

Impact of Foreign Exchange Reserve, Exchange Rate and Crude Oil Price on Dhaka Stock Exchange Index: An Empirical Evidence from Vector Error Correction Model

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Abstract

The supreme thrust of the present analysis is to explore the influences of foreign exchange reserve, exchange rate, and crude oil price on the stock index of the Dhaka stock exchange (DSE) of Bangladesh. Moreover, this study evaluates the identity of any unpremeditated relationship among the variables from the viewpoint of an emerging country like Bangladesh. Through using monthly time-series data, this study tries to discover the evidence of a long-run affiliation among the variables by using Johansen's Cointegration test and Vector Error Correction Model (VECM). Besides, the Granger Causality technique is introduced to examine the casualty among variables where the empirical results show a causal linkage between the Dhaka stock exchange index, foreign exchange reserve, and exchange rate, moving only in one way from Dhaka stock exchange index to foreign exchange reserve and exchange rate. In contrast, no causal link was identified between Dhaka stock exchange indexes and crude oil prices. Lastly, Impulse Response Function suggests a permanent effect of all selected macroeconomic factors on the Dhaka stock exchange index in the long run and Variance Decomposition Analysis settles that, the reform in Dhaka stock exchange index can be caused by the innovation in foreign exchange reserve, exchange rate, and crude oil price.

Keywords: Crude Oil Price, DSE Index, Exchange Rate, Foreign Exchange Reserve, VECM.

I. Introduction

Stock market indices are useful overall scores that show a clear historical record of market prices and thus allow investors, advisors, and the public to measure what the present state of stock price trend happens to be. It is also noticeable that company stock price may not always in the identical path as per the market index, rather it can be opposite to the trend. Indices are subject to fluctuation, so it is of great importance to determine the factors that play an imminent role in deciding the trend (Khan & Yousuf, 2013). Among some significant macroeconomic factors that affect market index, this paper cautiously picked up foreign exchange reserve, exchange rate, and crude oil price as the explanatory variables and explored the relationship pattern among them.

In general, one country differs from another in different points of view, such as its population, geography, level of education, development status. It is expected that Bangladesh will be a developing country from the least developed country (LDC) in 2024, where three indicators require proper positioning of gross national income, index of the human asset, and economic vulnerability. For Bangladesh, it is a difficult challenge, and the most pressing need to meet this challenge is to achieve economic viability. In this case, the foreign exchange reserve can play a significant character in maintaining the confidence of a country's economic market. However, nowadays, it is a debating issue whether excess foreign exchange reserve is good for the economy of any country or creates some opportunity and social costs for the country (Mezui & Duru, 2013).

The exchange rate is another problematic issue that often leaves policymakers in a dilemma. No country in the world is self-sufficient; therefore, one country has to rely on another for making both import and export, which requires the

exchange of currencies. Indeed, the increase of the exchange rate (devaluation of the currency) discourages the importer, just as it encourages the exporter and vice versa. Therefore, different countries decrease or increase their exchange rate according to their different policies, which in sequence influences the capital market in different ways through the production and sale of the products.

Without energy, the whole world is untouchable, and hence every country has to rely on crude oil for irrigation in agriculture and production in the industrial sector. Not all the countries in the world have oil reserves, and for this reason, many countries have to manage their production depending on the oil imported from other countries. The real situation of the stock market of countries in which countries conduct agricultural operations and industrial activities with imported oils is generally different from those countries which do not need to import oil.

Previously, numerous macroeconomic variables were used by many researchers to unveil the connection of these variables with the stock returns in different stock exchanges of different countries, including the Dhaka stock exchange (DSE) of Bangladesh. The impact of these variables is not same always due to the different contexts and nature of the market (Chauque & Rayappan, 2018). Several theories are applied to explore the intensity of the linkage among the variables. The time frame was also an essential factor to be considered as the researchers pondered different time range to conduct their study. However, authors of this paper are highly persuaded to inspect the influence of foreign exchange reserve, exchange rate, and crude oil price on the stock index and also inspect the cointegration among the variables in the context of DSE, Bangladesh. Although many other scholars have already explored the influence of the chosen variables in different stock markets (Hasan, 2018; Kibria *et al.*, 2014; Zaidi, Ahmed, & Siok, 2017) the nature and context of Dhaka Stock Exchange (DSE) vary from their observed markets which is the ultimate motivation of the authors in conducting this study.

