TRACING SPILLOVER EFFECT BETWEEN EXCHANGE RATE AND PAKISTAN STOCK MARKET PSX

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A Dissertation Submitted to the Pakistan Institute of Development Economics, Islamabad, in partial fulfillment of the requirements of the Degree of Master of Business Administration 3.5.

Department of Management Studies

Pakistan Institute of Development Economics

Islamabad, Pakistan

2019

Final Approval

This Thesis Titled

Tracing spillover effect between exchange rate and Pakistan stock market PSX

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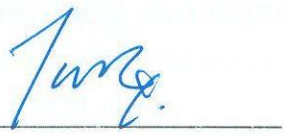

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DECLARATION

I ASAD ALI ASHRAF (REGISTRATION NO. PIDE-FMBA2015 (3.5) 03STUDENT OF (MBA) FINANCE SESSION 2015-2019, HEREBY UNDERTAKE THAT, I HAVE WRITTEN THIS THESIS ENTITLE "IMPACT OF POLITICAL AND FINANCIAL EVENTS ON COMMERCIAL BANKING SECTOR OF PSX" BY MYSELF UNDER THE GUIDANCE OF MY SUPERVISOR DR. SAUD AHMED KHAN. I HAVE READ IT CAREFULLY AND TAKE ALL THE RESPONSIBILITIES OF THE MISTAKES.

ASAD ALI ASHRAF

DEDICATION

THIS STUDY IS DEDICATED TO MY PARENTS.

Mr. Muhammad Ashraf (Late)

Mrs. Naseem Akhtar

A SPECIAL THANKS TO MY ELDER BROTHER *ZAHID ALI ASHRAF (LATE)* WHO SUPPORTED ME THROUGH OUT MY CARRIER

ACKNOWLEDGEMENT

IN THE BEGINNING I WOULD LIKE TO THANK ALLAH ALMIGHTY FOR GIVING ME ABILITY AND COURAGE TO COMPLETE THIS PIECE OF WORK. I WOULD LIKE TO PAY GRATITUDE TO MY SUPERVISOR DR. SAUD AHMED KHAN AND MY CO SUPERVISOR DR. GHULAM GHOUSE WHOSE KIND AND CONSISTENT GUIDANCE MADE THE TASK OF COMPLETING THIS THESIS EASY AND POSSIBLE FOR ME. HE ADDED A LOT TO MY CAREER, I OWE HIM A LOT. I AM THANKFUL TO ALL OF MY TEACHERS AND FRIENDS IN PIDE, WHO OPENED MY MIND AND ENLIGHTENED IT WITH THEIR KNOWLEDGE.

ABSTRACT

There are many previous studies which explored the spillover effect between KSE 100 index and exchange rate USD/PKR. There is no study which considered the spillover effect between PSX and exchange rate USD/PKR. This study explore the spillover effect between Pakistan stock exchange (PSX) index and exchange rate USD/PKR. The daily data are used for the period of Dec, 2016 to Dec, 2018. The generalized autoregressive conditional hetroscedastic (GARCH) model and autoregressive distributed lag (ARDL) model are used for tracing spillover effect between PSX and exchange rate USD/PKR. The results are indicating that there is bidirectional spillover effect between between PSX and exchange rate USD/PKR. These results can be used by central, policy makers and markets players for making effective policies.

Key words: *PSX, Exchange rate, Spillover, Volatility, GARCH and ARDL model.*

CHAPTER 1

INTRODUCTION

The world has observed a prompt in equity investment during last three decades. This rapid growth has increased the demand and supply of foreign currencies. The equity flows and greater demand of foreign currencies has generated interdependence between exchange rate and stock market prices. This phenomena leads to develop information transmission between the financial markets. The growing linkages between foreign exchange market and stock market have increased volatility spillovers between stock market and foreign exchange market. It is very important to analyze these linkages and estimate spillover magnitudes.

On theoretical basis these linkages between foreign exchange rates and stock market prices could be commonly derived from two well-known models; stock oriented model and flow oriented model. The stock oriented model presented by Frankel (1983) and Branson and Henderson (1985) which explains that the determination of exchange rate depends upon the financial assets; bonds and equity. It is further categories into monetary model and portfolio model.

The monetary model assumes no association or weak association of foreign exchange rate and stock market prices. This model considers the exchange rate as an asset's price and the assets prices are determined through future expected prices. In the same way the future foreign exchange rate prices are determined exchange rates. If factor effects the future expected prices of exchange rate will impacts the current value of foreign exchange rate. It is quite possible that the data generating process of exchange rate and stock prices are different or may not be. If they are same at some extent then

both markets are interlinked otherwise not (Kanas, 2000; Yang &Doong, 2004; O'Donnell & Morales, 2009).

The portfolio model suggests negative association between foreign exchange rate and stock prices and it refers the causality direction from stock prices to foreign exchange rate. This model also explains that the investors grip domestic and foreign assets comprising foreign and domestic currencies. When the stock prices which is domestic assets increases, the investor wants to buy additional domestic assets, which induce investors to sell foreign assets in order to keep domestic currency to buy extra domestic assets. This increases the wealth of investors because of increase in stock prices, this motivates investors to grow their domestic assets which further leads to rise in interest rate, and ultimately this will lead to appreciation of domestic currency value (Kanas, 2000, Adjasi et al., 2008).

The flow oriented model presented by Dornbusch and Fischer (1980) suggests that the exchange rate and stock prices are positively associated. This model refers that the exchange rate depends upon trade balance or current account balance of a country. This model also suggests that international competitiveness and trade balances could be effected by changing in exchange rate, therefore it effects the input and real income of a country. It can be elaborated as; the depreciation of domestic currency makes domestic firms more competitive by getting inexpensive exports in the international trade. The higher exports increases the wealth of domestic firms by appreciating the national stock prices of local firms. In this way the direction of causality is from exchange rate to stock prices.

Many financial and institutional reforms has been emerged throughout last three decades in the economy of Pakistan. The purpose behind of these rational reforms

were to increase the depth and efficiency of financial markets and to lessen local financial imbalances. The alteration to free flexible exchange rate and openness of stock markets makes them interlinked. The stock market openness came up with increase in portfolio investment inflows (Qayyum & Khan, 2014).

While the increment in investment supports in uprising investable found, which leads to huge volatility in stock indices. We can see the example from historical stock market and exchange rate data in 1995 the KSE 100 points were 2600 but decayed abruptly to 879 in 1998. The reason is that most of the investors has outflowed their assets due to financial crisis. Then after that low level in early 2005 the KSE 100 index traversed 10 thousand marks but after few months in May 2005 it declined again to approximately 7 thousand marks (Qayyum & Kamal, 2007).

