GCU Economic Journal, Volume L (1&2), 2017, pp. 73-92

Impact of Trade, Workers Remittances and Quasi Money on Volatility of Exchange Rate

Shehzad Ahmed*

Abstract: This paper addresses one of the core issues of Pakistan i.e. the volatility of exchange rate in the light of various determinants like the impact of trade, FDI, worker's remittances, money and quasi money (M2). Using a time series from 1976-2015 and by applying Johansen and Juselius (1990) cointegration technique, the results confirmed the presence of long run relationship among these variables. For the short run relationship the study employs Vector Error Correction Model (VECM). The estimation results show that these variables are co-integrated in short run as well. Moreover, VECM coefficient indicated that more than 10% of the disequilibrium in the volatility of exchange rate can be adjusted towards long run equilibrium annually and the time required for this approximately nine years and six months. Findings also show that except Trade, all other variables i.e. FDI, Remittances and Money supply are affecting positively to the exchange rate volatility in Pakistan.

Keywords: Investment, Trade, Remittances, Money, Time Series, Exchange rate
JEL Classification: E41, P33, C22, E22, F31

1. Introduction

This paper investigates the fluctuations in the exchange rate resulting from the changing in the trade (both exports and imports of the country), foreign direct investment (FDI), worker's remittances and money and quasi money (M2) in Pakistan. This study explains the empirical relationships between the dependent and independent variables of the interest. In the recent empirical literature, the effects of exchange rate volatility on exports, relationships between exchange rate volatility and foreign direct investment (FDI), relationship between exchange rate volatility and worker's remittances and relations of money and quasi money (M2) with exchange rate volatility indicate the ambiguous results. In spite of this ambiguity, some studies give the clear relations between the variables of interest. The high exchange rate volatility may reduce the trade by negatively affecting the exports from the developing countries. Because when the currency of the country appreciated its exports become expensive for the importer

* Graduate, Department of Economics, GC University Lahore

countries. The literature shows that there is a negative and significant long run relationship between exports and exchange rate volatility. Some literatures suggest that the worker's remittances have significant effect to appreciate the exchange rate and reduce the competitiveness of the tradable sector[1]. The exchange rate refers to the number of units of one currency which can be purchased from one unit of the other currency. The exchange rate gives us the relative worth of the domestic currency in terms of the foreign currency. The exchange rate volatility refers to the relative rate at which there are the up and down moments in prices of the securities. The annual standard deviation of daily price changes represents the volatility of exchange rate. There will be high volatility when there are rapid up and down moments over the short time period in the stock prices and low volatility when fluctuations in the stock prices are small or the stock prices almost never changes. The fluctuations in the exchange rate are considered one of the main issues of the economy of any country. It affects greatly the growth of the economy by influencing the major economic indicators like exports, macroeconomic stability, external demand, level of uncertainty, changes in the domestic credit, openness, external debt, tightness of the monitory policy and foreign direct investment etc. There were energy crisis almost throughout the world in 1990s which caused to increase the uncertainty and volatility of the exchange rate and because of this reason exchange rate volatility acquired a special importance in the most of the economies of the world. There is a high priority for exchange rate regimes and exchange rate fluctuations for the purpose of management and formulation of the macroeconomic policies in the economy of any country. There are different areas which affected by the fluctuations in exchange rate. These areas are the price stability, employment, cost of imported raw material and serving the foreign borrowings, general inflation, services sector (tourism), consumer product, foreign direct investment, BPO and income of the country. So, the economy as a whole bears occasionally but disproportionate effects resulting from the small and frictional changes in the fluctuations of the exchange rate. The economy of the Pakistan experienced the fluctuations in the exchange rate from the independence and largely influenced by the US economy, because the economies of the world are now interlinked with the notion of globalization. The economy of the United State affects the economies worldwide. Therefore, the policies

