AN ECONOMETRIC ANALYSIS OF DETERMINANTS OF EXCHANGE RATE IN PAKISTAN

Ahmed Saeed
Department of Business Administration
University of Sargodha
Pakistan

Rehmat Ullah Awan
Department of Economics
University of Sargodha
Pakistan

Dr Maqbool H. Sial
Department of Business Administration
University of Sargodha
Pakistan

Falak Sher
Department of Economics
University of Sargodha
Pakistan

Abstract

This study undertakes an econometric analysis of determinants of exchange rate for US Dollar in terms of Pakistani Rupee within the framework of monetary approach. Monthly data from January 1982 to April 2010 for Pakistan relative to USA have been used to examine the long run and short run behavior of PKR/USD exchange rate and relationship of exchange rate behavior with relative monetary variables. Stock of money, foreign exchange reserves and total debt of Pakistan relative to United States along with Political instability in Pakistan as a dummy variable are taken as determinants of PKR/USD exchange rate during the managed floating regime in Pakistan. ARDL approach to co-integration and error correction model are applied. Empirical results confirm that stock of money, debt and foreign exchange reserve balance all in relative terms are significant determinants of exchange rate between Pakistani Rupee and US Dollar. Moreover, Political instability has a significant negative effect on the value of domestic currency.

Keywords: Exchange Rate, Stock of Money, Foreign Exchange Reserve Balance, Debt, Monetary Approach, Co-integration, Error Correction Model, ARDL

Introduction

Modeling of exchange rate behavior is one of the unsolved issues of research to be dealt with. Due to the enormous significance of the exchange rate in an economy, no one can deny the need to understand the behavior of foreign exchange markets. There is a need to study exchange rate determinants and behavior of foreign exchange markets in detail. Monetary approach developed in 1970's is one important tool to explain variation in the exchange rate. Some questions require answers like: what should be equilibrium exchange rate? How is it determined? What are the determinants of exchange rate? Estimation and prediction of foreign exchange rate poses substantial theoretical and experimental challenge.

Changes in exchange rate have pervasive effects, with consequences for prices, wages, interest rates, production levels, and employment opportunities. Fluctuations in the value of currencies of different economies have increased after the collapse of Bretton Woods System. Especially short term variability has dramatically increased following the shift from fixed to flexible exchange rate in early 1970's and there after. High volatility and sudden changes in exchange rate is one of the hurdles for the success of macroeconomic policy. A model with theoretical and empirical validity needs to be developed. Forecasting nominal exchange rates is a difficult task especially in a flexible exchange rate arrangement (Rogoff, 2009).

Factors affecting exchange rate can be economic, political, psychological and also the short run or long run. Behavior of exchange rate may be more appropriately studied through macro variables and/ or micro variables.
Policy makers would like to know what can be feasibly done to limit the fluctuation in the values of the currencies. What forces are involved in the fluctuations of currency values? How can the behavior of exchange rate be estimated and predicted? To find the answers to these policy issues, economists have engaged in extensive conceptual and empirical research aimed at explaining the behavior of exchange rates since early 1970's. So far research efforts made by the researchers to understand the behavior of exchange rate have met with only limited success. Meanwhile policy guidelines have been evolved and lessons have been learnt from, but raised new questions by the experience of attempting to maintain macroeconomic stability in an evolving world economy.
There are two main schools of thought of fundamentalists addressing the issue of exchange rate determination and forecasting. One school of thought is of the view that it is the demand for and supply of currencies with flow concept that determines the equilibrium value of currencies. They use balance of payment information to determine the demand and supply of currencies. Whereas the other school of thought is of the view that equilibrium value of relative stock of financial assets determines the behavior of exchange rate. It is the ratio of financial assets of the respective country which determines the equilibrium exchange rate. Changes in the stock of financial assets are source of fluctuation in the values of exchange rate.

It can be inferred from the various approaches/models and discussions in prior studies, that the behavior of exchange rate is a complex issue having many dimensions. Research work based on balance of payment approach rests mainly on elasticity approach or absorption approach. Whereas research based on monetary approach uses purchasing power parity condition, Quantity theory of money (QTM), Interest rates parity, money demand function and cumulative current account position to examine the exchange rate behavior.

In the early 1980's, it appeared certain that empirical research has not founded support in favor of monetary approach to exchange rate. However, due to the advancement in the econometric techniques, statistical tools and model specifications, recent empirical research has provided supportive evidence for the long run validity of monetary approach (Wilson, 2009).

This study has been organized as follows; Section 2 presents a brief history of Exchange rate system for Pak Rupee. Detailed summary of various theoretical and empirical research is given in section 3. Section 4 describes data and methodology used for empirical estimations of the factors affecting foreign exchange rates in Pakistan. The results of the empirical estimations are presented and discussed in section 5. Section 6 concludes the study with policy recommendations and implications for further research.

2. Brief History of Exchange Rate System for Pakistani Rupee:

Before 1971, Pakistani Rupee was linked with Pound Sterling. In 1971, Pakistan decided to de-link Rupee from Pound and pegged it with US Dollar. In 1982, Pakistan moved towards managed floating exchange rate mechanism because it was believed by the policy makers that Rupee pegged rate with US Dollar was significantly shifted away from the fundamentals. Rupee was allowed to float on the basis of trade weighted basket of currencies. This managed floating exchange rate mechanism helped to reduce the gap between official rate and market rates.

