

## **Analysis of Exchange Rate Fluctuations: A Study of PKR VS USD**

Samea Khurram Bhutt\*, Mushtaq ur Rehman\*\* & Shafiq ur Rehman\*\*\*

### **Abstract**

*The current research is aimed to study the dynamic association between macro economic variables and exchange rate in Pakistan. For this purpose the study analyzes quarterly time series of the relevant variables from 1998 quarter 1 to 2012 quarter 4. The study tests the proposed hypotheses using econometric models that are widely accepted and practiced in academic research in the areas of economics and finance. In the first place the study investigates as to whether all-time series variables (exchange rate and the set of seven (7) macro-economic variables) are stationary or not. Then the study investigates in multivariate form, the co-integration properties of the variables under investigation. Further the study applies Granger-cause macro-economic variables or vice versa in the multivariate form. Along this line, the study also applies the Granger-causality test in the bi-variate form to investigate the lead-lag relationship and hence establish the direction of influence i.e. uni-directional. The study results suggest that there is a long-run association between exchange rate and inflation at 10% significance level. The Granger-causality test suggests that the direction of influence is more from inflation to exchange rate than from exchange rate to inflation (though both are statistically insignificant). The results from the Granger-causality test suggest that money supply leads exchange rate i.e. money supply Granger-cause exchange rate (a uni-directional causality). The study reports finding that indicate a bi-directional causality between exchange rate and total reserve less gold. A rise in the total reserve less gold causes exchange rate of Pak Rupee to appreciate and vice versa. The study also reports statistically significant inverse relationship between exchange rate and exports. The findings from the Granger-causality test suggest that exchange rate and industrial production share statistically significant relationship. The study failed to report evidence to support Share price index in multi-variate co-integration test as well as Granger-causality test. The study reported that both balance of trade and exchange rate were co-integrated. Further the study reports that exchange rate Granger-cause balance of trade in the short-run.*

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### **Background of the Study**

Due to globalization the world has become a global village and size of international trade has grown very swiftly. Due to this the need of foreign currencies has considerably been increased to make international transactions for goods and services as well as for a stable exchange rate. In financial arena the exchange rate (that can also be termed as Foreign Exchange rate or Forex) is the value of a foreign currency in term of home currency. The role of exchange rate is very important in the world's economy. A country such as Pakistan in which the exchange value of currency fluctuates frequently the stability of exchange rate is very important for economic growth and stability. There can be favourable or unfavorable consequences of the fluctuations in the exchange rate on macroeconomic variables of economy of a country depending upon the shared relationship. However the performance of macro economy also influences the exchange rate fluctuations. Further a lead-lag relationship that may exist i.e. exchange rate may be leading or lagging macro-economic variables. Another dimension is that the relationship may be short-run or long-run oriented or both. The economic literature suggests the purchasing power parity argument, the interest rate parity argument, the international fisher effect arguments among others to link exchange rate determination and macro-economic variables.

After independence there was no currency of Pakistan and for at least six months Pakistan used the currency of India. Fixed exchange rate was used by Pakistan system up to 1<sup>st</sup> half of 1982. During the 2<sup>nd</sup> half the same year Pakistan stopped using fixed rates as it faced severe budgetary deficits and switched over towards a currency-regime in which variations are allowed in the exchange rate within certain limits. However, in 1991, Pak Rupee become floating in the open market as part of economic and fiscal reforms. Hence market demand and supply were allowed to set exchange-rate value of Pak Rupee against all trading currencies. Significant depreciation in the Pakistani currency occurred due to several factors including economic instability, corruption, terrorism etc. due to this depreciation the value of PKR decreased against the major currencies specially US \$ since its floating point in 1991. However, there have been a constant interference from State Bank of Pakistan in exchange markets of Pakistan to stabilize the exchange rate (PKR/Dollar) so the exchange rate regime remain managed floating rather than free floating due to such positive interferences. These on and off interventions of central banks reflects the importance of exchange rate in the economic growth in an emerging economy like Pakistan. The

current exchange rate of Pakistani rupee to the dollar is in the range 100.17.

Exchange rate fluctuation affects growth of multinational companies and also increase degree of risk for financial institutions like (bank, stock exchange) and firms. On the other side stable exchange rate help firms to decrease their operational risk, check out their investment performance that whether firm getting profit or faces loss and also help in hedging. Other than this exchange rate fluctuation also affected macroeconomic factors these factors are market prices, inflation rates, interest rates, labor wages, and unemployment and output level. In case of macroeconomic variables it is important to forecast exchange rate fluctuation because macroeconomic variables have a large impact on economy. After the economic instability of the different countries their economy fluctuation in currency is common in character. In previous era, the countries poorly performed, however, for the last few years, the exchange rate is playing a very vital role in country economic situations. Very few attempts have been made to identify factors that are critical in the devaluation of currency in the country and hence in the overall growth of the economy have been badly affected. Aim of the study will be to investigate the dynamic relationship between Nominal exchange rate and macro-economic variables (Total reserve minus gold (TRMG), Inflation rate (WSPi), Share price index (SPI), Export (EXPT), Import (IMPT), Industrial production (IP) and Money Supply (MS) in the country so that the knowledge about these relationships in Pakistan can be enhanced, to identify the direction of influence, and to investigate the short-run and long-run dynamics of the relationship. Most of the economic literature has recently been focused on the exchange rate and it can be taken as the large scale recognition of the importance of exchange rate to the development of economy.

#### *Objectives of the study*

The research is being arranged for the achievement of the following objectives.