[1] Lopez et al. (2007)

of the US economy change the value of the dollar relative to the other currencies i.e. the interest rate throughout of the world would increase when the interest rate in the US economy increases because of the tight monetary policy. The trade of the Pakistan is mostly carried out in terms of dollar and the exchange rate of Pakistan shows volatility in terms of the US dollar because of the economic instability in the Pakistan's economy. Just after the independence in 1947, 1 PKR was traded with one Indian rupee. In 1955, value of dollar in Pakistani rupee was PKR.4.76. In 1971, Pakistan faced war with India, currency was devalued and PKR.25 was necessary to purchase 1 US$. The depreciation was continued in 1989 and 2000. The exchange rate was 31.64 in 1995, 53.64 in 2000, 59.51 in 2005 and 85.19 in 2010. There was 6.73 percent appreciation of the rupee in 2001 to 2002 and 3.9 percent appreciation in 2002 to 2003. Again the rupee was depreciated against US dollar from the years of 2004-2007[2]. This article deals with the impact of the trade (exports and imports as the constant local currency unit), foreign direct investment (FDI), worker's remittances and money and quasi money (M2) on the fluctuations and the volatility of exchange rate in Pakistan. This analysis is done by taking the exchange rate volatility as dependent variable and trade (exports and imports as the constant local currency unit), foreign direct investment (FDI), worker's remittances and money and quasi money (M2) as independent variables.

2. Literature Review

Goldberg and Charles (1994) worked to find the relationships between foreign direct investment and exchange rate variability. This paper also incorporates the effects of the demand uncertainty. In this study there is the case of UK, Japan, US and Canada for foreign direct investment (FDI) flows. This work examines the understanding of the real impact of exchange rates in many dimensions. The results of the paper indicates that the without depressing the economic activity in domestic economy there is the internalization of the production activity because of the volatility of exchange rate. So, the volatility of exchange rate without depressing the economic activity as a whole increases the flows of the international capital which can be put in place of the international trade in goods.

[2] Sbp.org.pk

Arize (1996) examined the effects of the exchange rate on the real exports. This work is done for a developing country, Korea. The result shows that both in long run and short run there is a significant and negative impact of the real exchange-rate uncertainty on exports. In this procedure the residuals thus work as explanatory variables in short run export demand function. The regression also shows the stable results. So the results indicate that without taking into account the stability and level of real exchange rate, the trade policies for stabilizing the export market will generate the uncertain results.

Chakrabarti and Barry (2002) examined the effect of the exchange rate expectations and exchange rate volatility on the foreign direct investment (FDI). The data used for this purpose was annual data ranges from 1982-1995. This paper dealt with the flows of FDI from USA to 20 OECD countries. The results of this paper after applying the econometric techniques showed that the skewness of the devaluation of the exchange rates have the positive robust effect on FDI flows and volatility of the exchange rate and its average devaluation do not have the robust positive effect on the FDI flows. This evidence can be viewed as consistent with the hypothesis because for the expectation about the future exchange rate the foreign investors make the adjustments in exchange rates relatively with larger shocks.

Laurent *et al.,* (2003) dealt with the debt dynamics and hard currency exchange rate in the emerging economies. In the emerging economies the major factors that affect the external debt dynamics are variations in the exchange rate and the interest rate. The result in this study indicated that the by using three parameters, geographic structure of trade, exchange rate regime and currency compositions the emerging countries can stabilize the domestic value of its external debt. So, this study aimed to make such policies which make the emerging countries to stable the debt dynamics due to the volatility of the hard currency. The emerging countries can make the debt dynamics insensitive to the volatility of the hard currency exchange rate when the geographic pattern of trade, the weights of the exchange-rate reference basket and the external debt currency composition are identical.

