is also able to incorporate the normative features of the FEER approach.

The behavioral approach includes models such as the stock-flow equilibrium model of Faruqee (1994), the natural real exchange rate (NATREX) of Stein (1995), and the Behavioral Equilibrium Exchange Rate (BEER) of Clark and MacDonald (1998). Each of these models involves the estimation of a reduced-form equation that explains the behavior of the real exchange rate given a certain set of economic fundamentals. The stock-flow model of Faruqee and the NATREX explicitly derive these fundamentals from an underlying model of internal-external equilibrium, and set them at levels consistent with the long-run steady state equilibrium. The behavioural equilibrium exchange rate (BEER) approach of Clark and MacDonald (1998), which we follow, incorporates not only the long-run elements of these models but also medium-run determinants of the exchange rate such as the country-risk adjusted interest rate differential.
In this approach of Clark and MacDonald, the “equilibrium” rate is determined using an econometrically estimated relation between the REER and two sets of economic fundamentals. The first set is derived from the Uncovered Interest Parity (UIP) condition, with relative asset returns adjusting for investors to be indifferent between domestic and foreign return-generating assets, taking into account country-risk premium and expected exchange rate devaluation, and abstracting from exposure to foreign exchange risk. The second set includes variables considered systemic determinants of the real exchange rate, such as net foreign assets, the international terms of trade, and domestic productivity in the non-tradable sector relative to the tradable sector vis-a-vis its foreign counterpart, as described below in detail.

A cointegration technique allows for the estimation of the long-run relation among the real exchange rate and all its economic fundamentals. Misalignment occurs when the actual exchange rate differs from what the econometrically estimated relation predicts in the light of the observed or sustainable fundamentals. Misalignment in this approach arises due to random disturbances, transitory factors and fundamentals being away from their long run or “sustainable” values.

Two relatively recent publications have shed some light on the issue of the Pakistan Rupee’s misalignment. A study published by the State Bank of Pakistan, Hyder and Mahboob (2006), uses a behavioral approach based on the behavioral model of Edwards (1989), which focuses on long-run fundamentals. The study relies on the Engle-Granger approach, which does not allow testing for multiple cointegrating relationships, and focuses on the 1978-2005 period. While usually there would be no need to update a study conducted less than a decade ago, its lack of consideration of multivariate relations and the abrupt recent changes in economic circumstances in Pakistan make such an update advisable. In the years following 2005, economic circumstances in Pakistan changed significantly: amidst changing political regimes, deteriorating security as well as climate-related calamities, the period 2005-10 has seen fiscal and current account deficits rise sharply, and overall economic growth slow, generating the need for an updated study of the exchange rate misalignment in the country.

More recently, the IMF noted the Rupee's misalignment in its Article IV consultation staff report (IMF 2012). Exchange rate assessments contained in these reports come from the IMF's Consultative Group on Exchange Rate issues (CGER) that monitors exchange rates of a number of advanced economies and more recently also a number of emerging market economies. The CGER applies these to a multi-country panel dataset as opposed to individual country time-series. This dataset allows the IMF to avoid small sample problems but produces a homogenous cointegrating equation for a diverse group of countries (IMF 2006) that does not fully capture the country-specificity of the relation between the real exchange rate and its fundamentals. Our econometric analysis intends to provide an updated and dedicated analysis of Pakistan alone, that tests against multiple cointegration relationships and complements results found in previous studies.

A. The Model

We begin with the uncovered interest parity (UIP) condition expressed in real terms and thus posit that the real exchange rate is a function of the real interest rate differential and risk premium between the domestic and the foreign economy (Tanner, 1988; Clark and MacDonald 1998). This condition assumes international capital mobility, which is suggested by the demand for money in Pakistan systematically falling when either the domestic or the foreign interest rate increase, as the recent econometric study of Yu Hsing (2007) finds. Having incorporated the UIP, long run variables that are deemed to impact the systemic component of the real exchange rate are then included. In line with the BEER approach of Clark and MacDonald (1998), and given the relatively small number of observations (annual data from 1982 to 2010), we choose a sparse specification with systemic covariates given by i) net foreign assets, ii) international terms of trade, and iii) a proxy for the Balassa-Samuelson effect or technological progress. We then apply Johansen's cointegration technique, using a Vector Autoregression (VAR) on the following equation of the real effective exchange rate and its fundamentals:

$$lreer = f(r - r^*, deficit;\ nfa,\ ltot, ltnt)\ , \qquad (1)$$

where:

$\boldsymbol{lreer}$ is the natural logarithm of the real effective exchange rate (REER) of the Pakistani rupee in terms of foreign currency, such that an increase in *lreer* means a real appreciation of the rupee. Specifically, the REER for Pakistan is given by:

$$reer = \prod_j \left(\frac{P.R}{P_j.R_j}\right)^{W_j} \qquad (2)$$

where j is an index that runs over Pakistan's trading partners, P (P_j) is the Consumer Price Index in Pakistan (Country j), R (R_j) is the nominal exchange rate of the Pakistani Rupee (country j's currency) in terms of US dollars, and W_j is the trade weight assigned to trading partner j.

$\boldsymbol{r} - \boldsymbol{r}^*$ is the difference between the domestic and the trade-weighted foreign real interest rate, leaving risk premium aside. We follow existing literature in using trade weights to calculate r*. The interest rates used are the annual average interest rates reported by the IMF adjusted for domestic or foreign inflation. A higher interest rate differential is expected to lead to an appreciation of the rupee via an increase in net capital inflow.

$\boldsymbol{deficit}$ is the overall fiscal deficit as a percentage of GDP. It is our proxy for risk premium in the risk adjusted interest parity condition. A higher deficit, associated with greater country risk, is expected to lead to capital outflows and a depreciation of the rupee.

$\boldsymbol{nfa}$ is the stock of Pakistan's net foreign assets (NFA) as a percentage of nominal GDP, in common currency. It can be seen as a reflection of the current account position over time; in particular, it is equivalent to the accumulated current account balance. Higher net foreign assets are expected to cause a real appreciation of the exchange rate via wealth effect and international investment income (Lane and Milesi-Ferretti 2004).

$\boldsymbol{ltot}$ is the relative terms of trade (in logs), that is, the ratio of Pakistan's terms of trade (the ratio of Pakistan's export unit price to its import unit price) in relation to the foreign trade-weighted terms of trade (calculated in an analogous way). The effect of terms of trade on real exchange rate is a priori ambiguous, with income and substitution effects working in opposite directions.

$\boldsymbol{ltnt}$ captures the Balassa-Samuelson effect (or productivity growth differentials between the tradable and non-tradable sectors within and across countries). In theory, ceteris paribus, higher productivity growth in the domestic tradable sector leads the relative price of non-tradables to raise, i.e. domestic real appreciation.