In 1991, financial sector reforms were initiated to increase the share of private sector in the banking business and to improve the banking sector performance in Pakistan. In 1998, Pakistan adopted multiple exchange rate system to deal with trade and other sanctions imposed after atomic explosions. Three different rates were introduced, Official rate i.e., rate in which Rupee was pegged with US Dollar at a fixed rate, Floating Inter Bank Rate (FIBR) through which first time commercial banks were allowed to quote their rate and, Composite rate that was calculated by combining official rate with FIBR rate.

In 1999 multiple exchange rate system was unified and Rupee was pegged with US Dollar flexible with in a band. In 2000, the Government of Pakistan removed the band set for the movement of exchange rate. Since then there is floating exchange rate system in Pakistan. All banks quote their own rates. State bank of Pakistan as an autonomous body is responsible for well functioning of the foreign market in Pakistan. Behavior of exchange rate needs to be studied due to two main reasons. Firstly, the economic impact of exchange rate fluctuations is very high and secondly determinants or basic sources of these variations/fluctuations are not finally known with empirical evidence.

Exchange rate of Pak Rupee against US Dollar has depreciated more than 700% since the introduction of managed float exchange rate arrangement in Pakistan starting from 1982 to 2010. This means Pakistan Rupee is continuously losing its value against Dollar. This situation is almost true for the behavior of Pakistani Rupee against other worldwide used foreign currencies. Exchange rate between Pakistani Rupee and US Dollar was 10.39 on January 1982 and 85.75 in December 2010. Minimum value of exchange rate during this period is 10.39 and maximum value is 86.28. There is more than 700% decrease in the value of Pakistani Rupee against US Dollar. Standard deviation of Rupee-Dollar exchange rate is 21.7598 and co- efficient of variation is 0.5384 which seems very high.

Exchange rate has shown the tendency to rise from 1982 to 2001 and started declining in late 2001till mid 2005. Since 2005, it has been rising up till now. Figure 1 describes the behavior of nominal bilateral exchange rate of Pakistani Rupee against US Dollar from 1982 to 2010, covering the period of managed floating system in Pakistan.

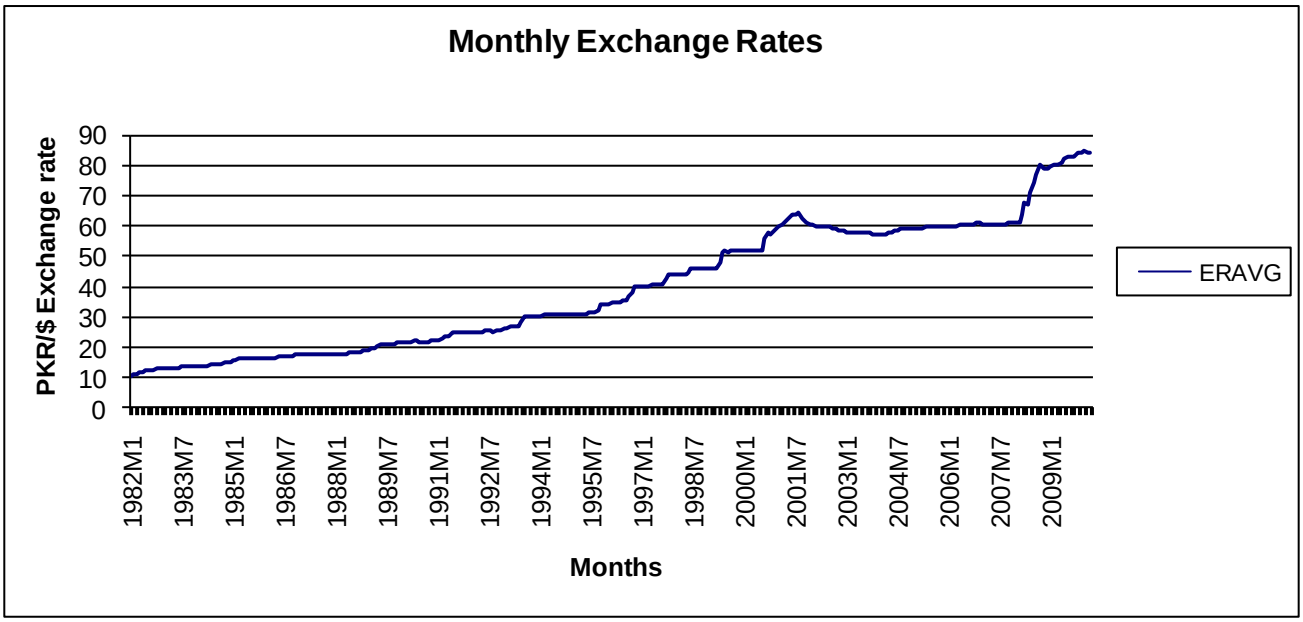
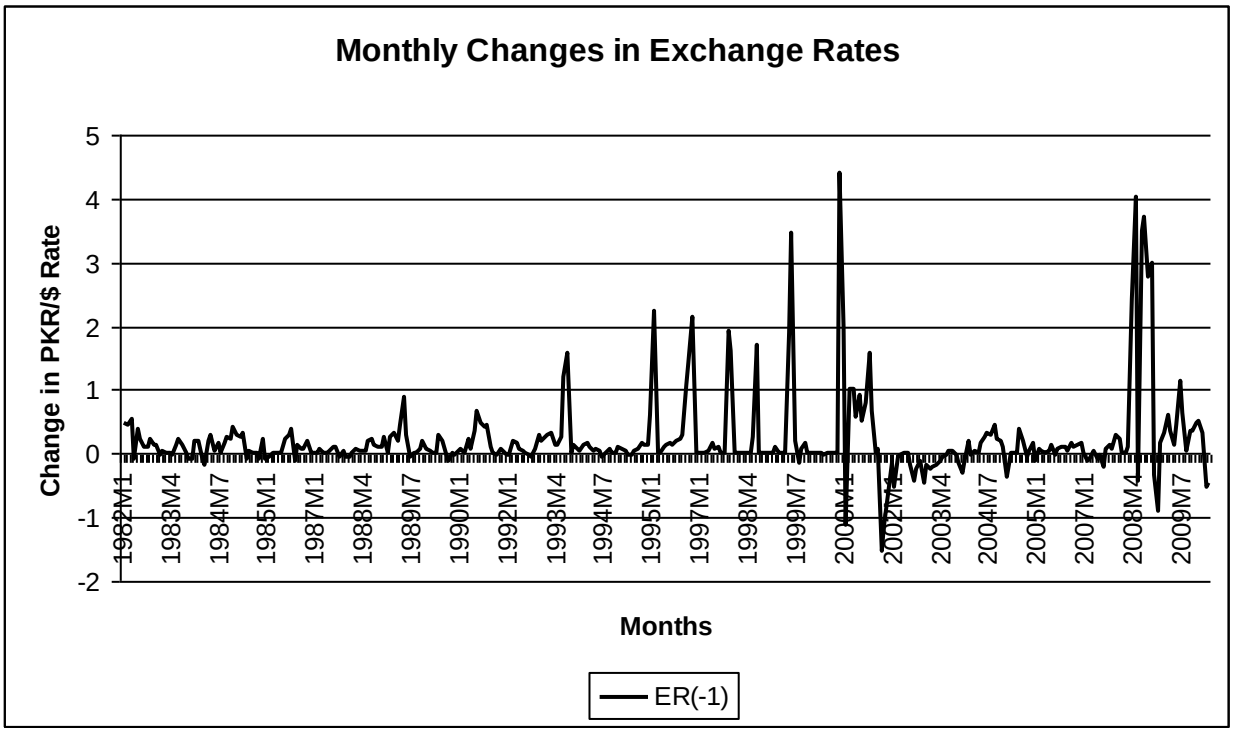


