Volatility Spillover Between Foreign Exchange Market and Stock Market in Bangladesh

Shibli Rubayat[1(✉)] and Mohammad Tareq[2]

[1] Faculty of Business Studies, University of Dhaka, Dhaka 1000, Bangladesh
shibli@du.ac.bd

[2] Department of Accounting and Information Systems, University of Dhaka, Dhaka 1000, Bangladesh

Abstract. This paper investigates the link between foreign exchange market and stock market in Bangladesh through volatility spillover between the markets. It also examines the volatility persistence and asymmetric effect of information on the volatility of these two financial markets. Using data from January 1, 2009 to December 12, 2016 Taka/USD exchange rate's volatility and the stock return's volatility of CSE General Index this paper utilizes ARCH and GARCH models to investigate the spillover, persistence and asymmetry effect of volatility. The results reveal high level of presence of volatility of CSE General Index but not of the Taka/USD exchange rate. The result also finds asymmetric effect of information i.e. bad news is followed by higher volatility compared to that of after good news in the stock market. However, the result shows that volatility in the CSE General Index spillover that of the Taka/USD exchange rate but not vice versa. The meaning and significance of the study is also presented in the paper.

Keywords: Foreign exchange market · Stock market · Volatility · Spillover · Taka/USD (The local and United States Currency)

1 Background of the Study

Foreign exchange market and capital market are linked in many countries and show inter-dependence [1,7,11]. Among others, volatility of these markets links each other and spillover from one market to another. The volatility is a key factor that causes risk in these markets and thus influences economic activities in a country. Volatility information of these markets is used for risk management, portfolio allocation and stock trading strategies [12].

Bangladesh, a south Asian country struggling for poverty reduction and economic development, has a smaller and less equipped capital market than its neighboring countries [10]. A developed capital market can aid a country's economic development by turning savings into investment. Researchers have consistently found a positive relationship between a developed stock market with economic growth and capital accumulation [8,9]. As mentioned above, knowledge

J. Xu et al. (eds.), *Proceedings of the Eleventh International Conference on Management Science and Engineering Management*, Lecture Notes on Multidisciplinary Industrial Engineering, DOI 10.1007/978-3-319-59280-0_116

about the volatility help investors in their risk management, portfolio allocation and stock trading strategies and is considered one of the ways of developing a capital market. However, there is no notable study in Bangladesh that has investigated the volatility of these financial markets, especially how these two markets are linked through volatility.

The contribution of the research lies in the fact that no notable study has been done so far that investigates the link between the volatility of the capital market and foreign exchange markets in Bangladesh. It is hoped that this study will inform policy-making decisions in relating to these two market and help investors in making investment decision.

1.1 Methodology

The study uses CSE General Index of Chittagong Stock Exchange (the 2^{nd} largest in the port city) from January 1, 2009 to December 1, 2016. The official exchange rate of Taka/USD of the same period was also used. These data were collected from Chittagong Stock Exchange and from the central bank of Bangladesh, 'Bangladesh Bank' respectively. The Taka/USD exchange rates and the CSE General Index for the sample period are shown in Figs. 1 and 2 respectively.

The return of the stock market was calculated as follows:

$$R_t = \ln\left(P_t/P_{t-1}\right) \times 100.$$

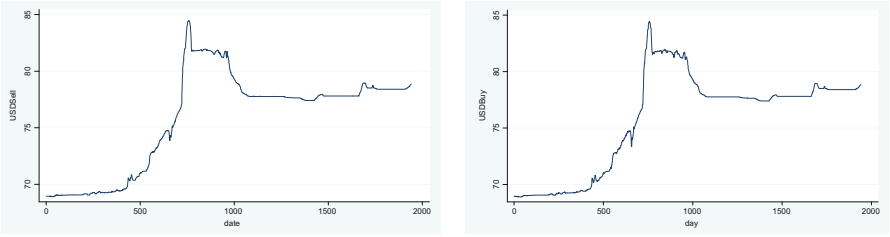

Fig. 1. Taka/USD exchange rate (From January 1 2009 to December 12, 2016)

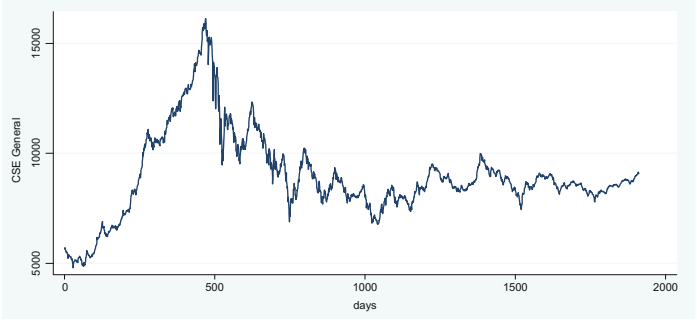

Fig. 2. CSE General (From January 1, 2009 to December 12, 2016)

Daily spread between buy and sell rate of Taka/USD was used to measure return on Taka/USD exchange rate. The Taka/USD exchange rates return and the CSE General Index daily return is for the sample period are shown in Figs. 3 and 4 respectively.