While detailed definitions and data sources for each of these variables are presented in Appendix I, Figure 3 below graphs all six of our constructed variables included in the model over the period of analysis. The real exchange rate experienced a consistent and sharp depreciation in the 1980s following the abandonment of a fixed exchange rate system in 1982. This was followed by a period of rather stable real exchange rate over the 1990s. In the 2000s, relative to earlier periods, volatility increased, and the general depreciating trend continued until 2005, after which some real appreciation took place. Looking at our posited explanatory variables, prima facie there is no obvious trend driving the behavior of the exchange rate. In the years since 1999, we see the real interest rate differential experienced larger than average fluctuations, rising sharply in the early 2000s and falling sharply later, ending up close to the start-of-decade initial value. Similarly, the fiscal deficit also saw large swings: falling steeply in the first half of the 2000's decade and then rising equally steeply. Among the systemic factors, terms of trade (*ltot*) worsened markedly since 1999, while net foreign assets (*nfa*) of domestic residents rose sharply as share of GDP until 2004, and declined since 2004[2]. In this context of absence of evidence of a single observable variable driving the real exchange rate, we provide a multivariate econometric approach that sheds light on the Pakistan's equilibrium exchange rate – and its drivers – and assesses its misalignment.

[2] The increase in 2008 responds to a fall in GDP associated to adverse natural conditions in the country (Yu et al 2013).

Figure 3: Evolution of Pakistan's Real Exchange Rate and its Economic Fundamentals, 1982-2010

Figure 3-1: Log of Real Effective Exchange Rate (*lreer*)

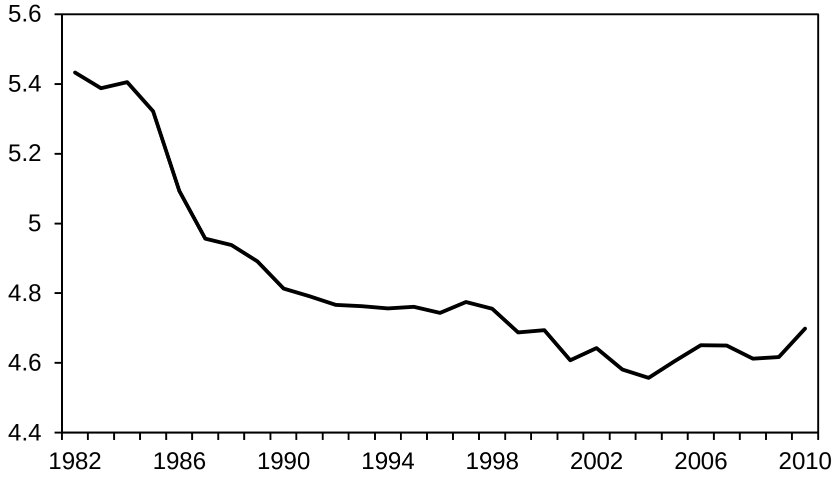


Figure 3-2: Real Interest Rate Differential (*rdiff*)

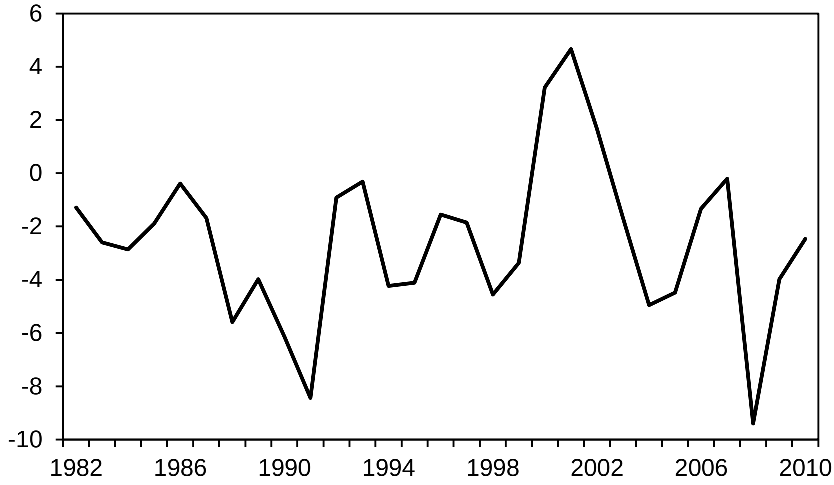


Figure 3-3: Public Deficit as Share of GDP (*deficit*)

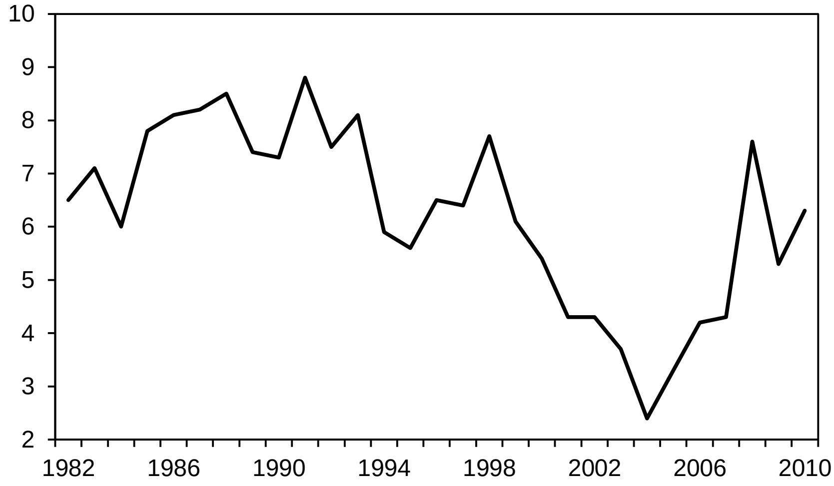


Figure 3-4: Log of Relative Terms of Trade of Pakistan (*ltot*)

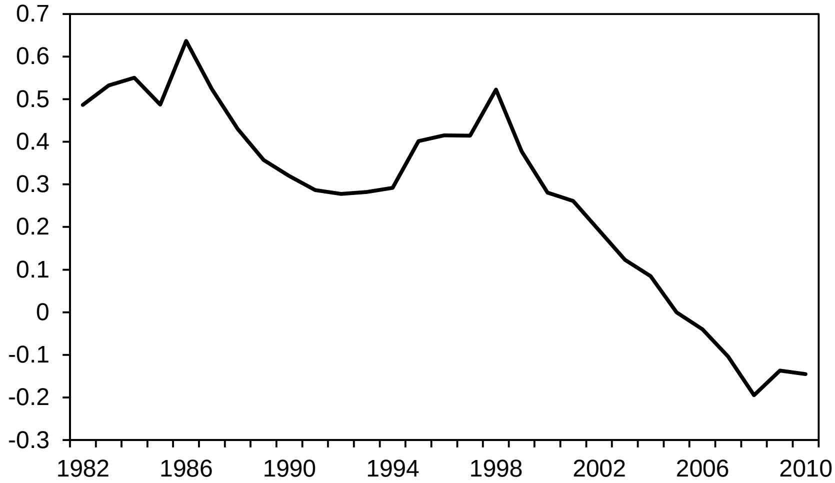


Figure 3-5: Log of Relative Tradable to Non-Tradable Growth (*ltnt*)