- i). To identify the link between macro-economic variables and exchange-rate.
- ii). To point out the direction of influence (if any) between these economic variables.
- iii). To investigate the lead/lag relationship (if any) between exchange-rate and macro-economic variables.
- iv). To study the short-run & long-run relationship between exchange-rate and macro-economic variables.
- v). To contribute in a positive way to the academic literature on exchange rate determination in Pakistan.

### Literature Review

It has been noticed that existence of both empirical and theoretical interaction between exchange rate and macro-economic variables are established. There are large numbers of studies that have been focused on the determination of exchange rate by means of macro-economic variables. Hypothetically it is described that direct relationship exists between the exchange-rate and other macroeconomic variables but practical studies gives us mixed result of exchange rate and its relation with other variables. Conway (1998) reaches on conclusion that if there is any change in exchange-rate it brings rapid change in the rate of inflation. Because of disturbances in the exchange rate the inflation level is also negatively affected. It was also reported that exchange rate disturbances cause's higher inflation. Sadehi, Samson & Sherafat (2007) also gives their conclusion that due to economic uncertainty in Pakistan one percent change in exchange rate will lead to ten percent increase in inflation rate. Ijaz, Akhtar and Abbas (2002) from his study reach on conclusion that budget deficit and real exchange rate has direct relationship among them. In addition to this they also give their remarks that real exchange rate is directly and indirectly affected through budget deficit. Their results recommended that differences in the Real exchange rate contingent on condensation of fiscal deficit whether by rising taxation or decreasing governmental expenditures. Dong (2006) also told about the effects of other variables on exchange rate. Dong provide a detailed statement that variance of exchange rate are importantly explained from monetary policy shocks, interest rates and output gap. Banita (2001) institute that daily variations in exchange rate against the U.S. \$ are affected through macroeconomic variables. They originate that the exchange rate fluctuations increases through elasticity of the exchange-rate, interventions by the central bank and the lack of certainty of the domestic economies, on the other hand exchange rate variation does not effect through the limitations on the flow of capital and the economic wealth of country decreases volatility. Bhatti (1997) used monthly data from 1982:1 to 1993:7 to investigate the ex ante Purchasing Power Parity (PPP) in Pakistan and found support for an efficient market i.e. the ex ante Purchasing Power Parity holds well and exchange rates follows a random walk in Pakistan. Bhatti further concluded that the exchange rate of Pak Rupee against currencies of industrial countries is determined by the differences in the level of inflation, income and interest. Rehman, Rauf and Rehman (2010) used monthly data from 1994 to 2004 to explore the impact of Interest Rate and inflation on Exchange Rate. According to them the relationship among interest rate and exchange rate of Pak Rupee with British pound is significantly positive and relationship of inflation with exchange rate is negative and significant.

Vergil (2003) examined the association among exchange rate and macro-economic variables inside Turkey and the European Union by means of quarterly data from 1990:1 to 2000:12. The results of Vergil's study demonstrate that real exports in Turkey are strongly affected through exchange rate volatility. The finding suggests that the relation of real exports and exchange rate has significantly negative. Jakab and Kovacs (1999) stated that tradable real exchange rate fluctuation do not affected through nominal exchange regimes. They claimed that exchange rate policies are not the main cause of fluctuation in real exchange rate. But instead important indicators of fluctuations of exchange rate were supply shocks. Coudert and Dubert (2005) give an account that growth of major Asian countries and inflation depends upon exchange rate regimes. Several statistical tools are used for classifying the imperfections of exchange rate systems. Four categories are used for explaining results of free floating, managed floating, crawling-peg and peg system. They compare the variances in the exchange rates and Forex reserves; also measure the exchange rate levels. This classification is used for recognizing the impacts of Exchange Rates regimes on growth and inflation by means of Ordinary Least Squares (OLS) regressions through dummies of Real Exchange rate regimes and some other controlling variables. Consequences of the study recommended that there is lesser growth of pegs instead of floating exchange rate regimes. Simon & Rajak (1999) make his description that changes in interest rate and exchange rate fluctuations has positive relationship. Ramasamy and Yeung (2000) are critical about this and said that there has been restored a new condition of interest in the strength of causality among stock markets and exchange rates. The causality among the two markets is examined in his study i.e. stock market and Forex market, in the economies of nine East-Asian. They bring into being that the trend of causality is in motion to describe a hit & run behavior as well as modify with the various time period selected. It means that one should be very much careful in the interpretation of Granger Causality results. Bénassy & Lahrèche-Révil (2001) claimed the exchange-rate is expected to be a growing apprehension equally for Foreign Direct Investment and trade. They recommended that in addition to this volatility of exchange rate plays an extensive role to attract FDI, other than this they were incapable of producing an evidence effect of exchange rate uncertainty on Trade.

Arizonan (1992) give his conclusion that fixed exchange rate encourage FDI and reverse implications were reported for nominal shocks in flexible exchange rate regimes on behavior of investments in economy. Mohammad, Hussain, Jalil and Ali (2009) used quarterly date from 1986 to 2008 to study the effect of economic variables on the prices of stock. They found that there was no major impact of exchange-rate on stock prices till 1991. However, after free floating of Pakistani currency