This study aims to know whether the foreign exchange reserve, exchange rate, and the crude oil price have a long-term consequence on DSE index. The status of a causal linkage between the variables is another exploratory question that leads to determining the aim of the paper. Another query that comes to the authors' investigative mind is that, if the background of the stock market changes, then what will be the difference in the result comparing to the past literature?

The researchers, therefore, find interest in re-examining the long-run influence of foreign exchange reserve, exchange rate and crude oil price on the stock index in a different setting by exerting Johansen's Cointegration test and VECM. Besides, the paper observes the presence of any causal affiliation among the dependent and explanatory variables via the Granger Causality approach.

This study has some practical implications in the real field and is equally essential for students, academicians, and policymakers of government. The adverse effects of foreign exchange reserve and crude oil prices are shown here with the finger-pointing. In short, the results of the study can help one to easily perceive how an importer and exporter can be benefited or suffered due to adverse fluctuations in the exchange rate.

2. Literature Review

2.1 Foreign Exchange Reserve and Stock Index

Foreign exchange reserve includes the deposits of foreign currency and bonds. However, in the broader sense, it is a country's holdings of gold, SDR, and reserve of IMF for meeting its short to medium term international financial liabilities (Maheshwari, Upamannyu, Bhakuni, & Saban, 2013). Generally, this reserve is used to settle the payment of imported goods and services and repayment of international loans taken by individuals and government. Moreover, multinational companies send their royalty and profit to their parent firms in international currencies. The importer can easily open L/C with a minimum cost because the foreign exporters consider the importing country less risky and are assured of receiving their money in time. It stimulates the stock index of the importing nation as it can import raw materials and capital goods for its production, which increases the firm's profit by selling produced goods and thereby flourishing stock index.

There is a maxim, "nothing excess is good." Though adequate reserve is considered blessings for any country, the excess reserve also has some adverse effects. If an import-oriented country can repay its import payment for the next three months, it is expected that the country has a standard reserve. The most troublesome negative impact of the excess reserve is the opportunity cost (Mezui & Duru, 2013). The central bank has to hold reserve either in direct currency or in extremely liquid financial assets that can be converted into cash with a little cost.

Furthermore, direct currency does not earn any interest, and the extremely liquid financial asset earns low yield. If the excess reserve were possible to invest in another productive sector, it would profit more, and the economy would be more flourished. Besides, the excess reserve is shaped when import payment is decreased continuously due to the decline in the import of raw materials and machinery used in the local industry.

2.2 Exchange Rate and Stock Index

The interrelation between exchange rate and stock performance has long continued a topic of debate. Several scholars consider the exchange rate as a double-edged blade as it converts one currency into another and displays an incongruous effect at the same time. There are two popular theories of the exchange rate, namely the flow-oriented and stock-oriented models (Fauziah, Moeljadi, & Ratnawati, 2015). Flow oriented theory (Dornbusch & Fischer, 1980) postulates that the exchange rate influences the nature of competitiveness of a business in international markets by affecting the rate of interest, profit, production, and mostly on the worth of the share of the respective firm. The influence of the movement of the exchange rate is different from the organization, which is operated in the international market from that of the local market. If the firm is export-oriented, an upsurge in the exchange rate (devaluation of local currency) will appreciate the exporter, and higher growth in export will

lead to higher profit and, ultimately, the share price will increase. Khan, Khan, Ahmad, and Bashir (2018) studied the monthly stock price data of 15 firms of Pakistan from the period of 2008 to 2012, and they confirmed a positive influence of the exchange rate on stock yields through using the OLS regression model.