Figure 2 Monthly fluctuations in exchange rates over time

Figure 2 reflects the month to month fluctuations in the Rupee/Dollar exchange rate showing frequent and abrupt changes. There are frequent, sudden and haphazard fluctuations in exchange rate between Rupee and Dollar, with more fluctuations in democratic regimes as compared to military regimes.

Figure 2 Monthly fluctuations in exchange rates over time



3. Review of Literature

MacDonald and Taylor (1984, 1993, 1994) estimated and tested the forecasting performance of unrestricted monetary model and random walk model for US Dollar and British Pound. Estimated results of study are supportive of unrestricted monetary model as compared to random walk result. Siddiqui et al (1996) estimate the determinants of real exchange rate for Pakistan and find that increase in governmental expenditures leads to depreciation in real exchange rate. Coefficient of terms of trade (TOT) is positive and statistically insignificant. Excess domestic credit creation significantly contributes to real exchange rate appreciation. Openness has also contributed towards appreciation in exchange rate. Technological progress has negative sign but statistically insignificant. Both monetary variables and real sector variables have significant effect on the equilibrium path determination of Real Exchange Rate. Reinton and Ongena (1999) used structural exchange rate models to study the Norwegian currency market. Empirical results of flexible and sticky price monetary models show that the error correction equation incorporating long run proportionality between exchange rates and money and money growth differentials will outperform random walk currency prediction in significant manner. Monetary exchange rate models outperform the random walk model at 6 and 12 months horizons by using Norwegian Krone against four major currencies exchange rate from 1986-96. Bahmani and Kara (2000) examined the case of exchange rate overshooting in Turkey using monthly data ranging from January 1987 to December 1998 for Turkish Lira per unit of US Dollar exchange rate.

Empirical estimates support the overshooting hypothesis in the short run. Sign of change in real income is negative which indicates the relative growth in the real income in Turkey relative to USA appreciates Lira. Interest rate differential and inflation differential has correct signs and are statistically significant. Papadopoulos and Zis (2000) study the determination of exchange rate by estimating Drachma/ECU rate applying co-integration technique, Impulse response and Variance decomposition analysis with monthly data from 1980 to 1991. Exchange rate variation appears to be dominated mainly by money and interest rate innovations. Fullerton et al (2001) test set of error correction model for Peso/Dollar rate based on balance of payment approach and monetary approach using annual data from 1976 to 2000. Estimated results show that an error correction technique is not an appropriate technique for Mexico when data frequency is annual. Karfakis (2003) tests the monetary model for Romanian Lei and US Dollar exchange rate and concludes that Money is positively related with the exchange rate. Increase in money is the source of depreciation in the domestic currency.

