EXCHANGE RATE VOLATILITY AND ITS RELATIONSHIP WITH MACROECONOMIC VARIABLES IN PAKISTAN

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ABSTRACT

This study investigates volatility of exchange rates and its relationship with selected macroeconomic variables; foreign direct investment, gross domestic product and inflation. Secondary time-series data is used and collected from world development indicators for the time period of 29 years (1991 to 2019) of Pakistan. Unit root test, co-integration test, GARCH and regression analysis are the techniques used for hypothesis testing. In this study, Unit root ADF test is used to check stationarity of data then GARCH is applied to check exchange rate volatility, co-integration and regression analysis is applied to check relationship between dependent and independent variables. Underlying study concludes the results that there is an existence of long term and persistent volatility in exchange rates, and exchange rate having positive relationship with gross domestic product and foreign direct investments but negative and insignificant relationship with Inflation. The findings suggest that exchange rate should be managed by decision makers to have positive impact on economy. Many studies suggest that fixed exchange rate should be adopted by developing countries instead of floating exchange rates. This study is helpful for policy makers and for researchers.

Keywords: Exchange rate, foreign direct investment, gross domestic product, inflation
JEL Codes: O24, F31

I. INTRODUCTION

Exchange rate is an important determinant for an economy of any country. As well exchange rates have gained a lot of attention for investors and policy makers from last decades. Now investors are more concerned about exchange rates of a country in which they are investing. Floating and fixed exchange rates are used by developed and developing countries. Developed countries are more towards using floating exchange rates but developing countries are more likely to go with fixed exchange rates because it is difficult for developing countries to bear high shocks in depreciation of country's currency. Exchange rates have also impact on macroeconomic variables like inflation growth rate, gross domestic product, foreign direct investment and interest rate but it depends on the volatility of exchange rates likewise it may short-term or long-term. Exchange rate refers as a value of one country's currency in other country's currency like how many Pakistani rupees are equal to how many US dollars. Real exchange rate is a rate which actually paid while purchasing commodities of the two countries, nominal exchange rate refers rate on which currencies of two countries are currently trading. Every developed and developing country is careful and keep an eye on stability of exchange rates, because exchange rate volatility or higher fluctuations in exchange rates are not suitable for an economy of a country. Foreign direct investment receives direct effect of exchange rate fluctuations in an economy that decreases the level of unemployment as well. Interest rates of countries also have great impact on exchange rates because central bank quarterly changes interest rate policy and if increase or decrease in interest rate of two countries are same then exchange rates will not be effected and if one country increase or decrease interest rate and other country don't then there will be no equilibrium (Ramasamy and Abar, 2015). Mahmood et al., (2011) expressed strict observation of exchange rate market lasted from 1980 to 1989 and then in early 1990s exchange rate market got some freedom and liberalization and then exchange rate started to manage by forces of supply and demand which caused high devaluation in currency of Pakistani rupee till 1996. And then in

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1998-1999 exchange rate showed some little improvements. Then in 2002-2003 exchange rate showed some stability due to developments in this period. Pakistani rupee depreciated its value near 0.5% to 0.6% in 2005 and 2006. The exchange rate was 60.021PKR per dollar at that time. In 2007 to 2008, it was again instable due to economic recession. And then in 2013- 2014 exchange rate showed instability when exchange rate was 120 PKR per dollar and that was highest of all time till then then in one year it was artificially managed and came down to 100 PKR per dollar and with economic growth and increasing GDP it got some stability till 2017 and then 2018 after changing of government in Pakistan exchange rate again showed big fluctuations and went to 164 PKR per dollar.

I.I. FOREIGN DIRECT INVESTMENT

Foreign direct investment has gained a lot of importance in world due to its impact on world economy developed countries are always welcoming FDI to increase the investment and take economy to next level, but underdeveloped countries seek more interest and show greater effort to engage FDI to make their economy stable. Countries like Pakistan need FDI which can reduce financial crisis like unemployment and capital growth. In the end of 1990 world economy feel increase in foreign direct investment and graph of developed countries was higher than developing countries. FDI faced ups and downs during decades, after 1990 first downfall came in 2002 and became very low noticed by Ullah et al. (2012). After 2002 graph again started increasing and FDI touched high in 2004. From 2004-2007 economies world over got a boom in FDI and it reached $1.9 trillion in 2007. In 2008-2009 FDI went down by 32% due to recession of 2007.Developing countries got nearly $5601 billion investment in 2010 which was a little increase after recession period.