After that in 2008 KSE 100 shown incredible performance by taking 15676.3 point but it declined due to global financial crisis to 10677.5 points. The global financial crisis of 2008 badly impacted the economy and stock markets of Pakistan (Ghouse & Khan, 2017). The situation got worse when in 2009 the KSE 100 only have 4,929.54 with total capitalization of market was RS1.58 trillion(Din et al., 2010). Same situation emerged since end of last year, the stock market indices points are facing wild swings.

On the other hand similar condition prevails in exchange market, it also shown huge volatility in 1998. In 1998 the Pakistani rupee exchange rate against $US was RS 43.19 but it was gone to RS 61.4 in 2001-02. It got appreciated and the exchange rate went to RS 57.5 per US dollar in Aug 2004. After that it again got volatile between RS 61.41 per US dollar to RS 57.5 per US dollar from 2004 to 2007. After 2007 the exchange rate depreciated badly and went to RS 85.5 per US dollar. Same situation

emerged since end of last year, the exchange rate depreciated and it went to RS 138.50 on 27 Dec, 2018.

This clearly indicates that both markets are interlinked each other. Many researchers done their empirical and theoretical studies to explore volatility spillover effect between stock market prices and exchange rate in case of Pakistan (see for example; Qayyum & Kamal, 2007; Qayyum & Khan 2014; Din et al., 2010; Ghouse & Khan, 2017; Jabran, 2017; Bhat and Shah 2015; Dar et al., 2013; Aslam, 2104; Ali, 2015). On the other hand many researchers explored causal linkages between these variables in case of Pakistan (see for example; Zubair, 2013; Khan & Ali, 2015; Zia & Rahman, 2011).

All the previous studies has been done on KSE 100 index and exchange rate prices but there is no study previously which explored the mean and volatility spillover effect between Pakistan stock exchange new index (PSX) and exchange rate. So, the contribution of this study in this setup is to explore the mean and volatility spillover effect between PSX and exchange rate.

1.1 Objective of Study

This study has following objectives:

i. To trace out the mean spillover effect between exchange rate and PSX.
ii. To explore the volatility spillover effect between exchange rate and PSX.

1.2 Significance of Study

The study has two contributions in existing literature first, volatility modeling of exchange rate and stock prices and second, to explore which theoretical model implies on the between exchange rate and stock market prices in Pakistan. Due to some

political and financial events stock market and exchange rates are changed drastically, so there is need to estimate their link.

CHAPTER 2

LITERATURE REVIEW

This chapter contains the reviews of previous studies which have been done related to objective of this study. In each study researcher presented their particular theoretical and econometric models. This chapter contains two portions: first part based on international studies and second consists on domestic studies. The arrangements of this chapter are following:

2.1 Foreign Prospect

Sui and Sun (2016) examined the spillover effect amongst stock market prices, interest differentials and exchange rate in case of BRICS by considering recent global financial crisis. The results are indicating that there is volatility spillover effect from US stock markets to China, Brazil, and South Africa stock markets. They also found that there is significant spillover effect between exchange rates and stock market returns in the period of global financial crisis of 2008.

Kumar (2013) explored the volatility spillover effect between exchange rate volatility and volatility of stock markets in case of IBSA countries (India, Brazil, and South Africa). The VAR model and multivariate GARCH-BEKK model are used to trace out the mean and volatility spillover effect between the series. They found bidirectional spillover effect between the financial series.

Aloui (2007) investigated the volatility and price spillover effect between stock prices and exchange rate for the pre and post euro period. The multivariate EGARCH model has been used to estimate the spillover effects. The results are indicating persistence volatility spillover effect and also refers the causal linkages between stock markets returns and exchange rates in pre and post euro periods. He explored that the stock

market prices have higher volatility spillover effect as compare to exchange rates in both eras.

Yang and Doong (2004)examined the mean and volatility spillover effect between stock prices and exchange rate in case of G-7 countries. The multivariate EGARCH model has been used to estimate the spillover effects. The results are demonstrating volatility spillover effect and also refers the causal linkages between stock markets returns and exchange rates. They explored that the stock market prices have asymmetric volatility spillover effect and the exchange rate has less spillover effect as compare to stock market returns. They also explored that the change in stock market prices effect exchange rate in future.

Majumder and Nag (2015) studied the spillover effect between stock prices and exchange rate in case of India. The bivariate EGARCH model has been used to estimate the spillover effects. The results are demonstrating volatility spillover effect and also refers the causal linkages between stock markets returns and exchange rates in pre and post financial crisis periods. They explored that the stock market prices have asymmetric volatility spillover effect and the exchange rate has less spillover effect as compare to stock market returns in post crisis period.

Yu and Liao (2017) studied the volatility spillover effect between money market and currency market and volatility of stock markets in case China. The VAR model and asymmetric GARCH-BEKK model are used to trace out the mean and volatility spillover effect between the series. They found bidirectional spillover effect between the financial series.

Morales and O'Donnell (2006) found the volatility spillover effect between exchange rate market and volatility of stock markets in case of East Asian markets. The VAR

model and EGARCH model are used to trace out the mean and volatility spillover effect between the series. They found bidirectional spillover effect between the financial series.

Mitra (2017) explored thevolatility spillover effect between exchange rate of four currencies in India (USD-INR, GBPINR, JPY-INR, and EURO-INR)and stock markets in case of India. The GARCH model and cointegration procedure are used to trace out the spillover effect between the series. They found bidirectional spillover effect between the four exchange rates and stock market prices and found that these markets are cointegrated.

Yen-Hsien et al. (2017) investigated the effect of hot money on exchange rate and stock markets in case of China. The VECM-BEKK model is used to trace out the spillover effect between these series. They found bidirectional spillover effect between the exchange rates and stock market prices and also found that the hot money has significant impact on stock market prices.

O'Donnell and Morales (2009)studied the spillover effect between stock prices and exchange rate in case of Slovakia, Hungary, Czech, and RepublicPoland. The EGARCH model has been used to estimate the spillover effects. The results are demonstrating volatility spillover effect and also refers the causal linkages between stock markets returns and exchange rates in pre and post euro periods. They explored that the stock market prices have asymmetric volatility spillover effect and the exchange rate and stock market returns volatility decreased as more countries joined European Union.

