

## An econometric analysis of the determinants of the exchange rate in Pakistan

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### Abstract

*The study investigated the determinants of the exchange rate in Pakistan by using annual time series data from 1970 to 2016. The main objective of the study was to examine quantitatively the relationship between the exchange rate, Inflation, real interest rate and GDP of Pakistan. Data stationarity checked by ADF and PP unit root test before applying ARDL model. Cointegration results indicate that a long-run relationship exists among the dependent and independent variables. Results of long-run ARDL model indicate that GDP and real interest rate have a negative and statistically significant effect on exchange in Pakistan while the inflation rate has a significant positive effect on the exchange rate. This study has policy implications for government as well as for local and foreign investors. The government should also play an important role to make such strategies which can increase the trade in Pakistan and can boost the economic growth of Pakistan indirectly.*

**Keywords:** Exchange rate, GDP, Inflation, Interest rate, ARDL

**JEL Classification:** F31, F33, F37

## 1. INTRODUCTION

The rate at which one currency exchange for another is known as the exchange rate. The exchange rate is either fixed or floating, the fixed exchange rate is decided by the central bank and the floating exchange rate is decided by the demand and supply mechanism of the market. For that, selling and buying rates are very important. Selling rate is the rate at which currency dealers sell the currency and buying rate is the rate at which currency dealers buy currency and they take some profit or commission.

The official medium of exchange which is issued by a government for purchasing goods and services is called currency. The relationship between two currencies where one currency is expressed in the terms of others, for example, United State Dollar against the EURO. The exchange rate with currency is always opposite in direction for example, if a country's home currency is strengthening or appreciating or become more valuable the exchange rate decreases conversely if the foreign currency increases and home currency is depreciating a currency will tend to become more value able when demand for it is greater than the available supply. It will become less value able when over demand is less than the available supply. Increase in demand for currency can be due to either an increased transaction demand for money or an increased speculation demand for money. Exchange rate volatility and depreciation of Pakistani rupee versus U.S dollar have multiple effects on the national economy. It affecting external debt Liability and increase the cost of imports and prices substantially in the domestic market. It also helps to boost export provided exporters help the capacity to benefit from it.

Pakistan external debt stocks consist of various currencies such as dollar, yen, euro and pound sterling but for the practical purpose, its exposure is 100% to US dollar for this

reason all loans are converted into Pakistan exchange rate at the time of disbursement and no exchange cover is arranged. It is most suffered in stock debt due to currency fluctuation there are three factor affecting rupee stability rise in foreign reserves, exports and remittances that kept rupee stable against a number of adds being faced by the economy increase in world price of oil, food and another commodity for in inflows would create a real challenging scenario for exchange. The government should start making measurements on the basis to improve the export, energy, and remittances to improve the exchange rate stable. (Economic survey of Pakistan 2009)

### **1.1. Brief History of Exchange Rate System for Pakistani Rupee:**

The history of Pakistan shows that the country has devalued its currency from time to time when faced with the problem of trade deficit. In 1955 during the post-Korean War, for the first time Pakistani rupee was devalued. The second devaluation in rupees occurred in 1972, which was due to oil crises. The rupee was devalued from Rs.4.92 to Rs.11.00 to US dollar. The government adopted a managed float system in 1982 due to the appreciation of the US dollar in the international market. The rupee was devalued by 3 percent in 1993 which was followed by a further devaluation of 6 percent after one week. The annual devaluation rate of nominal exchange rate during 1981-2004 was 7.7 percent while the real exchange rate has been devalued at the rate of 2.86 percent. In 1999 multiple exchange rate system was unified and Pakistan currency was pegged with the United States dollar within a band. In 2000 the government of Pakistan removed the band set the movement for the exchange rate. Since then there is a floating exchange rate system in Pakistan. The exchange rate of Pakistani rupee against the United States dollar has devalued 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 condition is exactly the same for the behavior of Pakistani currency contrary to other worldwide used foreign currencies. The exchange rate between Pak Rupee and the US Dollar was 10.39 in January 1982 and 85.75 in December 2010. The lowest value of the exchange rate during this period is 10.39 and highest value is 86.28.

