Estimation of Keynesian Exchange Rate Model of Pakistan by Considering Critical Events and Multiple Cointegrating Vectors

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by

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ABSTRACT

This study employs the Mundell and Fleming (1963) traditional flow model of exchange rate to examine the long run behavior of rupee/US $ for Pakistan economy over the period 1982:Q1 to 2010:Q2.This study investigates the effect of output levels, interest rates and prices and different shocks on exchange rate. Hylleberg, Engle, Granger, and Yoo (HEGY) (1990) unit root test confirms the presence of non-seasonal unit root and finds no evidence of biannual and annual frequency unit root on the level of series. Johansen and Juselious (1988,1992) likelihood ratio test indicates three long-run cointegrating vectors. Cointegrating vectors are uniquely identified by imposing structural economic restrictions of purchasing power parity (PPP), uncovered interest parity (UIP) and current account balance. Finally, the short-run dynamic error correction model is estimated on the bases of identified cointegrated vectors. The speed of adjustment coefficient indicates that 17 percent of divergence from long-run equilibrium exchange rate path is being corrected in each quarter. US war on Afghanistan has significant impact on rupee in short run because of high inflows of US aid to Pakistan after 9/11.

JEL classification: F31; F37

Keywords: Exchange Rate Determination, Keynesian Model, HEGY Seasonal Unit Root, Cointegration, Error Correction Model, Pakistan.

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1. INTRODUCTION

Stability of exchange rate is crucial for economic development. It has received a momentous consideration in the developing economics. Exchange rate provides the macroeconomic links among the countries via goods and asserts market (Moosa and Bhatti, 2009). In literature different approaches have been developed to analyze the behavior of exchange rate. Purchasing Power Parity (PPP) is the earliest approach for exchange rate determination, introduced by Swedish economist Gustav Cassel in 1920s. In case of Pakistan most of the studies have analyzed the PPP theory and have found mixed results. Chisti and Hasan (1993) does not support PPP model to explain the exchange rate variations. Bhatti and Moosa (1994) argued that the failure of PPP under flexible exchange rate is due to the negligence of expectations in exchange rate determination. Bhatti (1997) investigated and succeeded to prove the ex-ante version of PPP, in which exchange rate is explained not only by current relative prices but also by the expected real exchange rate. Moreover Bhatti (1996), Qayyum, *et al.* (2004) and Khan and Qayyum's (2008) results do support the validity of relative form of PPP in Pakistan.

PPP theory is based on the concept of good arbitrage and ignores the importance of capital movement in exchange rate determination. To fill this gap Keynesian Approach of exchange rate determination is initiated by Robert Mundell(1962) and James Fleming (1963) by introducing the capital flows into current account balance of payment approach. Bhatti (2001) empirically tested the Keynesian flow model for determining Pak rupee exchange rates against six industrial countries' currencies. He suggested that nominal exchange rate in Pakistan is determined by relative price level, relative income level and interest rates differentials. The relative version of exchange rate model assumes symmetry in the coefficients of domestic and foreign coefficients. However, no former information is available to assume this symmetry.

Moreover, relative version of exchange rate models is unable to find the multiple cointegrating vectors. Multiple cointegrating vectors contain valuable information and should be carefully interpreted (Dibooglu and Enders, 1995). In international literature a lot of studies are available that established and uniquely identified the multiple cointegrating vectors (see for example Juselius, 1995; Dibooglu and Enders, 1995; Helg and Serati, 1996; Diamandis *et. al.*, 1998; Cushman (2007); Tweneboah, 2009, among others).

Currencies under flexible exchange rate system generally tend to depreciate more than currencies having fixed exchange rate system due to the occurrence of critical events (Ltaifa *et al.*, 2009). Pakistan had adopted a flexible exchange rate system since 2000 and its currency is freely floating against US dollar. Therefore, any disaster emerged in US economy directly hit the Pakistan rupee. After 2001, nominal exchange rate of Pakistan is highly volatile, though, the other economic fundamentals remain the same. Its instability is attached to the happening of critical events during this era. 9/11 event and US war against terror in Afghanistan had appreciated the rupees against dollar. This appreciation was contributed to high inflows of remittances and foreign capital inflows to Pakistan. The appreciation of rupees is no more long lasting and turns into depreciation when Global Financial Crisis (GFC) has occurred in 2007. In the period of GFC the foreign exchange reserves decline from $ 14.2 billion in 2007 to $3.4 billion in 2008. Pakistan rupee exchange rate against US dollar has lost its value by 21 percent during 2008. So far no study is available to test the significance of these critical events on the exchange rate in the framework of Keynesian model. This paper fills this gap.

The objective of this study is to estimate the non relative version of Keynesian exchange and test the symmetry among the domestic and foreign price level, output level and the interest rate. Keynesian model incorporates the uncovered interest parity (UIP) and purchasing power parity

(PPP) conditions. The identification of these parity conditions are also the aim of this paper. To examine the effect of critical events on the exchange rate of Pakistan this paper uses the intervention dummies for 1998 Pakistan's nuclear test, 9/11 event, US war against terror in Afghanistan after 9/11and recent global financial crisis (2007) in the estimation process.

The rest of the study is organized as follows: Section 2 presents the theoretical framework of Keynesian model. Section 3 deals with the econometric methodology. The data and construction of variables is subject of section 4. Section 5 describes the empirical results. Section 6 concludes the study and identifies some policy implications.

2. THEORETICAL FRAMEWORK

The traditional Keynesian approach is developed by Mundell (1962) and Fleming (1962). They extended the Keynesian IS – LM framework to an open economy by incorporating the capital flow *via* balance of payment. Therefore, this is also known as a balance of payment approach or traditional flow model of exchange rate determination. Capital account consists of direct foreign investment, portfolio investment and other capital transactions such as short term money market transactions and net error and omissions, which significantly determine the exchange rate under the floating exchange rate regime (MacDonald, 1995). This model, therefore, gives equal importance to capital account and current account in exchange rate determination. Accordingly, the demand and supply of foreign exchange is determined by the flows of currency emanating from international transactions.

The standard Mundell–Fleming model can be represented by the following equations:

(Good Market) $$Y = C(\overset{(+)}{Y}) + I(\overset{(-)}{i}) + G + CA(\overset{(+)}{\frac{SP^f}{P}}, \overset{(+)}{Y^f}, \overset{(-)}{Y}) \quad (1)$$

(Money Market) $$L(\overset{(+)}{Y}, \overset{(-)}{i}) = R + D \qquad (2)$$

(Balance of Payment) $$\Delta f = CA(\overset{(+)}{\frac{SP^f}{P}}, \overset{(+)}{Y^f}, \overset{(-)}{Y}) + K(\overset{(+)}{i}, \overset{(-)}{i^f}) \qquad (3)$$

Equation (1) represents real income (*Y*) as the sum of real consumption by households (*C*) ,private real investment expenditure by firms (*I*), real government spending (*G*) and trade balance (*CA*). It depicts the *IS* curve, which traces the combination of interest rate and real income along with the good market in equilibrium.