2.2 Domestic Prospect

Qayyum and Khan (2014) investigated the spillover effect between Pakistan stock market and foreign exchange market. They employed EGARCH model and used weekly data of KSE 100 and exchange rate (PKR vs $US) data from the period of 1997 to 2012. They found that bidirectional volatility spillover effects and stock market returns are sensitive as compare to exchange rate volatility and returns. The concluded that these markets are strongly interlinked and there is information transmission in these markets.

Farooq et al. (2004) explored the relationship between Pakistan stock market and exchange foreign exchange rate market. They empirically investigated the co-movements between the Karachi stock market and exchange rate and used Johanson cointegration and Granger causality test. They found that there is causal relation between stock market index and exchange rate and also found the causality runs from exchange rate to stock market index. The cointegration results also validated this relationship.

Bhat and Shah (2005) examined the relationship between volatility of exchange rate and stock market volatility. They used Karachi stock market 100 index and exchange rate data from the period of 1997 to 2013 and employed GARCH models, Johanson cointegration, and Granger causality test. They found that both financial series are cointegrated and Granger causality test shows that there is two way causality between the financial variables. They concluded that there is information transmission between the markets.

Dar et al. (2013) traced out the relationship between stock market returns and exchange rate. They took monthly data from 2003 to 2017 and used Wavelet analysis

and quantile regression model. They found the similar results from both methodologies that there is no long run relationship between financial series and there asymmetric effect because the coefficients are changing with the each quantile.

Khan and Ali (2015) explored the causal linkages between Pakistan stock market and exchange rate volatilities. They employed GARCH models and Granger causality test to model and measure the causality between financial time series by taking monthly data from 1992 to 2013. They found that there is information flow in the markets and there is bidirectional causality between time series.

Aslam (2014) inspected the causal relationship between volatility of exchange rate and stock market volatility. They used Karachi stock market 100 index and exchange rate data from the period of 2006 to 2012 and employed Granger causality test. They found that both financial series Granger causality test shows that there is bidirectional causality between the financial variables. They concluded that there is causal linkages between the markets.

Zubair (2013) inspected the causal relationship between volatility of exchange rate, stock market, and M2. He used stock market index and exchange rate data from the period of 2001 to 2011 and employed Granger causality test. They found that both financial series Granger causality test shows that there is bidirectional causality between the financial variables. They concluded that there is causal linkages among the variables.

Ali (2008) examined the relationship among exchange rates NEER, REER, andPKR vs $US and stock market KSE 100 index. He used Karachi stock market 100 index and exchange rates data from the period of 2001 to 2009 and employed VAR models, cointegration, and Granger causality test. They found that both financial series are not

cointegrated and Granger causality test shows that there is one way causality between the financial variables. They concluded that there is information transmission between the markets.

Zia and Rehman (2011) examined the relationship among exchange rates and stock market KSE 100 index. He used KSE 100 index and exchange rates data from the period of 1995 to 2010 and employed Engle-Granger cointegration procedure and Granger causality test. They found that both financial series are not cointegrated and Granger causality test shows that there is no causality between the financial variables.

Saleem and Alifiah (2017) studied the causal relationship amongst macroeconomic variables interest rate, exchange rate and stock market KSE 100 index. They used KSE 100 index and macroeconomic variables data from the period of 1990 to 2015, employed Granger causality test. The Granger causality test shows that there is only causality between the interest rate and stock prices but not causal link with other variables.

Khalid (2017) anticipated the effect of macroeconomic variables interest rate, exchange rate on stock market KSE 100 index. He used KSE 100 index and macroeconomic variables data from the period of 1990 to 2017, used Granger causality test, Error Correction Mechanism (ECM) model and Johanson cointegration procedure. The Granger causality test shows that there is causality between the interest rate, exchange rate and stock prices and these financial series are also cointegrated. He found that there is short run relationship between the variables.

Masood and Sarwar (2015) estimated the relationship between exchange rate and stock market prices. They used KSE 100 index and macroeconomic variables data from the period of 1990 to 2017, used Granger causality test, and Johanson

cointegration procedure. The Granger causality test shows that there is causality between the interest rate, exchange rate and stock prices and these financial series are also cointegrated.

Jebran and Iqbal (2016)explored the volatility spillover effect between money market and currency market and volatility of stock markets in case selected ASIAN countries India, Pakistan, China,Sri Lanka, Japan and Hong Kong. The EGARCH model are used to trace out the mean and volatility spillover effect between the series. They found bidirectional spillover effect between the financial series. They found that there is significant mean and volatility spillover effect between the series of all the selected ASIAN countries.

In this chapter we reviewed the previous studies which have been done to find out the information transmission between the exchange rate market and stock market. Most of the studies concluded that there is significant spillover effect between the markets. Particularly, in case of Pakistan. All the studies which are done previous in case of Pakistan on KSE 100 index. There is no study which explored the relationship between newly developed in of Pakistan stock market PSX and exchange rate. So this is the gap in literature which can be fulfilled through this study.

CHAPTER 3

METHODOLOGY AND MODEL SPECIFICATION

The volatility modeling considers as one of the important issues in financial economics. The primary purpose of financial economics is to predict time variant volatility. The financial modeling commonly used to estimate conditional mean and conditional variance. The model financial econometric models are used to examine the historic nature of financial time series, volatility forecasting, volatility clustering, leverage effect, and persistence of shock. Some theoretical financial econometric models are also being used for estimation of mean and volatility spillover effect between financial time series. The co-movement and information transmission are also known as spillover effect. The volatility modeling means try to understand the data generating process of financial time series. The spillover effect means try to explore either the return or volatility of one financial series effect the return and volatility of other financial time series. Commonly these linkages are developed due to information transmission between the financial markets.

Since the purpose if this study is to model the variant volatility of exchange rate and spillover effect between financial markets. The financial time series are commonly trendy and nonstationary in nature Ghouse and Khan (2017). So, first we visualize the data through graphical analysis. At second we employ the unit testing to test the stationary of series. Thirdly, we used the ARCH type model to model the volatility of series. AT fourth we used ARCH type model to explore the spillover effect between financial markets. After employ ARCH type we use residual analysis for the validation of model results.

3.1. Econometric Model and Model Speciation

We use autoregressive conditional hetroscedastic (ARCH) type models for volatility modeling and spillover effect. When the variance of any time series depends upon time than OLS model cannot provide a unique coefficient value and it also violates the basic OLS model assumption of homoscedasticity. So, as we know that the financial series are having time variant variance, that is why OLS model cannot be applicable for modeling that is why we shift from OLS to ARCH type models. The ARCH model is only used when the volatility effect is symmetric in nature. The GARCH model is simply a generalized for of ARCH model which tackle the problem of long lag length of ARCH term, but both models have been used only for symmetric effect. The GARCH-GJR model is used when the effect is asymmetric in nature.