### **1.2. Research questions**

Are interest rate and inflation difference having a relationship with the exchange rate? Either Exchange rate affect economic growth positively or negatively?

### **1.3. Objectives of the Research**

The Objectives of the present studies are:

- a. To examine quantitatively the relationship between the exchange rate, Inflation, interest rate and GDP of Pakistan.
- b. To identify the reasons for continuous depreciation in the exchange rate of the currency of Pakistan.
- c. To suggest remedial measures to bring stability in the exchange rate of Pakistan based on the findings of the present study.

### **1.4. The significance of the Study**

Forex rate is considered a key to measure the economy. Pakistan exchange rate has not been striking over the period of time if, managed wisely it can give impetus to determine the path of our economy. The present study attempts to develop the relationship among vital determinants of exchange rate through short-run and long-run dynamics to capture the true picture of our economy.

## II. LITERATURE REVIEW

Burney and Yasmeen (1987) examine the relationship between the deficit budget of government and interest rate for the period (1970--1989) for Pakistan using Durbin Watson test and OLS technique to estimate the relationship. The study showed that there is non-existence of any relationship between government deficit budget and nominal interest rate and government deficit budget. And the government deficit budget has a positive and significant impact on the nominal interest rate. This may end crowding-out private investment and consumption expenditure. The government increased investment in the public sector and borrowing lead to slow down the economic process.

Chishti and Hassan (1993) showed that the real exchange rate determines behavior for Pakistan. The study used VAR or vector autoregression technique to estimate the relationship between real exchange rate and deficit financing for the period (1957-1992). The study showed that monetary expansions or domestic credit creation and due to deficit financing led to medium term disturbance in the equilibrium level of real exchange rate related with the impact variables such as revenue, nominal devaluation, capital inflows in long the term.

Afridi (1995) examines the real exchange determinants for developing country like Pakistan for the period (1960-1995). The study used multiple regression model technique to estimate the relation. The finding of the study showed that exchange rate is explained by capital flow, excess domestic credit and government consumption of no tradable GDP but is not explained by terms of trade, investment, and technological change but there is no significance for the trade variable or proxy variable. The study suggested that increasing the number of observation and use alternative determinants that appropriate for the real exchange rate.

Hyder (2005) examines the relationship of real effective exchange rate and exchange rate misalignment for Pakistan for the period (1978-2005). The study used the Engle-Granger co-integration technique to estimate this relationship. The study showed that monetary expansion which creates expansion in credit to the private sector which has started to create inflationary pressures in Pakistan and real exchange rate increases due to the inflation exchange rate is not fixed for all developing countries. Fiscal policy is implementing to stable the exchange rate of Pakistan.

Siddique (1996) examines the exchange rate determination for Pakistan for the period (1960-1990). The study used Two-Stage Least Square (2SLS) techniques to estimate the relation between exchange rate and monetary variables. The findings of the study showed that real variables and monetary variables affect the real exchange rate significantly and domestic prices control repeat devolution of currency or stable real exchange rate and the study suggested that monetary policy tools are used to solve the problem of real effectiveness of exchange rate. Those are also used in the current account deficit.

Chaudhry and Chaudhry (2006) examine the relationship between exchange rate and output on the price level for Pakistan for the period of (1975-2005). The study uses the VEC (Vector Error Correction) technique to estimate the relation. The study showed that devaluation has a positive effect on the level of price and negatively effect on output, and expansionary monetary policy has a significant and positive effect on both output and prices and also increase in import price has negative on both output prices. Increase in the rate of interest has an effect on output and prices. The study suggested that in Pakistan the policymakers should be very careful before taking any decision and devaluation the currency because to implement a flexible exchange rate system it may lead to a major depreciation that will create inflationary problems.