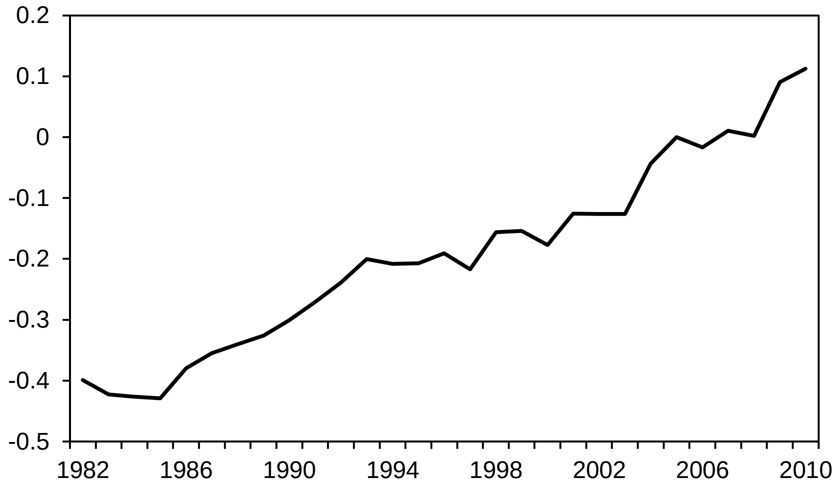
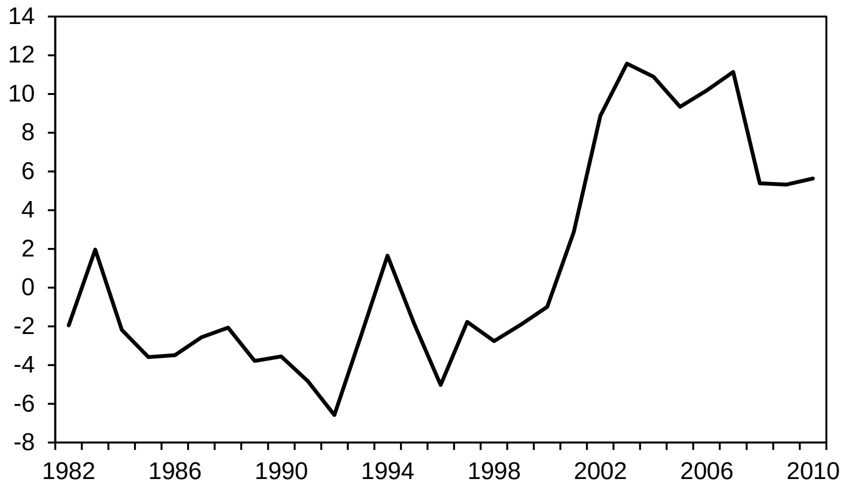


Figure 3-6: Net Foreign Assets as share of GDP (*nfa*)



Source – See Appendix.

B. The Johansen Approach

In estimating a long-run equation for *lreer* with an OLS (Ordinary Least Squares) approach, there is the possibility of a spurious regression resulting from our variables being non-stationary. To avoid this, we consider the cointegration methodology of Johansen (1995) to identify existent long-run relationships between non-stationary variables. This is a multi-regression approach where we model our set of variables as a vector auto-regression (VAR): a system of reduced form equations that determines each of our six variables as a function of lags (those predetermined values) of themselves and the other five variables, without imposing strong a priori restrictions such as particular structural relationships and/or the exogeneity of some of the variables. The approach allows to test for the existence of cointegration - long run relations between the non-stationary variables - and is able to identify more than one relation when present in the data.

Formally, we specify our variables as an unrestricted VAR with p lags:

$$x_t = \mu + \sum_i \pi_i x_{t-i} + u_t \quad (3)$$

$i = 1, \dots, p$

where, for a given period t, the column vector x_t includes the real effective exchange rate and its fundamentals, μ is a vector of constants, u_t is a vector of identically, normally distributed disturbance terms, x_{t-i} is a series of lags of vector x_t, π_i is the matrix of coefficients, and p is the number of lags that are included.

From Granger's representation theorem, if non-stationary variables have a cointegrating relationship, there exists an error correction model (ECM) allowing estimation of the long run cointegrating relation(s), as well as the short run adjustment coefficients. Formally, a VAR of non-stationary variables with p lags is equivalent to an ECM of the form:

$$\Delta x_t = \mu - \Pi x_{t-1} + \sum_{i=1}^{p-1} \Phi_i \Delta x_{t-i} + u_t \quad (4)$$

with the rank of Π determining the number of cointegrating vectors. Subject to the rank being below the number of variables in the cointegrating relationship, we can re-write Π as the product $\alpha\beta'$ with β being the matrix of linearly independent cointegrating column vectors, $\beta' x_{t-1}$ capturing the long-run relationship between the variables, and α being the matrix of adjustment coefficients, where each column in α distributes the impact of the associated cointegrating vectors over time, reflecting hence the speed of adjustment to the equilibrium relation.

C. Estimation Results

The approach described above requires some (though not necessarily all) of the variables to be non-stationary. To test for stationarity, we employ the Augmented Dickey Fuller (ADF), keeping with standard practice in the literature, as well as the Elliot-Rotheberg-Stock DF-GLS tests (an augmented Dickey-Fuller test where data is first transformed via a generalized least squares regression). The tests are perfromed with and without trend. The test statistics (reported in Table 1) are compared with McKinnon critical values[3], where a test statistic below the critical value leads to reject the null of non-stationarity. The results confirm that the real exchange rate is not stationary in levels - leading to reject the Purchasing Power Parity theory -, and that most series are indeed non-stationary in levels and achieve stationarity in first differences i.e. they are non-stationary and integrated of order 1. The only exceptions are the interest rate differential *rdiff* and possibly the public deficit (*deficit*), which appear stationary in levels in various tests and are kept in the regression given that the UIP condition underpins our theoretical framework. Given that the order of integration of all our variables does not exceed one, and that some variables are integrated of order one, we rely in the approach of Johansen (1995) for the subsequent analysis.

[3] Not tabulated.