Real income is negatively related with value of currency and Inflation is positively related with the value of Romanian currency against Dollar. Empirical estimates validate the monetary model. Hyder and Mehboob (2005) estimate equilibrium value of real effective exchange rate (EREER) of Pakistani Rupee, calculating exchange rate misalignment for Pakistan and identify that degree of openness, increase of governmental expenditure and capital account balance bring depreciation in the real effective exchange rate. Rise in worker remittances from abroad and the betterment in TOT and total factor productivity (TFP) relative to trading partners cause appreciation in the real effective exchange rate. Misalignment is smaller in flexible arrangements. Nieh and Wang (2005) re-examined the Dornbusch (1976) sticky price monetary model in Taiwan, examining the association between NTD/USD exchange rate and macro economic fundamental of Taiwan/USA. Empirical result of the study has found no long run relationship between exchange rates and macro fundamentals. Short run response supports the overshooting of currency depreciation as pre described by Dornbusch (1976).

Islam and Hasan (2006) test monetary model through examining behavior of Dollar–Yen exchange rate. Overall results of this study provide empirical evidence of supporting predictability for Dollar-Yen exchange rate through monetary model determinants. Janjua and Ahmed (2006) conducted study to test purchasing power Parity for Bangladesh, India, Pakistan, and Sri Lanka. Mean reversion properties of real exchange rate series have been investigated. No long run relationship exists between nominal exchange rate and relative price levels for Bangladesh. The evidence of co-integration for Sri Lanka and India was also quite weak. Co-integrating relationship for Pakistan between nominal exchange rate and relative price was significant both with respect to consumer price index and whole sale price index and lag length. Karim et al (2007) used quarterly data of macroeconomic variables for New Zealand and its trading partners (Australia, Japan and United States of America) to find the impact of monetary policy shocks on New Zealand's nominal and effective exchange rate. Empirical estimates of this study imply that implementation of tight monetary policy causes nominal exchange rate and effective exchange to appreciates.

Khan and Quyyum (2007) found empirical evidence on PPP for Pakistan Rupee and US Dollar using ARDL approach to co-integration over a period of 1982Q2-2005Q4. Chin et al (2007) test the alternative version of monetary model for exchange rate of Malaysian Ringgit per unit of US Dollar, using Johansen co-integration approach. In case of Dornbusch (1978) money and income differential signs are consistent with Dornbush model but interest rate variable has positive sign. For Frankel (1978) specification indicates that the coefficients of money and income differential carry correct signs and are statistically significant. Sulaiman et al (2009) test purchasing power parity theory in Pakistan using Engle and Granger (1987). Annual data from 1980 to 2008 of Consumer Price Index, Wholesale Price Index and nominal Exchange rate between Pakistan Rupee and US Dollar have been used to test purchasing power parity theory for Pakistan. According to the empirical estimate of error correction term disequilibrium of previous period shocks adjusts towards their long run equilibrium approximately in a period of one year. Wilson (2009) examined the effective exchange rate of US Dollar based on the weighted average trading partner of USA. Money supply is positively related to the effective exchange rate and increase in money causes decline in the value of currency.

Estimated coefficients of rates of interest, government expenditure and deficit to GDP are negatively related with effective exchange rate. Liew et al (2009) examine the behavior of Baht (Thailand) and Yen(Japanese Currency) exchange rate with in the context of flexible price monetary model. Empirical findings of the study suggest that exchange rate is effectively determined by flexible price monetary model. Hsieh (2009) has studied the behavior of Indonesian Rupiah per unit of US Dollar. Results of extended Mundell-Fleming model of exchange rate determination indicate that relatively more real money aggregate, a relatively higher domestic interest rate, or a relatively more expected inflation rate causes real depreciation for Indonesian Rupiah. Higher ratio of governmental spending to GDP or higher stock prices lead to real appreciation in IDR/USD exchange rate. Egert (2010) examines the behavior of South African Rand against US Dollar using data from January 2001 to July 2007, finding four factors affecting South Africa's exchange rate returns in South Africa including non linear monetary equilibrium mean reversion property, changes in gold prices, general risk perception of the market and innovations in exchange rate of Dollar and Euro. Kumar (2010) examines the real exchange rate determination of India Rupee and finds the existence of long run relationship.

Moura (2010) tested a model of economies of Chile, Mexico, Peru, Brazil and Colombia currencies incorporating the concept of endogenous monetary policy to forecast using Taylor rule reaction function. Rate of interest responds positively to lags of interest, the GDP gaps, and relative rate of increase in price and target inflation.

Summing up the review of literature it is obvious that international evidence in support of monetary approach has increased over time with the increase in the availability of data, improved econometric techniques and advancement in model specifications. Despite the fact of an increasing support of monetary model, still it cannot be claimed out right superiority over other approaches to explain the behavior of exchange rates.