Ramly (2008) examines the relationship between output and exchange rate for the Egyptian economy for the period (1982-2004). The study used VAR or Vector autoregression techniques to estimate the relation. The study showed that the changes in the exchange rate which create variations in growth rate of output in Egypt and flexible exchange rate system in which monetary policy play role to stabilize the economy in long run devaluation in the exchange rate which expansionary effect on the output which indicated currency depreciation due to increase in import bills. The increase in the price of imported inputs raises the cost of production and creates a slow production process. The Study suggested that Egypt needs to decrease its reliance's on imported production which influences the contractionary effect on output.

Chung and Majerbi (2009) examines the relationship between exchange rate and stocks returns related to firm character is for Korea for period (1988-2006) and the study used standard multi-beta pricing model to estimate the relation .the study showed that exchange risk premium and some individual firms characteristic such as firm size, foreign ownership and liquidity and over long run exchange risk is significantly priced in stock returns. The relationship between exchange rate risk and firm liquidity is less strong .that model which used in the study is more appropriate to estimate the exchange rate risk and stock returns.

Salman (2010) tested the relationship between money supply, current account and the exchange rate for Pakistan for the period (1975-2008). The study used a co-integration technique to estimate the relationship. the study showed that Monterey policy better influenced the domestic variables (output, inflation) and less effect on external variables as like exchange rate and current account central bank control the impact of currency depreciation and import prices inflation and also control interest rate which helps to stable producer prices

and study suggested that appreciation in the currencies does not decrease the inflation but it decrease the economy growth. Dimitrova (2010) examined the relationship between exchange rates and stock prices for the U.S economy from (1990-2004). The study used two SLS or two-stage least squares to estimate the relationship. The study showed that the negative relationship between exchange rate and stock prices then monetary policy will beneficial for stock prices. But if the exchange rate during appreciation rising of stock prices. The monetary policy remains ineffective and rapidly increase the exchange rate. Fall of Stack prices and vice versa and the study suggested that real and nominal exchange rate fluctuation in price is not fixed and not apply in long run and also use an appropriate technique that given a better result.

Rehman and Ahmad (2010) estimated the relationship of foreign direct investment and exchange rate for Pakistan for the period (1993-2009) using co-integration technique to estimate the relationship on the study showed that foreign direct investment (FDI) and income of people from foreign countries balance the exchange rate in Pakistan in real exchange rate misalignment is good for external competitiveness than the real effective exchange rate the study suggested that the estimation of equilibrium real exchange rate in Pakistan on regular basis.

Parsva (2011) examined the relationship between stock prices and the exchange rate for six Middle Eastern financial countries for the period (2004-2010). The study used a co-integration and Granger causality test technique to estimate the relation. The study showed that significant impact on stock prices results an increase in foreign exchange markets, which significantly increase fluctuation in Middle Eastern market in long run middle Eastern market are inefficient because of a dependent of exchange rate the changes in currency, assets, and liabilities also changes the firm value.

Ahmed and Sial (2012) estimate an econometric analysis of determinants of the exchange rate for US Dollar in terms of Pakistani rupee for a period of Monthly data from (January 1982 April 2010) the study used ARDL approach to cointegration and ECM technique used. The empirical results confirm that stock of money, debt and foreign exchange reserve balance all in relative terms are significant determinants of the exchange rate between Pakistani Rupee and US Dollar. Moreover, Political instability has a significant negative effect on the value of domestic currency.

### III. METHODOLOGY:

For measuring the determinants of exchange rate we have taken Nominal Exchange rate as dependent variables and real interest rate inflation and GDP as our independent variables in this study. The annually time series data from 1970 to 2016 were taken from the site of world development indicators, Economic survey of Pakistan (various issues), State Bank of Pakistan, International Financial Statistics (IFS), World Bank database and foreign exchange reserves. All variables are converted to natural log to become reliable.

$$LNEXTR_t = \beta_0 + \beta_1 LNGDP_t + \beta_2 LNRIR_t + \beta_3 LNINF_t + \varepsilon_t \quad (1)$$

Where

EXTR is exchange rate;

GDP is a Gross domestic product;

RIR is Real Interest rate;

INF is inflation

#### 3.1 Unit Root Test

We used the unit root test to identify the stationary of the series. One of the advantages of autoregressive distributed lag (ARDL), it can be applied on any combination either 1(0) or 1(1). Further, if we do not check the unit root of our variables,

then the outcomes can be spurious. We used two methods for Unit Root, Augmented Dickey-Fuller and Phillips-Perron.