As foreign direct investment is more dependent on political situation of country and security risks attached to that country Pakistan has faced political instability after every few years and an impact of terrorism was also there which was hurdle for foreign investors. Under all these situations Pakistan tried to increase its FDI growth through different policies. In Pakistan after 2003 FDI started increasing before 1995 it remained no more than 1% of total GDP. Pakistan has faced ups and downs in FDI since 2000. In 2002 Pakistan got 16% increase in FDI. From 2005 to 2007 Pakistan experienced 20% increase in FDI which was $5.4 billion in 2008 and then till 2012 FDI of Pakistan decreased to $859million. In 2014 after new government projects for energy and telecommunication sector were taken and with start of CPEC FDI deal of $46 billion made economy at stable position. According to world investment report FDI of Pakistan increased from $ 17 billion in 2018 to 22 billion in 2019.The factor of foreign direct investment can be enormous or biggest but exchange rate is among the extreme factor. Exchange rate volatility impacts positively as well as negatively on foreign direct investment. Exchange rates involves high volatility because to its delicacy to adjust to the alteration in local and global foreign market. The time series data for the period which is collected from World Bank. Time series data is used for to measure the volatility of exchange rate, exchange rate stability free market (trade openness) and rising prices (Inflation). High volatility of exchange rate is more effect foreign direct investment. The time series data is collected by using the different techniques. Time series data is collected by using various econometrics techniques (unit root test, volatility analysis, co-integration technique) have been used for the objective are analysis. Time series analysis tells about the stability in exchange rate and also tells us about the inflation condition of particular country. FDI is positively relates along with Rupee weakening and exchange rate volatility discourage International Investment (Ali and Naeem, 2017; Ali, 2011; Ali, 2015; Ali and Zulfiqar, 2018; Ali et al., 2015)

High volatility or instability of exchange rate decreases the International investment. Stable or less fluctuation of exchange rate appreciate the FDI and also gives benefits to economy. Exchange Rates Volatility impact positively and negatively on Foreign Direct Investment trade openness exotic or dramatically increases the foreign direct investment exchange rate volatility causes of foreign direct investment. By attracting more foreign direct investment we are able to overcome and break the dangerous circle of poverty. Mostly company focus on exchange rate for taking FDI and by this they can be improve the economic condition of their country. GARCH model was used to check Exchange rate volatility and investigated that exchange rate volatility impacts negatively to foreign direct investment and positively to Gross Domestic Product, growth rate and trade openness (Mahmood et al., 2011).

Foreign Direct Investment is beneficial for both developing and developed countries by more FDI the productivity is increases and particular country's economy becomes strong. FDI more facilitate to developing countries and increases the margin productivity of capital because of its shortage and investor of developed countries seek high profit. FDI plays vital role technological advancement, Infrastructure development, productivity enhancement, economy strengthen and to break vicious circle of poverty in developing countries. Exchange rate are very sensitive minor changes in local and global economic layout and then repeated changes. If exchange rate is high volatile in any one period of time then they shows their effect and show their changes repetitively by this the foreign direct investment of any country is affected. Mostly countries tries to prevent from high volatility of exchange rates. Exchange rate is one of the factor whose effect the foreign

direct investment (FDI).Many other factors or determinant can effects the foreign direct investment but the exchange rate effects more than from other determinant. The Relationship of Foreign Direct Investment and inflation is negative and inflation rate is used for measuring the macroeconomic condition. FDI is anticipated to be emphatically related with trade openness, by this countries can increases the GDP and economy becomes strong. Trade openness attracts the foreign investors and by this investor takes profits for themselves and also gives the benefits to entire country.

Pakistan is a developing country which is it hardly needs to makes attracting policy and controls the volatility of exchange rate for generating the more FDI. By attaining the attention of foreign investor Pakistan can be improved their Infrastructure level, Technological advancement, Employment's opportunities, Production level and also strong their economy by FDI. FDI helps in to break the vicious circle of poverty in particular country its more facilitate to developing country. For more FDI any country needs to control and manage their exchange rate and politically instability. Trade openness also helps in generating the more FDI and inflation is negatively related with FDI. The stable exchange rate bring the new and fresh FDI. Minimizing the volatility of exchange rates and to hold the exchange rates in a compatible mode (Aqeel et al., 2005). Real Exchange rate is normally used as a calculation of global Competitiveness and it also familiar as index of competitiveness of currency of any country. Index and competitiveness have negative associated with them. If the value of index is higher level of competitiveness of that country will be lower. When the exchange rate of the country is properly valued then it will not affect the macro economic factors then its effects the macroeconomic performance of entire country. Volatility of exchange rate disturbs the flow of investment stable and controlled exchange rates appreciates investment. Unexpected changes are day by day uncertain fluctuations or changes in exchange rate of any country can disturb the investment of that particular country negatively.