Lopez *et al.,* (2007) explored the effects of the worker's remittances on the exchange rate for the case of the countries of the Latin America. The study

showed that the worker's remittances affect the exchange rate in three ways. First, worker's remittances can have impact on the economy's external equilibrium by raising the country's net foreign asset position. Second, the worker's remittances may also have impact on the economy's internal equilibrium for a situation in which domestic labor and capital are utilized efficiently. Third, the worker's remittances have impact on growth, so affect the exchange rate although in this case the effects are likely ambiguous. The results of the study also show that when the flows are large enough relative to the size of the economy of the country which received flows, these flows may also cause of many undesired problems.

Nasir and Hassan (2011) investigated the impact of the economic freedom, exchange rate stability, investment climate and market size on the foreign direct investment. This relationship was examined for the South Asian countries by taken the panel data which ranged from 1995 to 2008. The FDI has negative relation with the effective real exchange rate when it is depreciated in the host country. It means that the depreciated effective real exchange rate will reduce the foreign direct investment (FDI). The host country should devise her monitory policy to provide the stability in her currencies. The market size (independent variable) is also positively related to the FDI because in the regression LNGDP (used for market size) showed positive and significant relation with FDI. The result showed that large is the market high will be FDI in that market.

Hassan and Holmes (2013) investigated the long run relationship between the real exchange rate and the worker's remittances for selected less developed countries (LDCs). The panel data was used for finding the long run relationship between the real exchange rate and the worker's remittances which ranged from 1960 to 2010. The econometric technique used for this purpose was the panel cointegration approach for long run relationship and quintile regression analysis for the potential asymmetries in the relationship. This study explored that the real exchange rate appreciates as the inflows of the worker's remittances increases. The worker's remittances also act like the Dutch Disease in which the country's international competitiveness decreases as the exploitation of the natural resources increases. The results of the study showed that there is improvement in the financial sector development by easing the credit constraints for investment when the worker's remittances are increased.

3. Methodology

3.1 Data Sources

This study gives the estimations to measure the effects of trade, foreign direct investment (FDI), worker's remittances and broad money on the volatility of the exchange rate in Pakistan. This relationship between the variables is found by using the time series data from the year 1976 to 2015. The data are sourced from the website of the World Bank (WB) namely World Development Indicators (WDI), State Bank of Pakistan (SBP) reports and international financial statistics (IFS). The study uses the Johansen and Juselius (1990) cointegration techniques to find the long run relationship and error correction mechanism (ECM) to find the short run relationship between the variables.

The variables used in this paper to find the impact on the volatility of the exchange rate are total trade (T), foreign direct investment (FDI), worker's remittances (WR) and Money and quasi money which is given the name of broad money (M2). The dependent variable is the volatility of the exchange rate which is obtained from standard deviation of the Official exchange rate (LCU per US$, period average) from world development indicators (WDI).

3.3 Model Specification

The aim of the study is to investigate the volatility of the exchange rate in Pakistan and the impact of trade, foreign direct investment (FDI), worker's remittances and broad money (money and quasi money) on the volatility of the exchange rate. After reviewing the different studies in the section of the literature review of this paper, it is suggested that the Johansen and Juselius (1990) cointegration technique is used for those time series having same order of integration. The order of integration and the level of the stationary are checked by applying the unit root tests. But the time series having different order of integration, autoregressive distributed lag (ARDL) model is applied. In this paper Johansen and Juselius (1990) Cointegration Technique has been used to see the existence of long run relationship among these variables. But for the short run relationship between the

dependent and independent variables, Vector Error Correction (VEC) is also applied. All this analysis is done by using the Eviews6.

The literature of the previous studies shows that the volatility of the exchange rate (VER) is influenced by several factors like macroeconomic stability, external demand, level of uncertainty, changes in the domestic credit, exports, external debt, tightness of the monitory policy and foreign direct investment etc. But the major variables that affect the volatility of the exchange rate (VER), evident from the literature review, are exports (X), imports (M), foreign direct investment (FDI), worker's remittances (WR) and money supply (money and quasi money) (M2) because these variables have the significant relationship with the volatility of the exchange rate (VER). Therefore, trade (exports and imports), foreign direct investment (FDI), worker's remittances (WR) and money supply (money and quasi money) (M2) are taken as the independent variables and volatility of the exchange rate is taken as the dependent variable.