Equation (2) is the money market equilibrium condition. The left hand side indicates the demand for money which positively relates to real income and inversely to interest rate and is equivalent to supply of money which comprises the official stock of foreign exchange reserves (*R*) and the domestic credit (*D*). All possible combinations of interest rate and real income along with the money market in equilibrium are known as the *LM* schedule.

Equation (3) defines the balance of payments. Δf denotes the change in foreign reserves which equals zero under the flexible exchange rates. The central bank does not intervene in the foreign exchange market under the flexible exchange rates. It neither purchases foreign exchange reserves to absorb excess supply, nor sells reserves to meet excess demand. As a result, the exchange rate fluctuates freely to clear the foreign exchange market. Therefore, the conventional balance of payments view of exchange rate suggests that the latter moves to equilibrate the sum of the current account (*CA*) and capital account (*K*) of the balance of payments, thereby ensuring that the change in reserves equals zero. *CA* is positively related to real exchange rate ($\frac{SP^f}{P}$), where *S* denotes nominal exchange rate measured by domestic currency per unit of foreign currency, P represents domestic prices and P^f the foreign price level. An increase in real exchange rate implies the depreciation of domestic currency against foreign currency after accounting for change in domestic and foreign prices. An increase in foreign output (Y^f) and depreciation of domestic currency has favorable effect on the balance of trade (BOT) by enhancing the demand for domestic exports. However, it is deteriorated by increase in domestic output level (Y). The traditional flow model also assumes that foreign and domestic assets are imperfect substitutes, which implies that interest rate differentials may causes finite capital flows into or out of a country. More precisely, it is argued that (given risk aversion) investors require a risk premium to move their capital funds from one financial asset to another. In the special case of perfect capital mobility, even the smallest deviation of the domestic interest rate from the foreign interest rate is predicted to induce infinite flows into or out of the domestic economy (Bhatti, 2001 and Moosa and Bhatti, 2009). Thus, the net capital inflow *(K)* is a positive function of domestic interest rate (i) and negative function of foreign interest rate (i^f).

The objective of this section is to derive the reduced form equation of the equilibrium exchange rate under the Keynesian approach. It suggests that the nominal exchange rate is determined by relative prices, relative incomes and relative interest rates. In the literature a number of studies, for example Gylfason and Helliwell (1982), Pearce (1983), Bhatti (2001) and Moosa and Bhatti (2009), have derived the Keynesian equilibrium exchange rate model by utilizing BOP equation (3). Following these studies, equation (3) can be written as

$$BOP = a(\frac{SP^f}{P}) + b^f\, Y^f - bY + ci - c^f i^f \qquad (4)$$

All variables of equation (4) except interest rate are expressed in logarithm form and denoted it by small letters. For simplicity a restriction $b^f = b$ and $c = c^f$ is imposed.

$$BOP = a(s + p^f - p) - b(y - y^f) + c(i - i^f) \quad (5)$$

where a and b are the price and income elasticities of trade inflows. The equilibrium exchange rate is determined when BOP is in equilibrium i.e. the net of current and capital account is zero and solving for nominal exchange rate ‘ s ’, we have

$$s = (p - p^f) + \frac{b}{a}(y - y^f) - \frac{c}{a}(i - i^f) \quad (6)$$

which explains that the equilibrium exchange rate is positively related to relative prices and relative incomes, but inversely related to relative interest rates. An increase in domestic prices relative to foreign prices is thought to depreciate the domestic currency. This is because an increase in prices leads to decrease the demand for exports and consequently deteriorates the current account balances. An increase in domestic real income relative to foreign real income is predicted to have a negative effect on the current account by increasing the demand for imports and depreciates the domestic currency. The increase in the domestic interest rate relative to foreign interest rate causes capital inflows into the domestic country and results in the appreciation of the exchange rate.

In general form, the above equation (6) is written as

$$s = f(\overset{+}{p}, \overset{-}{p^f}, \overset{+}{y}, \overset{-}{y^f}, \overset{-}{i}, \overset{+}{i^f}) \quad (7)$$

The Keynesian model suggests that PPP does not hold in the long run (Bhatti, 2001). Therefore, it portrays the short-run relationship of nominal exchange rate with domestic and foreign prices, domestic and foreign output and domestic and foreign interest rate. Pearce (1983) used the OLS regression analysis to test the empirical validity of the model but was unable to obtain satisfactory results. However, with the development of time series literature, particularly relating to cointegration and unit root testing, enables the researches to re-estimate the economic theories and solve not only the spurious results of the OLS technique but also explore the long run cointegrating vectors among the variables. The fundamental variables of exchange rate determination under the Keynesian model are found to be non-stationary in literature. Hence, these variables have a tendency to share similar long-run movements. MacDonald (1995) defined the theory of long-run exchange rate modeling by relating the concepts of uncovered interest rate parity, absolute and efficient markets PPP (EMPPP) to a standard balance of payments equilibrium condition. In order to link the absolute PPP with the current account balance he asserted that under a long-run net capital flows were zero when savings were at their desired level. This specification reduces the BOP account to current account balances. Thus we can write the equation (6) as,

$$s = (p - p^f) + \frac{b}{a}(y - y^f) \tag{8}$$

The current account balance approaches to PPP only when the difference between domestic and foreign income level i.e. $(y - y^f)$ tends to be zero. This would be possible if the price elasticity of domestic exports is infinitely large $(a \to \infty)$ (MacDonald, 1995 and Moosa and Bhatti, 2009), in this case the exchange rate is exclusively determined by the PPP that is,

$$s = (p - p^f) \tag{9}$$

On the other hand, the non-zero value of $(y - y^f)$ will produce a real exchange rate pattern that is not equal to zero. Hence even with full long-run price flexibility, changes in net excess demands for domestic goods can alter the relative price of traded to non-traded goods and therefore the real exchange rate (Balassa- Samuelson productivity bias). Balassa and Samuelson (1964) suggested that a high income country is technologically more advanced than a low income country. Therefore, the technological advantage is not uniform across sectors. The high income country is enjoying greater technological advantage in the tradable sector as compared to the non tradable sector. According to the law of one price, the prices of tradable goods will be equalized across countries. However, this would not be the case in the non tradables' sector, where the law of one price does not hold. Increased productivity in the tradable goods sector will increase real wages and as a result lead to an increase in the relative price of non tradables (but there has been no increase in the productivity of the non traded sector). If the overall price index is weighted at average of traded and non traded goods prices, the high income country will tend to enjoy overvalued currencies. Thus, long-run productivity differentials would lead to the trend of deviations from PPP. Balassa and Samuelson also examined the effect that deviations of exchange rates from PPP have on inter-country income comparisons. In particular, the lower the per-capita income of a country the lower the domestic price of services. This reasoning contradicts the predictions of the absolute version of PPP which states that exchange rate conversions based on PPP yield unbiased income comparisons. Hence, the non-zero value of $(y - y^f)$ is likely to be most important when comparing countries at different stages of development, but less important for countries at a similar level of development. Allowing a constant in equation (9) would represent a permanent deviation from absolute PPP due to productivity differentials and other factors (MacDonald, 1995 and Taylor and Taylor, 2004).

