

# EMPIRICAL INVESTIGATION OF THE RELATIONSHIP BETWEEN EXCHANGE RATE MOVEMENTS AND STOCK MARKET VOLATILITY IN THE CONTEXT OF PAKISTAN

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## Abstract

*The link between exchange rate fluctuations PKR/USD and volatility of stock returns of KSE 100 is analysed in the current study. Many statistical tests are conducted to study the relationship very effectively. ARCH GARCH models, Unit Root test, Johansen Co-integration test and Granger causality test are applied to have an empirical investigation of the relationship. Heterosekadescity ARCH test shows that there is autocorrelation in the data series, and then volatility has been extracted by using ARCH, GARCH, EGARCH and TGARCH. Unit root test is applied on the generated series which shows that both series are stationary at level. Co-integration test reveals that both variables are co-integrated to each other. Ganger causality test also show bidirectional causal relationship between the two variables. It is concluded in the findings that there is flow of information between two markets; investors can use information of the one market to predict about the other.*

**Keywords:** ARCH GARCH models, Stock Returns, Exchange Rates

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### **Introduction**

There are many factors which affect the volatility of stock market like dividends, enterprise performance, gross domestic product, employment, exchange rate etc. Kurihara (2006). However the effect of exchanges rate on stock market is much focused by the researchers, as it is supported by the theoretical justification and empirical evidences that movement of exchange rate and volatility in the stock market affect the economy of a country. Especially when we talk about emerging economies, it is observed that emerging economies are much attractive for investment community. Emerging markets are considered more volatile than developed markets, and according to risk and return theory investors can reap more returns in developing countries than developed. Many investors diversify their investment towards emerging economies in order to minimize risk. If it is found that stock prices affect exchanges rates, the regularity authority may take effective measures to stabilize the stock market. On the other hand, relation of both markets can help investors to forecast about one market by using information of the other.

Relation between stock prices and exchange rates are presented in two ways in theories. Dornbusch and Fischer (1980) the flow-oriented exchange rate model, it reveals that fluctuations in exchange rate affect stock markets. Branson and Frankel (1983) proposed a second approach which is called stock-oriented exchange rate model. It states that increase in stock price gives rise to exchange rates. Increase in stock prices attract foreign investors and they invest more in stock markets. Where they are supposed to buy local currency hence demand for local currency increases which causes appreciation in the local currency.

This study is going to empirically investigate either there is a link amid volatility in the stock market and fluctuations in the exchange rates in the context of Pakistan or not. There are contradictory results regarding link amid stock volatility and fluctuations in exchange rates

which varies on the basis of time and region. The empirical investigation of relation between exchange rates and stock market in the emerging economy, like Pakistan, helps us to know either flow-oriented model or stock-oriented model which are empirically proven in other countries are applicable in a developing country like Pakistan or not.

In current study, Weekly data of 15 years is used from 1997 to 2013 and all necessary tests are applied to reach at the accuracy of the results. As Karachi stock exchange represents the economy of the country so the study helps us to know how stock volatility and exchange rates movement reacts to each other, and as a result regulatory authorities and investors can take effective decisions.

After going through the literature, it is found while investigating the relationship that researchers have not much considered ARCH and GARCH models in the developing countries like Pakistan. ARCH, GARCH, EGARCH and TGARCH are used to overcome the factors like clustering volatility, leverage effect and asymmetrical response. So there exists a need to examine the link between exchange rate movements and stock volatility in the region by using these models. Theoretically, it will make addition in the existing literature. Besides theoretical contribution, the study will also make practical contribution the regulatory authority which can take effective decisions accordingly to stabilize stock markets as well as appreciate local currency. If relationship is found between two markets, the investors can use information of one market to forecast about the other.

The study is organized as follows: the first phase includes introduction, in the second phase related literature is discussed. In the third and fourth phase, methodology and empirical results are discussed. The fifth phase includes conclusion of the study.

### **Literature Review**

On the basis of economic theory, it is hypothesized that there is possible interaction between stock prices and exchange rates. The flow oriented exchange model proposed by Dornbusch and Fisher (1980) states that stock prices movements are caused by exchange rate movements. In the language of Granger Causality, we can say that unidirectional causality stock price movements are caused by fluctuation in exchange rate. The model is based on the view on which there is consensus in the literature that stock price represents the present value of firms' future expected cash flows so it reveals that phenomena which is responsible for change in the firm's cash flows would be seen in the firm's stock price if market is efficient as suggested by the efficient market hypothesis.