The financial series are commonly having trend and it could not be possible to get valid results from trendy series. So, that is why we take log difference of series. The difference is used to de-trend the series and log is used to reduce the dispersion of series.

$$\mathrm{R_t} = \log\left(\frac{p_t}{p_{t-1}}\right) \tag{3.1}$$

p_t= Series at level i.e. exchange rates and stock indices at time t.

p_{t-1}= First lag of raw series.

3.1.1. ARCH Model

The autoregressive conditional hetroscedastic (ARCH) model introduced by (Engle, 1982). The ARCH model covers the short comes of previous models. The ARCH model simultaneously estimate two equations, conditional mean equation and conditional variance equation. The both equation find out the data generating process,

the conditional mean equation keeps the ARMA (p, q) process and the past square value of error process predict the conditional variance equation. The generalized equations of ARCH model are following:

Conditional mean

$$R_t = \theta_0 + \theta_1 X_t + \varepsilon_t \quad (3.2)$$

Where $\varepsilon_t = z_t \sigma_t, \quad z_t \sim N(0,1)$

Conditional variance

$$\sigma_t^2 = \gamma_0 + \sum_{i=1}^{p} \gamma_i \varepsilon_{t-1}^2 + u_t \quad (3.3)$$

where i= 1,2,…….., p

The R_t shows return series and $\theta_1$indicates the parameters vector. The$\theta_1 X_t$empirically illustrates ARMA (p, q) process. It could be ARMA (0, 0) in some specific cases. There are some restriction attached with ARCH model are that it deals only with symmetric effects and the parameters of conditional variance equation must be positive. The $\varepsilon_t$shows innovation process and $\varepsilon_{t-1}^2$is considered as ARCH term.

3.1.2. GARCH Model

The GARCH model is an extension of ARCH process. The ARCH model has long length problem of ARCH term. This problem creates the problem of loss of degree of freedom. To deal with this issue Bollerslev (1986) introduced generalized autoregressive conditional hetroscedastic (GARCH) model. Ghouse and Khan (2017) employed GARCH model to model the volatility of stock market prices. Sajid et al. (2014) used GARCH model to inflation and uncertainty in inflation. Jabeen and Khan (2014) used GARCH model to measure the volatility of exchange rate due to

macroeconomic fundamentals in Pakistan. The extension in GARCH model is that it includes the lag value of conditional variance as independent variable in conditional variance equation.

The representation of GARCH (p, q) equations is following:

Conditional mean

$$R_t = \theta_0 + \theta_1 X_t + \varepsilon_t \quad (3.4)$$

Where $\varepsilon_t = z_t \sigma_t, \quad z_t \sim N(0,1)$

Conditional variance

$$\sigma_t^2 = \gamma_0 + \sum_{i=1}^{q} \gamma_i \, \varepsilon_{t-1}^2 + \sum_{i=1}^{p} \delta_j \, \sigma_{t-i}^2 + u_t \quad (3.5)$$

Therestriction on the parameters of conditional variance equation is that they must be positive. The R_t shows return series and $\theta_1$indicates the parameters vector. The$\theta_1 X_t$empirically illustrates ARMA (p, q) process. It could be ARMA (0, 0) in some specific cases. There are some restriction attached with ARCH model are that it deals only with symmetric effects and the parameters of conditional variance equation must be positive. The $\varepsilon_t$shows innovation process and $\varepsilon_{t-1}^2$is considered as ARCH term. The σ_{t-i}^2 is the lag value of conditional variance which is used as independent variable.

3.1.3. GARCH Model for Spillover Effect

For the exploration of spillover effect we follow the procedure proposed by Ghouse and Khan (2017). In which for mean spillover effect they include return of other series in mean equation and for volatility spillover effect they introduce square return

of other series in conditional variance equation. So, by following this procedure the simple GARCH (1, 1) spillover model equations are following:

Conditional Mean

$$R_{t,kse} = \theta_0 + \theta_1 X_t + +\pi_1 R_{t,exc} + \varepsilon_t \quad (3.6)$$

Where $\varepsilon_t = z_t \sigma_t, \quad z_t \sim N(0,1)$

Conditional Variance

$$\sigma^2_{t,kse} = \gamma_0 + \sum_{i=1}^{1} \gamma_1 \varepsilon^2_{t-1} + \sum_{i=1}^{1} \delta_1 \sigma^2_{t-1} + \pi_2 R^2_{t,exc} + u_t \quad (3.7)$$

The $R_{t,kse}$is the return series of KSE and $R_{t,exc}$is the return series of exchange rate. To find out mean spillover effect the return series of $R_{t,exc}$introduced in mean equation of KSE. The square return series of exchange rate $R^2_{t,exc}$ is included in conditional variance equation of KSE. Similar way we find out bidirectional spillover effects.

ARDL Model

The autoregressive distributed lag model (ARDL) model proposed by Davidson et al. (1978) to model the consumption function of economy of UK. It is a general model in nature in which the dependent variable determined by the present and lag value of independent variable and own lag value. The ARDL model is dynamic in nature and general which be modified into various forms by imposing linear and nonlinear restriction (Charemza & Deadman, 1997). It has lag values of dependent and independent variables so that is why it may control basic econometric problems like autocorrelation and misspecification.

The simplest form of ARDL modelis ARDL (1, 1). The equation of an ARDL (1, 1) model is following:

$$y_t = a + \gamma_1 x_t + \gamma_2 x_{t-1} + \theta_1 Y_{t-1} + \varepsilon_t \quad (3.8)$$

Where y_t and x_t are variables and γ_1, γ_1, and θ_1 are parameters while the ε is known as error term.

The ARDL (1, 1) model for Spillover effect

To explore the spillover effect we introduce the return series of one market into the equation of other market. The equation of ARDL model for spillover effect is following:

$$R_{EXR,t} = a + \gamma_1 R_{PSX,t} + \gamma_2 R_{PSX,t-1} + \theta_1 R_{EXR,t-1} + \varepsilon_{EXR,t} \quad (3.9)$$

Where $R_{EXR,t}$ the return series of exchange is rate and $R_{PSX,t}$ is the return of PSX series.

3.1.5 Residual Analysis

The validation of the results the post estimation analysis is also used. The Jarque-Bera test is used to check the normality of residuals. Q-stat employed to check the autocorrelation in residuals. Q-stat square test used to test the heteroscedasticity in residuals. The LM ARCH model is used to test the ARCH effect in residuals.