Table 1: Tests of Stationarity

	Levels		*First Differences*	
	ADF	*ADF with Trend*	*ADF*	*ADF with Trend*
Lreer	-1.866	-0.563	-4.625***	-5.909***
Rdiff	-3.903 (1)***	-3.815 (1)	-6.159 (1)***	-6.010 (1) ***
deficit	-2.101	-2.904	-7.567***	-7.444***
Nfa	-1.204	-2.914 (1)	-4.725***	-4.683***
Ltot	-0.259	-2.799 (3)	-5.262***	-5.301***
Ltnt	-0.197	-3.005	-6.394***	-6.371***
	DF-GLS	*DF-GLS with Trend*	*DF-GLS*	*DF-GLS with Trend*
lreer	-1.568 (1)	-1.639 (1)	-0.957 (3)	-4.453**
rdiff	-3.531***	-3.723**	-5.233***	-5.423***
deficit	-2.083**	-2.663	-7.278***	-7.355***
nfa	-1.175	-1.978	-4.150***	-4.577***
ltot	0.170	-1.674	-5.030***	-5.268***
ltnt	0.987	-2.933	-5.485***	-6.164***

Note – Table reports Augmented Dickey Fuller (ADF) and Elliot-Rothenberg-Stock DF-GLS unit root test statistics. The figure in parenthesis indicates number of augmented lags when present. The number of lags are set taking into account the maximum number of lags from int(min(T/3,12).$(T/100)^{1/4}$), with T being the number of observations. Final lag selection is done using Schwarz, Akaike and Hannan-Quinn information criteria. When not all the tests agree on number of lags, we use the number of lags identified by most of the tests.

***, **, and * indicate a rejection of the null hypothesis of unit root presence at 1percent, 5 percent and 10 percent level of significance, respectively, using MacKinnon critical values.

In specifying the VAR model, we considered the number of lags to include based on the number of observations available and a set of lag length criteria (Table 2). The number of observations set a maximum of two lags for the estimation to have enough degrees of freedom. All the information criteria – reported in Table below – are optimized for a single lag (the Likelihood Ratio – LR – is maximized and the rest are minimized), which led us to specify a first order VAR model.

Table 2: Lag Length Criteria

Lag	*LR*	*FPE*	*AIC*	*SC*	*HQ*
0	NA	0.0004	9.1047	9.3927	9.1903
1	186.8724*	4.91e-07*	2.4278*	4.4435*	3.0271*
2	29.7137	1.33E-06	2.9720	6.7155	4.0852

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

Table 3 reports the diagnostics on the residuals generated by the first order VAR. The Jarque-Bera test did not reject the null of multivariate normal residuals, the Lagrange Multiplier test did not reject the null of no serial correlation for lag of order 1 to 12 (the first and fifth are reported in table as illustration), and the White heteroscedasticity test did not reject the null of homoscedasticity. We only found some indication of non-normality of the residuals in the terms of trade equation. In sum, the statistics suggest that the model is well-specified.

Table 3: Diagnostics for residuals of First Order VAR

Test for Normality (Jarque-Bera)						*LM (Lagrange Multipier) Test for Serial Correlation*		*Test for Heteros-cedasticity*
lreer	*rdiff*	*debt*	*ltnt*	*ltot*	*nfa*	*1st Order*	*5th Order*	
3.94	0.92	1.24	0.90	7.16**	1.00	32.22	35.17	252.92
(0.14)	(0.63)	(0.54)	(0.64)	(0.03)	(0.61)	(0.65)	(0.51)	(0.47)

Note – Figures in parentheses are p-values. ** denotes rejection of the null hypothesis at 5 percent level of significance.

We then apply Johansen's trace procedure to identify the number of cointegrating vectors in the system following Johansen (1988), which focus on the rank of the matrix Π. The procedure involves calculating the trace test statistic for the null hypothesis that there are at most r cointegrating vectors, i.e. H_0: $rank(\Pi) \leq r$, with $r = 0,1,..,n-1$, and n being the number of variables in the system. The null is rejected when the test statistic exceeds the relevant maximum likelihood critical value. We derive our conclusion about the number of cointegrating relations from the first instance where we fail to reject the null. To calculate the trace statistics, the model specification (the inclusion of time trends and/or constants) needs to be specified. We use the Pantula principle, which jointly tests for rank and model specification. This method suggests a single cointegrating relation with a constant but no time trend in the cointegrating equation. Table 4 reports the Trace Test results with this model specification. We are able to reject the null that there is no cointegrating relation but fail to reject the hypothesis there is at most one cointegrating relation. We conclude that a single cointegrating relation exists, making interpretation of the cointegrating vector straightforward[4].

[4] Following Lütkepohl, Saikkonen and Trenkler (2001), we apply the Trace Test exclusively.

Table 4: Test for Cointegration

No. of CEs	*Trace Statistic*	*0.05 Critical Value*	*p value^*
None**	110.31	95.75	0.00
At most 1	68.92	69.82	0.06
At most 2	33.91	47.86	0.51
At most 3	14.85	29.80	0.79
At most 4	6.44	15.49	0.64
At most 5	0.66	3.84	0.42

Note – Trace test indicates 1 cointegrating equation (CE) at the 0.05 significance level, ** denotes rejection of the hypothesis at the 0.05 significance level, and ^ denotes MacKinnon-Haug-Michelis (1999) p-values.

The resulting cointegrating vector normalized on the $lreer$ (with standard errors in parentheses and t values in brackets) implies the following relationship:

$$lreer = 2.740 + 0.022rdiff + 0.243deficit - 1.209ltnt + 1.019ltot + 0.097nfa \qquad (5)$$

$$\begin{array}{ccccc} (0.01) & (0.03) & (0.45) & (0.32) & (0.01) \\ [2.07] & [7.30] & [-2.68] & [3.14] & [8.76] \end{array}$$

The signs are as expected for the interest rate differential term (*rdiff*), the terms of trade term (*ltot*), and net financial assets term (*nfa*). However, the *deficit* term has an unexpected sign, suggesting that the main channel by which the public deficit is operating is not as a measure of country-risk, but capturing the impact of consumption patterns which, if skewed towards non-tradables, cause a real appreciation. The Balassa-Samuelson effect predicts that technological progress in the domestic tradable sector - relative to own non-tradable sector and trading partners – increases income and the demand for non-tradable goods, raising the demand for and the relative price of non-tradables, that is, appreciating the exchange rate in real terms. The sign for the *ltnt* term is negative, suggesting that productivity growth in manufacturing and services lacks strong linkages with relative prices and wages for some reason, or that the ratio between manufacturing and service value added is a weak proxy for the Balassa-Samuelson effect.

Since our underlying VAR seems to be well-specified without serial correlation, non-normal or heteroscedastic residuals, and our present purpose of measuring misalignment requires within-sample prediction, we continue with the initial equation to calculate our behavioral equilibrium exchange rate. Following the methodology of Clark and MacDonald, we calculate total misalignment as follows: *reer* is defined as the actual real effective exchange rate, $Z_{1t} = (nfa, ltot, ltnt)$ as the set of fundamentals expected to have persistent effects on the real exchange rate in the long run, $Z_{2t} = (r - r^*, deficit)$ as the set expected to have medium-run effects, T the set of unobservable transitory short run variables, and ε_t the effect of purely random disturbances, such that:

$$reer_t = \beta_1' Z_{1t} + \beta_2' Z_{2t} + \tau' T_t + \varepsilon_t \qquad (6)$$