the foreign exchange rate have significant impact on stock price index. Lauterbach (2001) bring into being that the U.S. Dollar exchange rate daily variability is affected through macro-economic variables. They concluded that the exchange rate fluctuations increases due to flexible exchange-rate regime, interventions by the central bank and the lack of certainty in the host economy, while the exchange rate variations does not affected through limitations on the flows of capital and country's economic wealth decreases volatility. Berument and Pasaogullari (2003) takes quarterly data from 1987 2001 and apply ganger causality method on this data for estimating real depreciation effects on the turkey's economic performance the empirical evidence recommended that even if the economic factors like world market interest rates and capital inflows are being controlled against the classical wisdom the real depreciation are found to be contracted. Furthermore the consequences obtained by the analysis point out that inflationary depreciations in the real exchange rate. Sorsa (1999) for determining RER of Algeria from the impact of export diversification and trade protection he takes in oil prices, governmental consumptions, and protection level and oil volume as real macroeconomic variables. The research he made is on the basis of OLS which confirm those hypothesis which he made in his research that are RER is only affected by real variable on the other hand in long run nominal variables are insignificant. (Mac Donald, 1999) winds up that these ground rules have a pivotal role to take part in molding the in & out samples efficiency of patterns of exchange-rate. Moreover he assists that for a short time period almost one month exchange rate are able to be predicted and in both time period i.e. short run and long run exchange rate modeling are active. (Siddiqui et al 1996) in their most popular paper make estimation of both single and simultaneous equation models. It is mentioned in result that equilibrium path of real exchange rate is affected by both of monetary and real sector variables. From this research this point is concluded by researcher that if only control monetary side of economy is not suitable but to maintain the competitive and stable RER it is mandatory that real sector of economy also control. By controlling domestic price of currency and stops them from repeatedly devaluation is another way of maintaining the stable exchange rate. After 1982 price of other major currencies in terms of Rupees is 4-5 times increased. On the other hand price of Japanese Yen increased by 9 times in terms of rupees. By making analysis of determining factor of equilibrium exchange rate path it is shown trade terms, inflow and openness of resources are important determinants of ERER. (Hussain 2008) for calculating Pakistan's ERER and its misalignment apply techniques of co-integration on his study. Study calculate the impact of real monetary variable on RER by using data from 1970 to 2007 on

annual basis and it is concluded that capital inflows, GDP growth, government consumption, and terms of trade leads to ERER.

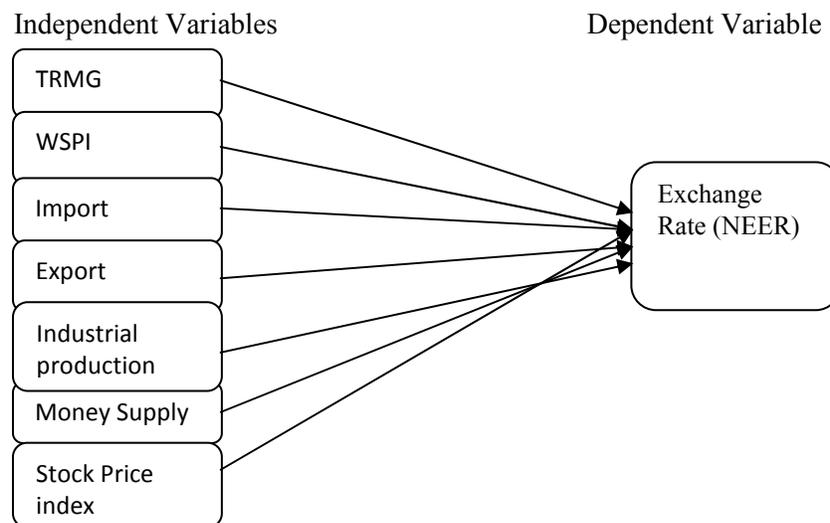
Eric Rosengren (1992) argues that since 1970 in the US, Real exchange- rate and inward FDI are significantly correlated. He also makes notice that in the United States foreign direct investment is significantly affected by relative wealth and FDI is shortly affected by effects of real wages. Olimor and Sirajiddinov (2008) in their investigation acknowledged a converse association between volatility of exchange rate in Uzbekistan on both the trade outflows and inflows. In this way it is more striking for foreign investors to make their investment in the host country and many more. They get hold of assets of foreign country which are cheaper in foreign country other than home country. In this way foreign country's currency devalues and FDI increases in foreign country (Blonigen, 1997). From time period 1975-1992 make the use of Japanese data, he thought that exchange rate that are favorable to Japanese was largely influenced from the acquisition of FDI in the US economy within the period underneath consideration and this take account of acquiring specific assets in foreign currency that can make happens the returns in other currency.

Chen, (2004) from his work explains that addition in price rigidity in the happening of the uncertainty make reasons for exchange rate volatility (that is to say that due to prospects of later reversion to exchange rate firms become unwilling to change their prices). Beside from this in cross country volatility would make description for much of inability of purchasing power parity (PPP) and diminishes the speed of mean adjustment in the direction of purchasing power parity. By making analysis of the speed of convergence, the researcher finds out the positive significant coefficient for exchange rate volatility that is to say that prices are sticker if exchange rate volatility is higher. Eichengreen and Leblang (2003) disclose twelve countries over 120 years and derive a significant negative relation amongst Exchange Rate regimes and growth. They reach on the conclusion that these assessment results are dependent on the specific period as well as on the samples taken into consideration. The standard rule that is followed in world economics that is the individual Exchange Rates always follow random walks. Very high frequencies occur when minor departures from random walk (Evans and Lyons 2005). Engel and West (2005) demonstrate that when risk premium remain constant then the exchange rates remains close to random walks and fundamentals will not remain stationary. The conclusion of this paper includes the changes in the exchange rates which is consistent with the random walk assessment of exchange rates. The variables which are not persistent variables includes dollar factor, conditional and unconditional carry factors. Lustin et al. (2011) didn't reports the regressions of bilateral exchange rates on any time series. The

dynamics of portfolios of currencies are focused by them. And when they assist the pricing of their assets effects on bilateral exchange rates, they only focus on the measures of the cross-sectional and don't focus on time series. The present paper is the fragment of the growing literature. This paper mainly focuses on the currency portfolios which help to study the currency risks. Risk premium can be studied with the help of these portfolios. These portfolios are constructed to balance out idiosyncratic components. And the main focus is on systematic risk. The focus of the current paper is on systematic versus idiosyncratic variation. There are many of the papers that have been written on the forward premium and the currency carries trades. Froot and Thaler (1990) review 75 approximations that are consist on the uncovered interest rate parity condition.