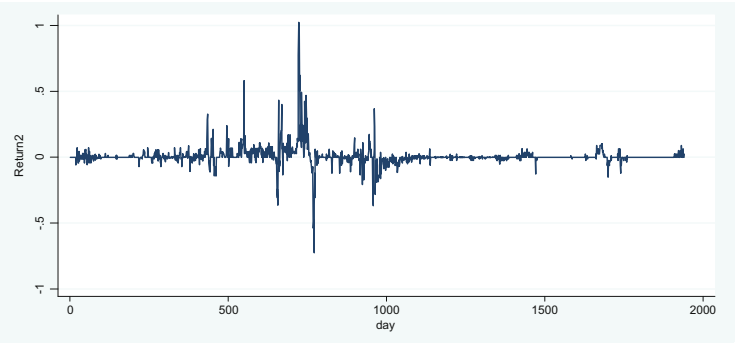

Fig. 3. USD/Taka exchange rate return (Dec 12, 16 to Jan 1 2009)

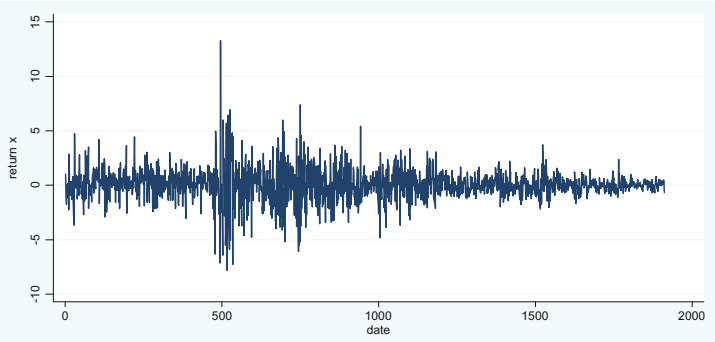

Fig. 4. CSE General Index stock return (Dec 12, 16 to Jan 1 2009)

To analyze volatility, asymmetric volatility and spillover effect, different variation of the Generalized Auto Regressive Conditional Heteroskedasticity (GARCH) were used in this study. Maximum Likelihood estimation method was used to estimate the parameters of the GARCH models of this study. Augmented Dickey–Fuller (ADF) unit root tests for the CSE General Index return and Taka/USD exchange rate return series were done and the results reject the hypothesis of unit root. GARCH is a model for time-series where volatility is clustered together. The autoregressive term in a GARCH model takes into account past values on the time-series. Heteroskedasticity means that data contains non-constant variance, which by running a standard OLS would result in erroneous

standard errors and confidence intervals. GARCH models corrects these treat heteroskedasticity as a variance inside the model.

The ARCH model was the forerunner to the GARCH specifications. Before this, volatility used to be measured using rolling standard deviations over past time periods. However, the problem with this approach is that each time period receives equal weight in the estimation of the current period's variance. The ARCH process, proposed by Engle [5], solves this by letting these weights be parameters to be estimated. This allows the data to determine the best weight to be used on the present volatility [6]. An ARCH model is presented below:

$$r = \pi + \varepsilon_t,$$
$$\sigma_t^2 = c + \sum_{i}^{q} \alpha_i \varepsilon_{t-i}^2,$$

where $\varepsilon_t = \sigma_t z_t$; z_t is an i.i.d random variable with mean zero and variance one and σ^2 is the squared conditional variance in the model.

So the conditional variance is here described as a distributed lag of past squared innovation [3]. That means that the variance of the current error term is a function of the size of the previous period's squared error term. In order to avoid a very large number of coefficient in high order polynomial, Bollerslev [2] developed the GARCH-model as a generalization of Engle's [5] ARCH-model. This makes a declining weight that never reaches zero [6]. GARCH $(1, 1)$ is the most common model to use in empirical research. A GARCH $(1, 1)$ model is presented below:

$$r = \pi + \varepsilon_t,$$
$$\sigma_t^2 = c + \alpha \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2,$$

where, $\varepsilon_t = \sigma_t z_t$; z_t is an i.i.d random variable with mean zero.