The current equilibrium exchange rate (*beer*) is defined as the exchange rate whose behavior is consistent with null transitory and random terms:

$$beer_t = \beta_1' Z_{1t} + \beta_2' Z_{2t} \qquad (7)$$

The difference between the observed real exchange rate ($reer_t$) and the equilibrium exchange rate ($beer_t$) is called "current misalignment" as it captures misalignment due to transitory factors and random disturbances only. However, absence of current misalignment does not preclude misalignment: the fundamentals determining the exchange rate may be in disequilibrium themselves, that is, out of their sustainable, long-run levels. Our purposes require that we capture misalignment due to this as well. Proxying the sustainable values of our fundamentals ($\bar{Z}_{1t}$ and $\bar{Z}_{2t}$) via the Hodrick-Prescott (HP) statistical filter[5] as Clark and McDonald (1998), we express "total misalignment" as the sum of current misalignment and long-run misalignment, i.e. the effect of fundamentals being away from their sustainable values:

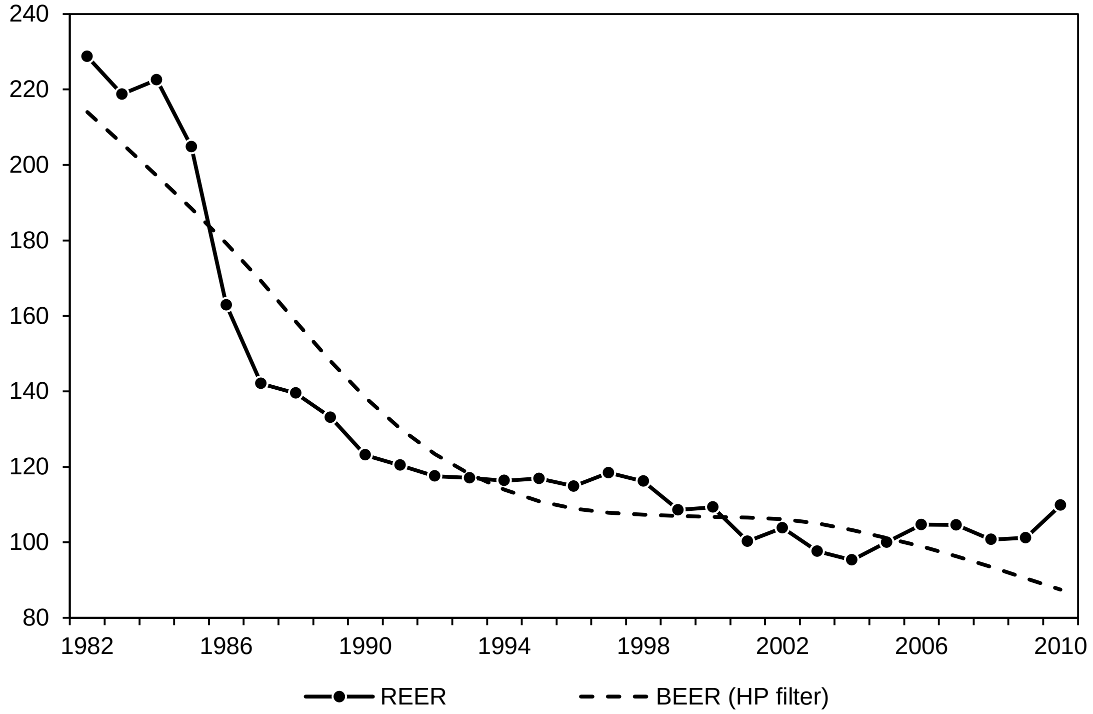
$$Total\ Misalignment_t = (reer_t - beer_t) + [\,\beta_1'(Z_{1t} - \bar{Z}_{1t}) + \beta_2'(Z_{2t} - \bar{Z}_{2t})\,] \quad (8)$$

$$= current\ misalignment + long\ run\ misalignment \quad (9)$$

Summarizing our results, Figure 4 shows the long run equilibrium exchange rate compared with the actual exchange rate for Pakistan during the 1982-2010 period, suggesting the presence of real appreciation after 2005.

[5] The filter produces a smoothed series of each of our explanatory variables by minimizing the sum of squares of the second difference.

Figure 4: Actual Real Exchange Rate (REER) vs. Long Run Equilibrium Exchange Rate (BEER-HP filter adjusted)



Source – REER (as explained in Appendix) and authors' econometric estimation of BEER. REER indexed with Base = 2005.

D. Expanded Sample with 2011

An extended sample was considered since at the time of writing this paper, data for the year 2011 also became available for most of the variables included in our model. The exception was $ltnt$: data on sector growth rates for the G7 countries were not available. In this extension, the construction of $ltnt$ was changed to be simply the growth of Pakistan's industrial sector relative to growth in its services sector. With this modified $ltnt$, the model with 2011 included was also run. This yielded similar diagnostics, and again a single cointegrating vector. Coefficients were similar with the exception of $rdiff$: the coefficient turns negative though small and insignificant.

Total misalignment calculated under this model (with 2011 included in the sample) yielded overvaluations of much larger magnitudes: an overvaluation of 60 percent in 2011 and 40 percent in 2010. For our Computable General Equilibrium (CGE) analysis we however, continue with the less extreme estimates of misalignment found in the prior analysis - for which all covariates are available- excluding the year 2011.