I.II. GROSS DOMESTIC PRODUCT

GDP of a country shows income of that country. Economic growth of any country can be measured with its GDP. Major contribution to GDP of Pakistan is agricultural sector that is more or less 30% average. In case of Pakistan GDP remained inefficient there many reasons for poor GDP growth like poor infrastructure, less exports insufficient FDI, high inflation lack of better taxation system, unemployment one of the major is political instability. If we look real gross domestic product (RGDP) from 1980-1990 it remained 4.6%. And 5% from 1990-1998. In 2002 GDP increased to $77,937 million that is 3.1 % from 2% which was in last year 2001. In 2004 GDP was increased to high of 7.5% and in 2008 attained a low of 1.7% this was due to recession of 2007. In next 4 to 5 years it started increasing gradually and in 2013 GDP was 4.6% and then in next year it get boost and touched level of 5.5% in 2017 and 5.8% in 2018 and in 2019 due to economic instability it came down to 0.99% (Iqbal et al., 2014).

GDP is the macroeconomic variable which involves in growth of the country's economy, many countries concern on the sustainable growth of an economy, gross domestic product is the valuating measure of economy of a country. Sketch of GDP includes the return of services and manufacturing goods with in a boundary, it includes all the income which is related within a country. GDP involve three approaches income, expenditure and product approach. It is an important element for assessing the economy position of a country. GDP is calculated and includes the market worth and production in a country, it includes final production includes products and services which are bought by their consumers, transfer payments and financial transactions, services and goods only produce in a country. GDP and exchange rate are linked in a relation because when there is a change in exchange rate it effect the GDP of a country GDP includes all the income which is related within a boundary. Exchange rate plays an important role in macroeconomic variables. Many researchers debate on that exchange rate influence the GDP and their relation with import and export because exchange rate effect the GDP when exchange rate sustainable for a period it results high exports it links with employment, it definitely add some value in economy of a country (Ali, 2018; Ali and Bibi, 2017; Ali and Ahmad, 2014; Ali and Audi, 2016; Ali and Audi, 2018; Ali and Rehman, 2015; Ali and Senturk, 2019; Hussain et al., 2019).

I.III. INFLATION

Inflation is a macroeconomic variable and it shows level of poverty of any country. Developing countries like Pakistan make policy to keep inflation to low level to increase living standard of people. We have taken inflation to check impact of exchange rate volatility on inflation of Pakistan. Inflation is the rise in prices and decline in purchasing power of a country. Purchasing power declines when there is more money circulating in country. When more money is circulating in market value of that money declines and the results is more rates of goods than previous periods. This study shows the uncertainty of inflation in Pakistan that how inflation occurs and caused to increase prices of the goods. Inflation is the key factor of an economy it is a macroeconomic factor that provide better economic improvements to country. Inflation is also give ease to low income people but in present as inflation is suitable for all around the world but for developing country like Pakistan it is difficult to maintain inflation rate so government is providing different reliefs to maintain their

inflation rate. Pakistan needs to maintain their inflation rate to boost their economy, because inflation has directly linked with unemployment when inflation rise unemployment may also increase. Inflation and exchange rate both effects prices of goods. Exchange influence the prices on global market and inflation directly affect the consumer goods. Exchange rate and inflation both have impact on each other in this study we understand how they are linked with each other by using GARCH approach.