3.2. Structure of Methodology

The data visualization is used at first for the understanding of behaviour of financial time series. Then the descriptive statistics are employed to see the characteristics of return series. After that the GARCH type models are used to model return series and spillover effects. At the end residual test are employed for the validation of results.

3.3. Description of Data and Sources

The daily data are used for all indices from the period of Dec, 2016 to Dec, 2018. The data set contains the data on exchange rate of PKR against $US, and PSX. The data is collected from State Bank of Pakistan, and Pakistan Stock Exchange sites.

CHAPTER 4

RESULTS AND DISCUSSION

This chapter contains the empirical analysis of study. At first we visualize the data to understand the trend and nature of series. At second we employed descriptive statistics to comprehend the initial statistics of series. At third we employed the regression analysis to trace out the spillover effect between Pakistan stock exchange and exchange market. To find out spillover effect between financial series we used GARCH model and ARDL model.

4.1 Data Visualization

The data visualization is commonly used to visualize the basic characteristics of the series. In this analysis we employed data visualization on PSXI series only for convenience and it can be employed on other series also.

Figure 1: The Raw Series of Pakistan Stock Exchange

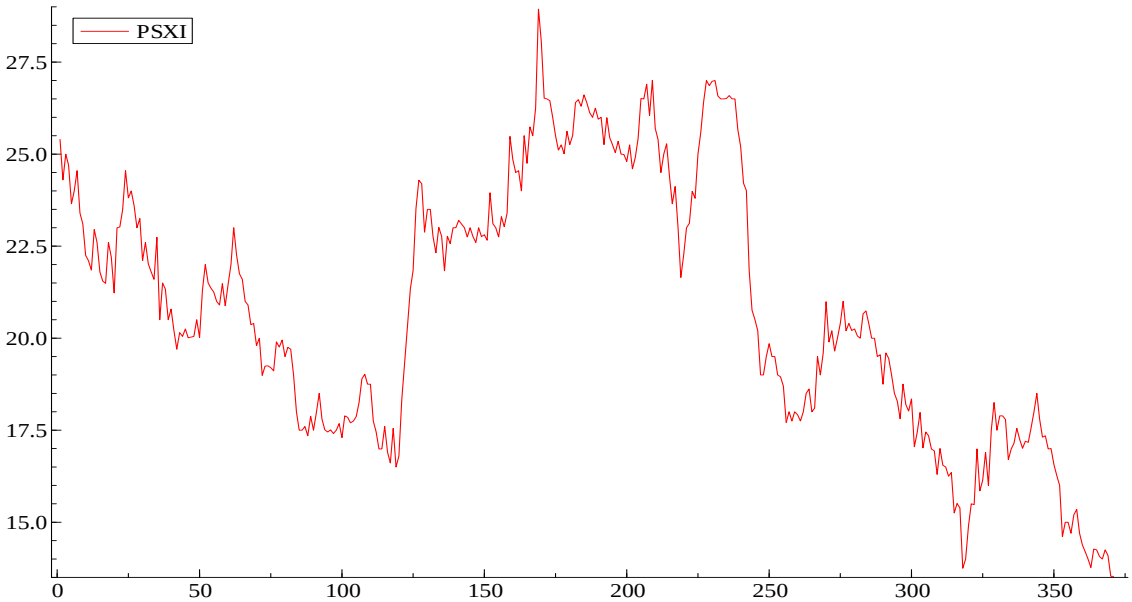
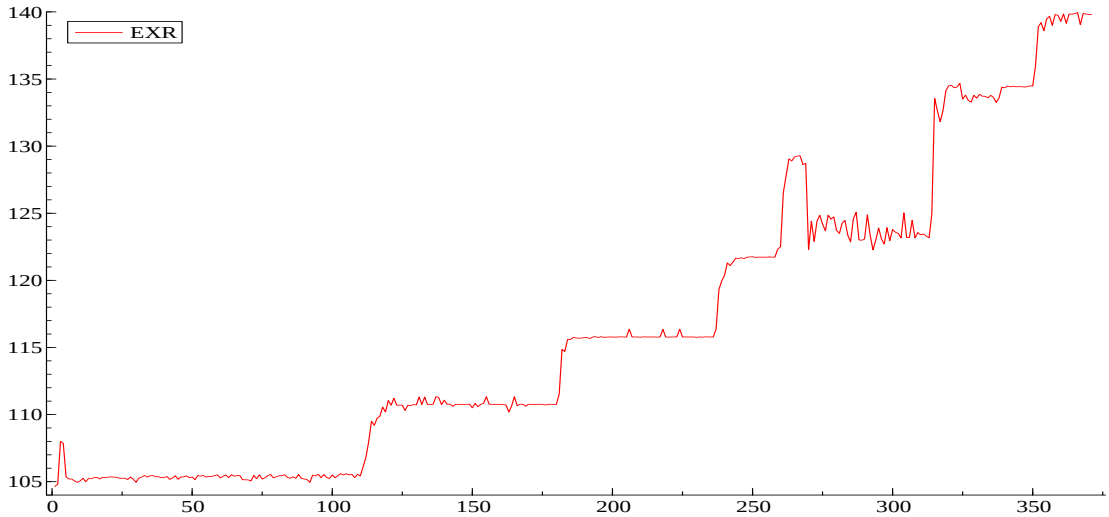
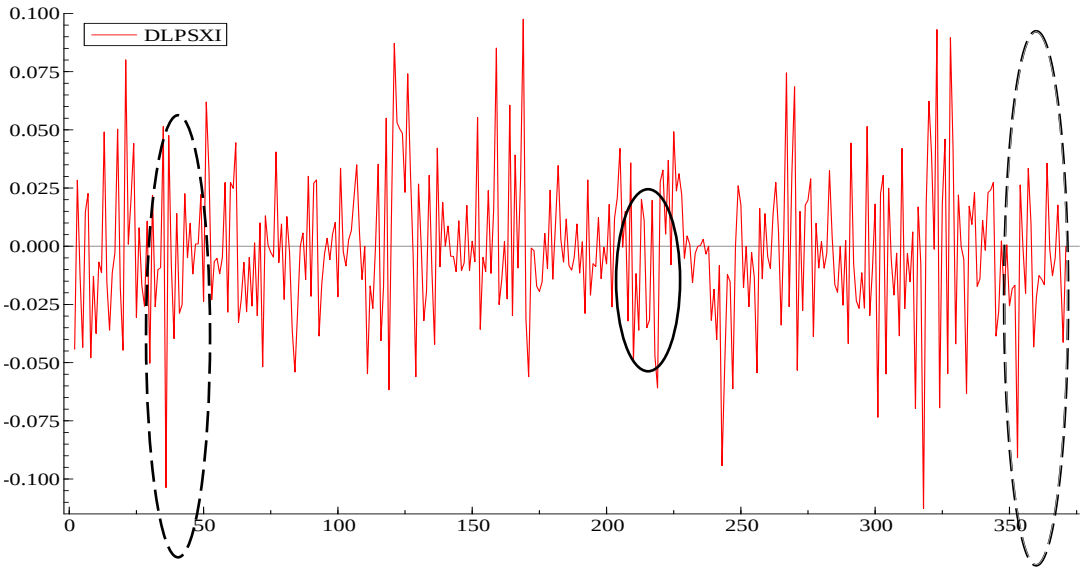