### 3.2 Autoregressive Distributed Lag Bound testing

ARDL is used to measure the short run and long run cointegration. There are some assumptions before using ARDL. Data must be free from serial correlation, normality issues. Data must not be stationary at the second difference. There are some steps for ARDL bound testing approach

1. The following equation was estimated for ARDL bound testing approach for measuring Determinants of the exchange rate in Pakistan

$$\begin{aligned} \Delta EXTR_T = \beta_0 + \sum_{\tau=1}^w \beta_1 i \Delta EXTR_{\tau-1} + \sum_{\tau=1}^w \beta_2 i \Delta GDP_{\tau-1} \\ + \sum_{\tau=1}^w \beta_3 i \Delta RIR_{\tau-1} + \sum_{\tau=1}^w \beta_4 i \Delta INF_{\tau-1} + \beta_5 i \Delta EXTR_{\tau-1} \\ + \beta_6 i \Delta GDP_{\tau-1} + \beta_7 i \Delta RIR_{\tau-1} + \beta_8 i \Delta INF_{\tau-1} + \varepsilon_t \end{aligned} \quad (1)$$

2. When co-integration exists between data, the second step is to find the long run model by using the following equation.

$$\begin{aligned} \Delta EXTR_T = \beta_0 + \sum_{\tau=1}^w \beta_1 i \Delta EXTR_{\tau-1} + \sum_{\tau=1}^w \beta_2 i \Delta GDP_{\tau-1} \\ + \sum_{\tau=1}^w \beta_3 i \Delta RIR_{\tau-1} + \sum_{\tau=1}^w \beta_4 i \Delta INF_{\tau-1} \end{aligned} \quad (2)$$

3. In the final step, it needs to check the error correction mechanism for the short run.

$$\begin{aligned} \Delta EXTR_T = \beta_0 + \sum_{\tau=1}^w \beta_1 i \Delta EXTR_{\tau-1} + \sum_{\tau=1}^w \beta_2 i \Delta GDP_{\tau-1} \\ + \sum_{\tau=1}^w \beta_3 i \Delta RIR_{\tau-1} + \sum_{\tau=1}^w \beta_4 i \Delta INF_{\tau-1} + \eta_1 ECT_{\tau-1} \end{aligned} \quad (3)$$

## IV. RESULTS AND INTERPRETATION

**Table. 1 Results of the ADF unit root test at Level and First Difference**

ADF			Philips-perron		
Level					
Variable	Intercept	Trend and Intercept	Intercept	Trend and Intercept	
ER	-1.3476(0.5992)	-3.5017(0.0513)	-1.4275(0.5605)	-3.6197(0.0393)	
GDP	-5.3685(0.0000)	-5.2835(0.0004)	-5.5602(0.0000)	-5.4954(0.0002)	
IR	-3.5932(0.0098)	-3.5729(0.0437)	-3.0304(0.0394)	-3.0195(0.1381)	
INF	-1.5253(0.5116)	-4.6005(0.0037)	-1.1146(0.7020)	-2.4296(0.3601)	
First Difference					
ER	-8.0666(0.0000)	-8.1775(0.0000)	-8.0406(0.0000)	-8.1142(0.0000)	
GDP	-9.6403(0.0000)	-9.6615(0.0000)	-11.1718(0.0000)	-11.0280(0.0000)	
IR	-5.5631(0.0000)	-5.5195(0.0002)	-5.4803(0.0000)	-5.4203(0.0003)	
INF	-3.1763(0.0282)	-4.4695(0.0060)	-3.3574(0.0181)	-3.4512(0.0500)	

At very first step the time series properties of the variables have been examined by applying a standard (ARDL) Philip-perron (PP) test. We applied the above test for whether the variable doesn't have the problem of unit root and the order of their integration is not more than one which is essential in empirical analysis. Augmented Dickey-fuller (ARDL) Philip-perron (PP) test was applied on two sets on the intercept and intercept with a time trend. All of the series are non-stationary at the level and become stationary at their first difference the order of integration was not more than one which is a good sign for long-run cointegration analysis.