The efficient market view of PPP suggests that in a world of high or perfect capital mobility it is not goods arbitrage that matters for the relationship between an exchange rate and relative prices, but interest rate arbitrage. Hence, a slow speed goods market arbitrage causes a temporary deviation of the exchange rate from PPP. The temporary deviation could be due to factors including relative growth differentials, interest rates, speculative price movements or commodity prices. This requires that the exchange rate drifts in such a manner as to restore the relative PPP. Algebraically these deviations can be expressed as

$$\Delta s = p - p^f - s \qquad (10)$$

A perfectly mobile capital immediately diverts the attention to focus on the capital account of the balance of payments. The assumption of perfect capital mobility may be represented as

$$\Delta s^e = i - i^f \qquad (11)$$

Equation (11) represents the uncovered interest parity condition. This condition defines that the difference between the domestic interest rate (i) and foreign interest rate (i^f) produces an expected depreciation of the exchange rate. The implication of this definition is that, if the domestic interest rate is high compared to its foreign counterpart, the domestic currency would be expected to depreciate. As a forward-looking market clearing mechanism, the UIP condition tends to be relatively fast under an efficient asset market assumption compared to the adjustment in the PPP.

As discussed earlier, under perfect capital mobility the deviation from long-run PPP can be defined by interest rate differentials. This fact is documented by Frenkel (1978) and Juselius, (1995) among others, as the fluctuations in exchange rate are attributed by both goods and assets market development. Therefore, PPP and UIP conditions may not be independent of each other in the long run. This allows us to substitute equation (11) into equation (10) to combine PPP with UIP and model the nominal exchange rate as.

$$s = p - p^f - i + i^f \qquad (12)$$

Tweneboah (2009) suggested a necessary condition to make sense for equation (12) is that the interest rate differential and PPP conditions are either stationary in process [$i - i^f \sim I(0)$ and

$p - p^f - s \sim I(0)$] or if the processes are non-stationary [$i - i^f \sim I(1)$ and $p - p^f - s \sim I(1)$] their combination , denoting the real exchange rate (q), as provided by Equation (12) produces a stationary process [$q = s - p \ \ + p^f + i - i^f \sim I(1)$].

The above discussion make it clear that it is not worthwhile to empirically analyze the short run relationship between exchange rate, domestic and foreign price level, interest rate and output and ignore their long run associations (defined in equation (8) to (12)). Hence, long run relationship(s) would be combined with the short run dynamics of exchange rate by employing the vector error correction mechanism.

3. EMPIRICAL METHODOLOGY

3.1 Unit Root Test

Cointegration analysis is based on the assumption that variables are integrated of same order. Pre-testing for unit root is necessary to avoid the problem of spurious regression. Quarterly time series usually contains unit roots at seasonal frequencies, such as seasonal unit root at biannual and annual frequency, and non seasonal zero frequency unit root. In this study Hylleberg, Engle, Granger, and Yoo (HEGY) (1990) has been used to test for non seasonal zero frequency unit root and biannual and annual frequency seasonal unit roots.

HEGY provide following auxiliary regression

$$\Delta_4 y_t = \mu_t + \pi_1 y_{1,t-1} + \pi_2 y_{2,t-1} + \pi_3 y_{3,t-1} + \pi_4 y_{3,t-2} + \sum_{i=1}^{l} \gamma_i \Delta_4 y_{t-i} + \varepsilon_t \qquad (13)$$

Where μ_t is a deterministic term which can include any combination of a drift term, trend term and a set of seasonal dummies. $y_{1,t}$, $y_{2,t}$, $y_{3,t}$ and $y_{4,t}$ are linearly transformed series as proposed by HEGY.

$$y_{1,t} = (1+B)(1+B^2)y_t = y_t + y_{t-1} + y_{t-2} + y_{t-3}$$

$$y_{2,t} = -\ (1-B)(1+B^2)y_t = -\ (y_t - y_{t-1} + y_{t-2} - y_{t-3})$$

$$y_{3,t} = -\ (1-B)(1+B\ \ )y_t = y_t - y_{t-2}$$

$$y_{4,t} = \Delta_4 y_t = y_t - y_{t-4}$$

B is a lag operator such that $B^k y_t = y_{t-k}$ and $\varepsilon_t \sim (0,\sigma_e^2)$ is Gaussian error term and white noise $Cov(\varepsilon_t, \varepsilon_{t-i}) = 0$. The auxiliary regression (13), comes from the fact that $\Delta_4 = (1-B^4)$ can be decomposed as $(1-B)\times(1+B)\times(1-iB)(1+iB)$ where each term in bracket corresponds to non seasonal zero frequency unit root 1, biannual frequency unit root -1 and annual frequency unit root $\pm i$.

HEGY method testing the significance of π_j (*j=1,2,3,4*) parameters. If $\pi_1 = 0$, then series contain non seasonal zero frequency unit root. If $\pi_2 = 0$, this implies biannual frequency seasonal unit root. If $\pi_3 = \pi_4 = 0$, then series has seasonal unit root at annual frequency. The appropriate filter if $\pi_1 = 0$ is (1-B), when $\pi_2 = 0$ then (1+B) filter is required and when $\pi_3 = \pi_4 = 0$ then (1+B^2) is needed to make the series stationary. Critical values for one sided t-test for $\pi_1\ (t_{\pi_1})$, $\pi_2\ (t_{\pi_2})$ and for the joint F- test for π_3 *and* $\pi_4 (F_{34})$ are provided by HEGY.

3.2 Johansen Cointegration Methodology

Johansen and Juselius cointegration technique is useful to construct a multiple long–run equilibrium relationships over multivariate system. Generally, this technique is applied to $I(1)$ variables. Johansen's method in k dimensional error correction (EC) form is presented as follows:

$$\Delta z_t = \sum_{i=1}^{l-1} \Gamma_i \Delta z_{t-i} + \Pi z_{t-1} + \phi D_t + \mu + \varepsilon_t \qquad (14)$$

Where z_t is $(k \times 1)$ dimensional vector of $I(1)$ variables.

D_t is consist of centered seasonal dummies, intervention and policy dummies such that all are $I(0)$.

μ is deterministic trend component, which is further consists of $\mu = \mu_1 + \delta_1 t + \mu_2 + \delta_2 t$. $\mu_1, \delta_1 t$ are constant and trend term in the long-run cointegrating equation and $\mu_2, \delta_2 t$ are drift and trend of short-run vector auto regressive (VAR) model. Five distinct has been discussed in literature (for example Johansen and Juselius (1990), Johansen (1991, 1995), Hamilton (1994), Hendry (1995), Pesaran, *et al.* (2000), Harris and Sollis (2003) and Enders (2004) among others) for appropriate treatment of deterministic components.