Similar findings were shown by Khalid and Khan (2017) who found a positive impact of the exchange rate by analyzing time series data from 1991 to 2017 in Pakistan. However, it will create a burden for import dominated industry by increasing the cost of imported raw material and thereby increasing the cost of production. It decreases the earnings of the firm, which also makes a decline in the stock price. Ndlovu, Faisal, Resatoglu, and Türsoy (2018) inspected the affiliation between stock yield and macroeconomic indicators in the context of South Africa from 1981 to 2016 by using a vector error correction model. They concluded that the exchange rate possesses a negative impact on share values. A downturn in the exchange rate (encouragement of local currency) will encourage importer, and thus the cost of production will be lower. It will create a high demand for domestic products, and the firm will earn more profit, which results in an upsurge in the share price. However, this arrangement will hamper the earnings of export-oriented firm and thus decreases the price of stocks.

Stock oriented theory (Frankel, 1993) states that there is a high capital inflow if the stock return is increased. Investor's insight into the capital market is very much crucial for the fluctuation of the stock price. If the price of the stock is increased, it will make a positive perception about the domestic stock market, and individuals will tend to invest in the local market by selling their foreign stocks and thus there will be a high demand for the local currency which will decrease the exchange rate by appreciating the worth of the domestic currency.

2.3 Crude Oil Price and Stock Index

Changes in the international oil price are measured as a vital issue for analyzing the change of the stock market index (Giri & Joshi, 2017). The influence of crude oil prices on the stock index is mixed that depends on the ground that whether the state is an oil-exporting or importing one. If the nation is an exporting one, a rise in oil price will upsurge cash inflow, and thereby the earnings of the company will be expanded, which will be reflected in the stock index. Consequently, income from exporting oil will increase public expenditure and create new investment opportunities. As per the findings of many researchers, the oil price possess a positive reaction on the stock index (Shafi, Hua, Idrees, & Nazeer, 2015). The effect of the crude oil price was also found positive in China (Hosseini, Ahmad, & Lai, 2011).

On the contrary, some others suggested that in the oil-importing state, there is an inverse relationship. The country whose production activities largely depend on imported oil, an upsurge in oil price, makes a significant contraction in its economic progress and decreases the stock index (Khan & Yousuf, 2013). Extensive shipping and production costs may lower the demand for the produced goods and lower the company profits, which can disincline the investor to purchase the share of the particular firm, and consequently, the stock index decreases (Miller & Ratti, 2009). Similar findings were reported in the stock exchange study, showing an adverse outcome of the oil price on stock return covering the year 1979 to 2014 (Giri & Joshi, 2017).

3. Methodology

3.1 Characterization of Data

This study has been conducted adopting monthly historical data ranged from July 2008 to October 2019. The index of Dhaka Stock Exchange is extracted from the authorized database of the company and the other two macroeconomic variables out of three, e.g., foreign exchange reserve and exchange rate were collected from the monthly publications (Monthly Economic Trends) of the central bank of Bangladesh (Bangladesh Bank, 2019). The data of the latter variable (crude oil price) was taken from the IFM's primary commodity prices (International Monetary Fund, 2019). For handling extreme values, all the variables have been converted into their natural log procedure and ensured the steadiness of the variables. However, the variables are symbolized by LOGDSEI (natural log of all share price index of Dhaka Stock Exchange), LOGFER (natural log value of foreign exchange reserve), LOGER (natural log of the exchange rate of BDT for US dollar), and LOGCOP (natural log of per barrel crude oil price in US dollar).

3.2 Conceptual Outline

This review emphasizes on the estimation of any long-run affiliation between the index of DSE and particular macroeconomic factors as well as defining the causal relationship among them. For fulfilling the objectives, the econometric model (1) was used:

$$LOGDSEI_t = \beta_0 + \beta_1 LOGFER_t + \beta_2 LOGER_t + \beta_3 LOGCOP_t + \varepsilon_t \quad (1)$$

Here, the variables have already been defined. ε_t indicates error terms. β_0 is constant, and β_1 , β_2 , and β_3 signify long term parameters.