#### *Conceptual framework*

Conceptual Framework shows the graphic representation of All selected variables for current study, among them the exchange rate are dependent variable and rest of the seven (7) was independent variables for our present study, that are Total Reserve less gold (TRMG), Inflation through whole sale price index (WSPI), Import (IMP), Export (EXP), Industrial Production (IP, Stock Price Index (SPI) and Money supply (MS).



## **Methodology**

### *Research design*

The research design of the study is descriptive. The study describes the relationship of exchange rate with macro-economic variables. For this purpose the study analyzes quarterly time series of the relevant variables from 1998 quarter 1 to 2012 quarter 4 from international monetary fund's IFS CD. The study tests the proposed hypotheses using econometric models that are widely accepted and practiced in academic research in the areas of economics and finance. In the first place the study investigates that whether all-time series variables (exchange rate and the set of seven (7) macro-economic variables) are stationary or not. This is necessary as ordinary least squares (OLS) regression can only be used when the time series variables are stationary. Then the study investigates the co-integration properties of the variables under investigation in multivariate form. The co-integration test is used to test that whether there is any long run equilibrium relationship between the two sets of variables or not. Further the study applies Granger-cause macro-economic variables or vice versa in the multivariate form. It also reveals that which variable(s) react to re-establish the deviations from the equilibrium relationship. Along this line, the study also applies the Granger-causality test in the bi-variate form to investigate the lead-lag relationship and hence establish the direction of influence i.e. uni-directional. The adopted methodology is in line with the nature (descriptive) of the study and allows for investigation of all the questions raised and the subsequent hypotheses.

#### *Explanation of the variables*

The following seven macro-economic variables have been recognized from the literature review for checking the theoretical and empirical relationship with the exchange rate.

- Exchange Rate and Export: Exports are the first variable. It is suggested through economic theory that among value of exports of an economy and exchange rate a negative relationship exist. By keeping other things constant it is suggested that value of exports rises when exchange rate depreciates and vice versa (Benita and Lauterbach, 2007).
- Exchange Rate and Imports: Imports are the second variable. Economic theory suggests that there exist a positive relationship among exchange rate and imports i.e. at the whole imports rise because of the increased buying power of the people in economy (keeping other things constant) when exchange rate appreciates, and vice versa (Kemal and Qadir, 2005).
- Exchange Rate and Foreign Reserve: Any country's currency appreciates relative to other currencies, when it has excessive foreign reserves and vice versa. It is estimated from the research that there exist long-run and a short-run relationship equally

among nominal exchange rate and foreign reserves (Kasman and Ayhan, 2008)

- Exchange rate and Industrial Production: Industrial production is also another major variable. Major role of the real rate of return is the increase in economic productivity in an economy. So economy experiences higher real rate of return when production volumes are high, and hence equally from abroad and internally economy is able to attract more investment. In result of this the value of local currency increases. When productivity in an economy falls, the opposite is true. The relationship can also be the other way around i.e. exchange rate influencing the level of output (Morley, 1992). He suggests that weakening of the currency reduces output.
- Exchange Rate and Inflation: The purchasing power parity (PPP) suggests that strong relationship prevails among exchange rate and inflation. Local currency appreciates or depreciates due to the relative increase or decrease in inflation (Sadeghi, Samson & Sherafat, 2007). On the other hand, by affecting the prices of local and foreign goods and services (increased/decreased price level) exchange rate is considered also to impact the level of inflation in an economy and the purchasing power of the people in an economy is effective (Bhatti, 1997, 2001). The study employed Wholesale Price Index (WPI) instead of Consumer Price Index (CPI) in light of the findings of Hyder and Shah (2004) who found that exchange rate pass-through was stronger in WPI than CPI.
- Exchange Rate and Money Supply: In an economy exchange rate is closely related to the volume of money supply. Inflation reduced value of local currency which is due to the level of money supply is increased in the economy, keeping other things constant. The supply of local currency increases for exchange of foreign currency to import more foreign goods and/or make foreign investments, due to the increase in money supply of an economy. Also increased money supply may result in inflation causing exchange rate to depreciate (Maswana, 2005).
- Exchange Rate and Stock Prices: In the equity market of an economy stock prices are also considered to be closely related to exchange rate. Initially, the level of productivity, interest rates, imports, exports, inflation and money supply in the economy has a relationship with exchange rate. For the performance of firms operating in the economy these variables are critical. For this reason among exchange rate and stock prices an indirect relationship is suggested. With the help of foreign portfolio investment in the stock market stock prices are directly affected

through exchange rate. It is also recommended that foreign investment is attracted through a well performing stock market (both FDI and portfolio investment) and for this reason value of the currency increases and vice versa. Dimitrova (2005) suggests that if exchange rate is the lead variable a weak currency should result in depressed stock prices and a strong currency should result in higher stock prices (a positive relationship). On the other hand if stock prices are the lead variable then rising stock prices should result in currency depreciation (a negative relationship). However, Dimitrova found weak support for these hypotheses.