I.VI. PROBLEM IDENTIFICATION

Developed and developing countries both have major concerns about their exchange rates. Exchange rates are important for foreign direct investment as well. Stability of exchange rate is important for developing countries like Pakistan for attracting the foreign direct investment. Purpose of this study is to investigate about exchange rates and some macroeconomic variables, such as FDI, GDP and Inflation. Volatility is also important in short term and long term, this study will investigate about nature of volatility in Pakistan whether there exist a short term or long term volatility in exchange rates of Pakistan. Macroeconomic variables are also important in financial management of any country because these economic variables are measure of economic conditions of any country like foreign direct investment will show the investment behavior in any country. Investors will be interested in knowing the policies of government of that country which will impact investor's investment and investors will be more likely to invest in that country which has stability in exchange rates. So this study will investigate relationship of exchange rates of Pakistan with Foreign direct investment in Pakistan. GDP of any country is very important for checking whether this country is capable of high growth in country or not. Relationship of GDP of country is also important with exchange rates of that country because it will show the positive or negative impact of one variable on other. Policy makers can take this information for better decision making in country and for betterment of economic condition. Inflation of country shows its level of growth and unemployment level. Countries like Pakistan which have higher inflation have low growth in economy. This study will check whether there is a positive or negative relationship between exchange rates and inflation of Pakistan. The problem is to investigate about Exchange rate volatility because in developing countries like Pakistan Exchange rate are important for investment purposes and macroeconomic variables affect economy of country so the problem is to check whether Exchange rates affect main macroeconomic variables or not.

This study is helpful in context of Pakistan, the study include measurement of Exchange rate volatility. The previous history of Exchange rate is observed in this study and macroeconomic variables have been selected for checking their impact and relationship with exchange rates. Implications of underlying study will be helpful in decision making for policy makers. This study is helpful in context of Pakistan. The study include show exchange rates affect macroeconomic variables positively or negatively. If Pakistan can stabilize exchange rates for long period without high volatility the other macroeconomic variables which are impacted by exchange rates can be stabilize and their performance can be increased. As Pakistan is facing problems in economic growth. Macroeconomic variables like GDP, FDI and Inflation are very consequential in economy of any country this study has selected these variables for adding some helpful conclusions for decision makers of Pakistan's economy. In Pakistan there is lack of political stability and Governments are changed frequently in this scenario policies cannot be implemented for long term and less duration of one Government affect stability there are also some other factors like terrorism and disturbing relations with neighboring countries. These factors also cause high volatility. Policies of different regimes also affect exchange rates if one have policy of floating exchange rates may have high volatility. A study given by Kocenda and Valachy(2006) included currencies of 4 different currencies and make conclusion that interest rate policies and external shocks make high volatility and currencies who have floating regime also have high volatility and high volatility do not help more in development of Exchange rates. So interest rate policy and external shocks are also responsible for high exchange rate volatility.

This study will help in stabilizing economy of Pakistan by some selected variables that have impact on economy. This study focus on exchange rates which are important part of economy from investment point and their volatility have impact on investment more volatile exchange rates are not good for economy because high volatility will make investor in problem because they will be uncertain about their investment, political stability is also very important because political instability will cause instability in stock market and in exchange rates. This study is for Pakistan and some macroeconomic variables are selected from country Pakistan. Data for 29 years is used for the study. The purpose of taking variables from Pakistan is that Pakistan is a developing country and exchange rates are very crucial part of economy from investment point and data for previous year of Pakistan shows high ups and downs in case of Exchange rates. The results for exchange rate volatility which has negative impact on foreign exchange reserves, imports are also taken as dependent variable which shows positive relationship GDP and exports the relationship of inflation and Exchange rate is negative and insignificant (Zamir et al., 2017).

II. LITERATURE REVIEW

II.I. THEORETICAL REVIEW

II.I.I. PURCHASING POWER PARITY THEORY

Purchasing power parity theory aims to determine the adjustments needed to be made in the exchange rates of two currencies to make them at par with the purchasing power of each other. Purchasing power parity theory explains actual buying of one country's currency into other country's currency. If we want to purchase commodity of US then the actual value of Pakistani currency which need to buy that commodity of US is purchasing power of Pakistani currency. PPT is important for exchange rates as well because it tells the exact value of currency and also reveals that whether currency is undervalued or overvalued. In 1918, Cassel gave purchasing power parity theory which explains the equilibrium position of exchange rates of two countries.

II.I.II. INTERNATIONAL TRADE THEORY

Theory of international trade was given by Hecksher Olin in 1919.Theory of international trade explains the causes that why one country needs to trade with another country. This theory talks about consequences of trade as trade increases the country's volume of exports. Relative prices of two countries are related to exchange rates as trade between two countries will increases the buying and selling of their currencies. Exchange rate plays an important role as it gives comparison of prices of two different economies.