$\varepsilon_t \overset{ii}{\sim} N(0, \Sigma)$ is $(k \times 1)$ vector of Gaussian random error terms and Σ is $(k \times k)$ variance covariance matrix of error terms.

$(i = 1,2,........, l-1)$ is the lag length.

$\Gamma_i = -(I - A_1 - .... - A_i)$ is short- run dynamic coefficients.

$\Pi = -(I - A_1 - .... - A_l)$ is $(k \times k)$ matrix containing long-run information regarding equilibrium cointegration vectors. The number of cointegrating vectors (r) are determines by rank of Π matrix. If $0 < rank(\Pi) < k-1$ then it is further decompose into two matrices i.e. $\Pi = \alpha\beta'$: α is $(k \times r)$ matrix contains error correction coefficients which measures the speed of adjustment to disequilibrium. β' is $(r \times k)$ matrix of $r(\Pi)$ cointegrating vectors.

The rank of Π matrix in Johansen and Juselius (1990) cointegration methodology is measured by likelihood ratio trace and maximum eigenvalue statistics. In case of multiple cointegrating vectors Johansen and Juselius (1990) allow the imposition of linear economic restrictions on β matrix to obtain long-run structural relationships.

3.3 Short-Run Dynamic Error Correction Model

Finally, after identifying the cointegration relationships, next step is to estimate the dynamic error correction model. According to Granger (1983) Representation Theorem, if there is long-run stable relationship among the variables then there will be a short-run error correction relationship related with it. Short-run vector error correction representation is as follows

$$\Delta z_t = \sum_{i=1}^{l-1} \Gamma_i \Delta z_{t-i} + \alpha(\beta' z_{t-1}) + \phi D_t + \mu + \varepsilon_t \tag{15}$$

$\beta' z_{t-1}$ is the error correction term. The traditional methodology uses the residuals from the identified cointegrating vector(s) to form $\beta' z_{t-1}$. α in dynamic error correction model measures the speed of adjustment toward equilibrium state. Theoretically speed of adjustment coefficient must be negative and significant to confirm that long-run relationship can be attained.

4. DATA AND CONSTRUCTION OF VARIABLES

This study has considered the quarterly data over the period spanning from 1982:Q1 to 2010:Q2. A start from 1982 is on account of implementation of flexible exchange rate policy in Pakistan. All variables are measured in the currency units of each country. The data are obtained from International Financial Statistics (IFS) and State Bank of Pakistan (SBP) Monthly Statistical Bulletin (various issues).

The nominal exchange rate is measured in terms of units of Pakistan rupee (PKR) per unit of US dollar (US $). Real Gross domestic product (GDP) is commonly used as a measure of real output level. Quarter wise nominal GDP of US is accessible from IFS. The real GDP at constant base of 2000 is found by deflating nominal GDP on GDP deflator (2000=100). In case of Pakistan only annual real GDP is available. Quarterisation of annual real GDP from 1982:Q1 to 2003:Q4 is done by using the percentage share of each quarterly to annual GDP at market price (1980-81), as estimated by Kemal and Arby (2004). However, quarterisation of 2004:Q1 to 2010: Q2 is made by utilizing the average share of each quarter to annual GDP in 2000s (2000 to 2003) i.e. 22.07, 27.15, 25.21 and 25.57 percent in first, second, third and fourth quarter respectively.

Consumer price index (CPI) is frequently used in literature as a measure of price level. CPI (2000=100) of corresponding countries is taken as a proxy of domestic and foreign price level. Call money rate for Pakistan and federal fund rate for US is used as a measure of interest rate.

During the analysis period exchange rate of Pakistan is also influenced by the critical events such as 1998 Pakistan's nuclear, 9/11 event, US war against terror in Afghanistan after 9/11and recent global financial crisis (2007). Dummy variables D_{98} (0 for $t < 1998$:Q2 and 1 for t 1998:Q2), D_{911} (1 for t = 2001:Q3 and 0 otherwise), D_{afgwar} (0 for $t < 2001$:Q4 and 1 otherwise) and D_{fc} (1 for 2007:Q1 $\leq t \leq$ 2009:Q2 and 0 otherwise) are used to capture the influence of these events on the exchange rate.

5. RESULTS AND DISCUSSION

This section implements the Johansen and Juselius (1988, 1992) multivariate cointegration methodology to detect the stable long run relationships between the exchange rate and fundamental variables. In case of multiple cointegrating vectors, we would impose structural economical restrictions to uniquely identify the cointegrating vectors. The identified cointegrating vectors are then used to estimate the parsimonious short-run dynamic error correction model. This final estimated model will be utilized to develop the out-of-sample forecasts. The preliminary time series properties for cointegration analysis are as follows:

5.1 Order of Integration (Unit Root test)

All the variables are transformed in logarithmic form except the interest rate. Cointegration technique is applicable only when the variables are integrated of same order. Therefore, the presence of seasonal and non seasonal unit roots for each quarterly series is determined via HEGY (1990) test. The results of the HEGY test are presented in Table 1. From this table we observed that the null hypothesis of a non seasonal unit root cannot be rejected whereas the null hypothesis of seasonal unit root at both biannual and annual frequency are rejected at 5 percent critical values for all of the variables. (1-B) is an appropriate filter to make the series stationary. The results of HEGY test after applying required filter is presented in Table 1 and we found no evidence of seasonal and non seasonal unit roots at 5 percent level of significance. Therefore, all variables in our cointegration analysis are integrated of order one and we may suspect multiple long run cointegrating vectors.

Table 1: HEGY Test at Level of Series

Variable	**Regressors**				Null & Alternative Hypothesis			**Roots (Filter)**
					$\pi_1 = 0$ $\pi_1 < 0$	$\pi_2 = 0$ $\pi_2 < 0$	$\pi_3 = \pi_4 = 0$ $\pi_3 \neq \pi_4 \neq 0$	
	Lags	Drift	Trend	Seasonal Dummies	Test Statistic			
					π_1	π_2	π_3, π_4	
s	0	Yes	No	No	-0.81	-5.76	55.37	1(1-B)
y	3	Yes	No	No	-2.10	-8.81	29.61	1(1-B)
y^f	0	Yes	No	No	-3.06	-4.50	101.23	1(1-B)
p	0	Yes	Yes	Yes	-1.69	-8.66	27.92	1(1-B)
p^f	0	Yes	No	No	-2.46	-9.89	20.52	1(1-B)
i	0	No	No	No	-0.23	-4.74	22.96	1(1-B)
i^f	0	Yes	Yes	Yes	-3.14	-8.12	73.87	1(1-B)
(1-B) s	0	Yes	No	No	-4.86	-4.79	26.77	--
(1-B) y	2	Yes	No	No	-2.96	-8.45	36.91	--