4. Data and Methodology

This study covers the period of managed floating or flexible exchange rate arrangement of Pakistan, using monthly time series data from January 1982 to April 2010 to examine the behavior of PKR/USD exchange rate and relationship of exchange rate behavior with relative monetary variables. Data have been obtained from International Financial Statistics (IFS), Hand book of statistics published by Federal Bureau of Statistics, Government of Pakistan, State Bank of Pakistan and US Treasury Direct Website of Government of United States. The variables used are the stock of money, foreign exchange reserves and total debt of Pakistan relative to United States as determinants of PKR/USD exchange rate. Moreover, a dummy variable representing Political Instability in Pakistan as the determinant of nominal exchange rate of Pakistani Rupee against US Dollar has also been incorporated.

$$er = a_0 + a_1\left(m - m^*\right) - a_2\left(fx - fx^*\right) + a_3\left(d - d^*\right) + a_4 PI + \mu_t \qquad (1)$$

Variables with star (*) are related to United States of America and without star represent the corresponding variables relating to Pakistan. The dependent variable is nominal bilateral exchange rate expressed as ratio of Pakistani Rupee per unit of US Dollar. First determinant of exchange rate is the stock of relative nominal money of the respective country measured in terms of the respective country's currency. Second explanatory variable is the natural log of relative foreign exchange reserve measured in terms of US Dollar for both countries. Third determinant of exchange rate is relative country's total domestic and foreign debt measured in terms of the respective country's currency. To capture the effect of non monetary factors on exchange rate, a dummy variable for political instability has been used as fourth determinant which incorporates critical incidents like atomic explosions of May 1998, 9/11 terrorist attacks and Benazir assassination in December 2007. An error term to imprison the random variation in exchange rate behavior is also used.

To test the stationarity of variables, Augmented Dickey Fuller (ADF) test is used. Autoregressive distributive lag (ARDL) approach to co-integration has been applied to estimate the long run relationship between the nominal PKR/USD exchange rate and explanatory variables. To estimate short run dynamics relating to the macro economic variables and nominal exchange rate, error correction mechanism (ECM) has also been employed.
ARDL approach is mainly developed and popularized by Pesaran and Shin (1995, 1998, 1999); Pesaran and Pesaran (1997); Pesaran and Smith (1998) and Pesaran et al (1996, 2001). This technique has certain advantages over other co-integration approaches. This technique can be applied for series having different orders of integration while same integration order is required for Engle Granger residual based co-integration or Multivariate Johansen co-integration approach. In order to fully cover the lag effect of dependent and independent variables ARDL model specification allows flexibility to incorporate required number of lags needed to describe dynamic behavior of the dependent variable. ARDL approach to the co-integration is useful technique even when the sample size is small.

In situations when variables involved into the study are endogenous, the use of bound testing approach normally provides unbiased long run estimates and valid t-statistics (Odhiambo 2008; Narayan 2005). ARDL approach simultaneously provides the long run and short run estimates for empirical investigation. This technique provides an efficient way to separately examine the long run and short run causal relationships (Bentzen & Engested 2001). ARDL bounds testing approach to co-integration involves two steps procedure. In the first step, existence of co-integration is tested by comparing the calculated value of conditional F-test of lagged level variables through variable addition test with the critical bounds provided by Pesaran and Pesaran. Lower bound is the critical value for I(0) variables and upper bound is for I(1). If the calculated value of the conditional F-statistics calculated through the use of variable addition test exceeds the upper bound critical value, then it is an evidence for the existence of long run relationship between the explanatory variables and dependent variable. If the calculated value is smaller than the lower critical bound, it is an evidence of no long run relationship. If calculated value of F-statistic lies between the upper bound and lower bound, then it is inconclusive.

Error correction version of ARDL model in variables, exchange rate, relative money, relative foreign exchange reserve, relative debt and political instability is as follows:

$$\Delta ert = a_0 + \sum bi\Delta er_{t-1} + \sum ci\Delta\left(m - m^*\right)_{t-1} + \sum di\Delta\left(fx - fx^*\right)_{t-1} + \sum ei\Delta\left(d - d^*\right)_{t-1} + \delta_1 er_{t-1} + \delta_2 L\left(m - m^*\right)_{t-1} + \delta_3\left(fx - fx^*\right)_{t-1} + \delta_4 L\left(d - d^*\right)_{t-1} + \delta_5 r_{t-1} + \mu_t \quad (2)$$

$H_0 : \delta_1 = 0, \delta_2 = 0, \delta_3 = 0, \delta_4 = 0, \delta_5 = 0$ (Non existence of long run relationship)

$H_1 : \delta_1 \neq 0, \delta_2 \neq 0, \delta_3 \neq 0, \delta_4 \neq 0, \delta_5 \neq 0$

$$\Delta\left(m - m^*\right)_t = a_0 + \sum bi\Delta\left(m - m^*\right)_{t-i} + \sum ci\Delta er_{t-i} + + \sum di\Delta\left(fx - fx^*\right)_{t-i} + \sum ei\Delta\left(d - d^*\right)_{t-i} + \delta_1\left(m - m^*\right)_{t-1} + \delta_2 er_{t-1} + \delta_3\left(fx - fx^*\right)_{t-1} + \delta_4\left(d - d^*\right)_{t-1} + \delta_5 pl + \mu_t \quad (3)$$

$$\Delta\left(fx - fx^*\right)_t = a_0 + \sum bi\Delta\left(m - m^*\right)_{t-i} + \sum ci\Delta er_{t-i} + \sum di\Delta\left(fx - fx^*\right)_{t-i} + \sum ei\Delta\left(d - d^*\right)_{t-i} + \delta_1\left(m - m^*\right)_{t-1} + \delta_2 er_{t-1} + \delta_3\left(fx - fx^*\right)_{t-1} + \delta_4\left(d - d^*\right)_{t-1} + \delta_5 pl + \mu_t \quad (4)$$

$$\Delta\left(d - d^*\right)_t = a_0 + \sum bi\Delta\left(m - m^*\right)_{t-i} + \sum ci\Delta er_{t-i} + \sum di\Delta\left(fx - fx^*\right)_{t-i} + \sum ei\Delta\left(d - d^*\right)_{t-i} + \delta_1\left(m - m^*\right)_{t-1} + \delta_2 er_{t-1} + \delta_3\left(fx - fx^*\right)_{t-1} + \delta_4\left(d - d^*\right)_{t-1} + \delta_5 pl + \mu_t \quad (5)$$

If results of the first step provide evidence for the existence of co-integration then we should move to next step for estimation of coefficients and testing their significance.