Figure 2: The Raw Series of Exchange Rate (Pakistan PKR vs $US)



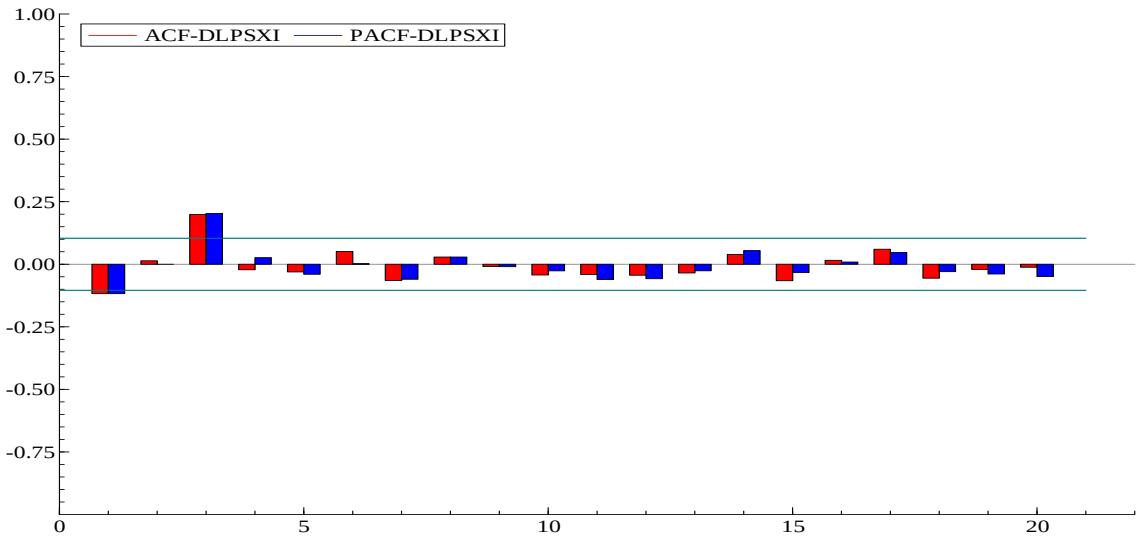
The figure 1 and 2 are showing the trendy behavior with some fluctuations. The figure 1 which is of PSXI is showing downward trend due to bearish market behavior from several month. It is due to some political instability in country and exchange rate fluctuations. While the figure 2 which is of exchange rate showing upward trend due to devaluation in Pakistan currency.

Figure 3: The Returns Series of PSXI



The figure 3 shows the picture of returns series of PSXI which is clearly indicating that there is bunch of volatilities. It means there is volatility clustering which leads to ARCH effect. The dash line circles are indicating high volatility clustering and plane line circle is indicating about low volatility clustering.

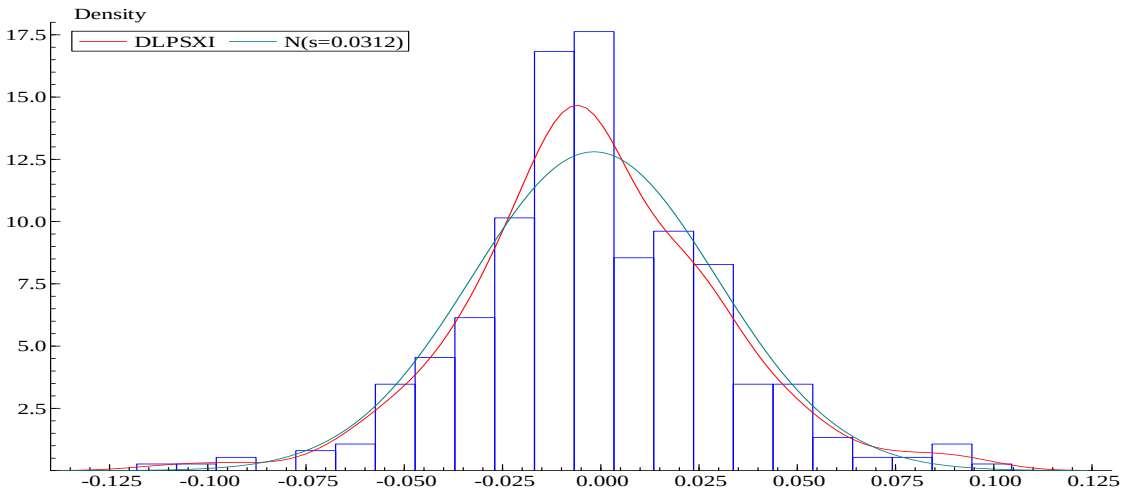
Figure 4: The ACF and PACF of Return Series of PSXI



The figure 4 show the ACF and PACF of PSXI. The red bars show the ACF and blue bars show PACF of PSXI. The ACF indicates about the moving average which shows the relationship between current and previous variations. PACF explains the autoregressive behavior which shows the relationship between current and previous value. The 1st and 3rd lag bars are outside the bend which means that probably these lag values are significant. This figure can be made of EXR series.