II.II. EMPIRICAL REVIEW

Exchange rate volatility has become important factor in economies of developing as well as developed countries with the fluctuations of exchange rates. Policy makers are always interested that in which pattern exchange rate is going and what is the level of its volatility. Exchange rate volatility and macroeconomic variables cannot be ignored together by the nature of their relationship. Balaam et al. (2019) found that there is a negative impact of high exchange rate volatility in manufacturing sector but it is measured as positive between total foreign direct investment and exchange rate volatility. Exchange rate volatility is not significant measure of foreign direct investment statistically in transport and communication sector but it varies sector-wise. Barguellil et al. (2018) concluded that impact of exchange rate volatility on economic growth is negative and affect to economies which are more open to accept high volatility it shows that developing countries should adopt policies that handle exchange rate fluctuations. Alagidede and Ibrahim (2017) revealed exchange rate volatility is significantly influenced by government expenditures, money supply and foreign direct investment flows in long run. Osabuohien et al. (2018) stated that exchange rate volatility has significant and positive impact on inflation in the long run. Thuy and Thuy (2019) showed that exchange rate volatility negatively affect exports volume in the long run.

Hanusch et al. (2018) showed inverse relationship between short run and long run exchange rates volatility with foreign direct investment inflows. Anita (2013) showed that exchange rate volatility have direct and indirect relationship with different macroeconomic variables like inflation and exchange rate has indirect relationship and direct relationship has been found between exchange rate and gross domestic product. Ali et al. (2015) insisted that there is an existence of positive relation between inflation and exchange rate volatility while negative relation between interest rate and money supply with exchange rate volatility. Exchange rate plays an important role and source of inflationary pressure. Fetai et al. (2016) elaborated that policy makers weighted the costs and benefits associated with flexible exchange rates in small economies because they can have more cost than benefits. Berganza and Broto (2011) exhibited that inflationary countries will used fixed exchange rate because inflation targeted countries are more effective to lower exchange rate volatility. Exchange rate volatility and exchange rate regime have no effect on exports volume of British and the United States in last century (Aristotelous, 2001). Pakistan is a developing agriculture country and it relies more on exports of its agriculture products. It helps for achieving balance of trade or decreasing the imports of a country. Furthermore, Pakistan imports more consumer products and machinery items which may increase the growth rate by applied them for production and exports agriculture products or raw material in return. According to Alam and Ahmed (2011), bilateral trade has a significance effect on balance of trade. Bahmani-Oskooee and Hegerty (2007) also found that trade flow have negative effect on exchange rate volatility.

Ullah et al. (2012) worked on volatility of exchange rates and explored unidirectional relationship between exchange rate volatility and foreign direct investment. Nguyen and Do (2020) commented that political instability affects negatively to exchange rates and other macroeconomic variables. So, the important way to grow up an economy is to attract the foreign direct investment and it's possible when the exchange rates and political condition of country is stable. Kamal et al. (2012) worked on exchange rate volatility by using different models like GARCH-M, TARCH and EGARCH and concluded that EGARCH is the best model to explain volatility of exchange rate behavior and TARCH represents time series

behavior. Ramasamy and Abar(2015) showed that all macroeconomic variables significantly influence exchange rate except employment and budget deficit, and investor behavior like confidence dominate over economic variables in deciding exchange rate fluctuations. Aurangzeb et al. (2005) checked the short-term and long-term effect of exchange rate volatility on the volume of exports and showed that the presence of long run equilibrium relationship between exports foreign prices and exchange rate volatility while on the other side, there is a negative link between the exchange rate volatility and exports in a short run. Aasim et al. (2005) documented that small investors and exporters stopped their exports and cause low foreign reserves in developing countries due to negative exchange rate volatility. Exchange rate has negative relationship with macroeconomic variables like inflation, foreign direct investment, imports and positive relation with GDP per capita and exports supported by theory and results (Zamir et al., 2017; Ahmad et al., 2022).

H_1: There is long-term exchange rate volatility.
H_2: There is a significance relationship between Exchange rate and FDI.
H_3: There is a significance relationship between Exchange rate and GDP.
H_4: There is a significance relationship between Exchange rate and Inflation.