Optimal lag order is selected via using AIC model selection criterion. Then with optimal lags order selected, long run ARDL model and error correction representation of ARDL model is estimated. Parameter stability is tested by applying CUSUM and CUSUMSQ.

Following long run ARDL (p, q1, q2, ---- qn) model, equation is estimated.

$$ert = a_0 + \sum \delta_1 er_{t-p} + \sum \delta_2\left(m - m^*\right)_{t-q1} + \sum \delta_3\left(fx - fx^*\right)_{t-q2} + \sum \delta_4\left(d - d^*\right)_{t-q3} + + \delta_5 pl + \mu_t \quad (6)$$

Following error correction model is estimated:

$$\Delta ert = a_0 + \sum bi\Delta er_{t-i} + \sum ci\Delta\left(m - m^*\right)_{t-j} + \sum di\Delta\left(fx - fx^*\right)_{t-l} + \sum ei\Delta\left(d - d^*\right)_{t-m} + f_i\Delta Pl + \delta ecm_{t-1} + \mu_t \quad (7)$$

The present study has tested following hypotheses:

1. Relative increase in the money supply is positively related to the exchange rates (d/f) (depreciation) i.e. H0 ≤ 0, H1> 0.
2. Relative increase in domestic country debt to foreign country debt is positively related to the exchange rates d/f i.e. H0 ≤ 0, H1> 0.
3. Relative increase in the balance of foreign exchange reserves is negatively related to exchange rates i.e. H0≥0, H1<0.
4. Political instability significantly affect exchange rate H0 = 0, H1 ≠ 0

5. Results and Discussions

Descriptive statistics of variables are given in Table 1.

TABLE 1: Descriptive Statistics of Variables

selbairaV	naeM	Std. Deviation	Max. Value	Min. Value	Co-eff. of Var.
Ln (PKR/USD)	3.510	0.587	4.442	2.323	0.167
(m - m*)	-1.611	0.721	-0.470	-2.767	0.447
(fx –fx*)	-2.736	1.141	-1.083	-5.838	0.417
(d –d*)	-1.184	0.481	-0.511	-2.001	0.406

Time series properties of the variables have been examined by applying unit root test. All the series are non stationary at level and become stationary at first difference. Tables 2a and 2b report the results of time series properties of the variables. At level both with intercept & no trend and with intercept & trend calculated values of ADF are less negative than critical value at 5% significance level.

TABLE 2a: Results of ADF unit root test at Level

Variables	Without Trend	With Trend	Status
Exchange Rate	- 0.9072	- 1.7328	I(0) Non Stationary
Relative Money	- 0.35416	- 1.0427	I(0) Non Stationary
Relative Fx Reserve	- 1.4613	- 2.0833	I(0) Non Stationary
Relative Debt	- 0.80541	- 1.2159	I(0) Non Stationary

Critical value for the ADF statistic with an intercept but not a trend = - 2.8703 %95
Critical value for the ADF statistic with an intercept an Trend = - 3.4248 %95

TABLE 2b: Results of ADF unit root test at First Difference Level

Variables	Without Trend	With Trend	Status
Exchange Rate	-10.703	- 10.711	I(1) Stationary
Relative Money	- 11.078	- 11.062	I(1) Stationary
Relative Fx Reserve	- 12.720	- 12.751	I(1) Stationary
Relative Debt	- 16.251	- 16.239	I(1) Stationary

Critical value for the ADF statistic with an intercept but not a trend = - 2.8703 %95
Critical value for the ADF statistic with an intercept an Trend = - 3.4248 %95

After identifying time series properties, existence of long run relationship is tested through the conditional F-test. In order to test the presence of long run relationship between nominal exchange rate and relative stock of money, relative foreign exchange reserve and relative debt, the error correction version of ARDL model has been estimated.

Results of the F-statistics using ARDL bound testing approach to co-integration are reported in table 3. With two lags, there is an evidence for the existence of co-integration as the calculated value of F-statistics is 4.5608 obtained by using variable addition test which is greater than upper bound of critical value as calculated by Pesaran et al (1997). Null hypothesis of no co-integration is rejected with two lags against an alternative for the existence of long run co-integrating relationship. ARDL approach to co-integration provides an evidence for existence of long run relationship between the monetary variables (relative stock of money, relative foreign exchange reserve and relative debt) and nominal Rupee/Dollar exchange rate. Results indicate that there is no evidence of long run relationship in all other cases which implies that there is no co-integrating relationship when the relative money or relative foreign exchange reserve or relative debt is used as a dependent variable.