#### *Models specifications*

- Unit Root Test: Ordinary least squares (OLS) may result in spurious regression so it cannot be applied to non-stationary time series. For that reason, from non-stationary time series generalizations are not possible using OLS (Gujarti 2003). So, the order of integration of variable is investigated to establish that whether a time series variable is stationary using augmented Dickey Fuller (ADF) test (Dickey and Fuller, 1979, 1981). The following ADF models are estimated:

$$\Delta Y_t = \hat{\alpha}_1 + \hat{\alpha}_{2t} + \theta Y_{t-1} + \lambda \sum_{i=1}^n \Delta Y_{t-i} + \mu \quad (1)$$

$$\Delta Y_t = \hat{\alpha}_1 + \theta Y_{t-1} + \lambda \sum_{i=1}^n \Delta Y_{t-i} + \mu \quad (2)$$

Where, both constant terms are included in equation 1 i.e. ( $\hat{\alpha}_1$ ) and a trend term i.e. ( $\hat{\alpha}_{2t}$ ), however, only a constant term ( $\hat{\alpha}_1$ ) is included in equation 2.  $\theta=0$  is tested in both the equations in order to establish stationarity of the series under investigation.

- Co integration Test: Johansen's co-integration test (Johansen, 1991 and 1995) is estimated to investigate the co-integration (long run equilibrium) relationship of the variables integrated of the same order. Johansen's co-integration model specification is as follows:

$$\Delta X_t = \lambda X_{t-1} + \sum_{i=1}^{n-1} \alpha_i \Delta X_{t-i} + \beta Y_t + \varepsilon_t \quad (3)$$

Where

$\Delta$  = the first difference lag operators

$X_t = (n \times 1)$  random vector of time series variables integrated of the order one,  $I(1)$

$\beta Y_t = (n \times 1)$  vector of constants

$\perp_i = (n \times n)$  matrices of parameters

$\lambda = (n \times n)$  matrix of parameters

$\varepsilon_t =$  Sequence of random  $p$ -dimensional white noise vectors

Rank ( $r$ ) of  $\lambda$  entails information for the co-integration (long run relationships) of the time series variables under investigation. The columns of  $\beta$  contain the co-integrating vectors while  $\alpha$  contains the adjustment parameters in the VECM. To investigate the co-integration properties of the time series the study uses the Johansen's method (both bivariate and multivariate) where in first  $\lambda$  Matrix is estimated in the unrestricted form which is then tested for the restriction imposed by the reduced rank of  $\lambda$  i.e.  $0 < r < p$ .

The Trace Static tests (model 4) the null hypothesis of  $r$  co-integrating relations against the alternative of  $k$  integrating relations where  $k$  is the number of endogenous variables, for  $r = 0, 1, 2, \dots, k_1$ . The Trace Statistic for the null hypothesis of  $r$  co-integrating relations is calculated as:

$$LR_{tr}(r|k) = -T \sum_{i=r+1}^k \log(1 - \lambda_i) \quad (4)$$

For  $r = 0, 1, 2, k_1$ . Where  $\lambda_i$  is the  $i$ -th largest Eigenvalue of the matrix  $\lambda$  (see model 4). A second test is the maximal Eigenvalue Statistic (model 5) which tests the null hypothesis of  $r$  co-integrating relations against the alternative of  $r+1$  co-integrating relations. The mathematical representation of the test is as:

$$\begin{aligned} LR_{max}(r|r+1) &= -T \log(1 - \lambda_{r+1}) \\ &= LR_{tr}(r|k) - LR_{tr}(r+1|k) \end{aligned} \quad (5)$$

- Granger Causality Test: The Granger causality tests the null hypothesis that  $\gamma = 0$  in the bivariate regressions expressed as:

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \dots + \alpha_n Y_{t-n} + \gamma_1 X_{t-1} + \dots + \gamma_n X_{t-n} \quad (6)$$

$$X_t = \alpha_0 + \alpha_1 X_{t-1} + \dots + \alpha_n X_{t-n} + \gamma_1 Y_{t-1} + \dots + \gamma_n Y_{t-n} \quad (7)$$

The null hypothesis in the first equation is that  $X$  does not Granger cause  $Y$  and in the second equation, the null hypothesis is that  $Y$  does not Granger cause  $X$ . The study use  $F$ -statistic to test for Granger-causality. The outcome of the Granger-causality analysis can be:

- a) No causality; the variables do not Granger-cause each other
- b) Uni-directional causality; only one variable Granger-causes the other

### *Hypotheses*

The study mainly aimed to test the following hypotheses:

H01: In log level form all the time series are stationary.

H02: In first difference form all the time series are stationary.

H03: In multivariate settings there is no co-integration between Exchange rate and Macro-economic variables.

H04: The long run equilibrium relationship of the time series variables is investigated here.

The study also applies the Granger-causality test if the variables were found not to be co-integrated to test the following hypotheses.

H05a: Exchange rate does not Granger-cause Macro economic Variables.

H05b: Macro economic variables does not Granger-cause Exchange rate

## **Results & Discussions**

### *Descriptive statistics*

This chapter contains explanation of the results, which were identified from applying different statistics tests and tools on selected dependent and independent variables time series data, the explanation of results are given below.