A contrasting view of flow oriented exchange rate model is that exchange rate movements are caused by change in stock prices, which is proposed by Branson and Frankel (1983). It gives a contrasting view to the flow oriented exchange model which states that firms earning are influenced by change in currency rates hence change in stock price is caused by exchange rate movements. Stock oriented model suggests that change is caused in stock prices due to change in exchange rate through transactions of capital account. To what extent stock market effects currency market depend upon things like stock market liquidity and segmentation. For instance, illiquidity in the stock market makes it difficult for investors to buy and sell stock in minimum time bound, while on the other hand segmented markets have some unfavourable characteristics like foreign currency risk, high transaction cost, government constraints and market imperfections.

Relationship of uncertainty shocks with economic activity is widely analyzed in the literature and there is found a general consensus that positive economic shock affects economic activity negatively Bernanke (1983) and Kimball (1990), which ultimately have influence on stock market and exchange rates. Financial crises in 2007 are

considered the biggest financial crisis after 1930s recession; the stock market has been affected adversely due to these crises. To investigate the impact of crises on stock markets, few studies assess its effect on stock market like Olowe (2009) it was concluded in the study that stock returns and its volatility is free from the severity of this crisis. The link amid fluctuations of the exchange rate movements and volatility in the stock market has been worth mentioning in the research field. There is also a need to examine relationship in the context of Pakistan to come with results to check either our results are consistent with previous studies conducted in the different countries at different time periods.

Causal relationship has been examined to check relationship between stock exchange and stock volatility in macroeconomic perspective. Islam and Murinde (1997) conducted a study which concludes that appreciation of currency helps the stocks to perform well and it shows poor performance when currency depreciates. Nyamute (1998) noted a link amid returns of stock and fluctuations of exchange rate where coefficient is found positive; he studied the stock prices and other financial variables like exchange rates, inflation rates, interest rates and money supply during his studies which he conducted in Kenya. Chiang, Yang, and Wang (2000) noted a positive link amid stock prices and fluctuations in exchange rates in the Asian countries. Sabri (2004) investigate the relation in the emerging countries to check either exchange rate affects stock prices in emerging countries or not. It was concluded that there was very strong positive correlation amid volatility in the stock market and exchange rate movements in the emerging stock markets. Dornbusch (1976) and Boyer (1977) presented models that changes occur in exchange rates and stock prices have relation with the capital movements in the country. So we can say reduction in domestic wealth subsequently reduce the demand for money and interest rates, which is self-evident because it leads to capital outflow and currency depreciation.

There is a support of empirical literature which is in favour of argument that there is no significant link of stock volatility with fluctuations in exchange rate. Chiang, Yang, and Wang (1992) conducted a study to examine the link of returns of stock with fluctuations in exchange rate in the United States; they came to conclusion that there is no long-term association of movements between exchange rates and stock volatility. Chiang et al (1998) studied a link amid stock prices and fluctuations in exchange rates in Hong Kong, Singapore, Thailand and Malaysia. Nieh and Lee (2001) conducted studies in the G-7 countries where study did not prove any casual link amid the variables; study also could not find any long-term link between fluctuations in the currency prices and volatility in the stock market. Nandha and Smyth (2003) examined a link amid two variables change in currency prices and volatility in the stock market rate in the context of Malaysia. The empirical investigation did not reveal a significant long-term link between amid fluctuations in currency prices and volatility in the stock market. Ozair (2006) investigated a connecting link amid fluctuations in currency prices and volatility in the stock market, it was concluded that no long-term link amid variables exists in the USA; He used data from 1960 to 2004 on quarterly basis to study the variables.

Literature also supports a link between fluctuations of currency prices and volatility in the stock market with negative coefficient. According to Ma and Kao (1990) there can be both negative and positive effects of currency appreciation on stock prices for an import- dominant country and export-dominant country. Granger, Huang and Yang (2000) conducted a research to study the bivariate link amid fluctuations in currency prices and volatility in the stock market. It was examined that either the depreciation in currency leads to reduce stock prices or decline in the stock prices leads to depreciation of the currency exchange .The results showed that there is negative causality relationship between exchange rates and stock prices The data of Asian countries was used in this study. Soenen and Hanniger (1988) noted that there is strong negative relationship

between U.S dollar value and stock prices. The data used in the study was monthly data on stock prices and effective exchange rates from 1980-86. Clive W.J Granger, Bwo-Nung Huang, and Chin Wei Yang (1998) conducted study in the Taiwan where daily data was used from 1986 to 1997. The results concluded that there is negative casual relationship between stock prices and exchange rates in Taiwan.