2 Persistence and Asymmetry of Volatility

The study utilize a GARCH $(1, 1)$ model for the CSE General Index return and Taka/USD exchange rate return. The result shows that the "$\alpha + \beta$" estimated from the CSE General Index is about .99. This means that volatility is highly persistent for the CSE General Index. It means that if there is volatility in the CSE stock market it decays slowly over a long period of time. However the study did not find the persistence of volatility in the Taka/USD rate (See Table 1).

In the world of financial market the reality is that negative news often has much bigger impact on volatility than good news has on relaxing these fluctuations i.e. negative shocks at time $t - 1$ have a stronger impact on the variance at time t than positive shocks. The GARCH model is symmetrical, negative and positive shocks are given equal weight. The study also investigated the asymmetry effect of positive news and negative news on the market volatility using EGARCH-model. Result of the asymmetric GARCH shows that bad news causes

Table 1. Persistence and asymmetry of CSE General Index and Taka/USD exchange rate

	CSE General Index	CSE General Index	Taka/USD exchange rate
Con	.005*(.027)	.005*(.027)	0.00**(00)
α	.16***(.014)	.16***(.014)	1.23(1.15)
β	.83***(.011)	.83***(.011)	.34***(.03)
γ (asymmetric term)	-	−.02*(.011)	−.6(1.16)
n	1911	1911	1940

*$p < .05$; **$p < .01$; ***$p < .001$

higher volatility ($\gamma = -0.02^*$).compared to good news in the stock markets in Bangladesh (See Table 1).

Past studies have shown that volatility in one market can affect other markets [4,11]. The study also investigates whether the volatility crated in stock market spills over the other and vice versa. To study this, MGARCH is used. The result shows that volatility in the CSE General Index spillover that of the USD/Taka exchange rate but not vice versa. Table 2 shows the spillover effect of CSE General Index on the Taka/USD exchange rate market.

Table 2. Spillover effect of stock market on foreign exchange market

	CSE General Index	Taka/USD exchange rate
Volatility Taka/USD	−.02(.40)	-
Volatility CSE General Index	-	.0007***(.0002)
N	1911	1940

*$p < .05$; **$p < .01$; ***$p < .001$

3 Conclusion

This study investigates and analyses the link between the stock market and foreign currency (ForEx) market of Bangladesh. The study was done to get insight about on the volatility and its spillover effect between the stock and the foreign exchange markets, and consequently the degree of their integration to expand the information set available to international portfolio managers, multinational corporations and policymakers for decision-making and policy formulation.

It was found that the persistence of volatility in stock market in Bangladesh is very high which indicates that volatility clusters in stock market and decays slowly. This study is similar to studies to Wu [11] and Jebran and Iqbal [7]. However, the study found low persistence in Taka/USD currency market. The study also found that there is asymmetry in the volatility of in the stock market i.e. negative news causes higher volatility compared to good news in the market. The result shows that volatility in the CSE General Index spillover that of the Taka/USD exchange rate but not the opposite.

References

1. Bala DA, Asemota JO (2013) Exchange-rates volatility in Nigeria: application of garch models with exogenous break. J Appl Stat 4(1):89–116
2. Bollerslev T (1986) Generalised autoregressive conditional heteroskedasticity. Econometrica 31(302):2–27
3. Campbell JY, Lo AW et al (1997) The econometrics of financial market. Princeton University Press, Princeton
4. Cheung YW (2001) Equity price dynamics before and after the introduction of the euro: a note. Multinational Financ J 5(2):113–128
5. Engle RF (1982) Autoregressive conditional heteroscedasticity with estimates of the variance of United Kingdom inflation. Econometrica 50(4):987–1007
6. Engle RF, Patton AJ (2001) What good is a volatility model? Quant Financ 1(2):237–245
7. Jebran K, Iqbal A (2016) Dynamics of volatility spillover between stock market and foreign exchange market: evidence from Asian countries. Financ Innov 2(1):1–20
8. Levine R (1999) Financial development and economic growth: views and agenda. J Econ Lit 35(2):688–726
9. Levine R, Zervos S (1996) Stock markets, banks, and economic growth. Am Econ Rev 88(3):537–558
10. Siddiqui J (2010) Development of corporate governance regulations: the case of an emerging economy. J Bus Ethics 91(2):253–274
11. Wu RS (2005) International transmission effect of volatility between the financial markets during the Asian Financial Crisis. Transition Stud Rev 12(1):19–35
12. Zivot E (2009) Practical issues in the analysis of univariate GARCH models. Springer, Heidelberg