So, by keeping in account the role of these variables the proposed model in this paper will be of the following:

$$LVER_t = \beta_0 + \beta_1 T_t + \beta_2 FDI_t + \beta_3 WR_t + \beta_4 M2_t + \mu_t \dots\dots\dots (1)$$

t = time period ranges from 1976 to 2015.
$LVER_t$ = logarithm of volatility of real exchange rate
T_t = represents the trade including imports and exports of goods and services in constant local currency unit.
FDI_t = foreign direct investment (FDI) as a percentage of GDP
WR_t = Workers' remittances and compensation of employees as a percentage of the GDP.
β_0 = constant
β_1, β_2, β_4, β_3 = elasticities or coefficients of trade (exports and imports of goods and services), foreign direct investment (FDI), worker's remittances and money and quasi money (M2) respectively
μ_t = white noise error term

3.4 Methodology

The unit root test is applied to check the problem of non-stationary of each time series used in the model. If the non-stationary time series are regressed, the results thus obtained will be spurious unless they are co-integrated. So it is necessary to check the stationary status of each time series before regressing the variables to find the long run relationships between them. If it is found that the underlying time series is non-stationary, then it would be made stationary by taking difference.

If mean and variance of time series is not independent of time and they change over the time, this indicates that the time series is non-stationary or it has the problem of unit root. The stationary time series is obtained from non-stationary time series simply by differencing the non-stationary time series. The number of times we take the difference (d) of time series to make it stationary is called the order of the integration simply denoted by I(d). If the time series become stationary by taking first difference its order of integration would be I(1), when difference is taken two times to make a non-stationary time series a stationary time series its order of integration would be I(2). The time series having order of integration I(0), it is a stationary time series at level. There are different tests which are used for the detection of the non-stationary time series or the unit root problem.

Johansen and Juselius (1990) gave the cointegration approach to find the cointegration between the dependent and independent variables. This technique is applicable only for the time series having same order of integration (find through unit root tests). If the order of integration is not same for all the time series involved in analysis the Johansen and Juselius (1990) cointegration technique would not be useful and gives the robust results. This technique gives only the long run relationships between the variables and the short run relationships are carried out by using the vector error correction model (VECM). In this paper the time series are stationary at first difference, so having same order of integration, I(1). Therefore, Johansen and Juselius (1990) cointtegration technique is used for long run and vector error correction model (VECM) is used for short run relationship between the variables.

4. Empirical Results

4.1 Results of Unit Root Test

The unit root test presented by Dickey & Fuller (1981) Tests (DF-Test) and Augmented Dickey Fuller Test (ADF-Test) do not follow the t-distribution. In t-distribution the given time series is considered as stationary and this distribution does not take into account the problem of the non-stationary. These tests are used to check the stationary status of the time series because the given series can be stationary or non-stationary. Therefore, Dickey and Fuller (1981) gave their own critical values by taking into account the non-stationary aspect of the time series. These values are given the name of the τ (tou) values instead of the t-values. This study employs the Augmented Dickey Fuller Test (ADF-Test) and Phillips-Perron (1988) test to check the stationary status of the time series. This null hypothesis will be rejected when the calculated value of test statistic is less than the critical value (p-value). The results of the different unit root tests to check the stationary of different time series are given below in the Table 1. The model is selected with intercept when the graph shows random walk with drift and when the graph shows random walk with drift and deterministic trend the model is selected by including intercept and trend. But for more rigorous results the following Table shows the values of the test statistic of all the time series by including intercept and intercept and trend both.

