

Does Volatility Transmission Between Stock and Foreign Exchange Markets in Pakistan Reveal Asymmetry?

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Abstract: Foreign exchange and stock markets are closely interlinked and affect each other in different ways; volatility of each market is transferred to the other market due to many reasons. This study examines the direction and nature of volatility transmission between the stock market and foreign exchange market of Pakistan. Volatility transmission between the two markets is examined using bivariate diagonal BEKK-GARCH and bivariate E-GARCH models. Stock market returns are measured using the KSE-100 index and daily Pakistan Rupee-PKR to the United States Dollar-USD exchange rate is used for the foreign exchange market. Normality is examined through Skewness and Kurtosis, Autocorrelation through Correlogram Q-statistics, and ARCH effect through ARCH-LM test. Results of the study indicate that bi-directional volatility transmission exists between the stock market and foreign exchange market of Pakistan and E-GARCH model further indicated asymmetric volatility transmission between these two markets, which means bad news of one market have a greater impact on the volatility of another market than good news. Findings of the study are helpful for investors and policy makers both. Knowledge of market response to changes in the other market can assist them to devise hedging strategies and for diversification decisions. Policy makers can use findings of this study in making policies for currency markets. The literature lack consensus regarding relationship of FORX and stock market in general and more precisely in the context of developing economies. Considering the fact that limited literature on the topic for developing economy like Pakistan, where variation in results exist hence dynamics of relationship between these two markets need to be explored.

Keywords: Bi-directional Volatility, Asymmetric Volatility, PKR to USD Exchange Rate, Volatility Impact of Bad News, Hedging and Diversification Strategies

1. Introduction

These study intents to determine the direction and nature of volatility transmission between foreign exchange market (FORX) and stock market of Pakistan. The returns in FORX and stock market are highly unpredictable due to high level of fluctuations in Pakistan. The fluctuation in both markets is also interlinked (Dua & Tuteja, 2016). The volatility transmission between two markets can be an outcome of volatility cause and effect or feedback relationship among both markets (Ebrahim, 2000). This study considers the previous effect of volatility in stock market on current volatility of FORX and effect of previous volatility in FORX on current volatility of stock market is considered as transmission. This study has also analyzed asymmetric linkages between two financial markets of Pakistan. This refers to existence of greater impact of bad news than good news of one market to volatility of second market (Koutmos & Booth, 1995). This means that negative and positive returns in one market do not have same impact on returns of other market.

The presence of volatility transmission between two markets in Pakistan need to be verified for the comprehensive understanding about the market behavior.

Investors without having knowledge of existence and nature of volatility transmission cannot devise effective investment strategy which in turn may cause them to face heavy lose. Hence this study determines that whether volatility transmission between two financial markets is one sided or two sided and also determine that transmission is symmetric or asymmetric. Findings of this study will help local and international investors in making hedging and investment related decision. Table-1 shows a brief profile of PSX for the five years and Table-2 shows the performance of the KSE-100 Index.

Function of foreign exchange market in any economy is to manage flow of foreign currencies, specifically currency in which reserves of a country are held for fulfilling financial obligation of a country; through foreign exchange market country can avoid abnormal changes in exchange rate; it also facilitate investors to hedge their risk (Arif, 2012).

Initially, since the independence PKR was linked with Sterling Pound till 1971, since that PKR was linked with USD the official exchange rate was PRK/USD was 4.76. During the early 1972 PKR was depreciated against gold 56.7 percent (Arif, 2012)

Table 1: *Profile of Pakistan Stock Exchange*

Description	Up to 31-12-2015	Up to 31-12-2016	Up to 31-12-2017	Up to 31-12-2018	Up to 31-12-2019	Up to 31-12-2020	Up to 31-12-2021	Up to 31-12-2022
Total Listed Companies	638	573	569	557	560	558	559	560
New companies listed	4	4	4	5	9	4	1	1
Total Listed Capital (Rs. In million)	1,048,443.87	1,094,367.40	1,129,787.32	1,168,484.88	1,165,183.86	1,291,040	1,300,256	1,297,159
Total Market Capitalization (Rs. In million)	2,945,784.51	4,242,278.04	6,056,506.03	7,380,531.74	7,081,220.83	9,628,514	10,095,160	9,594,806
Total shares volume (Million)	24,434.39	49,282.42	54,319	56,581	57,204	55,430	56,370	56,255
Average daily shares volume (Million)	96.91	196.68	221	229	233	221	222	224