At first, unit root methods were carried to confirm if the data is stationary. The regression outcomes will not be valid unless the time series data is stationary. There are several methods for testing the stationarity of the data, and each of these has been using widely in the modern econometric arena. However, this study used both Augmented Dickey-Fuller (ADF) (Dickey & Fuller, 1981) and Phillips-Peron (PP) (Phillips & Perron, 1988) unit root methods to verify the stationarity of the data and to cross-check the results. After that, the optimum number of lags was selected for conducting Johansen's Cointegration test, and VECM as those determine whether there is any long-run linkage between the index of Dhaka stock exchange and foreign exchange reserve, exchange rate, and crude oil price.

Maximum likelihood process is applied for examining the existence of a cointegrating vector for non-stationary time series data (Johansen & Juselius, 1990). However, the Johansen-Juselius technique is indirectly implemented in Vector Auto-regression to assess the integrating association (Masuduzzaman, 2013) which is based on the equation (2):

$$\mathbf{z}_t = \mathbf{A}_1 \mathbf{z}_{t-1} + \mathbf{A}_2 \mathbf{z}_{t-2} + \dots + \mathbf{A}_p \mathbf{z}_{t-p} + \boldsymbol{\varepsilon}_t \quad (2)$$

Where, \mathbf{z}_t is a "n" vector of $I(1)$ variables, $\boldsymbol{\varepsilon}_t$ is an innovation vector. However, VAR can be rewritten as follows:

$$\Delta \mathbf{z}_t = \Pi \mathbf{z}_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta \mathbf{z}_{t-i} + \boldsymbol{\varepsilon}_t$$

Where,

$$\Pi = \sum_{i=1}^p A_i - I \quad \text{and} \quad \Gamma_i = - \sum_{j=i+1}^p A_j$$

Here, Π matrix discloses disequilibrium adjustment and Γ matrix indicates an adjustment of short-run dynamic. Johansen & Juselius (1990) propose two tests to check hypothesis viz.

$$\text{Trace Test} = \lambda_{\text{trace}} = -T \sum_{j=r+1}^k \ln(1 - \hat{\lambda}_j)$$

$$\text{Maximum Eigen Value Test} = \lambda_{\text{max}} = -T \ln(1 - \hat{\lambda}_{r+1})$$

Where, T= Size of sample and $\hat{\lambda}_j$ = Eigenvalues.

Equation (3) shows the estimation of VECM with Dhaka stock exchange index as the target variable:

$$\Delta \log DSEI_t = \alpha_0 + \alpha_{1t} \sum_{i=1}^p \Delta \log DSEI_{t-i} + \alpha_{2t} \sum_{i=1}^p \Delta \log FER_{t-i} + \alpha_{3t} \sum_{i=1}^p \Delta \log ER_{t-i} + \alpha_{4t} \sum_{i=1}^p \log COP_{t-i} + \delta_1 ECT_{t-1} + \mu_{1t} \quad (3)$$

Where, α_1 to α_4 denote elasticity of the short run, ECT_{t-1} depicts error correction term, and δ_1 is the coefficient of ECT which depicts the swiftness of modification in the equilibrium if there is any shock in the system.

However, the Cointegration test only estimates whether the variables are correlated or not, but it does not specify any information about the path of their causality (Hossain, Hossain, & Sadi, 2013). Granger causality test identifies whether the historical values of one variable significantly affect in determining the forthcoming value of another variable. This study tries to inspect whether the selected macroeconomic factors help predict the fluctuation of the DSE index. Besides, it attempts to inspect whether the selected macroeconomic variables are affected by the fluctuations of the DSE index. Finally, impulse response function and variance decomposition analysis were applied to reveal some insights about the variables. For validating the selected model and ensuring its accuracy, this study applies heteroskedasticity and autocorrelation test.