So , it is found that there is a theoretical support for casual relationship, empirical literature also prove relationship between two variables exchange rate and stock prices in many developed countries. So the study is going to empirically investigate relationship between exchange rates and stock prices in the context of Pakistan, which will help us to understand if our results are consistent with the results of previous studies conducted in different countries at different time periods. As a result study may suggest to act accordingly to stabilize stock markets.

### **Hypotheses**

- H0:** There is a no causal relationship between stock market volatility and exchange rate movements.
- H1:** There is a causal relationship between stock market volatility and exchange rate movements.

### **Data and Methodology**

The relationship between exchange rates and stock volatility is empirically investigated in this research paper. Stock returns of KSE 100 index and PKR/USD dollar exchange rates are examined in the study. Data has been taken for the time period of 13 years from 1997 to 2013, the data period in the study would have been extended beyond 13 years to cover all the shocks which may have taken place during that time period but the data was only available from 1997 and that is why the time period considered in the study is from 1997 to 2013. Data for stock prices would be considered closing price of stock and for exchange rate movements it would be change in the

Pakistani Rupee/US Dollar. Natural logarithm of stock prices as well as exchange rates is taken. The values obtained as a result of natural logarithm are investigated empirically to study the relationship. The source of data for stock prices is ([www.yahoofinance.com](http://www.yahoofinance.com)). The data for exchange rate movement is collected from the website ([www.oanda.com](http://www.oanda.com)).

### Models used

Mishra, Swain and Malhotra (2007) investigated the relationship between stock volatility and exchange rate movements by adopting ARCH, GARCH and EGARCH. Dr. Agrawal (2010) studied the relationship in the India by using Unit root and Gaunger causality test. This study will adopt ARCH and GARCH models to examine the relationship.

### Variables

Variables	Description	Measurement
Stock Returns	Weekly stock returns of KSE 100	$\ln(P_t)/(P_{t-1})$
Exchange Rates	Weekly exchange rates of PKR/USD	$\ln(E_t)/(E_{t-1})$

Where  $P_t$  is the stock prices of at the week  $t$  and  $E_t$  is the exchange rate at week  $t$ .

### Data Analysis techniques

Many statistical tests are applied to reach the accuracy of results. ARCH heteroscedasity test is used in the study to check either ARCH effect exists or not in the data. The study used ARCH GARCH family models to extract volatility series, and then the volatility series are run in unit root test to check stationary of the data. To find out co-integration between the variables Johansen Co-integration test is applied on volatility series of both variables. To check whether there is casual relationship between two variables Granger causality test is applied.

#### Arch effect

#### Results

#### Heteroskedasticity Test: ARCH for exchange rates

F-statistic	27.90504	Prob. F(5,807)	0.0000
Obs*R-squared	119.8426	Prob. Chi-Square(5)	0.0000

Data series of foreign exchange rate is passed through heteroskedasticity ARCH test to check whether there is Arch effect or not. The results show that ARCH effect exists in the data as F-statistics probability is less than 0.05. It means that null hypothesis is rejected that there is no arch effect and alternative is accepted that there is arch effect in the series of exchange rates.

#### Heteroskedasticity Test: ARCH for stock returns

F-statistic	27.26830	Prob. F(5,807)	0.0000
Obs*R-squared	117.5032	Prob. Chi-Square(5)	0.0000

Data series of stock returns is passed through heteroskedasticity ARCH test to check whether there is Arch effect or not. The results show that ARCH effect exists in the data as F-statistics probability is less than 0.05. It means that null hypothesis is rejected that there is no arch effect and alternative is accepted that there is arch effect in the series of stock returns.

#### Extraction of volatility by using ARCH GARCH models for exchange rates

	ARCH	GARCH	TGARCH	EGARCH
<b>Akaike info criterion</b>	-7.381005	-7.589361	-7.587675	-7.609654
<b>Schwarz criterion</b>	-7.357989	-7.560591	-7.553150	-7.575129
<b>Adjusted R-squared</b>	0.033848	-0.01541	-0.014203	-0.015738

ARCH, GARCH, EGARCH AND TGARCH is used to analyze which is most appropriate model to extract volatility of the data series of exchange rates. The analysis is made on the basis of Akaike info criterion, Schwarz criterion, Adjusted R-squared. Model having least Akaike info criterion and Schwarz criterion is used to extract volatility series. The above mentioned table shows that EGARCH has least

Akaike info and Schwarz criterion so volatility is extracted for the series of exchange rates by using EGARCH.