Table 2 Leading Stock Market Indicators on KSE-100 Index

	2017/18			2018/19			2019/20			2020/21		
	KSE-100 (End Month)	Capitalization (Rs. Billion)	Turnover of Shares (Billion)	KSE-100 (End Month)	Market Capitalization (Rs. Billion)	Turnover of Shares (Billion)	KSE-100 (End Month)	Market Capitalization (Rs. Billion)	Turnover of Shares (Billion)	KSE-100 Index (End Month)	Market Capitalization (Rs. Billion)	Turnover of Shares (Billion)
July	23,313.00	5,711.70	6.6	30,314.07	7,120.67	2.6	35,741.52	7,701.71	9.9	39,528.82	7,887.25	4.0
August	22,161.00	5,514.20	3.8	28,567.74	6,726.93	3.1	34,726.51	7,535.84	7.1	39,809.58	8,011.36	7.1
September	21,833.00	5,185.00	4.7	29,726.39	6,914.10	4.0	32,287.41	6,952.85	4.5	40,541.81	8,223.53	12.1
October	22,776.00	5,423.10	2.3	30,376.53	7,033.70	4.1	34,261.60	7,284.24	4.5	39,893.84	8,082.52	10.1
November	24,302.00	5,874.50	2.9	31,197.98	7,152.18	5.2	32,255.20	6,867.98	4.3	42,622.37	8,696.51	12.6
December	25,261.00	6,056.50	4.8	32,131.28	7,380.53	6.3	32,816.31	6,947.36	4.0	47,806.97	9,628.51	9.1
January	26,784.00	6,607.30	7.2	34,443.87	7,798.41	7.6	34,443.87	6,699.11	3.8	31,298.60	9,727.73	11.6
February	25,783.28	6,279.20	4.7	33,632.19	7,615.59	6.2	33,632.19	6,587.38	3.4	31,369.51	9,619.84	8.8
March	27,159.91	6,579.10	4.8	30,233.87	6,760.76	4.3	30,233.87	6,915.68	4.2	33,139.00	9,594.81	7.0
April	28,912.98	6,920.10	6.7	33,729.96	7,305.81	7.3	33,729.96	7,205.96	6.1	34,719.29	9,835.43	6.0
May	29,737.69	7,042.82	4.10	33,056.79	7,179.85	4.2	33,056.79	7,357.59	7.5	36,061.56	10,044.07	6.5
June	29,652.53	7,022.69	4.90	34,398.86	7,421.03	9.8	34,398.86	7,588.47	5.5	37,783.54	10,044.07	7.0

Source: Ministry of Finance (Economy Survey of Pakistan)

2. Literature Review and Hypotheses Development

There is no consensus in findings of prior research regarding volatility transmission of these two financial markets. A few studies conclude that volatility transmission is unidirectional and move from FORX to stock market. While few other studies conclude the contrary volatility transmission move from stock market to FORX (Horobet et al., 2007). However, literature is unable to conclude the direction and nature of relationship between these two financial markets.

In stock market of Japan transmission from foreign exchange market was exist for eight sectors whereas in five sectors nature of transmission was asymmetric in nature (Fo, Holmes, & Choi, 2011). Bukhari (2013) in his study found for London Stock Exchange (LSE) that all eighteen stocks are exposed due to volatility of FORX however, level of exposure was not same for all kinds of stocks.

Daniel, Victor, and Tian (2009) found that in case of New Zealand volatility transmission move from stock market to FORX of two currencies which are Australian and American dollar. The same results were concluded by few other studies (Yang, & Doong, 2004). However, evidence of two sided volatility transmission was also found for Australian market with existence of asymmetric linkages (Hakim & McAleer, 2009).

Zhao (2009) determined that volatility of Taiwan dollar exchange rate against Japanese yen and stock market of the country are interlinked. In case of Hong Kong both financial markets have longrun relationship and both markets transmit volatility to each other (Lee, 2012). Another research found that in case of Japan and China the flow of volatility transmission was from FORX to stock market (Wei, 2009). Lee, Doong, and Chou (2011) infer that in Philippines, Malaysia, Indonesia, and Korea volatility of stock market impact on FORX but no evidence was traced from FORX to stock market. Ahmedi, Rezayi, and Zakeri (2012) studied different sectors of Tehran stock market and found that sign of relationship for food and cement sector was positive with asymmetric nature; for pharmacy and chemistry sector sign of relationship was negative and nature of relationship was asymmetric.