4. Results and Arguments

The outcomes of the unit root method set out in table I demonstrate that both in the ADF and PP unit root test, all the variables are non-stationary at the level. However, the variables are stationary at first difference both in ADF and PP unit root method, indicating the refutation of the null hypothesis that evidenced the nonexistence of unit root issue in variables at $I(1)$.

Table I. Results of Unit Root Test

Variables	From	ADF		PP	
		C	CT	C	CT
		t-stat	t-stat	t-stat	t-stat
LOGDSEI	I (0)	-2.4214	-2.1311	-2.4297	-2.1436
	I (1)	-11.4345***	-11.4997***	-11.4345***	-11.4997***
LOGFER	I (0)	-2.0635	-2.2474	-1.7199	-1.4113
	I (1)	-3.4092**	-3.8031**	-16.9305***	-17.0957***
LOGER	I (0)	-1.2528	-1.8446	-1.1579	-1.6675

	I (1)	-7.3832***	-7.3678***	-7.3351***	-7.3188***
LOGCOP	I (0)	-2.3052	-2.4450	-2.3404	-2.3415
	I (1)	-7.7746***	-7.7378***	-7.4110***	-7.3694***

Note: *** and ** represent 1% and 5% level of significant respectively, C and CT refer to constant and constant plus trend respectively.

Source: Researchers' calculation

Table 2 exhibits the outcomes of lag selection norms where the FPE and AIC recommend lag 3 as optimum; however, SC and HQ signpost lag 2 as optimum. Moreover, the sequential modified LR test statistic indicates 10 as the optimum number of lags. This study adopted the AIC for selecting the optimum number of lag and used lag 3 as optimum lag for further studies.

Table 2. Choosing of Lags

Lag	LogL	LR	FPE	AIC	SC	HQ
0	585.5250	NA	1.15e-09	-9.230556	-9.140515	-9.193975
1	1416.823	1596.620	2.76e-15	-22.17179	-21.72159	-21.98889
2	1492.146	139.8859	1.08e-15	-23.11343	-22.30306*	-22.78420*
3	1515.961	42.71574	9.54e-16*	-23.23748*	-22.06695	-22.76193
4	1527.525	20.00750	1.03e-15	-23.16706	-21.63637	-22.54519
5	1536.454	14.88128	1.16e-15	-23.05482	-21.16397	-22.28663
6	1554.249	28.52830	1.13e-15	-23.08331	-20.83230	-22.16879
7	1563.920	14.89060	1.27e-15	-22.98286	-20.37168	-21.92201
8	1582.394	27.27064	1.24e-15	-23.02212	-20.05078	-21.81496
9	1606.342	33.83190	1.12e-15	-23.14829	-19.81678	-21.79480
10	1627.403	28.41507*	1.06e-15	-23.22861	-19.53694	-21.72880

Note: * designates lag order selected by the criterion.

Source: Researchers' calculation

The evaluations of the Johansen Cointegrating approach are depicted in table 3 to check the long-run connection of the variables. This test is much responsive to slight changes to the lag length, so this study uses one lag less than the optimum lag length selected by the information criteria.

Table 3. Results of the Johansen Cointegrating Test

CE(s)	Trace Statistics (λ_{trace})	5% Critical Value	Max Eigen Statistic (λ_{max})	5% Critical Value
$r=0^*$	62.46252	47.85613	34.52087	27.58434
$r \leq 1$	27.94165	29.79707	14.86852	21.13162
$r \leq 2$	13.07313	15.49471	9.420578	14.26460
$r \leq 3$	3.652552	3.841466	3.652552	3.841466

Note: r denotes the number of cointegrating linkages, CE(s) indicates cointegrating equations and * signifies refusal of the hypothesis at the 0.05 level.