Table 1: Unit Root Test

Variables	Tests			
	ADF Tests		Phillips-Perron Tests	
	Intercept	*Intercept & trend*	*Intercept*	*Intercept & trend*
T_t	0.0989 (0.9610)	-1.9965 (0.5823)	0.1511 (0.9651)	-1.9965 (0.5823)
ΔT_t	-5.3314* (0.0001)	-4.8804* (0.0031)	-5.3223* (0.0001)	-5.2866* (0.0008)
FDI_t	-2.6835 (0.1876)	-4.6797 (0.1044)	-1.9651 (0.3001)	-2.0987 (0.5280)
ΔFDI_t	-4.3343* (0.0023)	-3.8929** (0.0278)	-3.3344** (0.0212)	-3.2184*** (0.0983)
WR_t	-1.4857 (0.5286)	-2.1597 (0.4957)	-1.6972 (0.4236)	-2.4963 (0.3278)
ΔWR_t	-5.5376* (0.0001)	-5.4245* (0.0005)	-5.5630I* (0.0001)	-5.4491* (0.0005)
$M2_t$	-3.2367 (0.1266)	-4.4182 (0.2069)	-2.7624 (0.1744)	-1.8613 (0.6522)
$\Delta M2_t$	-5.0153* (0.0003)	-5.0380* (0.0015)	-5.7900* (0.0000)	-6.3934* (0.0000)
$LVER_t$	-1.5506 (0.4927)	-2.2191 (0.4601)	-3.1977 (0.1288)	-3.8950 (0.1233)
$\Delta LVER_t$	-6.9085* (0.0000)	-6.7568* (0.0000)	-7.6888* (0.0000)	-7.9279* (0.0000)

Δ Represents the first difference of the variable
Values in the parentheses are *P*-values.
* shows significance at 1%, ** shows significance at 5%, *** shows significance at 10%

The above Table shows that the no variable is stationary at level as verified by Augmented Dickey-Fuller test and Phillips-Perron test as well. The test statistic values are checked against the Table values at 1%, 5% and 10% level of significance. The results of the unit root tests show that variables have the same order of integration which validates the use of Johansen (1988, 1991) cointegration test.

4.2 Lag Selection Criteria

For employing Johansen cointegration technique the lags are selected by applying VAR model because before applying Johansen cointegration technique lag selection criteria for selecting the optimal lag length. In VAR model large numbers of lags are taken and the model is estimated again and again by reducing the lag length by one lag each time till zero lag. In this method to select the optimal lags, three lag selection criteria are used, one is Akieke Information Criteria (AIC), second is Schwartz Bayesian Criteria (SBC) and third is Hannan-Quinn (HQ) information criterion. The optimal lag length will be those lags for which Schwartz Bayesian Criteria (SBC), Akieke Information Criteria (AIC) or Hannan-Quinn (HQ) information criterion gets minimum value. This paper chose the Akieke Information Criteria (AIC) and select lag 3 because for lag three Akieke Information Criteria (AIC) gets minimum value.

4.3 Johansen Cointegration Test

The Johansen cointegration test is applied to assess the long run relationship of the volatility of the exchange rate and trade, foreign direct investment (FDI), worker's remittances and money and quasi money (M2). Before applying this test stationary status of the time series and optimal lag length are checked. The results for the unit root test shows that the variables are stationary at first difference so order of integration is I(1). According to the Akieke Information Criteria (AIC) the lag 3 is selected because for lag 3 Akieke Information Criteria (AIC) gets minimum value. So after assessing the stationary properties of time series and finding optimal lag length, for final estimations Johansen cointegration technique is used for joint hypothesis of both rank order and deterministic components. It involves the estimation of all models and represents the results from the most restrictive hypothesis through the least restrictive hypothesis. The values of the trace statistic and the maximum eigenvalue statistic are captured which are given in the following tables along with the critical values at 5% and the MacKinnon-Haug-Michelis (1999) p-values. The numbers of the cointegrating equations are found by comparing the Trace statistic and Maximum Eigen statistics with critical values at different significance levels.