In case of South Asian economies there is no one point on relationship between two markets. In one study four major South Asian countries were examined and revealed that in these countries, India, Pakistan, Bangladesh, and Sri Lanka, these two financial markets have no relationship effect behavior of foreign exchange market of a country. This is because

investors seek to make decisions which minimize their risk and maximize their return. This theory was first

neither in short run nor in long run (Naeem & Rasheed, 2002). Similar results were also revealed by other studies for financial markets Pakistan and India but in Bangladesh these two markets reveal the relationship (Noman et al., 2012; Rehman & Uddin, 2009).

The direction and nature of relationship between FORX and stock market of Pakistan is still not yet confirmed. Different studies had shown different results. Some studies found that no long run relationship exists between FORX and stock market (Qayyum & Kemal, 2006; Zia & Rahman, 2011). On the other side few studies conclude that FORX can predict the nature and direction of stock market. However, no evidence found of volatility transmission from stock market to FORX (Khalid & Rajaguru, 2006; Mustafa & Nishat, 2008). Another research has shown that both markets transmit volatility to each other, and past volatility can predict current behavior of second market (Khalil et al., 2013).

As we have seen that there is no consensus regarding relationship of FORX and stock market in literature. Specifically in case of Pakistan variation in results is exist and dynamics of relationship between these two markets needs to be explored.

Theoretical Framework

There are different theories which have explained nature of relationship between these two financial markets. Two theories which are mostly referred to explain relationship of these two markets are Portfolio Balance Theory and Goods Market Approach. According to the Goods Market Approach depreciation is expected to increase the exporting firms' value while appreciation is expected to increase the value of import-based industry, therefore, the relationship is expected to be positive (Dornbusch & Fischer 1980). Many companies are exposed to foreign current risk when they involve in imports and exports. According to this theory such transactions effect profitability of companies which in turn effect stock price. Therefore, according to theory flow of relationship between these two markets is from foreign exchange market to stock market. In this study direction of volatility transmission between two markets were examined and viewpoint of this theory is used to explain logic of relationship between these two markets.

Another theory which is Portfolio Balance Approach explained relationship between these two markets. This theory suggest that it is stock market of any country which

developed by Branson, Halttunen, and Masson (1977) whereas other contributors to the model were Dornbusch

(1976) and Frankel and Rodriguez (1975). This model suggests that primary problem that investors face is right combination of different securities to minimize their risk.

Above theories had explained the relationship between two financial markets. Goods market approach argued that flow of relationship is from stock market to exchange market whereas Portfolio balance approach claim that it is other way round. However, there are studies which have suggested that both markets can affect each other at same time (Azman-Saini et al., 2003; Khalil et al., 2013). In this study all these approaches were examined.

3. Methodology

Data of both time series were collected from official websites. Data of stock prices was taken from the website of Pakistan Stock Exchange. Official website of central bank of Pakistan (SBP) was used to collect daily US dollar rate in terms of Pakistan rupee. Period of this study was from 1st January 2015 to 31st December 2022. Reason to choose this period was due to major international and national economic changes that occurred during this period.

Stock Prices (SP) = Daily PSX-100 Index

Exchange Rate (ER) = Daily US dollar rate

Augmented Dickey Fuller-ADF Test is applied to determine at which level variables of this study are stationary; normality of variables is checked with Jarque-Bera Test, and Correlogram Q-statistic is used to find out the correlation among squared residuals i.e. auto-correlation. The ARCH effect is initially checked and then multivariate BEKK-GARCH is applied. This model developed by Baba, Engle, Kraft, and Korner in 1995 to find out the nature of linkages. Different multivariate GARCH model assume that correlation between two variables (financial markets) is constant. But this model does not assume that correlation between variables is constant. This enables the study to explore more dynamics about relationship exist between variables. BEKK GARCH model is helpful to find that whether volatility transmission between two financial markets exist or not. Secondly model also explained asymmetric nature of relationship. Conditional variance equation is as follows.