**Table 4.1 Descriptive Statistics of The Sample Log Levels.**

Descriptive Statistics of Time Series Variables in Levels Without Log								
	NEER	TRMG	IP	WPI	SPI	EXPT	IMP	MS
Mean	85.82003	8609.483	8.398245	130.9049	236.3537	202397.6	333518.5	2718171
Median	81.505	10738.85	8.81365	131.59	264.43	227165	347265.5	2870305
Maximum	119.85	14725.8	15.98	176.07	414.16	287143	689167	4357690
Minimum	73.27	675.73	1.21	89.91	63.02	91618.2	100853	1200260
Std. Dev.	11.69561	4818.509	3.413127	26.59861	130.0405	66287.19	174283.6	1076111
Skewness	1.055997	-0.64159	-0.12159	-0.08049	-0.13191	-0.36552	0.03099	-0.14697
Kurtosis	3.443632	1.707705	3.310478	1.420938	1.27101	1.515643	1.386978	1.368254
Jarque-Bera	11.25522	8.015112	0.375878	6.088426	7.392592	6.616203	6.297061	6.643409
Probability	0.003597	0.018178	0.828665	0.047634	0.024815	0.036586	0.042915	0.036091
Sum	4977.562	499350	487.0982	7592.484	13708.51	11739060	19344075	1.58E+08
Sum Sq. Dev.	7796.881	1.32E+09	664.018	40326.71	963900.8	2.50E+11	1.73E+12	6.60E+13
Observations	58	58	58	58	58	58	58	58

*Note: the lag length was selected using the SIC*

In first step the study investigated simple descriptive statistics before applying natural Log on data, According to Descriptive statistics which are shown in table 4.1 Among them the first selected variable which were dependent variable for current study as well is Exchange rate and their mean were 85.82 and the median of 81.5 with the selected sample observation of 58, Mean shows the percentage average of all data of specific variable, the Second selected variable for study was total reserve less gold (TRMG) which was first independent variable for study, which the mean of 8609.4, the third selected variable for current study was Industrial production (IP) which shows the mean of 8.39, the fourth selected variable was inflation through whole sale price index (WSPI) and their mean was 130.9, the fifth variable was share price index (SPI) which shows the average mean 136.35, the next selected variable for study was export (EXP) which identified the mean value of 2023.97, then the study emphasize on import (IMP) which shows the mean results of 333.5, and further the study select the money supply (MS) as last independent variable, which shows the mean of 27181.

#### *ADF test results*

Table 4.2

	Level	1 <sup>st</sup> Difference
Variables	Constant	Constant
Exports	-0.51623	-4.18986
TRMG	-1.4853	-6.22619
IMPORTS	-1.39496	-9.71989
IPP	-1.813783	-3.122258
MTW	-0.597181	-9.25408
NEER	-2.89743	-6.50489
SPI	-1.46365	-6.8608
WSPI	-0.84799	-7.39025
1% Critical Value*	-4.13728	-4.13053
5% Critical Value	-3.4953	-3.49215
10% Critical Value	-3.17662	-3.1748

*Note: the lag length was selected using the SIC.*

After the Descriptive statistics the data are converted by taking natural log of selected data, the purpose of taking natural log is that all data become in one time series and in one sequence. After that ADF test was applied to both Log level and first differenced form of all the time series variables to examine the stationarity property of all the variables. By assuming both constant and trend the test was applied. Table 4.2 shows the ADF test results. The results show that all selected variable Nominal exchange rate (NEER), Total reserve less gold (TRMG), Share price index (SPI), Import (IMP), Export (EXP), Industrial Production (IP),

Whole sale price index (WSPI) and Money supply (MS) were not stationary in Log level and not significance assuming constant. As the data are not stationarity in level so no further test apply on such time series, for applying further test like co-integration the time series data must be stationarity form, for converting time series data into stationarity form the study apply first difference to the all selected variables data, the result shows in the table were clearly shows that after applying first difference in ADF test the all selected time series data of all variables become stationarity in nature and ready for further analysis.

#### *Multi co-integration test results*

The outcome of the multi-variate co-integration tests are provided in table 4.3. Table 4.3 tells that apart from NEER with Import, NEER with export, NEER and WSPI, NEER with Money supply and NEER with foreign reserve were co-integrating relationship at 5% and 10% level of significance respectively suggested by both MEV test and Trace test, there was no evidence of multi-variate co-integration between NEERI and the rest of variables.

Table 4.3

Hypothesized	Trace		0.05	
No. of CE(s)	Eigen value	Statistic	Critical Value	Prob.**
None *	0.751347	307.8956	159.5297	0
At most 1 *	0.674733	229.9604	125.6154	0
At most 2 *	0.552032	167.0664	95.75366	0
At most 3 *	0.485337	122.0965	69.81889	0
At most 4 *	0.443189	84.89884	47.85613	0
At most 5 *	0.405807	52.10915	29.79707	0
At most 6 *	0.211176	22.95828	15.49471	0.0031
At most 7 *	0.158658	9.674419	3.841466	0.0019

*Note: the lag length was selected using the SIC*

Consequently to investigate the long run relationship of exchange rate with other macro-economic variables the multivariate co-integration test was applied. In Table 4.3 the results of the multivariate co-integration tests are provided. It is suggested through trace test that at 5 % level of significance there are at least six co integrating relationships. There are two co-integrated vectors suggested by MEV test that bind the long run relationship among the variables. Therefore the co-integrations tests suggest in a multivariate setting that among these variables there exists a strong long run relationship. And it is also suggested that these variables cannot move independently of each other. Another important thing is one or more variables react to re-establish the equilibrium relationship, whenever there is a deviation from the long run relationship,