**Table 2. Lag length selection criteria for Cointegration**

Lag	LogL	LR	FPE	AIC	SC	HQ
0	80.15006	NA	3.13e-07	-3.626193	-3.460701	-3.565534
1	266.7286	328.7336	9.32e-11	-11.74898	-10.92152*	-11.44568
2	287.8674	33.21808	7.47e-11	-11.99368	-10.50425	-11.44775*
3	308.0931	27.93072*	6.46e-11	-12.19491	-10.04351	-11.40633
4	327.5044	23.10873	6.15e-11*	-12.35735*	-9.543983	-11.32614

The lag length criteria are selected through the ARDL bound testing approach. We use the Akaike Information Criterion (AIC) and Schwarz Bayesian criterion (SBC). Since the study

uses yearly time series data we used with a maximum of four lags. The calculated AIC and SBC figures with different lags were then evaluated which can be observed from the table 2 that at lag 4 the AIC criterion is significant however the SBC is significant at lag 1. we to have selected in this study the AIC criterion for Lag selection.

Diagnostic Tests

**Table 3 Diagnostic Tests Results**

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	8.18029	Prob. F(3,42)	0.0002
Obs*R-squared	16.96522	Prob. Chi-Square(3)	0.0007
Breusch-Godfrey Serial Correlation LM Test			
F-statistic	3.73913	Prob. F(2,38)	0.0325
Obs*R-squared	7.24542	Prob. Chi-Square(2)	0.0267

Table 4 shows the diagnostic tests of data. We used Serial correlation, Normality, and Heteroscedasticity. Results show that our data is free from serial correlation, normality issues, and heteroscedasticity problems by using optimum lag length criteria (2, 3, 3, 4).

**Table 4 ARDL bound test result for co-integration**

Dependent Variables	F-Values	K
F <sub>excr</sub> (EXCR/GDP,RIR,INF)	4.9889	Co integrations
	Critical Values Bounds	
Significance	I(0) Bound	I(1) Bound
10%	2.72	3.77
5%	3.23	4.35
2.5%	3.69	4.89
1%	4.29	5.61

Table 4 shows the estimated value of F-statistic which is 4.9889 that is greater than lower and upper bounds at 5% level of significance. So it means that the null hypothesis is rejected and conclude that there is cointegration in the equation  $F_{EXCR}$  (EXCR | GDP, RIR, INF) between variables of this study.

## Long Run Coefficient Results

**Table 5 Long Run Association ARDL (2, 3, 3, 4)**

Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGDP	-0.479904	0.067522	-7.107335	0.0000***
LNINF	0.762260	0.021515	35.429285	0.0000***
LNRIR	-0.420573	0.088687	-4.742229	0.0001***
C	1.229760	0.126280	9.738353	0.0000

Table 5 shows the long-run association of independent variables with the dependent variable. The exchange rate is used as dependent variable and Gross domestic product, interest rate and inflation used as independent variables.it should be noted that all the variables are transformed into logarithmic transformation form. The exchange rate has a positive and significant relationship with Inflation in long run. Money GDP and Interest Rate have a significant but negative relationship with Exchange rate. So all independent variables are co-integrated with the dependent variable in the long run