Source: Researchers' calculation

The result identifies that the null hypothesis (no cointegration between variables) cannot be accepted up to the level of zero both in trace statistics and max Eigen statistics at a 5% level of significance. It infers at least one cointegrating equation that exists between the index of the DSE and other selected macroeconomic factors.

Table 4 shows the coefficient of the long-run model with t statistics.

Table 4. Long-Run Model

Exploratory Variables	Coef.	Std. Err.	t-stat
Constant	-5.925886	-	-
Foreign Exchange Reserve (LOGFER)	-0.439875	0.10268	-4.28395***
Exchange Rate (LOGER)	2.688054	0.78237	3.43576***
Crude Oil Price (LOGCOP)	-0.514410	0.10774	-4.77445***

Note: ***, ** and * represent 1%, 5% and 10% level of significant respectively.

Source: Researchers' calculation

Based on cointegrating outcomes, this study derives the following long-run relationship among variables:

$$LOGDSEI = -0.439875LOGFER + 2.688054LOGER - 0.514410LOGCOP - 5.925886$$

Foreign exchange reserve is identified to have a significantly negative ($p < 0.01$) relationship with the Dhaka stock exchange index. This result is coherent with the theory of opportunity and social cost (Mezui & Duru, 2013) which postulates the negative impact of the excess reserve on the economy of a country. Bangladesh is an agrarian country, and till 31st October 2019, it has a total reserve of 32437.7 million U.S dollar (Bangladesh Bank, 2019) and by using this, it can meet its up to seven months import payment which is four months extra than usual. Nevertheless, Bangladesh Bank does not invest those excess reserves in any productive sector; thus, the opportunity cost is swelling day by day. Generally, most of the foreign currency of Bangladesh comes from remittance, and most of this through whom is earned is the working class. The local beneficiary uses that remittance in different unproductive sectors, e.g., building the house, purchasing land, flat and consumer goods. As a result, this excess reserve is not using for productive purposes and thus creating opportunity cost. Due to lower import payment, the excess reserve is increasing, which is not good news for the economy of Bangladesh, thus reducing the country's production and enfeebling the stock market simultaneously. However, these findings are conflicting with (Abakah & Abakah, 2016; Akinlo, 2015; Hasan, 2018; Ray, 2012) where they concentrated only on reserve and did not pay attention to excess reserve and recognized that foreign exchange reserve has a noteworthy positive influence on stock index.

The Exchange rate occupies a positive and significant ($p < 0.01$) association with the index of the Dhaka stock exchange, which supports the flow-oriented theory of Dornbusch and Fischer (1980). Currently, an upsurge in the exchange rate of Bangladeshi taka (devaluing the money) in contradiction of the U.S. dollar encourages native exporters; thus, an expansion of export upsurges company's profit. Higher profit hints to an increase in the value of a firm and thereby increase the stock index. This finding is consistent with (Giri & Joshi, 2017; Keat, Ling, Yi, & Yee, 2017; Kibria *et al.*, 2014). However, an opposite outcome is identified by (Ali, 2013; Chauque & Rayappan, 2018; Hsing, 2014; Khan & Khan, 2018; Khan & Yousuf, 2013) who elucidate that increase of exchange rate (currency devaluation) forces the import dominated industry to raise the price of the products. This action negatively influences the cash inflow and thereby decreases the firm's profit, which negatively impacts the stock index. Besides, the stock oriented theory of Frankel (1993) states that if some stocks give a high return, investors tend to purchase those stocks by selling foreign stock, which also appreciates local currency, and thus exchange rate demonstrates a negative relationship with stock index.