III. RESEARCH METHODOLOGY

III.I. DATA

In this study, data of four macroeconomic variables; exchange rates, foreign direct investment, gross domestic product and inflation is used. The data is secondary and time series. Selected country is Pakistan and Data is collected from reliable source of World Development Indicators (WDI). Data of macroeconomic variables is collected from year 1991 to 2019.Data of 29 years are used in this study. The data for all the variables is converted to log to make the results more clear, and to increase robustness of data.

$$r_t = 100^{*} log\{E_t/E_{t-1}\}$$

III.II. UNIT ROOT TEST

Unit root test is used to check stationary of data. Most commonly used Augmented Dickey Fuller (ADF) is applied. If data is non-stationary at level then we will apply first difference to data if data remains non stationary then we apply second difference to data. By this way applying unit root test we can make non stationary data into stationary date-views software is used to perform unit root test. In this study, applying 1st difference at intercept for FDI, GDP and inflation to changing data into stationary. While applying 2nd difference at intercept for data stationary of exchange rates. ADF test is used to check stationarity of data (Siddiqui and Erum, 2016).

III.III. GARCH

In 1985, Tim Bollerslev gave an idea of generalized autoregressive conditional heteroscedasticity (GARCH) which was extension of ARCH which tells about whether volatility exist in variables or not. GARCH model have two assumptions; data should be time series and data should be Heteroskedasticor data should not be homoscedasticity. And if variance of time series changes over time then it will be Heteroscedastic. Kroner and Lastrapes (1993) used GARCH modeling to check impact of exchange rate volatility on international trade, data for their research was time series and their aim was to check significance and fluctuations in exchange rates over different time period. To applying GARCH, need to have a time series data and then applying ARCH to check homoscedasticity of data. If data is not homoscedasticity or data is heteroskedasticity then proceed to GARCH model.

$$h_t = \alpha_0 + \beta_1 h_{t-p} + \alpha_1 \mu_{t-q}^2 \quad \text{---------- Eq.1}$$

ARCH model include only error term but, GARCH model include lagged variance term of dependent variable, which is h_{t-p} shown in eq (4). This model is GARCH (p, q) model in which p shows how many terms of ARCH should be included in model and q shows number of lagged variance term. α_o is the intercept and β_1 is the coefficient of dependent variable.

III.IV. CO-INTEGRATION

Co-integration test is used to check the relationship among different variables. In our study we want to check relationship of Exchange rate and our selected variables. The concept of co-integration was first introduced by Nobel laureates Robert Eagle & Clive Granger in 1987. Before the co-integration test researchers use linear regression to check the relation between time series data. Granger and New bold argued on regression that we can't use linear regression to checking and analyzing the time series data because of chances of producing spurious correlation. Spurious factor occurs when two variables are deemed causally related by chance or by other factor.

$$\Delta Y_t = \gamma + \delta \Delta Y_t + \theta \mu_{t-1} + e_t \quad \text{---------- Eq.2}$$

Δ is the first difference operator, e_t is the error term and μ_{t-1} is the lag value of error term from co-integration equation. Θ shows magnitude of movement to restore equilibrium.Alagidede and Ibrahim (2017) used unit root and co-integration tests. Unit root test was applied to check whether variables are stationary or not and revealed the fact through ADF test

that data is non stationary at level. Then they converted non stationary data to stationary data through first differencing and made the data stationary for co-integration test.

III.V. REGRESSION ANALYSIS

Regression analysis is used to check relationship between two or more variables. In our case regression is applied because we were unable to achieve our purpose of achieving results through co-integration. By regression we will be able to check the relationship between our variables. We have three dependent and one independent variable. Following are the regression equations:

$$InGDP = \beta_0 + \beta_1 InEXR \quad \text{---------- Eq.3}$$
$$InFDI = \beta_0 + \beta_1 InEXR \quad \text{---------- Eq.4}$$
$$InINF = \beta_0 + \beta_1 InEXR \quad \text{---------- Eq.5}$$

In equation 1, 2 and 3,*In* represents logged value of dependent and independent variable, βo is the intercept and $\beta_1$is the slope and coefficient of *EXR*.

IV. RESULTS

Table 1: Augmented Dickey Fuller Unit Root Test

Variables	Levels	ADF test statistic	Critical values @5%	Probability level	Order of Co-integration	Remark
EXR	2nd difference	-5.1898	-2.9862	0.0003	(I),2	Stationary
FDI	1st difference	-4.2718	-2.9763	0.0025	(I)1	Stationary
GDP	1st difference	-4.6589	-2.9763	0.0010	(I)1	Stationary
INF	1st difference	-5.0541	-2.9763	0.0004	(I)1	Stationary

Note. Unit root to check stationarity of data.