Table 2: Long Run Relationship using λ_{trace} Statistics

Hypothesized No. of CE(s)	Eigen value	λ_{trace}	Critical Value 0.05	Prob.**
r = 0 *	0.8314	113.6685	69.8188	0.0000
r < 1 *	0.7084	67.3686	47.8561	0.0003
r < 2 *	0.5718	35.3249	29.7970	0.0104
r < 3	0.2954	13.2670	15.4947	0.1054
r < 4 *	0.1478	4.1612	3.8414	0.0414

* denotes rejection of the hypothesis at the 0.05 level. **MacKinnon-Haug-Michelis (1999) p-values.

Table 3: Long Run Relationship using λ_{max} Statistics

Hypothesized No. of CE(s)	Eigen value	λ_{max}	Critical Value 0.05	Prob.**
r = 0 *	0.8314	46.2998	33.8768	0.0010
r < 1 *	0.7084	32.0436	27.5843	0.0125
r < 2 *	0.5718	22.0575	21.1316	0.0370
r < 3	0.2954	9.10613	14.2646	0.2774
r < 4 *	0.1478	4.16123	3.84146	0.0414

* denotes rejection of the hypothesis at the 0.05 level. **MacKinnon-Haug-Michelis (1999) p-values.

In above Tables for Trace statistic and Maximum Eigenvalue statistic, the steric sign (*****) shows the rejection of the null hypothesis of "no

cointegration" therefore, it indicates the presence of cointegration equations. Under the Trace Statistics criteria, there are 4 cointegration equations and Max Eigen statistic criteria also shows the presence of 4 cointegration equations at 5% level of significance. So the presence of cointegration equations indicates the existence of long run relationship among the variables of the interest.

4.4 Vector Error Correction Model (VECM)

The previous section indicates the long run relationship between volatility of exchange rate and independent variables, used in this study, by employing Johansen and Juselius procedure. In this section the short run relationships between the times series is found by using the Vector Error Correction Model (VECM). The specification for Vector Error Correction Model (VECM) is given as:

$$\Delta LVER = \alpha_0 + \alpha_1 ECT_{t-1} + \Delta\alpha_2 T_{t-1} + \Delta\alpha_3 FDI_{t-1} + \Delta\alpha_4 WR_{t-1} + \Delta\alpha_5 M2_{t-1} + \varepsilon_t \quad (14)$$

In the above equation, ECT_{t-1} represents the error correction term. This error correction term indicates the speed of adjustment towards long run equilibrium that affects short run movement in volatility of the exchange rate. According to the theory:

- This term must be negative.
- Absolute value of this term must be less than 1.
- It should be significant.

The negative sign explores overall stability of the model and convergence towards the long run. In this paper this value is also negative. This value represents the speed of adjustment and time required for convergence towards the long run equilibrium.

Table 4: Error Correction Terms

Error Correction	ΔLVER	ΔT	ΔFDI	ΔWR	ΔM2
	-0.1043 [-2.7547]	0.4810 [3.5148]	0.2266 [3.6930]	0.1216 [0.9734]	0.5226 [1.3207]

t-statistics in [ ].

In above Table the value for LVER is negative, shows convergence towards the long run equilibrium. The other variables show the divergence from the long run equilibrium. For error correction the most important is the negative sign of the dependent variable because it is for the overall stability of the model. It is clear from the results of the error correction mechanism (ECM) given in the Table that annually about more than 10% of the disequilibrium in the volatility of exchange rate is adjusted. So the time required for volatility of exchange rate to return its long run equilibrium is less than ten years. It is approximately 9 and half years. The following Table shows the values of the cointegrating coefficients of the independent variables used in the model of this research paper.

Table 5: Co-integrating coefficients for the other variables

Variables	Coefficients
Constant	0.51713
T(-1)	0.1770 [8.5055]
FDI(-1)	-6.6177 [-7.1504]
WR(-1)	0.5226 [5.87326]
M2(-1)	-0.3970 [-3.4509]

t-statistics in [ ].