The result ascertains a significant long-run negative association ($p < 0.01$) between Dhaka stock exchange and crude oil price. This finding is certainly consistent with (Dhaoui & Kheraief, 2014; Giri & Joshi, 2017; Kamande, 2015) where it has been concluded that oil-importing country faces high importing cost due to raises of crude oil price. As Bangladesh is an oil-importing country, the increased price of crude oil in the global market puts pressure on the country's economy. If the price of crude oil in the international market rises, the losses in the domestic market increases. The price has to be adjusted in the local market, which has a negative impact on all types of products. Besides, crude oil is used not only in transportation, agriculture, and production of goods as factory fuel but also in electricity generation. It may lead to upsurges in the price of both agricultural and manufacturing products of the country and negatively influences the stock market by decreasing the stock index. However, this result is inconsistent with (Aigbovo & Izeke, 2015; Khan & Yousuf, 2013) who investigated a long-run positive linkage between crude oil price and stock index where the business cycle and the global economic boom in energy, industrial and material sectors were thought to be the primary motives.

Table 5 represents the results of the error correction mechanism. As this study has a coefficient of error correction term -0.099064, it signposts a 9.91 percent speed of adjustment, which is significant at a 1 percent level. Finally, it postulates that if there is an exogenous shock, it will make a 9.91 percent adjustment per month to reach in the long-run equilibrium.

Table 5. Results of VECM

Exploratory Variables	Coef.	Std. Err.	t-stat
Speed of Adjustment	-0.099064	0.037143	-2.667100***
$\Delta LOGDSEI_{t-1}$	0.001053	0.088684	0.011875
$\Delta LOGDSEI_{t-2}$	0.051320	0.087986	0.583270
$\Delta LOGFER_{t-1}$	0.062330	0.203014	0.307024
$\Delta LOGFER_{t-2}$	0.090643	0.203210	0.446059
$\Delta LOGER_{t-1}$	-0.695179	1.063916	-0.653415
$\Delta LOGER_{t-2}$	2.175796	1.044064	2.083967**
$\Delta LOGCOP_{t-1}$	0.082852	0.078487	1.055608
$\Delta LOGCOP_{t-2}$	-0.067637	0.075673	-0.893807
Constant	-0.000498	0.003602	-0.138181

Note: *** and ** represent 1% and 5% level of significant respectively.

Source: Researchers' calculation

The outcomes of table 6 show the effect of both heteroskedasticity and Breusch-Godfrey Serial Correlation LM test, where the prob. value of Chi-Square is 0.1017 in heteroskedasticity test that is more than 0.05; hence this study confirms the

presence of homogeneity in residuals. On the other hand, in the LM test, the prob. value of Chi-Square is 0.2589, which is more than 0.05; hence this study also confirms the absence of serial correlation in our model.

Table 6. Results of Heteroskedasticity and Serial Correlation Test

Heteroskedasticity Test: ARCH			
F-statistic	2.313901	Prob. F(2,128)	0.1030
Obs*R-squared	4.571003	Prob. Chi-Square(2)	0.1017
Serial Correlation Test			
F-statistic	1.254885	Prob. F(2,121)	0.2888
Obs*R-squared	2.702616	Prob. Chi-Square(2)	0.2589

Source: Researchers' calculation

The empirical results of table 7 demonstrate that there stands a causal bond between Dhaka stock exchange index, foreign exchange reserve and exchange rate, moving only in one way from Dhaka stock exchange index to foreign exchange reserve and the exchange rate which indicate that if there is an upsurge or decline in the index of DSE, it will affect in foreign exchange reserve and exchange rate. However, no causal linkage is identified between Dhaka stock exchange indexes and crude oil prices.

Table 7. Results of Pairwise Granger Causality Tests

Causality Direction		F-Statistic	Prob.	
LOGFER	~	LOGDSEI	0.43723	0.6468
LOGDSEI	→	LOGFER	15.9099***	7.E-07
LOGER	~	LOGDSEI	0.75989	0.4698
LOGDSEI	→	LOGER	3.37123***	0.0374
LOGCOP	~	LOGDSEI	0.87809	0.4180
LOGDSEI	~	LOGCOP	0.66622	0.5154

Note: *** represents 1% level of significant.