$$H_{t+1} = C/C + B/H_tB + A/\epsilon_t \epsilon_t / \epsilon_t A$$

$$\sigma_{s,t}^2 = \alpha + \delta_s \ln \sigma_{s,t-1}^2 + \theta_s Z_{s,t-1} + \beta_s (|Z_{s,t-1}| - E(|Z_{s,t-1}|)) + \theta_{sx} Z_{x,t-1} + \beta_x (|Z_{x,t-1}| - E(|Z_{x,t-1}|)) + \theta_{sx} Z_{s,t-1} + \beta_s (|Z_{s,t-1}| - E(|Z_{s,t-1}|)) + \theta_{sx} Z_{x,t-1} + \beta_x (|Z_{x,t-1}| - E(|Z_{x,t-1}|))$$

Equation (4) explain variance dynamics of stock market and equation (5) is for exchange market. In both variance equations 'θ' is used to measure asymmetric nature of volatility transmission both within the market and between two markets. Negative value of θ means that asymmetric

Above conditional variance equation has H_{t+1} matrix includes coefficients of conditional variance. Constant coefficients are included in lower triangular matrix C. In matrix B diagonal elements captures effect of past fluctuations on volatility within the market, whereas off diagonal elements describe volatility transmission between two markets.

Matrix A determined how past residuals impact current residuals of other market. Reduced form of this model is diagonal BEKK GARCH with few parameters. In this form diagonal elements of A and B matrices capture volatility transmission within the market. Parameters estimated by full BEKK-GARCH are greater than parameters calculated through diagonal equation. With few numbers of parameters make interpretation is easy to explain. For the purpose of this study three equations are developed to determine volatility transmission within the market and between two markets.

$$H_{11,t+1} = C_{11}^2 + B_{11}^2 H_{11,t} + A_{11}^2 \epsilon_{1,t}^2 \dots \dots \dots (1)$$

$$H_{22,t+1} = C_{22}^2 + B_{22}^2 H_{22,t} + A_{22}^2 \epsilon_{2,t}^2 \dots \dots \dots (2)$$

$$H_{12,t+1} = C_{12}^2 + B_{11} B_{22} H_{12,t} + A_{11} A_{22} \epsilon_{1,t} \epsilon_{2,t} \dots \dots \dots (3)$$

In above three equations first two equations relationship between past fluctuations and volatility of a market is determined. Equation (1) has estimated conditional variance of stock prices of PSX whereas equation (2) is for foreign exchange market. Coefficient 'B' in both equations measure the effect of past volatility on conditional variance of market whereas coefficient 'A' determines how previous shocks effect volatility of a market. Co volatility between two markets is determined in equation (3). Coefficient $B_{11}B_{22}$ determine whether previous years fluctuations in one market effect volatility of second market. This equation also determines existence of significant effect of previous year's shocks in one market on volatility of second market through parameter $A_{11}A_{22}$.

This study also intends to determine asymmetric nature of volatility transmission between two markets. For this purpose, Exponential GARCH (E-GARCH) is model used. By measuring asymmetric nature relationship of two markets investors enable to risk level of each market in relation to fluctuation in other market. Variance equations for both markets are given below.

relationship is exist within or between the markets. Coefficient δ in both equations' measures persistence level of volatility in both markets.

4. Results Hypotheses Testing:

4.1 Data Analysis

Table 3: Descriptive Statistics

	PSX 100 Index	US Dollar
Mean	11,182.46	74.77
Median	10,063.58	64.05
Maximum	34,826.51	108.63
Minimum	1075.16	57.18
Standard Deviation	7989.441	16.69
Skewness	1.10	0.46
Kurtosis	3.76	1.64
Jarque Bera	788.66	389.80
Probability	0.00000	0.0000

Both time series are not normally distributed. This problem is existing in daily data time series. As it is shown in Table 3 values of skewness and kurtosis are not equal to criteria required for normally distributed time series.

Table 4: Stationarity Results

Variables	ADF Test	
	Level	1 st Difference
Stock Prices (SP)	1.964816 (0.999)	-50.70845 (0.0001)
Foreign Exchange Rates (FX)	0.482606 (0.9862)	-18.48464 (0.0000)

4.2 Heteroscedasticity in Residuals

Residuals of two time series were examined. Residuals are tested to determine existence of ARCH effect. Existence of normality, conditional Heteroscedasticity, and autocorrelation in residuals of time series means ARCH effect is exist time series.