TABLE 3 : Result of Bound Testing Approach to Co-integration

Dependent Var. & Regressors	AIC Lags	F-Statitics
F(er | m-m*, fx-fx*, d-d*)	2	4.5608**
F(m-m*) | er, fx-fx*, d-d*)	2	1.0921
F(fx-fx*) | er, m-m*, d-d*)	2	1.7374
F(d-d*| er, fx-fx*, m-m*)	2	2.4271

Critical values for F-static at 95%** 3.219 - 4.378
Critical value for F-Statistic at 90%* 2.711 - 3.800

This table shows the results of bound testing approach to co-integration when variable of political instability is added to other macro economic variables as a determinant of nominal exchange rate. Results of conditional F-test indicate that evidence of the existence of long run relationship is further improved. Co-integration between the macro economic variables and political instability with the nominal exchange rate exists in case of Pakistan. When exchange rate is used as dependent variable with 2 lags of all the variables, the calculated value of the F-statistics is 12.8194, which is greater than upper bound critical value at 95% level of confidence, thus Null hypothesis of no co-integration relationship is rejected.

TABLE 4 : Results of Bound Testing Approach to Co-integration with Political Instability

Dependent Var. & Regressors	AIC Lags	F-Statitics
F(er | m-m*, fx-fx*,d-d*,PI)	2	12.8194**
F(m-m*) | er, fx-fx*, d-d*,PI)	2	0.87150
F(fx-fx*) | er, m-m*, d-d*,PI)	2	1.5190
F(d-d*| er, fx-fx*, m-m*,PI)	2	2.5614

Critical values for F-Statistic at 95%** 2.850 - 4.049
Critical value for F-statistic at 90%* 2.425 - 3.574

After finding the evidence for the existence of long-run relationship among the variables in first stage, the estimates have been obtained in the 2nd stage. Table 5 describes the results of ARDL model (2, 1, 0, 0) based on Akaike information criterion with maximum lag length of two.

Coefficient of exchange rate at first lag is significant but insignificant at second lag while Coefficient of relative stock of money at first lag is positive and significant which indicates that there is a lagging effect of the increase in the money supply immediately. Coefficient of the relative foreign exchange reserve is negative and significant in its relation to nominal exchange rate. Coefficient of relative debt is positive and significant at 95% level of confidence while coefficient of political instability is positive and significant suggesting that with an increase in the political instability, exchange rate increases.

TABLE 5: Autoregressive Distributed Lag Estimates
ARDL(2,1,0,0) selected based on Akaike Information Criterion
Dependent variable is natural log of nominal bilateral exchange rate of PKR/USD

Regressors	Coefficients	Standard error	T-Ratio(Prob)
C	0.17526	0.054427	3.2201(0.001)
er (-1)	1.3091	0.047132	27.7744(0.000)
er (-2)	- 0.34545	0.45887	-7.5283(0.000)
(m-m*)	- 0.081508	0.052990	-1.5382(0.125)
(m – m*) (-1)	0.098157	0.053220	1.8443(0.066)
(fx –fx*)	- 0.0020229	0.7004E-3	-2.8882(0.004)
(d – d*)	0.019434	0.0093610	2.0761(0.039)
PI	0.016307	0.0024178	6.7447(0.000)

Diagnostic tests of serial correlation, functional form and heteroscedasity are conducted. There is no serial correlation, no functional form misspecification and no heteroscedasity problem with the data set at 1% &5% level of significance.

Figure 3 Plot of cumulative sum of Recursive Residuals

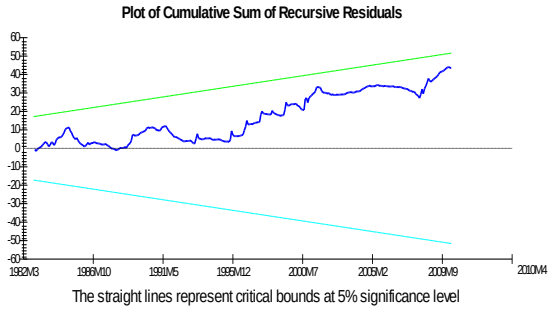


Figure 3 describes the Cumulative Sum of Residuals (CUSUM) test used to detect systematic changes in the regression co-efficients which indicates that changes in the regression coefficient are within the critical bounds at 5% level of significance

Figure 4 Plot of cumulative sum of squares of Recursive Residuals

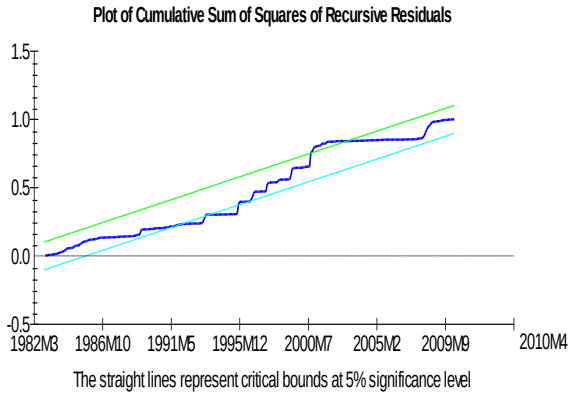


Figure 4 indicates results of Cumulative sum of squares of Residuals test. There is some evidence of haphazard and departure of coefficients at 5% significance level which is insignificant at 10% significance level.