## Error Correction Mechanism

**Table 5 Short Run Co-efficient Results ARDL (2, 3, 3, 4)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNER(-1))	0.198723	0.164458	1.208353	0.2378
D(LNGDP)	-0.085498	0.033922	-2.520422	0.0182
D(LNGDP(-1))	0.037922	0.036370	1.042668	0.3067
D(LNGDP(-2))	0.110130	0.027190	4.050405	0.0004*
D(LNINFLATION)	-1.412385	0.466372	-3.028451	0.0055**
D(LNINFLATION(-1))	0.808255	0.684424	1.180927	0.2483
D(LNINFLATION(-2))	-0.638858	0.329899	-1.936524	0.0637
D(LNRIR)	0.071403	0.057671	1.238119	0.2267
D(LNRIR(-1))	-0.077679	0.075193	-1.033056	0.3111
D(LNRIR(-2))	0.110794	0.067707	1.636374	0.1138
D(LNRIR(-3))	0.129821	0.054841	2.367251	0.0256
Coint Eq (-1)	-0.673574	0.163109	-4.129594	0.0003*

\*\*Indicates significance at the 1% level.

\*Indicates significance at the 5% level.

Table 4 shows the short run coefficients and error correction mechanism of the model. In short-run GDP has a significant and negative relationship with the exchange rate in the short run. Moreover, the previous two-year value of GDP has a positive and significant relationship with the exchange rate in the short run. Value of inflation has a negative and insignificant relationship with Exchange rate. The interest rate coefficient shows Positive and statistically non-significant impact on exchange rate and indicates that a 1% increase in interest rate may increase the exchange rate up to 0.07%. The value of ECM is significant and negative which shows that the model is moving towards the equilibrium position. However, the speed of adjustment is 67.

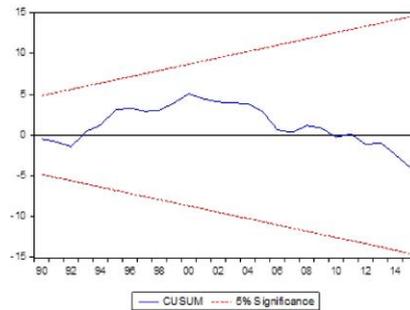


Figure 1

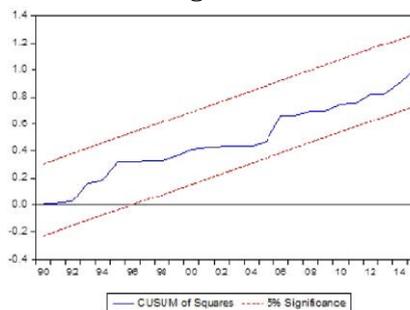


Figure 2

We have checked the model stability through CUSUM and CUSUM of the square. In both above figures, the blue lines are between red lines which means that our model is stable under a 5% level of significance as you can see in Figure 3 and Figure 4.

If the blue line goes out from two critical lines, then it said to be instability of our model.

## V. CONCLUSION AND RECOMMENDATION

The main goal of the study is to check the determinants of the exchange rate in Pakistan in the presence of inflation, GDP and interest rate. We have used the exchange rate as the dependent variable while our independent variables are inflation, GDP and real interest rate. The annual time series data from 1970 to 2016 was taken from world development indicator. Economic survey of Pakistan (various issues), State Bank of Pakistan, International Financial Statistics (IFS), World Bank database and foreign exchange reserves the results reveal that GDP and the real interest rate has a negative and significant relationship with the exchange rate, in the long run, it means that Pakistani rupee is depreciated against USD. The inflation has a positive and significant relationship with the exchange rate in long run, but in the short run, inflation has negative and insignificant on the nominal exchange rate. In the short run, GDP has a negative but significant effect on the exchange rate while the real interest rate has a negative and insignificant effect on the exchange rate in the short run. Error correction term indicates that the economy recovers with 67% per annum. This study has policy implications for government as well as local and foreign investors. On the basis of results, it is recommended that the government of Pakistan should adopt such policies that stabilize the Pakistan currency by increasing export to its trading partner countries. The exchange rate determination may depend on several other variables, these variables may be targeted by the monetary authority efficiently to regulate exchange rate movements in case of unwarranted volatility. This study we used annual data and in future one may use monthly data if possible which will give better and comprehensive results and can use more economic variables.

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