Table 5: Normality of Residuals

	Stock Prices	Foreign Exchange Rate
Skewness	1.10	0.46
Kurtosis	3.76	1.64
Jarque Bera	788.66	389.80
Probability	0.0000	0.0000

Value of skewness and kurtosis in Table 5 revealed that residuals of both time series are not normally distributed. Correlogram shows that autocorrelation exists in residuals of both time series, which indicates that conditional heteroscedasticity is exist in residuals. Results of all diagnostic tests had shown that GARCH model should be used to analyze dynamics of both markets.

Table 6: ARCH LM Test

	Stock Prices (SP)	Foreign Exchange Rate (FX)
F Statistics	3191401 (0.0000)	4238941(0.0000)
Obs. R Squared	3466.233 (0.0000)	3467.163 (0.0000)

In the above table ARCH results are shown for both time series. Significant value of F statistics means that element of ARCH is present in both time series used in this

study. Existence of ARCH effect in variables means that ordinary least square regression cannot produce valid results. Therefore, multivariate GARCH models are used in this study.

4.3 Diagonal BEKK-GARCH Results

Results of three variance equations computed by Diagonal BEKK GARCH are given below.

$$H_{11} = 1.53e^{-8} + 0.8592H_{11,t-1} + 0.1754 \varepsilon_{1,t-1}^2 \dots\dots\dots$$

$$H_{22} = 1.0111e^{-5} + 0.8388H_{22,t-1} + 0.1076\varepsilon_{2,t-1}^2 \dots\dots\dots$$

$$H_{12} = 2.29e^{-11} + 0.8464H_{12,t-1} + 0.1374 \varepsilon_{2,t-1}^2 \dots\dots\dots$$

Equation (6) and (7) confirmed that in both markets of Pakistan previous variations and shocks have significant impact on volatility. Both these financial markets are highly volatile but foreign exchange market is more volatile than stock market. This finding is useful for investors in distributing their funds between two markets.

Co variance equation for both markets confirmed the existence of co volatility between two markets of Pakistan. This means that past volatility and shocks influence current volatility of other market. We can say that both markets have capability to predict future volatility of other market. This finding is useful for inventors in making decision regarding shifting of their finds from one market to other market.

4.4 EGARCH Results

Nature of volatility of these two-time series was also estimated through E-GARCH model. Coefficients of both equations are significant at 5% level of significance. Equations are given below.

$$H_s = -0.72 + 0.92\delta_s + 0.35\beta_s - 0.99\theta_s + 0.072\beta_x + 0.13\theta_x$$

$$H_x = -0.30 + 0.97\delta_x + 0.37\beta_x + 0.13\theta_x - 0.043\beta_s - 0.32\theta_s$$

Equation (9) has estimated covariance of Pakistan equity market. Flow of transmission was existing from currency market to equity market. Both asymmetric term in this equation is significant and positive which show that leverage effect does not exist in stock market of a country. Stock market is response is same for its own both good and bad news and of exchange market.

Equation (10) is estimated for currency market of Pakistan. Volatility is transmitted to currency market from stock market of the country. Results of this equation has revealed that currency market response is same for its own good or bad news. But in case of stock market news (good or bad) responses is not same as bad news left more impact on market than good news. So, leverage effect is prevailed in currency market in terms of news from stock market.

Findings of both models Diagonal BEKK-GARCH and E GARCH has confirmed that in case of Pakistan volatility transmission between two markets bidirectional. Previous

years volatility and shocks can predict volatility within the market and can also predict volatility of other market. These findings are like previous studies conducted on Pakistan (Khalil et al., 2013; Qayyum & Kemal, 2006). Through E GARCH model results it is also revealed that leverage effect is exist in volatility transmission between two markets

4.5 ARCH Test

Residuals derived from models were examined for ARCH effect and it was found that residuals of stock market were free from this effect whereas it was found in residuals of foreign exchange market.