*Granger causality test results*

Table 4.4: Granger Causality Test Results

Null Hypothesis	Obs	F-Stat.	Prob.
LNIP does not Granger Cause LNNEER	52	2.14151	0.0702
LNNEER does not Granger Cause LNIP		1.40975	0.2355
D_EXP does not Granger Cause D_NEER	52	3.04093	0.08571
D_NEER does not Granger Cause D_EXP		0.40354	0.5274
D_IMP does not Granger Cause D_NEER	52	0.01343	0.90807
D_NEER does not Granger Cause D_IMP		0.33336	0.56557
D_TRMG does not Granger Cause D_NEER	52	12.5035	0.00073
D_NEER does not Granger Cause D_TRMG		4.55843	0.03631
D_IP does not Granger Cause D_NEER	52	9.96519	0.00237
D_NEERI does not Granger Cause D_IP		11.9489	0.00094
D_MS does not Granger Cause D_NEER	52	9.01613	0.00372
D_NEER does not Granger Cause D_MS		0.32323	0.57152
D_SPI does not Granger Cause D_NEER	52	1.23594	0.27011
D_NEER does not Granger Cause D_SPI		2.60801	0.11089
D_WSPI does not Granger Cause D_NEER	52	2.77438	0.10032
D_NEER does not Granger Cause D_WSPI		0.04724	0.82858

*Note: the lag length was selected using the SIC*

To investigate whether macro-economic variables granger-cause the exchange rate or vice versa Granger causality test was applied. In Table 4.4 the results are provided. The results of Granger causality illustrate that EXPRTS (at 10% level of significance) and MS (at 5% level of significance) exhibit uni-directional causality towards NEER. On the other hand, bi-directional causality was provided for TRMG, IP and NEER (at 5% level of significance).

**Discussions of the Findings**

Hyder and Shah (2004) point out that given the considerable deregulation of Pakistan's economy in the recent year's inflation in Pakistan cannot remain unaffected by changes in the exchange rate. Bhatti (1997, 2001) reported that inflation was instrumental in the determination of exchange rate of Pak Rupee. The findings of the study are in line with these earlier studies and suggest that there is a long-run relationship between exchange rate and inflation at 10% level of significance (Table 4.3). This provides a weak support for the purchasing power parity theory. This finding is conformity with Khan and Qayyum (2007) who also found support for the purchasing power parity in Pakistan. The Granger-causality test (Table 4.4) suggests that the direction of influence is more

from inflation to exchange rate than from exchange rate to inflation (though both are statistically insignificant). However, report no statistically significant relationship between inflation and exchange rate. This finding contradicts Hye and Siddiqui (2010) who found that exchange rate changes were the main cause behind rising industrial and agricultural prices after 2004. One plausible explanation could be the problem of multi-collinearity that may exist given the other macro-economic variables. The results from the Granger-causality (Table 4.4) test suggest that money supply leads exchange rate i.e. money supply Granger-cause exchange rate (a uni-directional causality). This finding is consistent with the proposition of Maswana (2005) who suggests that money supply has an instrumental role in the determination of exchange rate in an economy. Hye and Siddiqui (2010) also reported that money supply and exchange rate were co-integrated and that the direction of influence was from money supply to exchange rate. This finding indicates that to preserve the value of Pak Rupee and stabilize its exchange rate against other currencies (especially the U.S. Dollar) government must follow fiscal discipline and reduce budget deficit by all possible means. This can be attributed to multi-collinearity as money supply and inflation is also part of the model along with other macro-economic variables.

The study reports findings that indicate a bi-directional causality between exchange rate and total reserve less gold (Table 4.4). This finding is consistent with Kasman and Ayhan (2008). However, the findings of the current study are different than Kasman and Ayhan (2008) as it failed to find both a short and long relationship between exchange rate and total reserve less gold and exchange rate (Table 4.3). This finding explains that both exchange rate and total reserve less gold Granger-cause each other. A rise in the total reserve less gold causes exchange rate of Pak Rupee to appreciate and vice versa. Similarly an appreciation of Pak Rupee causes a rise in total reserve less gold. This finding is consistent with main stream international finance which suggests that investors prefer countries with stable and strong currencies so that their investment value is retained. One of the most important elements of total reserve less gold is foreign remittances from Pakistanis living and working abroad. Given that central bank's intervention into the foreign exchange market is costly, time consuming, disliked by many and uncertain to be able to manipulate exchange rate over a longer period, the government's policy makers and regulators should encourage and facilitate remittances by compatriots living abroad. It will positively influence exchange rate and stabilize the value of Pak Rupee in foreign exchange market. Alongside this the government should devise ways and means to increase exports in the long run.

The study also reports statistically significant inverse relationship between exchange rate and exports. It suggests that a rise in exports causes Pak rupee to appreciate against the U.S. Dollar and vice versa. It can be concluded that a rising exports value increases the demand for Pak Rupee and causes it to appreciate against the U.S. Dollar in the long run. Further the study reports that exports react to correct any deviations from the long-run equilibrium. Hence it suggests that exports Granger-cause exchange rate in the long-run while exchange rate Granger-cause exports in the short-run. The findings from the Granger-causality test (Table 4.4) and suggest that exchange rate and industrial production share statistically significant relationship. The Granger-causality test suggests that there exists a bi-directional causality between exchange rate and industrial production. The results suggest that industrial production leads exchange rate in the long run and increase in productivity is accompanied by depreciation of Pak Rupee. A rise in productivity occurs in economic recovery and economic boom. In an emerging market like Pakistan, increased productivity is accompanied by higher and higher inflation and consequently higher interest rates by central bank as a monetary policy tool to maintain economic stability. This causes exchange rate to depreciate in spite of increased productivity. Because this study has taken nominal industrial production than real industrial production, the given explanation becomes more plausible for the observed results. This finding is consistent with Dogruel, Dogruel and Izmen (2010) and Morley (1992) who also suggests that exchange rate influences output i.e. industrial production.