Specification for the Vector Error Correction Model (VECM) is given as:

$$\Delta LVER = \alpha_0 + \alpha_1 ECT_{t-1} + \Delta\alpha_2 T_{t-1} + \Delta\alpha_3 FDI_{t-1} + \Delta\alpha_4 WR_{t-1} + \Delta\alpha_5 M2_{t-1} + \varepsilon_t \quad (2)$$

By putting the values of co-integrating coefficients of the independent variables in the model of error correction mechanism (ECM), we have:

$$\Delta LVER = -0.5171 - 0.1043 ECT_{t-1} - 0.1770 T_{t-1} + 6.6177 FDI_{t-1} - 0.5226 WR_{t-1} + 0.3970 M2_{t-1} + \varepsilon_t \quad (3)$$

This equation shows the presence of the short run relationship among the variables used in this study. For short run relationship, ECM coefficient should be significantly negative and less than 1. All these conditions are met in the estimation results of this study too. Moreover after knowing that whether both long and short run relationships exist among these variables, the sign of coefficients also helped us in finding the nature and strength of this relationship among variables. Impact of trade and workers remittances is being observed negative with respect to exchange rate volatility while foreign direct investment and money supply is showing positive relation with dependent variable which is also evident from the present experience of the economies. Because when due to more of trade share and remittances, inflow of foreign reserves will increase then to correct disequilibrium from the balance of payments (usually deficit experienced by developing countries like Pakistan) will not be done by devaluing the currency. Hence more of these two factors will help in reducing this exchange rate volatility. On the other side more of money supply results more of this volatility because this increased supply will interrupt the workings of money and capital markets and this will ultimately destabilize the exchange rates due to excess demand of monetary and capital assets.

4.5 Diagnostic Tests for Residuals

In diagnostic analysis, certain tests are performed to check whether the model is good in all the aspects or not. These diagnostic analyses are done for residuals. Misspecification test for the residuals and descriptive statistics of the residuals are important to check the acceptability of the model. In this study for the autocorrelation and serial correlation of the residuals, Serial Correlation LM Tests is performed. The test suggests the acceptance of the null hypothesis, so there is no correlation. To check

heteroskedasticity of the residuals, VAR Residual Heteroskedasticity Test is performed which shows that there is no problem of the heteroskedasticity of the residuals. The VAR model for the selection of the optimal lags is performed which discussed three lag selection criteria; one is Akieke Information Criteria (AIC), second is Schwartz Bayesian Criteria (SBC) and third is Hannan-Quinn (HQ) information criterion. This test suggests selecting lag 3 on the basis of Akieke Information Criteria (AIC) because for lag 3, Akieke Information Criteria (AIC) gets minimum value. Then the test for the normality is performed which captures the values of the skewness, kurtosis and Jarque-Berra of the residuals. For this purpose one test Cholesky (Lutkepohl) is used and on the basis of the values of skewness, kurtosis and Jarque-Berra of the residuals, it is determined that the residuals are multivariate normal. Their null hypothesis states that residuals are multivariate normal. The result of the tests also shows the symmetry of the distribution and normally distributed error terms. The results of the normality test and test of heteroskedasticity are given in the following Tables:

Table 6: Normality Test

VAR Residual Normality Test Cholesky (Lutkepohl)	Skewness	d.f	Prob.
	1.3822	5	0.9262
	Jarque Berra	d.f	Prob.
	20.75621	10	0.0229

Table 7: Heteroskedasticity Test

Chi-square	d.f	Prob.
312.4887	300	0.2980

The results of the vector error correction mechanism (VECM) will be non-satisfactory if there is the problem of the non-normality and Heteroskedasticity in the residuals. But the results show that the estimations of the vector error correction mechanism (VECM) are satisfactory because joint test indicates that the residuals are normally distributed and there is no heteroskedasticity in the residuals.