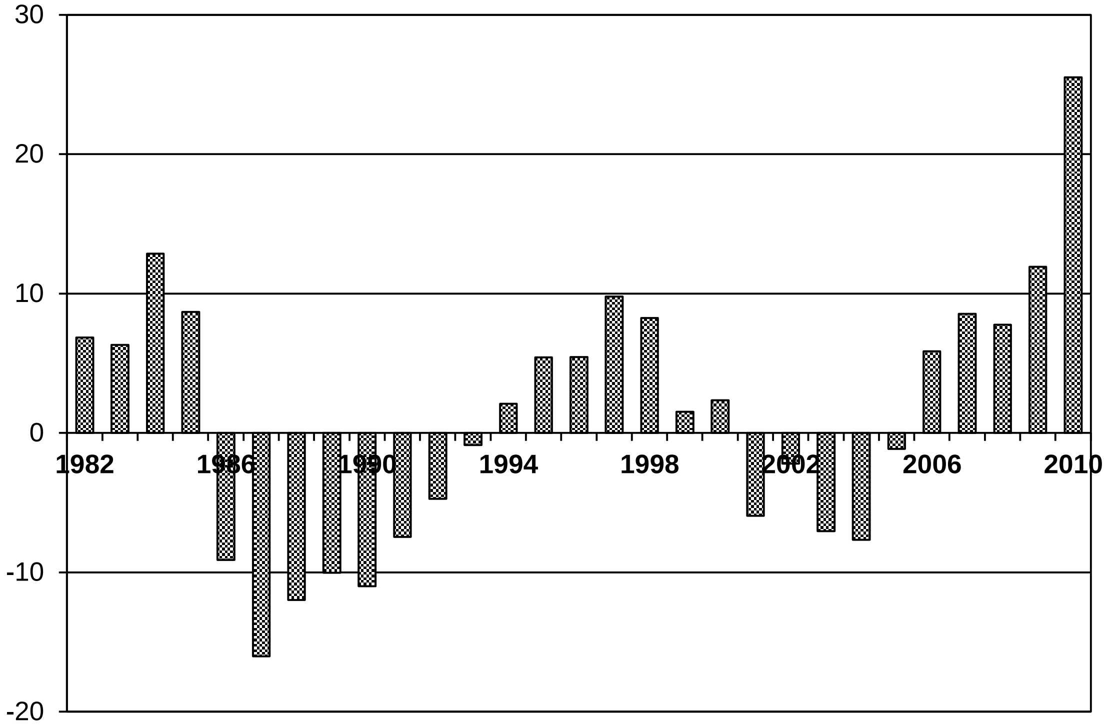
E. Discussion

In Figure 4, the BEER evaluated at the sustainable or long run values of fundamentals provides a measure of the long run equilibrium real exchange rate. It reveals that, in recent years (starting in 2006), the rupee has been overvalued, and by a growing margin. This is mostly due to the BEER depreciating over these years and – to some extent - to the actual REER appreciating in parallel. Overvaluation as a percentage of the HP-filtered BEER was as high as 25 percent in 2010 (Figure 5 and Table 5). Applying the HP-filter and differencing equation (7), we decompose the fall in the HP-filtered $beer_t$ ($\overline{beer_t}$) from 2005 to 2010 into changes in its underlying fundamentals, such that $\Delta\overline{beer} = \beta_{11}\Delta\overline{nfa} + \beta_{12}\Delta\overline{ltot} + \beta_{13}\Delta\overline{ltnt} + \beta_{21}\Delta(\overline{r-r^*}) + \beta_{22}\Delta\overline{deficit}$, where Δ stands for the observed change in the level of the variable from 2005 to 2010 and the β_{ij} are the coefficients estimated in equation (5). The fall in the HP-adjusted BEER that is observed in the 2005-2010 period is more than explained (173 percent) by the worsening of the Pakistani's terms of trade[6] during this increasing-oil-price period, and was not accompanied by a simultaneous real devaluation.

Our findings for the 1982-2000 period are in line with those of Haider and Mahboob (2005). In this period, as in that study, we find two episodes of undervaluation (from 1987 to 1995, and from 2003 to 2005) and two episodes of overvaluation (from 1981 to 1986 and from 1996 to 1998). Our results begin to disagree somewhat for the last seven years of their sample: they find that from 1999 to 2005 exchange rate was close to equilibrium while our results suggest undervaluation of up to 7 percent. For the most recent years in our sample we are able to contrast our results against the IMF ones, which are affected by the relation between the real exchange rate and its fundamentals out of Pakistan. We find overvaluation around 8 percent in 2008, which is above the 2 percent of overvaluation found with the behavioral approach and in line with the macro-balance approach (5-10 percent overvaluation) found by IMF in 2009 (IMF 2009). While the next IMF's Article IV (IMF 2012) reports little misalignment based on the behavioural approach and finds an overvaluation of about 10 percent using the macro-balance approach, recommending greater flexibility in Pakistan's exchange rate policy, our estimates in comparison suggest a stronger over-valuation, in the order of 25 percent in 2010.

[6] The main counteracting factor is given by the country's increasing public deficit. $\Delta\overline{beer} = -0.15, \beta_{11}\Delta\overline{nfa} = 0.04, \beta_{12}\Delta\overline{ltot} = -0.25, \beta_{13}\Delta\overline{ltnt} = -0.16, \beta_{21}\Delta(\overline{r-r^*}) = -0.05 \text{ and } \beta_{22}\Delta\overline{deficit} = 0.28$

Figure 5: Total Misalignment (in Percent of Actual REER)



Source – REER (as explained in Appendix) and authors' econometric estimation of BEER. REER indexed with Base = 2005.

Table 5: Total Misalignment by Year

Year	*Actual REER (Index: Base = 2005)*	*BEER (Index)*	*BEER (HP Adjusted Index)*	*Total Misalignment (Percent)*
1982	228.7	160.1	214.0	6.9
1983	218.7	284.1	205.7	6.3
1984	222.5	147.7	197.1	12.9
1985	204.8	191.8	188.5	8.7
1986	162.9	236.4	179.2	-9.1
1987	142.0	222.5	169.2	-16.0
1988	139.5	206.0	158.5	-12.0
1989	133.1	126.2	148.0	-10.0
1990	123.1	112.2	138.3	-11.0
1991	120.4	126.3	130.1	-7.5
1992	117.5	87.4	123.4	-4.7
1993	117.1	146.3	118.1	-0.9
1994	116.3	120.0	113.9	2.1
1995	116.9	88.9	110.9	5.4
1996	114.9	85.4	108.9	5.5
1997	118.4	117.2	107.9	9.8
1998	116.2	142.6	107.3	8.3
1999	108.6	92.7	107.0	1.5
2000	109.3	92.2	106.8	2.4
2001	100.3	97.8	106.6	-5.9
2002	103.8	153.0	106.2	-2.2
2003	97.6	149.0	105.0	-7.0
2004	95.3	82.4	103.2	-7.7
2005	100.0	77.5	101.2	-1.1
2006	104.7	109.9	98.9	5.9
2007	104.6	114.9	96.3	8.6
2008	100.7	110.0	93.5	7.8
2009	101.2	67.2	90.4	11.9
2010	109.8	88.0	87.5	25.5

Source – Authors' estimations.

In the section that follows, we explore how the significant correction of the real exchange rate suggested by the above estimate would affect the economic structure and the income distribution among a set of socioeconomic groups in Pakistan, placing particular attention on the income composition of these groups.

III. The Structural Effects of Aligning the Real Exchange Rate

A. The Analytical Framework

The analysis above suggests that the rupee has been overvalued during the last half a decade, with a misalignment as high as 25 percent in 2010, making the case for a significant real devaluation in Pakistan in order for its exchange rate to be consistent with its economic fundamentals. However, the analysis of the misalignment with fundamentals is silent with respect to the country's income distribution. Hence, in the following, we look into what the distributional consequences of a significant devaluation in the country would be. Such an analysis can only be carried out within a general equilibrium framework.