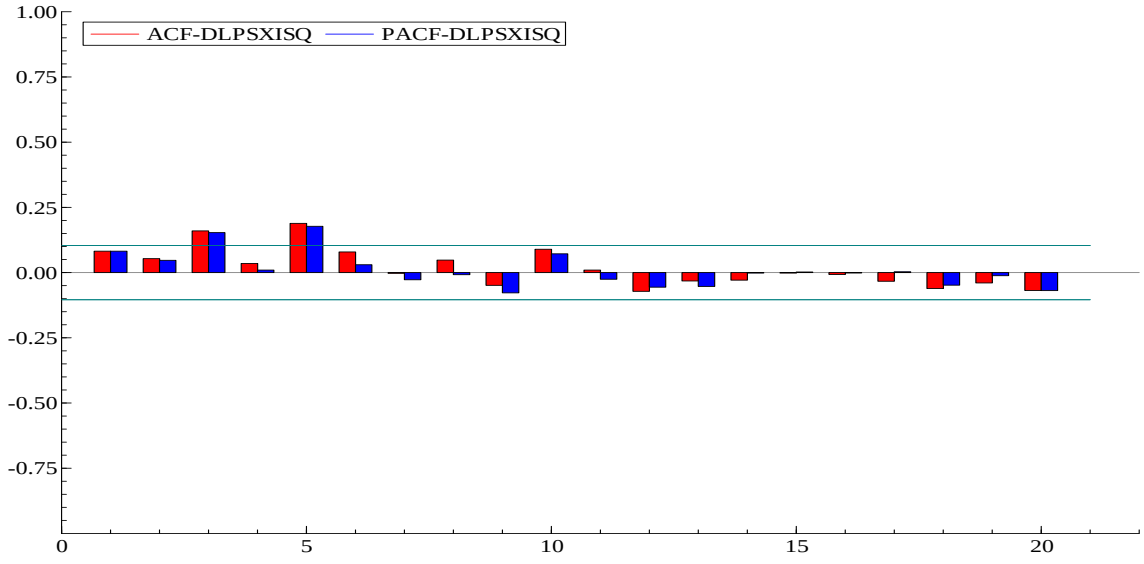
The figure 5 shows the distribution of PSXI series with reference normal distribution. The red line is the actual distribution of PSXI and green line shows the reference normal distribution of PSXI series. The figure shows that peak and tails of actual distribution of PSXI are greater than the normal that is why we can access that the distribution of PSXI is non normal. It can be made of EXR.

Figure 5: The distribution of PSXI Return Series



The figure 6 show the ACF and PACF of PSXI square series. The red bars show the ACF and blue bars show PACF of PSXI. The ACF indicates about the moving average which shows the relationship between current and previous variations.

Figure 6: The ACF and PACF of Square Return Series of PSXI



The PACF explains the autoregressive behavior which shows the relationship between current and previous value. The 3rd and 5th lag bars are outside the bend which means that probably these lag values are significant. This figure can be made of EXR series.

4.2 The Summary of Statistics

The summary of statistics provide the basic statistics of series which helps a lot to understand the nature of series. The summary of statistics tells about averages, normality and deviations.

The table 1 explains the initial statistics of PSXI and EXR. The mean of both series is around zero which shows that there is mean reversion behavior of series. The skewness test is indication that the PSXI series has no skewness while the EXR distribution is positively skewed. The Kurtosis shows that peak of both distribution is leptokurtic, which mean that peak of distribution is higher than the normal distribution peak. It shows both distributions are non-normal in nature. The Jarque-Bera test is used to test the normality of the distribution which clraly indicates that both distributions are non-normal.

Table 1: Summary of Statistics of PSXI and EXR

	Summary of Statistics								
Series	**Mean**	**Standard deviation**	**Skewness**	**Jarque Bera**	**Excess Kurtosis**	**Q-stat (5)**	**Q2-stat (5)**	**ARCH 1-2**	**KPSS**
PSX	-0.0071	0.0311	0.0836 (0.5099)	16.865 (0.0021)	1.0325 (0.0000)	20.5913 (0.0009)	27.1305 (0.0000)	4.8491 (0.0003)	0.1474
EXR	0.0008	0.0068	2.0749 (0.0000)	19311 (0.0000)	35.148 (0.0000)	4.33321 (0.5025)	1.35624 (0.9290)	0.26663 (0.9312)	0.1580
Null Hypotheses (All Null Hypotheses are for nth order) "KPSS H0: Return series is level stationary, Asymptotic significant values 1% (0.739), 5% (0.463), 10% (0.347). Q-stat (return series) there is no serial autocorrelation. Q2-stat (square return series) H0: there is no serial autocorrelation. Jarque-Bera H0: distribution of series is normal. LM-ARCH H0: there is no ARCH effect. Use these Asymptotic Significance values of t-stat 1% (0.01), 5% (0.05), 10% (0.1) and compare these critical values with P-values (Probability values). P-values are in the parenthesis."								

The Q test is used to test the autocorregressive behavior in return series which shows that there is autoregressive behavior only in returns of PSXI. The Q square return

used to test the autoregressive behavior in square series which check the heteroscedasticity. It indicates that there is hetroscedasticity on PSXI series. The ARCH test shows the ARCH effect in series the statistics shows that the only PSXI series has ARCH effect. The KPSS test is used to check stationary which shows that both return series are stationary.

4.3. Tracing Spillover Effect

In this section regression model are used to trace out the spillover effect between the financial series. The descriptive statistics show that the PSXI series has ARCH effect that is why we used GARCH model to trace out the spillover effect from EXR to PSXI and EXR return series has no ARCH effect that is why we used ARDL model to find out the spillover effect from PSXI to EXR. The table 2 explains the results of GARCH model.

The table 2 shows the results of GARCH model which is used to trace out the spillover effect from EXR to PSXI. This model trace out the mean and volatility spillover effect, the first equation of model is conditional mean equation which is used to find out means spillover effect and second equation is conditional variance equation which is used to check the volatility spillover effect. In mean equation we introduced the return series of EXR as independent variable if it is significant it indicates there is mean spillover effect from EXR to PSXI. The$\pi_1$is the coefficient of EXR return series which is significant at 10% nominal level of significance.

Table 2: Results of Spillover Effect from EXR to PSXI

Parameters	Coefficient	Std.Error	t-value	t-prob
Conditional Mean Equation				
Constant θ_0	-0.002	0.001	-1.706	0.089*
DLEXR (M) π_1	-0.612	0.366	-1.872	0.065*
AR(1) ϑ_1	-0.151571	0.056117	-2.701	0.0072***
MA(1) $\emptyset_1$	----------	----------	----------	----------
Conditional Variance Equation				
Constant γ_0	1.760	0.603	2.921	0.004***
DLEXRSQ (V) π_2	0.7676	0.4437	1.9800	0.0441**
ARCH(1) γ_1	0.136	0.053	2.571	0.011**
GARCH(1) δ_1	0.691	0.068	10.100	0.000***
Student (DF)	5.298	1.524	3.476	0.001***
Persistence of shock	0.8455			

Null Hypotheses(All Null Hypotheses are for nth order)
AR (p) H0: ϑ_i= 0 No AR Process, MA (q) H0: $\emptyset_i$= 0 No MA Process, ARCH H0: θ_i= 0 No ARCH effect, GARCH H0: φ_i= 0 No GARCH effect. The *, ** and *** are showing the significance at 10%, 5% and 1% respectively.