(1-B) y^f	1	Yes	No	No	-3.69	-4.05	39.85	--
(1-B) p	0	Yes	No	No	-3.07	-6.77	15.54	--
(1-B) p^f	0	Yes	No	No	-4.34	-6.64	19.13	--
(1-B)i	0	No	No	No	-6.20	-3.72	13.27	--
(1-B)i^f	0	Yes	No	Yes	-4.94	-6.31	51.09	--

5.2 Unrestricted VAR Model Specification

The next step after implementing the unit root test is to decide the optimal lag length of the multivariate system of equations (VAR), which ensures that residuals of VAR model are white noise. For this purpose different information criterion has been used in the literature such as Akaike Information Criteria (AIC), Schwarz Information Criterion (SIC), and sequential modified likelihood ration (LR) test. Cheung and Lai (1993) have found that AIC and SIC lag selection criteria may be inadequate to tackle the problem of serial correlation. Hence, we used Johansen (1995) multivariate LM test and choose the appropriate lag structure of the VAR equation is 3 quarters. Three central seasonal dummies and four intervention dummies D_{98}, D_{911}, D_{afgwar}, D_{fc} are also included.

The residual of the VAR(3) passed the diagnostic test of no serial correlation ($\chi^2_{(49)} = 52.31$ with four lags), no heterosedasticity ($\chi^2_{(1372)} = 1355.36$) at 5% level of significance, but fail to pass the null hypothesis of normally distributed error terms under Jarque - Bera (JB) test ($\chi^2_{(14)} = 73.24$). However, lack of normality does not affect the results of Johansen (1988) likelihood ratio tests (Gonzalo, 1994; Paruolo, 1997; Cheung and Lai, 1993; Eitrheim, 1992 and Goldberg, 2001).

5.3 Multivariate Cointegration Analysis

After selecting the lag length of VAR model, another fundamental issue is the suitable treatment of deterministic components such as drift and trend term in the cointegrating and the VAR part of the VECM. Most of the series in our analysis, exhibit a linear trend in the level of the series. Therefore, we introduce intercept term unrestrictedly both in long run (cointegrating part) and short run (VAR) model while performing cointegration analysis (Johansen, 1995; Harris and Sollis, 2003 and Qayyum, 2005). Table 3, presents the trace and maximum eigenvalue statistic after adjusting by factor (T-kl)/T to correct the small sample bias.

Table 3: Cointegration Test Results

Trace statistic				**Maximum Eigenvalue statistic**			
Null Hypothesis	**Alternative Hypothesis**	**Chi-Square**	**0.05 Critical Value**	**Null Hypothesis**	**Alternative Hypothesis**	**Chi-Square**	**0.05 Critical Value**
r = 0	r > 0	155.05	125.62	r = 0	r = 1	50.81a	46.23
r ≤ 1	r > 1	104.24	95.75	r = 1	r = 2	32.81	40.08
r ≤ 2	r > 2	71.43	69.82	r = 2	r = 3	30.65	33.88
r ≤ 3	r > 3	40.78	47.86	r = 3	r = 4	19.85	27.58
r ≤ 4	r > 4	20.94	29.80	r = 4	r = 5	15.16	21.13
r ≤ 5	r > 5	5.77	15.49	r = 5	r = 6	5.49	14.26
r ≤ 6	r > 6	0.29	3.84	r = 6	r = 7	0.29	3.84

Note: '[a]' indicates the rejection of null hypothesis at the 5 percent level.

The trace test shows that the null hypothesis of no cointegration (r=0), one cointegration (r ≤ 1) and two cointegrating vectors (r ≤ 2) can be rejected, but fails to reject the null of three cointegrating vectors at 5% level of significance. Therefore, variables of Keynesian exchange rate model are found to be cointegrated with three cointegrating vectors. Whereas, the maximum eigenvalue statistic with the null hypothesis r=1 is rejected, but the null hypothesis of r=2 is not rejected and refers one long run relationship exists among the variables. This contradiction among the tests for cointegrating vector is common. We continue our analysis on the basis of trace test, as it is a more powerful test as compare to maximum eigenvalue statistics in case of not normally distributed error terms (Cheung and Lai, 1993; Hubrich *et al.* 2001).Kasa (1992) and Serletris and King (1997) also preferred trace statistics as it considers all k-r (k is no. of variables in the system and r is the cointegrating vectors) values of smallest eigenvalues.

As described earlier that multiple cointegrating vectors contain valuable information and must be carefully interpreted. To obtain this information we start by imposing proportionality and symmetry restriction on all vectors in proceeding section.

5.4 Proportionality and Symmetry Restrictions

Before the identification of cointegrating vectors, we proceed to test the proportionality and symmetry restrictions of prices, interest rates and output through likelihood ratio test on all cointegrating vectors. The acceptance of these restrictions provides the validity of strict form PPP and UIP. The likelihood ratio (LR) test statistic along with their probability values for the proportionality and symmetry restrictions are reported in Table 4.

Table 4: Restricted Cointegrating Vectors

Hypothesis	**Restrictions**		χ^2 **(df)**	**P-Value**
Symmetry Restrictions				
Price Symmetry	H1:	$\alpha_1 = -\alpha_2$	9.33(3)[a]	0.03
Output Symmetry	H2:	$\alpha_3 = -\alpha_4$	7.13(3)[aa]	0.08
Interest rate Symmetry	H3:	$\alpha_5 = -\alpha_6$	16.41(3)	0.00
Price and output Symmetry	H4:	$H_1 \cap H_2$	15.73(6)[a]	0.02
Price and interest rate Symmetry	H5:	$H_1 \cap H_3$	23.24(6)	0.00
output and interest rate Symmetry	H6:	$H_2 \cap H_3$	23.00(6)	0.00
Joint Symmetry of prices, interest rate and output	H7:	$H_1 \cap H_2 \cap H_3$	25.92(9)	0.00
Proportionality Restrictions				
	H8:	$\alpha_1 = -\alpha_2 = 1$	14.80(6)[a]	0.02
	H9:	$\alpha_3 = -\alpha_4 = 1$	32.85(6)	0.00
	H10:	$\alpha_5 = -\alpha_6 = 1$	32.85(6)	0.00

Note: [a],[aa], and[aaa] indicates the significance at 1%, 5% and 10%.

First part of Table 4, reports the result of symmetry restrictions on prices, output and interest rates on all three cointegrating vectors, in order to find whether they enter in the equilibrium relation or not. The symmetry restriction implies that prices, output and interest rates influence the exchange rate regardless of where they originate. According to LR test statistics, symmetry restrictions are hold for prices and output. Under H_3, we found no evidence of interest rate symmetry. The joint symmetry restrictions implied by H_4 through H_7 are mostly rejected at 95 percent confidence interval.

Further, the proportionality restriction (H_8) holds for prices but not for output and interest rate in all three cointegrating vectors. Symmetry and proportionality of prices is opposite to the finding of Khan and Qayyum(2008). The basic reason for this contradiction is the absence of other fundamental variables such as output levels and interest rate in their analysis. In our analysis we can predict the long run strong form PPP in the presence of other fundamental variables.