Table 7: ARCH LM Test

		Stock Prices (SP)	Foreign Exchange Rate (FX)
F Value		2.0126 (0.1560)	6.804(0.0091)
Obs. R Squared		2.0126 (0.1559)	6.795 (0.0091)

Findings of this study has shown that volatility of both markets is affected by volatility of other market and previous shocks of a market also have effect on volatility of second market. Leverage effect is not found for stock market of Pakistan as market response is same for both types of news (good and bad). Stock market response for its own good or bad news is also same. However, leverage effect is existing for foreign exchange market as market response is not same for both types of news (good or bad). This leverage effect in foreign exchange market is exist both for news in the market and news from stock market.

Findings of this study can be helpful for government bodies and both local and international investors. Investors after knowing how one market responses to changes in other market can device hedging strategies more effectively. Similarly, after knowing level of integration of both these markets will be help investors to diversify their investment in both these markets. For policymakers' findings of this study will be helpful in making policies for currency markets. Specifically, when government about to adopt fixed rate system for foreign exchange market.

5. Conclusion

Ethical Consideration

Not Applicable.

Conflict of Interest

The authors declare that they have no conflicts of interest

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References

- Abdalla, I. S., & Victor, M. (1997). Exchange rate and stock price interactions in emerging financial markets: Evidence on India, Korea, Pakistan, and the Philippines. *Applied Financial Economics*, 7, 25-35.
- Aggarwal, R. (1981). Exchange rates and stock prices: A study of US capital markets under floating exchange rates. *Akron Business and Economic Review*, 2, 7-12.
- Ahmedi, R., Rezayi, M., & Zakeri, M. (2012). Effect of exchange rate exposure on the stock market: Evidence from Iran. *Middle-East Journal of Scientific Research*, 610-616.
- Alagidede, P., Panagiotodis, T., & Zhang, X. (2010). The causal relationship between stock prices and exchange rates. *Stirling Economics Discussion Papers*.
- Aloui, C. (2007). Price and volatility spillovers between exchange rates and stock indices for the pre and post-euro period. *Quantitative Finance*, 669-685.
- Andreou, E., Matsi, M., & Savvides, A. (2013). Stock and foreign exchange market linkages in emerging economies. *The University of Cyprus*.
- Apergis, N., & Rezitis, A. (2001). Asymmetric cross-market volatility spillovers: Evidence from daily data on equity and foreign exchange market. *The Manchester School Supplement*, 81-96.
- Aquino, R. (2005). Exchange rate risk and Philippine stock returns: Before and after Asian financial crises. *Applied Financial Economics*, 765-771.
- Arif, M. (2012). *Dynamics of the foreign exchange market in Pakistan*. Karachi.
- Azman-Saini, W., Habibullah, M. S., & Azali, M. (2003). Stock price and exchange rate dynamics: Evidence from Thailand. *Savings and Developments*, 245-258.
- Bahmani-Oskooee, M., & Sohrabian, A. (1992). Stock prices and the effective exchange rate of the dollar. *Applied Economics*, 459-464.
- Beer, F., & Hebein, F. (2008, August). An assessment of the stock market and exchange market dynamics in industrialized and emerging economies. *International Business & Economic Research Journal*, 7(8).