Mostly data of time series is non-stationary and first we need to make it stationary. The significance level is 0.05 if value of probability is more than 0.05 then we say that data is non-stationary at that level. To apply co-integration we first checked stationary of data for that applying the Augmented Dickey Fuller (ADF). Table 1 for unit root test shows the results that data is non-stationary at level with intercept and after applying first difference to data of FDI, GDP and Inflation they became stationary with intercept at 0.05 significance level. But data of Exchange rate became stationary at second difference with intercept.

Table 2: GARCH Test

GARCH(1,1)	Coefficient	p-value
Mean Equation		
ER(-1)	1.0031	0.0000
C	0.0549	0.2005
Variance Equation		
C	5.65E-05	0.7077
RESID(-1)^2	0.1343	0.7657
GARCH(-1)	0.8456	0.0245
Akaike Info Criterion	-4.0673	
Log Likelihood	62.9416	

To apply GARCH, first check data is time series and data is heteroscedasticity. GARCH is used to check volatility of one variable at same time. Data of this study is time series and stationary at second difference, heteroscedasticity is checked in e-views software and probability value was less than 0.05 at 5 percent significance level which shows variance of data is not same over different period of time and data is heteroscedasticity. Now GARCH model is applied and table 2 shows results of GARCH model. Value of GARCH (-1) shows existence of volatility in Exchange rate. To check long term or short term volatility we will add values of α and β. Values of α and β should always be positive. Table 2 shows positive

values for both α and β. Sum of α and β near to 1. (0.1343+ 0.8456= 0.9799). It shows long term persistence of volatility in exchange rates. H_1 is accepted that there is an existence of long term volatility.

Table 3: Co-Integration between FDI and EXR

Trace Values	Critical Values	Probability
18.6379	25.8721	0.3027

Max Eigen values	Critical Values	Probability
5.9083	12.5179	0.4720
12.7296	19.3871	0.3503
5.9083	12.5179	0.4720

Johansen co-integration test is used to check co-integration between variable. Co-integration checks the correlation between the variables. From results, columns are used to choose lag intervals and rows suggest assumption which select for checking co-integration.

Table 3 shows the value of probability which is greater than 0.05 which depicts no correlation between variables. Another method to check correlation in co-integration is by comparing trace value, critical value and max Eigen value. If trace values and max Eigen values are greater than their critical values then it shows correlation between variables. If critical value is less than trace values and max Eigen values then there will be no correlation between variables. Probability values, trace values and max Eigen values suggests the same thing. Trace value is 18.6379 and critical value is 25.8721 so there is no correlation between variables.

Table 4: Co-Integration between GDP and EXR

Trace Values	Critical Values	Probability
14.6634	18.3977	0.1542
0.6439	3.8415	0.4223

Max Eigen values	Critical Values	Probability
14.0194	17.1477	0.1349
0.6439	3.8415	0.4223

Table 4 shows values of probability is greater than 0.05 or insignificant which shows that there is no co-integration between variables. Trace value and max Eigen values are greater than their critical value which shows the same thing that there is no co-integration between GDP and exchange rates.

Table 5: Co-Integration between INF and EXR

Trace Values	Critical Values	Probability
17.1001	25.8721	0.4075
4.0728	12.5179	0.7315

Max Eigen values	Critical Values	Probability
13.0273	19.3871	0.3258
4.0728	12.5179	0.7315

Table 5 shows the probability value is greater than 0.05 which shows that there is no co-integration between variables. Max Eigen and trace value are greater than critical values, it means there is no co-integration between inflation and exchange rates.

Table 6: Estimate of Regression Equation of Dependent Variable (GDP)

Explanatory Variables	Coefficient	Std.Error	T.statistic	Probability
Constant	8.8648	0.0782	15.8443	0.0000
D(VREXR,2)	1.2395	0.1407	62.9751	0.0000
R-Squared	0.9029	F.Statistic	251.0418	
Adjusted R-squared	0.8993	Prob(F.Statistic)	0.0000	
Durbin Watson stat	0.4511			

Table 6 shows that there is significance relationship between exchange rate and GDP. The significance level is 0.05 and above table shows probability value is less than 0.05. Value of coefficient shows the positive or negative relationship between dependent and independent variable. Value of coefficient is 1.2395, which shows increase in 1 unit of exchange rate will increase 1.2395 units of GDP. Value of R^2 tells that how much independent variable is predicting dependent variable. Value shows that exchange rate is predicting GDP 90%.H_3 is accepted that there is a significant relationship between exchange rates and GDP.