Residual Analysis

Tests	Jarque Bera	Q-Stat (5)	Q-Stat (10)	Q^2-Stat (5)	Q^2-Stat (10)	LM – ARCH (1-2)	LM-ARCH (1-5)
Values	6.0271 (0.0000)	0.1019 (0.9978)	0.0124 (0.8090)	0.7020 (0.9690)	0.0139 (1.0000)	0.0054 (0.9967)	0.0043 (0.9000)

Null Hypotheses(All Null Hypotheses are for nth order)
Q-stat (return series) there is no serial autocorrelation. Q^2-stat (square return series) H0: there is no serial autocorrelation. Jarque-Bera H0: distribution of series is normal. LM-ARCH H_0: there is no ARCH effect. P-values are in the parenthesis.

It indicates that there is weak mean spillover effect from EXR to PSXI. The sign of the coefficient is negative which indicates that there is negative relationship between the series. It can be validated from figure 1 and figure 2 where EXR series going downward and PSXI is going upward. The AR term shows the autoregressive term

which is also significant 5% level of significance. The moving average term is equal to zero.

The conditional variance equation is the second equation in the model which trace out the path of volatility. To trace out the volatility spillover effect we introduced square of return series of EXR in PSXI series. The π_2 is the coefficient of square term which is significant at 5% level of significance. It shows that there volatility spillover effect from EXR to PSXI. The sign of coefficient is positive which indicates that there is positive relationship between volatility of EXR and volatility of PSXI. It indicates that if the volatility of EXR is increase the volatility of PSXI is also increaser and same in reverse. The employed GARCH model has GARCH (1, 1) specification that is there is only one term of ARCH and one term of GARCH. The ARCH term is significant at 5% level of significance which indicates there is ARCH effect in PSXI series. The sign of $\gamma_1$coefficient of ARCH term is positive which meets the assumption of GARCH model. The GARCH term is significant at 5% level of significance which indicates there is GARCH effect in PSXI series. The sign of $\gamma_2$coefficient of GARCH term is positive which meets the assumption of GARCH model. The distribution of PSXI series is non normal as we have seen in descriptive statistics and in graphic analysis that is why we used student t distribution. The student t distribution is commonly behave well in presence of extreme values. The student t term is also significant which indicates that it can be used for this analysis. The persistence of shock is 0.8455 which is less than one it means the ARCH and GARCH effect decay after in short period of time.

The residual analysis is used to validate the results of regression model. The third panel of table 2 shows the results of residual analysis after GARCH model. The Jarque-Bera test statistics is still significant which means that the distribution of error is not normal which is no necessary to be normal. The Q stats are insignificant at 5^{th} and 10^{th} lags which means that there is no more autocorrelation in residuals. The Q square stat are also insignificant at 5^{th} and 10^{th} lags which shows that there is no more hetroscedasticity in residuals. The LM-ARCH test statistics also insignificant which at 1^{st} and 5^{th} lags. It means there is no more ARCH effect in residuals.

The table 3 shows the results of ARDL model which is being used for tracing spillover effect from PSXI to EXR. The ARDL model used because the dependent variable EXR has no ARCH effect. The results indicates that there is significant spillover effect from PSXI to EXR. The specification of ARDL model is ARDL (1, 1) which means one lag of dependent variable and current and first lag value of independent variable. The DLEXR_1 is the first lag value term of dependent variable which is insignificant at any level of significance. The constant term is significant at 5% level of significance. The DLPSXI is the current term of PSXI which is significant at 5% level of significance. The sign of the coefficient is negative which means that the current values of EXR and PSXI are negatively associated. It is validating the results of conditional mean equation of GARCH model. It means that the return of both series are negatively associated. The lag value of PSXI DLPSXI_1 is

also significant at 5% level of significance. It means that the lag value of PSXI is significantly effects the current value of EXR.

Table 3: Results of Spillover Effect from PSXI to EXR

Variables	Coefficient	Std.Error	t-value	t-prob
DLEXR_1	-0.0489	0.0523	-0.9350	0.3502
Constant	0.0008	0.0004	2.1400	0.0328**
DLPSXI	-0.0316	0.0114	-2.7700	0.0059***
DLPSXI_1	-0.0040	0.0115	-2.3460	0.0295**
Diagnostic Statistics				
AR 1-2 test	0.2325 (0.7926)	**ARCH 1-1 test**		0.4742 (0.4915)
Hetero test	4.2190 (0.1408)	**RESET23 test**		1.3737 (0.2545)

The second panel of table 3 indicating that there is no econometric problem left in residuals. The AR test statistics are insignificant which means that there is autocorrelation in residuals. The Hetero test results are indicating that there is no hetroscedasticity in residual. The ARCH test results are also indicating that there is no ARCH effect left in residuals. The tests are showing insignificant results.

CHAPTER 5

CONCLUSION AND POLICY IMPLICATIONS

5.1 Conclusion

This study is done to trace out the spillover effect between exchange rate market and Pakistan stock market. The daily data has been used from the period of November 2016 to December 2018. The GARCH model and ARDL model are employed to explore the spillover effect of between foreign exchange rate market and Pakistan stock market. The GARCH model and ARDL model suggests spillover effect between these two markets. The main findings of this study are following:

1. The results are indicting that the path of exchange rate series are Pakistan stock market index series are moving in opposite direction but they are associated at some extent.

2. There is mean spillover effect from exchange rate series are Pakistan stock market series and the reverse is also observed.

3. The volatilities of both markets are positively interlinked, the increase in the volatility of one market leads to increase volatility in other market.

4. It concludes that there is significant interaction between exchange rate series and Pakistan stock market series.

5. The volatility spillover effect is more dominants are compare to mean spillover effect.

5.2 Policy Implications

The results may provide a guide line in making policy regarding these markets. The results of this study may also play very important role for market players.

These results may be considered by the state bank of Pakistan when changing the policy regarding exchange rate. It may provide an indication that the evaluation or devaluation in currency impacts the stock markets. These conclusions may provide a guide line to policymakers to stabilize the volatilities in both markets. They can make an effective policy by considering these results which minimize the adverse effects spillover effects. The effective policy may stabilize the both markets which will increase the foreign direct investment and portfolio investment.

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