- Bollerslev, T. (1986). Generalized autoregressive conditional heteroscedasticity. *Journal of Econometrics*, 307-327.
- Branson, W., Halttunen, H., & Masson, P. (1977). Exchange rate in the short run: The Dollar Deutsche mark rate. *European Economic Review*, 303-324.
- Bukhari, I. H. (2013). The social relationship between exchange rate and stock prices, a case on SAARC economies. *Argosy University in Chicago*.
- Butt, B. Z., Rehman, K. U., Khan, M. A., & Safwan, N. (2010). Do economic factors influence stock returns? A firm and industry level analysis. *African Journal of Business Management*, 583-593.
- Caporale, G., Pittis, N., & Spagnolo, N. (2002). Testing for causality in variance: An application to the East Asian markets. *International Journal of Finance and Economics*, 235-245.
- Chaojun, D. S. (2007). An empirical study on the relationship between stock price and exchange rate in China. *Journal of Financial Research*.
- Chow, E. H., Lee, W. Y., & Solt, M. S. (1997). The exchange rate exposure of asset returns. *Journal of Business*, 105-123.
- Daniel, F. C., Victor, F., & Tian, Y. F. (2009). Volatility spillovers between New Zealand stock market returns and exchange rate changes before and after the 1997 financial crises. *Asian Journal of Accounting and Finance*, 1, 106-117.
- Donnell, M., & Morales, L. (2009). Volatility spillover between stock returns and foreign exchange rates: Evidence from four Eastern European countries. *International Journal of Business*.
- Dornbusch, R., & Fischer, S. (1980). Exchange rates and current accounts. *American Economic Review*, 960-971.
- Dorubusch, R. (1976). Expectations at exchange rate dynamics. *Journal of Political Economy*.
- Ebrahim, S. K. (2000). *Volatility transmission between foreign exchange and money markets*. Ottawa, Ontario, Canada: Bank of Canada.
- Engle, R. (1982). ARCH with estimates of the variance of United Kingdom inflation. *Econometrica*, 987-1007.
- Engle, R., & Korner, K. (1995). Multivariate simultaneous generalized ARCH. *Econometric Theory*, 122-150.
- Erbaykal, E., & Okuyan, H. (2007). The relationship between stock prices and exchange rates: An empirical study on emerging markets. *Journal of BRSA Banking and Financial*.
- Fang, W., & Miller, S. (2002). Currency depreciation and Korean stock market: Performance during the Asian financial crises. *The University of Connecticut, Department of Economics, Working Paper Series*.
- Farooq, M. T., Keung, W. W., & Kazmi, A. A. (2004). The linkage between stock market prices and exchange rate: A causality analysis for Pakistan. *The Pakistan Development Review*, 639-649.
- Fedorova, E., & Saleem, K. (2009). Volatility spillover between stock and currency markets: Evidence from emerging Eastern Europe. *Australian Finance and Banking Conference*.
- Frank, P., & Young, A. (1972). *Stock price reaction of multinational firms to exchange realignments, financial management*. New York: McGraw Hill.
- Frankel, J., & Rodriguez, C. (1975). Portfolio equilibrium and the balance of payments: A monetary approach. *American Economic Review*, 674-688.
- Giovannini, A., & Jorion, (1987). Interest rate and risk premia in the stock market and in the foreign exchange market. *Journal of International Money and Finance*, 6, 107-124.
- Hakim, A., & McAleer, M. (2009). Modeling the interactions across international stock, bond, and foreign exchange markets. *Applied Economics*.