5.5 Identification of Cointegrating Vectors

In Table 5, we proceed by imposing the theoretical restrictions such as PPP, UIP and their combinations. The first part of Table 5 reports individual parity conditions. Under $H_{11,}$ strict version of PPP is tested in all cointegrating vectors. The LR test statistics accepts this hypothesis at 10 percent level of significance. Similarly strong PPP form with unrestricted output coefficients (H_{24}) and with unrestricted interest rate coefficients (H_{22}) are also accepted at 5 percent level of significance.

H_{12} analyzed the strict form of PPP with restricted fundamental variables in the first cointegrating vector only. This hypothesis is rejected by the LR test and suggests that the strong form of PPP does not hold on its own. Weak form of PPP is investigated under H_{13} and H_{14} , both of these hypothesis are rejected by LR test.

Table 5: Identification of Cointegrating Vectors

Some Theoretical Restrictions				
Hypothesis		*Restricted CI vectors* $s\ p\ p^f y\ y^f i\ i^f$	χ^2 (df)	P- Value
Individual Parity Conditions				
PPP in all three vectors (Strict PPP with other fundamental Variables)	H_{11}:	1 -1 1 * * * * 1 -1 1 * * * * 1 -1 1 * * * *	14.80(6)[a]	0.02
PPP in one vector (strict PPP on its own)	H_{12}:	1 -1 1 0 0 0 0 * * * * * * * * * * * * * *	15.98(4)	0.003
Weak PPP in all three vectors	H_{13}:	1 ** 0 0 0 0 1 ** 0 0 0 0 1 ** 0 0 0 0	52.83(12)	0.00
Weak PPP in one vector (PPP on its own)	H_{14}:	1 ** 0 0 0 0 * * * * * * * * * * * * * *	16.44(2)	0.00
UIP in all three vectors (Strict UIP with other fundamental variables)	H_{15}:	1 * * * * 1 -1 1 * * * * 1 -1 1 * * * * 1 -1	32.85(6)	0.00
UIP in one vector (Strict UIP on its own)	H_{16}:	1 0 0 0 0 1 -1 * * * * * * * * * * * * * *	2.06(4)[aaa]	0.73
Weak UIP in all three vectors	H_{17}:	1 0 0 0 0 * * 1 0 0 0 0 * * 1 0 0 0 0 * *	70.84(12)	0.00
Weak UIP in one vector (UIP on its own)	H_{18}:	1 0 0 0 0 * * * * * * * * * * * * * * * *	0.58(2)[aaa]	0.75
Combined Parity Conditions				
PPP and UIP (Strict PPP and Strict UIP)	H_{19}:	1 -1 1 0 0 1 -1 * * * * * * * * * * * * * *	1.48(4)[aaa]	0.83
PPP and UIP (Weak PPP and Strict UIP)	H_{20}:	1 * * 0 0 1 -1 1 * * 0 0 1 -1 1 * * 0 0 1 -1	60.95(12)	0.00
PPP and UIP (Weak PPP and Strict UIP)	H_{21}:	1 * * 0 0 1 -1 * * * * * * * * * * * * * *	0.73(2)[aaa]	0.69
PPP, i, i* (Strict PPP and weak UIP)	H_{22}:	1 -1 1 0 0 * * * * * * * * * * * * * * * *	0.42(2)[aaa]	0.82
Weak PPP and Weak UIP	H_{23}:	1 * * 0 0 * *	26.35(6)	0.00

		1 * * 0 0 * * 1 * * 0 0 * *		
Other Restrictions				
PPP, y, y*	H_{24}:	1 -1 1 * * 0 0 * * * * * * * * * * * * * *	1.72(2)[aaa]	0.22
Relationship between s,y,y*	H_{26}:	1 0 0 * * 0 0 * * * * * * * * * * * * * *	4.30(2)[aaa]	0.12
PPP,UIP and output symmetry	H_{27}:	1 -1 1 -1 1 1 -1 * * * * * * * * * * * * * *	0.38(4)[aaa]	0.85

Note: * in column three represents no restriction.
[a],[aa], and [aaa] in column four indicates the significance at 1%,5% and 10%.

The rejection of both strict and weak forms of PPP on its own (in the absence of other fundamental variables) is consistent with different studies in literature such as Khan and Qayyum (2008), Helg and Sarati (1996), Diboogluand Ender (1995) and MacDonald (1993). These studies indicate different causes for the rejection of strong PPP. For example, Diboogluand and Enders (1995) and MacDonald (1993) argued that different methods have been developed to measure the national indices which result in non-proportionality of price and rejects the PPP. According to Helg and Sarati (1996) during the period of flexible exchange rate, PPP does not hold on its own. Khan and Qayyum (2008) argue that rejection of strong form of PPP is due to the significance of transportation and transaction cost which create a deviation among the prices.

After investigating the different versions of PPP restrictions, we now analyze the UIP condition. First we examine whether the strong form of UIP restriction applies to all three cointegrating vectors or not, by formulating H_{15}. This hypothesis is strongly rejected by the LR test. However, under H_{16}, we hold that UIP relationship is stationary by itself by imposing unity restriction on interest rate coefficients and zero restriction on prices and output coefficients in the first cointegration vector. The LR test result supports that one of the cointegrating vectors maintains a stationary relationship between the interest rate variables. This result is consistent with Johanson and Juselius (1992).

Further, the weak form UIP is tested in all cointegrating vectors by H_{17} and in the first cointegrating vectors through H_{18} with zero restriction on the coefficient of prices and output. H_{17} is rejected by the LR test but not the latter hypothesis. From the results of various forms of UIP conditions, we can conclude that UIP holds with or without the fundamental variables.

Following this, we combined the PPP and UIP restrictions by H_{19} through H_{23}. On the basis of LR statistic, we find that the strong form PPP with the strong UIP (H_{19}), the weak form PPP with strong form UIP (H_{21}), and the strong form PPP with weak form UIP (H_{22}) enter the cointegrating vector. Finally it is determined that the joint hypothesis of PPP, UIP and output symmetry in one cointegrating vector is not rejected under H_{27}.

The general hypothesis tested from H_1 to $H_{27,}$ is informative in formulating unique vectors in the multiple cointegration space. These results suggest that the strong form of PPP with output relationship (H_{24}) is considered in one vector while the UIP relationship is in the second vector and the strict form PPP, output proportionality and unrestricted interest rate in the third vector. Thus all cointegrating vectors are normalized on the nominal exchange rate. It would therefore be applicable to specify the long run cointegrating vector β' matrix as:

$$\beta' = \begin{bmatrix} 1 & -1 & 1 & * & * & 0 & 0 \\ 1 & * & 0 & 0 & 0 & 1 & -1 \\ 1 & -1 & 1 & -1 & 1 & * & * \end{bmatrix}$$

For the identification of cointegrating vectors, we include unrestricted domestic price coefficient with UIP condition in the second vector. Because, as a general rule if each cointegrating vector contains at least one variable unique to it, it would imply that the cointegration relationship will always be identifiable.