The study failed to report evidence to support Share price index in multi-variate co-integration test as well as Granger-causality test (Table 4.3 and Table 4.4 respectively). However, the study reports a long term positive relationship of exchange rate with share price index which suggests that a rise in share price index causes the local currency to depreciate i.e. Pak Rupee to depreciate against the dollar. The study reported that both exchange rate and balance of trade were co-integrated (Table 4.3). Further it was found that balance of trade led exchange rate in the long-run and negatively influenced the value of Pak Rupee against the U.S. Dollar. Falling exports and rising imports causes trade balance to rise and hence affect the demand for and supply of the local currency in the foreign exchange market. In the case of Pakistan, a consistently rising balance of trade causes the value of Pak Rupee to depreciate against the U.S. Dollar. Further consistent with the proposition of Krueger (1983) the study reports that exchange rate Granger-cause balance of trade in the short-run. It is the balance of trade that reacts to re-establish the equilibrium long-run relationship. It is therefore suggested that macro-economic policy makers should stabilize exchange rate by devising policies to ensure fiscal and monetary discipline.

Economic policies encouraging the use of new technologies and production processes should be devised to improve productivity both effectively and efficiently. This will allow for simultaneously increasing exports and reducing imports through better quality of improved import substitution in the local market.

### **Conclusion**

Pakistan is one of the developing country and like other developing countries there are many variables responsible for fluctuation of exchange rate but study includes only seven variables other than exchange rate these variables are Exports, imports, Stock price index, Foreign reserve less gold, Industrial production, Whole sale price index and Money supply. It is consider that these seven variables have an effect on exchange rate and from data analysis made in the study this can be proven that in reality these variables are affected by exchange rate. For survival in this competitive economy there is need to have a stable exchange rate because of it exchange rate relation with other variables is examine in this study.

Thus the current research is aimed to study the dynamic association between macro economic variables and exchange rate in Pakistan. For this purpose the study analyzes quarterly time series of the relevant variables from 1998 quarter 1 to 2012 quarter 4. The study tests the proposed hypotheses using econometric models that are widely accepted and practiced in academic research in the areas of economics and finance. In the first place the study investigates that whether all-time series variables (exchange rate and the set of seven (7) macro-economic variables) are stationary or not. Then the study investigates in multivariate form, the co-integration properties of the variables under investigation. Further the study applies Granger-cause macro-economic variables or vice versa in the multivariate form. Along this line, the study also applies the Granger-causality test in the bi-variate form to investigate the lead-lag relationship and hence establish the direction of influence i.e. uni-directional. The study results suggest that there is a long-run association between exchange rate and inflation at 10% significance level. The Granger-causality test suggests that the direction of influence is more from inflation to exchange rate than from exchange rate to inflation (though both are statistically insignificant). The results from the Granger-causality test suggest that money supply leads exchange rate i.e. money supply Granger-cause exchange rate (a uni-directional causality). The study reports finding that indicate a bi-directional causality between exchange rate and total reserve less gold. A rise in the total reserve less gold causes exchange rate of Pak Rupee to appreciate and vice versa. The study also reports statistically significant

inverse relationship between exchange rate and exports. The findings from the Granger-causality test suggest that exchange rate and industrial production share statistically significant relationship. The study failed to report evidence to support Share price index in multi-variate co-integration test as well as Granger-causality test. The study reported that both balance of trade and exchange rate were co-integrated. Further the study reports that exchange rate Granger-cause balance of trade in the short-run.

## References

- Conway, F, Drew, A., Haunt, B. Scoff, A. (1998). Exchange Rate Effects and Inflation Targeting In Small Economy: A Stochastic Analysis Using Fps Techniques.
- Hsing, Y. (2006). "Analysis of Exchange Rate Fluctuations in Poland: Test of the Interest Parity Condition". *International Research Journal of Finance and Economics*, (2), 1-5.
- Jakab, M. Z. (1999). "Determinants of Real-Exchange Rate Fluctuations in Hungary". NBH Working Paper.
- Kandal, M. (2004). "Exchange Rate Fluctuations and Economic Activity in Developing Countries: Theory and Evidence". *Journal of Economics Development, Volume 29, Number1, June 2004*.
- Lahiri, A., Hantrovaska, V., Vegh, A.C. (2008). "Interest Rates and the Exchange Rate: A Non- Monotonic Tale". NBER Working Paper No. 13925
- Razak, A. W., Simon. D. N. (1999). "Nominal Exchange Rates and Nominal Interest Rate Differentials". IMF Working Paper, Wp/99/141.
- Sadeghi, M., Samsami, H., & Sherafat, N. (2007). "Inflation-Targeting Exchange Rate Model for an Oil Producing Country: The Case of Iran". *International Research Journal of Finance and Economics*, (12), 80-97.
- Sato, K., Ito, T. (2006). "Exchange Rate Changes and Inflation in the Post-Crisis Asian Economies: VAR Analysis of Exchange Rate Pass- Through". CIRJE Discussion Papers, F, 406.
- Simon, D.N.F. (1997). Current Account and Exchange Rate Behavior under Inflation Targeting In Small Open Economy.
- Wu, Y. (1996), "Are Real Exchange Rates Non-Stationary? Evidence from a Panel Data Unit Root Test", *Journal of Money Credit and Banking*, 28, pp. 54-63.