Results of the estimated long run coefficients using ARDL Model (2, 1, 0, 0) selected based on Akaike Information Criterion are reported in Table 6. Long run determinants of the nominal exchange rate include the relative stock of money, relative debt and relative foreign exchange reserve. The results show that 1% increase in the relative stock of money in terms of respective country currencies causes 0.45774% increase in the nominal exchange rate. Evidence for the proportionate increase in the exchange rate and money increase is not found.
As per empirical estimates, 1% increase in the relative balance of foreign exchange reserve (measured in terms of US Dollar) causes a decrease of 0.055% in the bilateral nominal exchange rate between Pakistan Rupee (PKR) and US Dollar (USD). Results confirm that there is significant association between relative foreign exchange reserve balance and value of the exchange rate. One % increase in the relative debt will cause 0.53432% increase in the nominal bilateral exchange rate which is supportive of the portfolio balance approach to exchange rate determination. Political disturbance has caused an increase in the exchange rate by 44% against the bench mark category. This is an evidence of how significantly related the political disturbances are for foreign exchange markets. Especially for a developing country like Pakistan, non economic factors may have more significant effect on exchange rate determination. Fluctuations in both the monetary factors and non economic factors cause fluctuations in exchange rates.

TABLE 6: Estimated Long Run Coefficients using the ARDL Approach
ARDL(2,1,0,0) selected based on Akaike Information Criterion
Dependent variable is ln(PKR/USD) Exchange Rate

Regressor	Coefficient	Standard Error	T-Ratio(Prob)
C	4.8186	0.053186	90.5977(0.000)
(m – m*)	0.45774	0.083777	5.4638(0.000)
(fx – fx*)	-0.055619	0.017713	-3.1400(0.002)
(d – d*)	0.53432	0.13118	4.0733(0.000)
PI	0.44836	0.16438	2.7276(0.007)

TABLE 7: Error Correction Representation for the Selected ARDL Model
ARDL(2,1,0,0) selected based on Akaike Information Criterion
Dependent variable was dLERAVG

Regressor	Coefficient	Standard Error	T-Ratio (Prob)
C	0.17526	0.054427	3.2201(0.001)
dER1	0.34545	0.045887	7.5283(0.000)
D(m-m*)	- 0.081508	0.052990	-1.5382(0.125)
D(fx – fx*)	- 0.0020229	0.7004E-3	-2.8882(0.004)
d(d – d*)	0.019434	0.0093610	2.0761(0.039)
dPI	0.016307	0.0024178	6.7447(0.000)
Ecm(-1)	- 0.036371	0.011199	-3.2477(0.001)

Table 7 reports the estimates of selected optimal error correction model ARDL (2,1,0,0) using Akaike Information Criterion. All coefficients are significant except stock of money. The coefficient of error-correction term, -0.036371(0.01119) exhibits correct sign and has significant t-value. Approximately 3.63% of long run disequilibrium is adjusted from lagged period error shocks.

Summing up the empirical results, it can be inferred that there is reasonable evidence depicting both long-run and short-run relationship between the monetary variables and exchange rate in case of Pakistan. Disequilibrium in exchange rate converges towards equilibrium in long-run. Non-economic factors like Political Instability also negatively affect the value of Pakistani Rupee.

6. Conclusion and Policy Implications

Empirical results of present study support the role of economic and non economic factors in the determination of exchange rate in Pakistan. Relative stock of money and debt are positively and significantly related to exchange rate. Relative foreign exchange reserve is negatively and significantly related to foreign exchange reserve. Political instability negatively affects the value of currencies in case of Pakistan. Variables like relative short term interest rate and relative real GDP are not significantly related to the determination of PKR/USD exchange rate but they carry negative sign in accordance with the sticky price monetary model. Empirical results indicate that exchange rate is strongly associated with ratio stock of nominal money of respective currencies.

Increase in the relative debt is another important source affecting nominal exchange rate. Borrowing of the government from domestic and foreign sources has been one of the major causes of depreciation in the Pakistan Rupee against US Dollar. Government borrows to finance budget deficits, balance of payment deficits and development projects. All those policy measures aiming at decreasing these deficits will decrease the need for borrowing and will help in maintaining stability in the value of currency. To make best use of available limited funds for the private sector target, credit policy should be implemented in addition to increase in the availability of funds for private sector business needs. The export oriented sector should be financed on priority basis. Debt retirement should be planned out and burden of debt should be reduced.

Foreign exchange reserve position is also significantly related with the behavior of exchange rate. Measures to reduce balance of trade deficit and current account deficit are required. To keep the foreign exchange rate stable, the macro economic environment must be conducive to maintain relatively stable price levels. Fiscal and monetary discipline is an essential precondition for price level stability. Independent and professional behavior of State Bank of Pakistan and Federal as well as Provincial governments is very vital in order to create an environment conducive for the price level and exchange rate stability. The political stability ensures commitment toward the consistent policies.

To sum up the analysis, it can be concluded that exchange rate behavior significantly depends upon the macro or monetary fundamentals of the respective countries. There is a strong relation between the ratio of financial assets (money stock, foreign exchange reserves and debt) of Pakistan relative to United States and bilateral nominal PKR/USD exchange rate. Changes in these financial assets cause changes in the exchange rate. A well thought fiscal and monetary policy along with political stability is needed to maintain the exchange rate and macro economic stability in Pakistan.

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