5. Conclusions

This study examines the volatility of the exchange rate in Pakistan and tries to assess the impact of the trade (exports and imports of the goods and services, constant local currency unit), foreign direct investment (FDI), worker's remittances (WR) and money and quasi money (M2) on the volatility of the exchange rate. For this purpose data has been used for Pakistan from the time period 1976 to 2015. Johansen and Juselius (1990) cointegration technique has been applied for testing the relationship among desired variables. Results show the existence of long run relationships between the volatility of the exchange rate and all the proposed determinants of this crucial issue i.e. trade (exports and imports of the goods and services, constant local currency unit), foreign direct investment (FDI), worker's remittances (WR) and money and quasi money (M2). VECM has also confirmed the signs of short run relationship among these factors and suggested that more than 10% of the disequilibrium in the volatility of exchange rate is adjusted towards long run equilibrium annually and the time required for adjustment is less than 10 years (approximately 9 and half years). The paper further investigates the diagnostic tests for the residuals. The correlation, heteroskedasticity and normality of the residuals are checked by applying Serial Correlation LM, VAR Residual Heteroskedasticity and VAR model Cholesky (Lutkepohl) Tests respectively. The results of these tests prove that the residuals do not have the problems of non-normality, Heteroskedasticity and correlation; the model is perfect in nature and estimations of the vector error correction mechanism (VECM) are satisfactory.

6. Policy Recommendations

On the basis of these findings this study gives few recommendations for policy making regarding this problem of economy. These are:

- Effective and smooth running of fiscal and monetary policies are required to reduce inflation through controlled money supply for stabilizing the exchange rate.
- The State Bank of Pakistan (SBP) should intervene in the exchange rate to reduce the fluctuations in the exchange rate by selling and purchasing the US$ in the interbank market.

- Traders should be facilitated by reducing tariff rates and removing quotas so that foreign reserves could be increased to stabilize foreign exchange rate.
- Inflow of FDI should be regulated by commercial banks so that supply of money could not increase which can ultimately lead to increased demand and cause fluctuations in money market.

References

Arize, A. C. 1996. “The impact of exchange-rate uncertainty on export growth: evidence from Korean data”. *International Economic Journal, 10*(3), 49-60.

Chakrabarti, R. and Barry, S. 2002. “Exchange rate expectations and foreign direct investment flows”. *Review of World Economics, 138*(1), 1-21.

Dickey, D. A., & Fuller, W. A. (1981). Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica*: Journal of the Econometric Society, 1057-1072.

Goldberg, L. S. and Charles, K. D. 1994. “Foreign direct investment, exchange rate variability and demand uncertainty*”. National Bureau of Economic Research, Working Paper No.4815*.

Hassan, G. M. and Holmes, M. J. 2013. “Remittances and the real effective exchange rate”. *Applied Economics, 45*(35), 4959-4970.

Johansen, S. 1988. “Statistical Analysis of Cointegration Vectors”. *Journal of Economic Dynamics and Control, 12*(2–3), 231–254.

Johansen, S. 1991. “Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models”. *Econometrica, 59*(6), 1551–1580.

Johansen, S. and Juselius, K. 1990. “Maximum Likelihood Estimation and Inference on Cointegration with Applications to the Demand for Money”. *Oxford Bulletin of Economics and Statistics, 52*(2), 169–210.

Laurent, P., Meunier, N., Miotti, L., Quenan, C. and Seltz, V. 2003. “Emerging Countries' External Debt”. *Revue Économique, 54(*5), 1033-1055.

Lopez, H., Bussolo, M. and Molina, L. 2007. “Remittances and the real exchange rate”. *FEMS Yeast Res, 7*(3), 391-403.

McKinnon, J., Haug, A. and Michelis, L. 1999. “Numerical Distribution Fucntions of Likelihood Ratio Tests for Co-integration”. *Journal of Applied Econometrics, 14*(5), 563-577.

Nasir, Z. M. and Hassan, A. 2011. “Economic freedom, exchange rates stability and FDI in South Asia”. *The Pakistan Development Review,* 423-432.

Phillips, P. C., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, 75(2), 335-346.