Specifically, we use a structural general equilibrium model specifically targeted to developing economies to analyze the general equilibrium effects of the devaluation, as documented in Debowicz and Golan (2013). Following general equilibrium theory, representative consumers (households) and producers in our model are treated as individual economic agents. Households maximize a Stone-Geary utility function, such that their consumer behavior is driven by a linear expenditure system (LES) taking income and commodity prices as given. Sector-specific producers have a constant elasticity of substitution (CES) value-added function with arguments given by labor, capital, and land, and choose factor inputs to maximize their expected profits assuming wages and prices are given. Domestic agents consider import and export world prices as given. Domestically produced goods, imports, and exports are assumed to be imperfect substitutes. Imports are determined to minimize the cost of domestic absorption given import and domestic prices, and exports are determined to maximize producers' profit given export and domestic prices. Commodity-specific domestic price changes equilibrate the commodity markets, and factor-specific wage changes equilibrate the factor markets. Production factors are fully mobile among the sectors where they are originally used. Households' incomes are the sum of factor incomes earned by them plus public and foreign transfers. Regarding macroeconomic closures, the model has (1) savings-driven investment with exogenous marginal propensities to save for the households and endogenous investment, (2) exogenous public expenditures and tax rates with endogenous public savings, and (3) exogenous real exchange rate[7] and endogenous trade balance $TBAL$ and foreign savings $FSAV$, such that $FSAV(q) \equiv -\left[TBAL(\bar{q}) + \overline{TR}_{G,R} + \overline{TR}_{H,R}\right]$, with the trade balance $TBAL$ adjusting endogenously to changes in the real exchange rate ($\bar{q}$), and $\overline{TR}_{G,R}$ and $\overline{TR}_{H,R}$ being foreign transfers to the domestic public and private sector, both measured in foreign goods, with the numeraire of the model given by the basket of consumer goods of domestic households (the consumer price index or CPI).

We calibrate its parameters using the Social Accounting Matrix for Pakistan (Debowicz et al 2012), which we update to 2010-2011 using cross-entropy methodology, and the elasticity parameters present in Yu et al (2013). As highlighted by Willenbockel (2006), comparative-static simulations using this type of model are in conception comparisons of stationary "long-un" equilibria in which the classical dichotomy is assumed to hold. The CGE model for Pakistan has 22 production sectors, 3 production factors (labor, capital and land), and 7 representative household groups, and identifies the average incomes of rural versus urban households and, among them, the incomes of households with different initial per capita income levels.

[7] While in order to assess the general equilibrium implications of a devaluation on the structure of the economy we focus on the real sphere of the economy and assume for simplicity that the real exchange rate is simply exogenous, we acknowledge that the exchange rate is in part endogenously generated by the economy, and in particular affected by the differential of the domestic interest rate to the world interest rate (adjusted for risk) and other variables presented in our VAR model of the real exchange rate estimated above.

B. Simulation Analysis

Reflecting the results of the econometric analysis above, we consider a real devaluation of 25 percent, based on total exchange rate behavioral misalignment for year 2010. After implementing the simulation (denoted as 'DEV25'), the endogenously generated changes in producer prices, production by sector, exports and imports, the real wages of the production factors, and household incomes for representative household groups can be inspected[8]. We find that, as the real devaluations take place, the relative producer prices of agricultural traded goods rise in the 2.3-4.0 percent range[9]. These changes in output prices lead to factor and production reallocation among sectors in favor of agricultural (tradable) production and against the production of manufacturing goods that are destined mostly to the domestic market (Table 6). We find that changes in output prices are not enough to explain the changes in the allocation of production factors and, in turn, value added, and that changes in input prices have a significant role in factor allocation. Ceteris paribus, as the output prices of agricultural goods rise, the profitability of agro-processed goods falls, and hence factors move out of the sectors that are highly intensive in tradable inputs (e.g. wheat milling, other manufacturing). In parallel, following the fall of the relative price of non-tradable commodities, production of non-tradable services such as energy and construction shrinks, with a significant fall in the construction sector (12.7 percent), the production of which falls due to the reduction in investment generated by the fall in foreign and hence total savings associated with the real devaluation.

[8] Given that this model is especially sensitive to the trade elasticity parameters, we conducted sensitivity analysis on them, and found that the main results regarding changes in income distribution are not significantly affected by them. The analysis is available from the authors.
[9] Not tabulated.

Table 6: Value added, Exports and Imports (Billions of Pakistan rupees for base, rest in percentage changes at constant prices)

	Value-Added		*Exports*		*Imports*	
	Value in Base (Rs. Billion)	*Percent Change*	*Value in Base (Rs. Billion)*	*Percent Change*	*Value in Base (Rs. Billion)*	*Percent Change*
Agriculture	**2,017**	**0.3**	**25**	**18.2**	**83**	**-11.0**
Wheat	235	2.1			65	-10.1
Rice - Irrigated	79	0.2				
Rice - Basmati	72	0.2				
Cotton	125	4.7				
Sugarcane	93	-0.1				
Other field crops	161	0.0			10	-12.8
Other agriculture	1,252	-0.3	25	18.2	8	-15.6
Manufacturing	**2,252**	**-0.9**	**1,010**	**10.3**	**1,632**	**-5.1**
Other Manuf.	953	-2.3	265	11.3	1,285	-6.0
Other Food	67	-0.1	26	11.9	139	-3.9
Wheat Milling	295	-0.1	0	11.4		
Rice Milling	420	0.3	119	8.1		
Sugar Milling	83	-0.1	6	10.8	1	-10.7
Cotton Processing	140	5.6	314	7.6	95	2.4
Textiles	77	3.6	249	13.6	4	-1.0
Chemicals	74	0.4	31	10.4	108	-2.7
Fertilizer	35	1.6				
Cement & Bricks	108	-9.4				
Services	**5,652**	**0.1**	**466**	**8.6**	**545**	**-11.6**
Energy	146	-0.1				
Construction	260	-12.7				
Trade	1,829	-0.2			17	-16.3
Transport	1,156	-0.1	223	11.1		
Other Services	2,261	2.0	242	6.3	529	-11.4
Total	9,922	-0.4	1,500	12.4	2,261	-9.2

Source – Social Accounting Matrix for Pakistan 2007-08 and CGE model simulations.

As the real exchange rate devalues, net exports increase in every tradable sector and the external trade balance improves. With a 25 percent devaluation, two of the largest export sectors, processed cotton and textiles, increase their exports by 7.6 and 13.6 percent respectively, and agriculture exports increase by 18.2 percent. Imports fall in almost every importing sector, with the surprising exception of processed cotton, which rises by 2.4 percent. This outcome is explained by bi-directional foreign trade with a high import-content of exports in the cotton-textile production chain: processed cotton is partly imported from China and other origins for subsequent use in the production of textiles and exports. When the economy receives a signal to increase its textile exports, it finds its additional input needs partly by producing more cotton domestically, but also partly by importing more cotton, eventually leading to an increase in cotton imports.

Given that land is only used by agriculture, which is heavily involved (directly or indirectly) in the production of tradable commodities, and that labor and capital contribute a significant share of their value added into mostly non-traded services (64 and 59 percent, respectively[10]), the change in relative prices in favor of tradable goods translates into a change in relative wages that benefits land at the expense of labor and capital, as shown in Table 7.

Table 7: Real wages (Base as Index for land and labor and assumed rental rate for capital, rest in percentage changes)

	Base	*DEV25*
Land	1.0	4.7
Labor	1.0	-2.3
Capital	0.2	-4.4

Source – CGE model simulations.

The changes in factor wages – combined with a significant increase in purchasing power of foreign remittances[11] - translate into changes in household incomes reflecting the factor endowments of representative household groups in Pakistan. In Table 8 we see that the devaluation increases the average income of the rural households (from 0.1 to 1.3 percent) and increases that of the urban poor by 3.5 percent at the expense of the large group of urban non-poor (who rely mostly on capital income), redistributing part of the urban income in favor of the urban poor and the rural, where the incidence of poverty is larger[12].