- Horobet, Alexandra, Ilie, & Livia. (2007). On the dynamic link between stock prices and exchange rates: Evidence from Romania. *MPRA Paper*.
- International Finance Corporation. (1992). *Emerging Stock Market Factbook*. Washington, DC: The World Bank.
- International Monetary Fund. (2004). *Pakistan: Financial system stability assessment-country report no.04/215*. Washington DC.
- Iorio, A. D., & Faff, R. (1999). An analysis of asymmetry in foreign currency exposure of the Australian equities market. *School of Economics and Finance*.
- Iqbal, J. (2012). The stock market in Pakistan: An overview. *Journal of Emerging Market Finance*, 11-61.
- Kanas, A. (2000). Volatility spillover between stock returns and exchange rate changes: International evidence. *Journal of Business Finance and Accounting*, 447-467.
- Karachi Stock Exchange. (2013, October 10). *Karachi Stock Exchange*. Retrieved from Karachi Stock Exchange: www.kse.com.pk
- Kashefi, J. (2006). The effect of the Euro on European equity markets and international diversification. *Journal of International Business Research*, 1-21.
- Khalid, A. M., & Rajaguru, G. (2006). Financial market integration in Pakistan evidence using post-1999 data. *The Pakistan Development Review*, 1041-1053.
- Khalil, M. Z., Usman, M., & Shafique, I. (2013). Volatility spillover between the stock market and the foreign exchange market in Pakistan. *Academy of Business and Scientific Research*, 695-704.
- Koutmos, G., & Booth, G. G. (1995). Asymmetric volatility transmission in the international stock market. *Journal of Money and International Finance*, 747-762.
- Kumar, M. (2009). A bivariate linear and nonlinear causality between stock prices and exchange rates. *Economics Bulletin*, 29(4), 2884-2895.
- Kumar, M. (2013). Returns and volatility spillover between stock prices and exchange rate: Empirical evidence from IBSA countries. *International Journal of Emerging Markets*, 108-128.
- Lee, C.-H., Doong, S.-C., & Chou, P.-I. (2011). Dynamic correlation between stock prices and exchange rates. *Applied Financial Economics*, 789-800.
- Lee, J. (2010). Currency risk and volatility spillover in emerging foreign exchange markets. *International Research Journal of Finance and Economics*, 37-45.
- Li, Y., & Huang, L. (2009). On the relationship between stock return and exchange rate: Evidence from China.
- Mishra, A., Swain, M., & Malhotra, B. (2007). Volatility spillover between stock and foreign exchange markets: Indian evidence. *International Journal of Business*.
- Morales, L. (2007). International transmission effects of volatility between financial in the G-7 since the introduction of the Euro. *Conference on International Finance*.
- Morales, L. (2008). Volatility spillovers between equity and currency markets: Evidence from major Latin American countries. *Cuadernos de Economia*, 185-215.
- Mun, K.-C. (2008). Effects of exchange rate fluctuations on equity market volatility and correlations: Evidence from the Asian financial crises. *Quarterly Journal of Finance and Accounting*, 77-102.
- Mustafa, K., & Nishat, M. (2008). Exchange rate and equity prices relationship: An empirical evidence from Pakistani financial markets. *Savings and Development*, 32(2), 127-140.
- Naeem, M., & Rasheed, A. (2002). Stock prices and exchange rates: Are they related? Evidence from South Asian countries. *The Pakistan Development Review*, 535-550.
- Nieh, C., & Lee, C. (2001). The dynamic relationship between stock prices and exchange rate for G-7 countries. *Quarterly Review of Economics and Finance*, 477-490.
- Noman, A. M., Kabir, S. H., & Bashar, O. K. (2012). Causality between stock and foreign exchange market of Bangladesh. *Studies and Economics and Finance*, 174-186.
- Qayyum, A., & Kemal, A. (2006). Volatility spillover between the stock market and the foreign exchange market in Pakistan. *PIDE Working Papers*.
- Raghavan, M., & Dark, J. (2008). Return and volatility spillover between the foreign exchange market and Australian all ordinary index. *Journal of Applied Finance*, 14, 41-48.
- Rehman, M. L., & Uddin, J. (2009). The dynamic relationship between stock prices and exchange rates: Evidence from three SouthAsian countries. *International Business Research*, 2.
- Roll, R. (1992). Industrial structure and the comparative behavior of international stock market indices. *Journal of Finance*, 3-41.
- Saha, S., & Chakrabarti, G. (2011). Financial crises and financial market volatility spillover. *The International Journal of Applied Economics and Finance*, 185-199.
- Solnik, B. (1987). Using financial prices to test exchange rate models-A note. *Journal of Finance*, 71-76.
- Standard & Poors. (2004). *Global stock market factbook*. New York.
- Standard & Poors. (2007). *Global stock market factbook*. New York.
- State Bank of Pakistan. (2011). *Financial markets review*.
- Stavarek, D. (2005). Stock prices and exchange rates in the EU and the USA: Evidence on their mutual interactions. *Czech Journal of Economics and Finance*, 141-161.
- Uppal, J. (1998). Stock return volatility in an emerging stock market: A case study of Karachi stock exchange. *Managerial Finance*.

- Wai-Choi Lee. (2012). A study of the causal relationship between the real exchange rate of renminbi and Hong Kong stock market index. *Modern Economy*, 563-566.
- Wei, C. (2009). Using the component GARCH modeling and forecasting method to determine the effect unexpected exchange rate mean and volatility spillover on the stock market. *International Research Journal of Finance and Economics*, 63-76.
- Yang, S., & Doong, S. (2004). Price and volatility spillover between stock price and exchange rates: Evidence from the G-7 countries. *International Journal of Business and Economics*, 139-153.
- Yau, H.-Y., & Nieh, C.-C. (2006). Interrelationship among stock prices of Taiwan and Japan and NTD/Yen exchange rate. *Journal of Asian Economics*, 17, 535-552.
- Zhao, H. (2009). The dynamic relationship between exchange rate and stock prices: Evidence from China. *Research In International Business and Finance*, 103-112.
- Zia, Q. Z., & Rahman, Z. (2011). The causality between the stock market and foreign exchange market of Pakistan. *Interdisciplinary Journal of Contemporary Research In Business*.