The LR test statistics for these restrictions are $\chi^2_{df=7} = 9.17$ which do not reject this hypothesis.

The results of the long-run cointegrating vectors are presented as;

$$s_t = p_t - p_t^f + 4.81 y_t - 6.38 y_t^f + 39.85 \quad (16)$$

$$s_t = -i_t + i_t^f + 2.88 p_t - 5.48 \quad (17)$$

$$s_t = p_t - p_t^f + y_t - y_t^f + 0.21 i_t - 0.25 i_t^f + 0.98 \quad (18)$$

The restriction on the first cointegrating vector (equation 16) indicates that the exchange rate is determined by current account balance independent of net capital inflows (zero restriction on domestic and foreign interest rates). The existence of unrestricted domestic and foreign output level in this vector configures the non- zero value of real exchange rate and confirms the Blassa Samuelson productivity bias. Hence, it may be concluded from this vector that with full long-run price flexibility, changes in net excess demand for domestic goods can alter the relative price of traded to non-traded goods and therefore the real exchange rate. The signs of the coefficients are according to theoretical expectations. The results can be interpreted as:

- Strong form PPP suggests that exchange rate moves one-for-one with the prices of two countries.
- Positive significant coefficient of domestic output on nominal exchange rate reveals that one percent increase in domestic output result in a 4.81 percent depreciation of domestic currency via higher demand of imported commodities.

- A one percent increase in foreign output level tends to appreciate the nominal rate by 6.38 percent.

The second cointegrating (equation 17) suggests that in the long run the exchange rate is determined by the interest rate differential (UIP). Under UIP, a currency with higher interest rate is expected to depreciate by the amount of interest rate differential. This vector also proposed that nominal exchange rate is exclusively determined by net capital inflows. Domestic prices are also included for the purpose of identification; its estimated parameter shows that one percent increase in domestic prices result in 2.88 percent depreciation of currency.

The last cointegrating vector (equation 18), combines both current and net capital inflows to account for exchange rate determination. Moreover, we impose strong form of PPP and output proportionality restrictions. A positive coefficient of domestic interest rate on exchange rate suggests that a one percent increase in domestic interest rate leads to depreciate the domestic currency against the US dollar by 0.21 percent whereas an increase in foreign interest rate results in the appreciation of domestic currency by 0.25 percent. The estimated parameters of both interest rates are not according to theory; the opposite signs of interest rate were also observed in Bhatti (2001).

5.6 The Dynamic Error Correction Model for Keynesian Exchange Rate:

This section presents the short-run dynamic error correction model (ECM) of the Keynesian exchange rate model. The residuals of the long run cointegration functions (from equations 11 to 13) are used as an important determinant of ECM. These residuals are also known as disequilibrium estimates or error correction terms. It measures the divergence from long run equilibrium in period t-1 and provides the speed of adjustment information toward the equilibrium.

The ECM is estimated by ordinary least squares (OLS) method. The estimation process considers the Hendray ‘general-to-specific’ strategy (1992). The general model is initiated by incorporating drift term, three seasonal dummies, intervention dummies (D_{98}, D_{911}, $D_{afgwar,}$ D_{fc}), lag of error correction terms and lag length of three for each first difference variables (exchange rate, prices, outputs, interest rates). The specific model is achieved by dropping the insignificant lags. The parsimonious ECM model with t- ratios in parentheses is as follows;

$$\Delta s_t = \underset{(1.87)}{0.21\Delta y_{t-1}} \underset{(-3.24)}{-1.26\Delta y^f{}_t} \underset{(3.08)}{+0.53\Delta p_{t-3}} \underset{(3.91)}{+1.74\Delta p^f{}_t} \underset{(3.13)}{+1.24\Delta p^f{}_{t-2}} \underset{(2.87)}{+0.003\Delta i_{t-3}} \underset{(-2.04)}{-0.01\Delta i^f{}_t} \underset{(-4.76)}{-0.03D_{afgwar}} \underset{(2.48)}{+0.03EC1_{t-1}} \underset{(-4.45)}{-0.03EC2_{t-1}} \underset{(-4.69)}{-0.15EC3_{t-1}} \qquad (19)$$

$Adj\ R^2 = 0.41$ $\qquad F_{(13,92)} = 10.21\,\text{prob}(0.000)$

The residual of parsimonious ECM satisfied the diagnostic tests of Breusch-Godfrey (1978) LM test of no serial correlation ($\chi^2{}_{(1)} = 0.01$ and $\chi^2{}_{(4)} = 5.54$), Engle’s (1982) ARCH LM test ($\chi^2{}_{(1)} = 0.57$ and $\chi^2{}_{(4)} = 1.10$ and Jarque-Bera normality test ($\chi^2{}_{(2)} = 5.24$) at 5 percent level of significance.

Finally, the stability of ECM’s parameters is examined by utilizing Cumulative Sum of Recursive Residuals (CUSUM) and Cumulative Sum of Squares of Residuals (CUSUMSQ) test. The plots of CUSUM and CUSUMSQ are provided in Figure 1 and Figure 2. The plots show that CUSUM and CUSUMSQ remain within the 5 percent critical bound suggesting that there is no significant structural instability and the residual variance is stable during the period of analysis.

The estimated coefficients of ECM in equation (19), show that in the short run the exchange rate responds to change in domestic and foreign price level, real output and interest rates. In the short run dynamic model the high coefficients of foreign variables relative to domestic variables imply the dominant role of foreign variables in affecting the exchange rate.

In the short-run change in foreign price level has a dominant effect on the nominal exchange rate among other variables, due to its higher coefficient. The positive sign of change in foreign price level indicates that an increase in foreign price level depreciates the domestic currency in the short run and does not appreciate the currency as suggested by the theory. It confirms the finding of Ahmed and Alam (2010) that Pakistan is a growth driven economy and an increase in relative price of imports may not reduce the import demand. Pakistan's major imports consist of petroleum products, essential capital goods and machinery. These goods contribute more than 50 percent share of total imports and among these goods the Petroleum Group alone constitutes the largest share in our import bill, that is 32 percent in 2010 (State Bank of Pakistan). An increase in oil prices disturbs the balance of payment and puts downward pressure on the exchange rate which makes imports more expensive (Malik, 2008; Kinani, 2010). A change in domestic output level in preceding quarter depreciates the domestic currency by 0.21 percent.

The estimated parameter of lagged change in domestic interest rate significantly depreciates the nominal exchange rate, whereas, the change in foreign interest rate appreciates it. According to estimates, the change in foreign interest rate in period *t* tends to change the nominal exchange rate in the same period, although the nominal exchange rate responds to change in domestic interest rate after three quarters.