[10] Not tabulated.

[11] Foreign remittances to households in Pakistan are equivalent to eight percent of the country's GDP (Debowicz et al 2013).

[12] While there is no consensus on the poverty headcount of the country, preliminary estimations by members of the Pakistan Working Group on Poverty chaired by the Federal Minister for Planning released in January of 2014 and elaborated based on the Household Income and Expenditure Survey 2010-2011 suggest that poverty incidence is significantly higher in the rural areas (39.7 percent) than in the urban areas (27.7 percent).

Table 8: Household incomes (Base in thousand rupees per capita per year, rest in percentage changes)

	Base	*DEV25*
Large and Medium Landlord Farmers	236.4	1.3
Small Landlords and Tenant Farmers	63.2	0.4
Waged Farmers	46.7	0.1
Non-Farm Poor (Quintile 1 and 2)	37.1	0.9
Non-Farm Non Poor	64.1	1.4
Urban Poor (Quintile 1 and 2)	36.2	3.5
Urban Non Poor	152.9	-0.8
Total	78.2	0.4

Source – Social Accounting Matrix for Pakistan 2007-08 and CGE model simulations.

IV. Conclusion

Global evidence found by Rodrik (2008) and evidence specific to Pakistan presented above suggest that undervalued exchange rates lead to periods of economic activity growth. Our comparison of the observed real exchange rate of Pakistan against the equilibrium real exchange rate as based on a cointegration analysis of the real exchange rate shows that the Pakistan rupee has been overvalued during the last years by large and increasing margins, contrasting with the real exchange rates of rapidly growing economies like India and China, where large undervaluation is present. Our results add to the assessment of the IMF (IMF 2012) that the exchange rate of Pakistan has been overvalued, though our research, which is based on a single-country analysis rather than panel data for a set of countries, finds significantly higher overvaluation.

After identifying the degree of overvaluation in Pakistan – finding that the Pakistani rupee has been over-valued from 2006 to 2010 by on average 10 percent and as much as 25 percent in 2010 - , we simulate the long-run general equilibrium effects of re-aligning the real exchange rate with economic fundamentals. Realigning the exchange rate with economic fundamentals would lead to mobilization of production factors from the non-tradable to the tradable sectors, generating significant growth in sectors like cotton, cotton processing and textiles, and an increase in exports (and fall in imports) consistent with stated promotion goals of the government. It would also increase the purchasing power of poor rural and urban households receiving foreign remittances. Fortunately, the price changes associated with the devaluation do not have significant adverse distributional implications, reinforcing the argument in favor of achieving and then keeping a more competitive exchange rate in Pakistan. According to our analysis, it would be advisable for the government to progressively devalue the nominal exchange rate while keeping domestic inflation under control in order to sustain a competitive real exchange rate that allows the country to enter into a high-growth trajectory with a more progressive income distribution.

V. Appendix - Variable Definitions and Data Sources

Trade Weights

Effective exchange rate calculations start with constructing the weights to be applied to each trade partner. Within each commodity category, the weight the home country assigns to country j is unrelated to bilateral commodity trade. The calculated trade weights are based on the methodology of the IMF's Information Notice System as originally described in Zanello and Desruelle (1997) and improved by Bayoumi, Lee and Jayanthi (1999) - in terms of the calculation of the importance of domestic sales and third-market weights -, and account for third-market competition. Weights for Pakistan's trading partners were calculated using trade values from the United Nation's UNCTADStat database for the years 2008-10. At first, we attempted to work with all Pakistan trading partners. This involved looking for 1982-2010 data on terms of trade, interest rates, and other data. Several data gaps were found for China, Taiwan, Russia, Saudi Arabia, UAE, India, Uruguay, Belgium and Tanzania, particularly for terms of trade data. Due to these data availability limitations, we focused on the G7 trade partners, which account for 37.8 percent of Pakistan's external trade. To validate working with this set of trade partners, after calculating the trade weighs and real exchange rate for the 1982-2010 period, we validated our results comparing our real exchange rate series against IMF's one for the 1990-2010 sub-period – reported in WDI-, confirming a very high correlation coefficient (0.997) of our real exchange rate measure with the IMF measure for Pakistan.

Real Effective Exchange Rate

Using the trading partner weights, we calculated the CPI-based Real Effective Exchange Rate (REER) for Pakistan for the period. We use the CPI rather than a wage-based measure due to the absence of reliable data on Unit Labour Cost for the country and also for consistency with the methodology used by national authorities (State Bank of Pakistan) to measure the REER. The REER for Pakistan for each year is calculated as a trade-weighted geometric average of the relation between Pakistan and its partner's price levels in a common currency. In formula, $q = \prod_j \left(\frac{P.R}{P_j.R_j}\right)^{W_j}$, where q is the effective real exchange rate of Pakistan, j is an index that runs over the G7 trading partners, W_j is the weight assigned to trade partner j, P and P_j are the consumer price index of Pakistan and its trading partner j, and R and R_j are the exchange rates of Pakistan and its trading partner j in US dollars per local currency unit. The source of data for CPIs and the nominal exchange rates is the World Bank's World Development Indicators (WDI) database, with missing nominal exchange rate data for Euro countries completed using Penn World Tables (Heston 2011) until 1998, and US dollar per euro exchange rate reported by the European Central Bank (ECB) from the inception of the euro in 1999.

Real Effective Exchange Rate Fundamentals

Data for domestic and foreign interest rates was obtained from the country-specific average annual interest rate on government bonds present in the International Financial Statistics (IFS) database of IMF, using the weights calculated above. Pakistan's annual overall fiscal deficit measured as a percentage of GDP ($deficit$) was obtained from various issues of the Pakistan Economic Survey. The value of net foreign assets as a percentage of GDP (*nfa*) was obtained from WDI. Export and import prices of Pakistan and its trading partners for the calculation of the terms of trade (*tot*) comes from WDI, except for those of France which, missing in WDI, were calculated dividing trade values by trade volumes present in the IMF's World Economic Outlook database. Finally, measuring the Balassa-Samuelson effect (*tnt*) is not straightforward for a developing country like Pakistan since reliable data on productivity is not available. Commonly used proxies in the literature for developing countries include GDP growth[13] (implicitly assuming growth is driven by productivity growth in the tradable sector), growth in the Industrial Production Index[14] (implicitly assuming productivity growth in the tradable sector is mainly associated to the industrial sector), and a time trend[15] (which assumes that any residual trend is due to productivity changes). In this study, it is proxied by the ratio of the growth rate of value-added of the industrial (tradable-proxy) sector to the growth rate of value-added of the services (non-tradable-proxy) sector, relative to the equivalent foreign (trade weighted) ratio, as informed from the WDI database, and expressed in logs.

[13] Edwards (1989)
[14] Cheng and Orden (2007)
[15] Cottani, Cavallo and Khan (1990)

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