Table 7: Estimate of Regression Equation of Dependent Variable (FDI)

Explanatory Variables	Coefficient	Std.Error	T.statistic	Probability
Constant	6.9606	0.2563	4.5414	0.0000
D(VREXR,2)	1.1642	0.4613	15.0901	0.0001
R-Squared	0.4331	F.Statistic	20.6243	
Adjusted R-squared	0.4121	Prob(F.Statistic)	0.00011	
Durbin Watson stat	0.4594			

Table 7 shows that there is significance relationship between exchange rate and FDI. The significance level is 0.05 and above table shows probability value is less than 0.05. Value of coefficient shows the positive or negative relationship between dependent and independent variable. Value of coefficient is 1.1642, which shows increase in 1 unit of exchange rate will increase 1.1642 units of FDI. Value of R- square tells how much independent variable is predicting dependent variable. Table value shows that exchange rate is predicting FDI 43%. H_2 is accepted there exist a significant relationship between FDI and Exchange rate.

Table 8: Estimate of Regression Equation of Dependent Variable (INF)

Explanatory Variables	Coefficient	Std.Error	T.statistic	Probability
Constant	1.3882	0.2031	-1.4355	0.0008
D(VREXR,2)	-0.2921	0.3662	3.7917	0.1626
R-Squared	0.0709	F.Statistic	2.0607	
Adjusted R-squared	0.0365	Prob(F.Statistic)	0.1626	
Durbin Watson stat	0.6271			

Table 8 shows that there is insignificance relationship between exchange rate and inflation. The significance level is 0.05 and above table shows probability value is less than 0.05. Value of coefficient shows the positive or negative relationship between dependent and independent variable. Value of coefficient is -0.2921, which shows increase in 1 unit of exchange rate will decrease -0.2921 units of Inflation in which exchange rate shows the negative relationship with inflation.

V. CONCLUSION

This study concludes that exchange rates of Pakistan are volatile and have long term persistence of volatility. This study next examined the relationship of exchange rate volatility with FDI and from results it is concluded that the existence of positive relationship of exchange rates with FDI, and positive relationship with GDP and exchange rate have negative and insignificant relationship with inflation. Underlying study proposed that high exchange rate volatility weakens the power of currency. Mahmood et al. (2011) also concluded the long term volatility in exchange rates and exchange rates have positive impact on GDP, trade openness and growth. The study of Madeeeha et al. (2017) studied relationship of exchange rate volatility with different macroeconomic variables and concluded that exchange rate has negative and

insignificant relationship with inflation and exchange rate volatility has negative impact on foreign exchange reserves on imports and exports. The above study first show the results for Exchange rate volatility and conclusion is made on the basis of results that exchange rates of Pakistan are seen highly volatile in previous years and high volatility should be controlled by making different policies which can control high volatility and in result value of Pakistani rupee can be stabilize. Exchange rates have positive impact on GDP and FDI so exchange rates are also important for these macroeconomic variables so exchange rates should be managed for making better decision and policy making. Time series data for this study was taken and unit root was applied first which is diagnostic for time series and data was stationary at first difference and then data was make stationary at first level of three variables GDP, FDI and inflation and data for exchange rates was made stationary at second difference. GAARCH was applied for checking volatility in exchange rates first heteroskedasticity was checked and there exist hetroscedasiticty, and exchange rate show high volatility in results. Co-integration was applied for checking relationship between exchange rates and other variables but assumption of co-integration was not fulfilled so results of co-integration are not reliable, regression was applied then to check the relationship of exchange rates and other variables and results showing positive relationship of exchange rates with FDI and GDP and negative and insignificant relationship with inflation. Data of this study is only taken from Pakistan with selected four economic variables but there are many other macroeconomic variables which can be included, but this study includes exchange rate, FDI, GDP and inflation. The study is limited in context of its data and country and variables which are used in this study. Further studies can use other countries individually or they can use data for more than one country to check exchange rate volatility of those countries and there macroeconomic variables. Researches can take a region like countries included in Asia or Europe which can help to increase scope of research and more wide range study can be presented by increasing number of countries or regions. This study has included some selected variables which are more important in the context of Pakistan and its economic conditions, there can be many other macroeconomic variables which can be used for further research so that better understanding can be developed for impact of exchange rates. Variables like interest rates, growth rate, and foreign exchange reserves can be used for further research. Further studies can increase data for more years, this study included yearly data further researches can used data on monthly basis or daily basis which can be more helpful and more understanding and robust results for these variables or other variables can be achieved.

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