Among the intervention dummy variables only D_{afgwar} is found to be significant in the short run dynamic model. Its negative coefficient signifies the appreciation of the rupee. During the period of the US ‘war on terror’ in Afghanistan the total US foreign assistance received by Pakistan since fiscal year 2002 was $ 20 billion. This is more than the aid Pakistan received from the US between 1947 and 2000, which is $12 billion only (Epstein and Kronstadt, 2010).

The absence of financial crisis dummy variable does not imply that nominal exchange rate of Pakistan is independent of financial crisis. But the reason is the absence of the financial sector in the Keynesian model. Therefore, the effect of financial crisis will clearly measure in those models that incorporate the financial sector.

Theoretically, the sign of error correction term should be negative and significant. The negative sign confirms adjustment towards equilibrium state. In our analysis, the coefficient of first error correction term is positive and statistically significant, while the coefficients of second and third error correction terms obey the theoretical definition that is negative and significant.

The result of $EC1_{t-1}$ indicates that the exchange rate overshoots from long run equilibrium path by 3 percent if the exchange rate is measured only by current account balance. The second error correction term is attained from the UIP/net capital inflows cointegrating vector. Its estimated parameter confirms the exchange rate adjustment towards the long run equilibrium path by 3 percent. The third error correction term recommends that long run deviation of nominal exchange rate from its equilibrium path is being corrected by 15 percent every quarter. Therefore, the net convergence of exchange rate towards its equilibrium state is 15 percent per quarter. The time required to remove 50 percent of disequilibrium from its exchange rate equilibrium path is three quarters (nine months)[1].

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[1]The time required to remove the x percent of disequilibrium from its equilibrium path is determined as $(1-EC)^{4t} = (1-x)$, where t is required number of periods to dissipate x percent ofdisequilibrium.

Figure 1: Cumulative Sum of Recursive Residuals

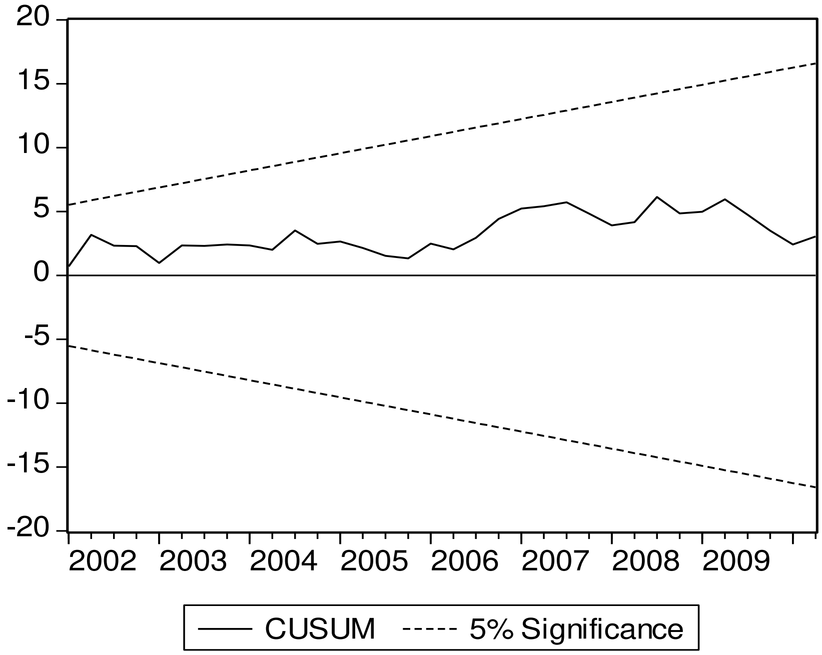
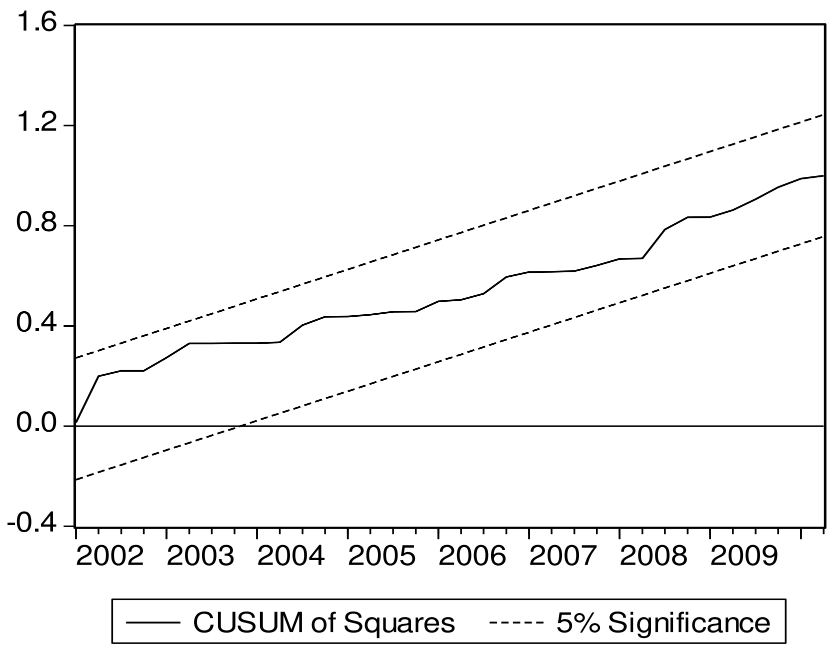


Figure 2: Cumulative Sum of Squares of Recursive Residuals



6. CONCLUSIONS

This paper has empirically analyzed the Keynesian exchange rate model by employing Johansen and Juselius (1988, 1992) cointegration method. Trace test has found three long run relationships among exchange rate, prices, interest rates and output levels. The symmetry restrictions on price coefficients and output coefficients and proportionality restriction on price coefficients are only satisfied by maximum likelihood ratio test. This chapter has tested the various form of PPP, UIP and their combinations to identify the cointegrating vectors. The results support the validity of PPP with the presence of other fundamental variables such as unrestricted output level and interest rates. However, UIP condition holds on its own. Based on the these restrictions, further, the first cointegration vector has defined the current account, the second vector has explained the UIP and the last vector has described the Keynesian approach to exchange rate determination. The entire coefficients (except the interest rates) estimated in the system are significant and according to theory. The error correction terms suggest that the net convergence of exchange rate towards its equilibrium state is 15 percent per quarter and three quarters are required to remove 50 percent of exchange rate misalignment from equilibrium path.

The main policy implications drawn from this chapter are;

- The maintenance of PPP ensures that obtaining unlimited benefits from arbitrage in traded goods is not possible. Therefore, Pakistan is unlikely to improve its external competitiveness against US.
- Validity of PPP and UIP allows the use of inflation differentials and interest rate differentials to forecast long-run movements in exchange rates.

- The exchange rate of Pakistan against US dollar is significantly determined by output levels, prices and interest rates. Therefore, interaction between good and capital assets market is required for conduction of exchange rate dynamics in Pakistan.

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