#### Extraction of volatility by using ARCH GARCH models for stock returns

	ARCH	GARCH	TGARCH	EGARCH
<b>Akaike info criterion</b>	-3.887729	3.956935	-3.963128	-3.961755
<b>Schwarz criterion</b>	-3.864713	3.928165	-3.928604	-3.927230
<b>Adjusted R-squared</b>	0.020569	0.030017	0.028314	0.027849

ARCH GARCH EGARCH and TGARCH is used to analyze which is most appropriate model to extract volatility of the data series of stock returns. The above mentioned table shows that TGARCH has least Akaike info and Schwarz criterion so volatility is extracted for the series of stock returns by using TGARCH.

#### Unit Root Test

Null Hypothesis: FX2 has a unit root

Exogenous: Constant

Lag Length: 4 (Automatic - based on SIC, maxlag=20)

	t-Statistic	Prob.*
<b>Augmented Dickey-Fuller test statistic</b>	-9.156815	0.0000
<b>Test critical values:</b>		
1% level	-3.438168	
5% level	-2.864881	
10% level	-2.568603	

To check the stationary of extracted series of exchange rate volatility unit root test is applied at level. It shows that ADF is greater than critical value at one percent significant level and null hypothesis is rejected, so exchange rate volatility series is found stationary at level.

Null Hypothesis: KSE2 has a unit root

Exogenous: Constant

Lag Length: 1 (Automatic - based on SIC, maxlag=20)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-5.910368	0.0000
Test critical values: 1% level	-3.438139	
5% level	-2.864868	
10% level	-2.568596	

To check the stationary of extracted series of stock volatility unit root test is applied at level. It shows that ADF is greater than critical value at one percent significant level and null hypothesis is rejected, so exchange rate volatility series is found stationary at level.

### Johnsen Co-integration test

Unrestricted Co-integration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.110400	128.9295	15.49471	0.0001
At most 1 *	0.040748	33.82231	3.841466	0.0000

Trace test indicates 2 co-integrating eqn(s) at the 0.05 level

The Co-integration test is applied to know either there are co-integration equations between the variables or not. Trace statistics is greater than critical value at significant level which reveals that variables are Co-integrated to each other. There are two co-integrating equations between the variables.

### Ganger Causality Test

Pairwise Granger Causality Test

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
KSE2 does not Granger Cause FX2	816	11.9022	8.E-06
FX2 does not Granger Cause KSE2		6.13340	0.0023

Ganger Causality test is used to check the casual relationship between the variables, whether there is casual relationship between two variables or not. The results of the test show that there is a casual relationship between the variables. The null hypotheses KSE2 does not ganger cause FX2 and FX2 does not granger causes KSE2 are rejected. It is concluded that there is bidirectional casual relationship between two variables.

### **Discussion**

First auto correlation was checked by Heteroskedasticity ARCH test and then data was made amenable by using ARCH GARCH model by extracting volatility. Mishra swain and Malhotra (2007) adopted the ARCH GARCH models to extract volatility. The co-integration is conducted between the volatility of stock returns and exchange rates, where it is found that there are two co-integration results between two variables which is consistent with some previous studies, like Mishra Swain and Malhotra (2007) conducted the studies in India and found co-integration equation between the variables. To find out casual relationship between variables, the Ganger causality test is conducted, which shows that both variables have casual relationships with each other which. The results of the current study are consistent with some previous studies like; Dr. Sarbapriya (2012) conducted the Ganger study in India and found that there is casual relationship between stock prices and exchange rates in India and Singapore.

### **Conclusion**

The evidence of bidirectional relationship between volatility of stock prices and exchange rates has been found in the study. It is also suggested in the findings that both variables move in the same direction, results support the long run relationship of both variables. The bidirectional causality between the variables proves that there is information flow between two markets and they are integrated with

each other. Findings of the study reveal that investor can use information of one market to predict something about the other. Regulatory authority can also play its role to stable one market like stock market to appreciate exchange rates.

### **Recommendations**

The findings of the study can help both regulatory authority and investors in decision making. Regulatory authority can play their role in the stock market development by devising effective policies, these policies should be in the favor of investors which would attract investors and will have consequently positive effect on stock market. As study proves there is causal link between volatility of stock returns and exchange rate hence development of stock market will play its role for stability of exchange rates. The study can also help foreign investors to take the volatility of stock market into consideration while decision making to invest in their concerned economies because stock volatility cause change in exchange rates so investors can also anticipate their exchange risk on the basis of volatility of stock returns.

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