Source: Researchers' calculation

Figure I represents the shape of the IRF of the Dhaka stock exchange index to an innovation in foreign exchange reserve, exchange rate, and crude oil price. Along with their impacts, this figure forecasts 36 months or 3 years of data plotted on IRF. The figure shows, a one standard deviation innovation to its own stock index indicates a substantial decrease in the Dhaka stock exchange index primarily. However, this impact decreases with time and settles at a permanent level of 0.011 units above the baseline. The impulse response of the Dhaka stock exchange index of 1 percent increased shocks coming from foreign exchange reserve leads to a permanent increase in the Dhaka stock exchange index of 0.024 from the 24th month, indicating a long-term positive relationship. A one standard deviation innovation to exchange rate initially decreases the Dhaka stock exchange index, and after the second month onward, it increases and settles at 0.001 units above the baseline at a permanent level from 15th month. Lastly, a one SD innovation to crude oil price causes the Dhaka stock exchange index primarily to fluctuate positively, and it goes to a permanent level from 15th month at 0.011 units above the baseline. So, in the long run, all the selected macroeconomic factors have a permanent consequence on the Dhaka stock exchange index.

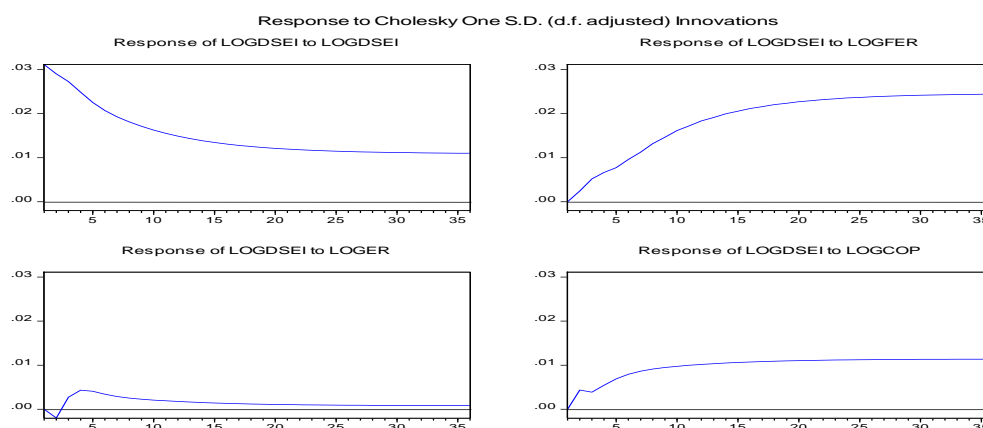


Figure I. Impulse Response Function (IRF) for Dhaka Stock Exchange Index

Source: Researchers' computation

Table 8 limns the consequences of variance decomposition analysis up to the 20 months, where it shows how much of the Dhaka stock exchange index's individual innovation is explicated by movement in its individual variance along with foreign exchange reserve, exchange rate, and crude oil price. The results show 20 months of forecast where it demonstrates that most of the Dhaka stock exchange index variations are elucidated by itself. In the 5th month, the Dhaka stock exchange index explains 92.56 percent of variation by shocks to itself, 3.44 percent by foreign exchange reserve, 1.18 percent by the exchange rate, and 2.81 percent by the crude oil price. In the 10th month, the Dhaka stock exchange index explains 76.95 percent of variation by shocks to itself, 14.41 percent, 1.19 percent, and 7.44 percent by foreign exchange reserve, exchange rate, and crude oil price respectively. So, it can be marked that in the long run, the oscillation in the Dhaka stock exchange index can be caused by the shock in foreign exchange reserve, exchange rate, and crude oil price.

Table 8. Variance Decomposition of LOGDSEI

Period	S.E.	LOGDSEI	LOGFER	LOGER	LOGCOP
1	0.031080	100.0000	0.000000	0.000000	0.000000
2	0.042843	98.42375	0.326756	0.209064	1.040433
3	0.051253	97.02071	1.247897	0.432370	1.299023
4	0.057761	94.87791	2.300499	0.906790	1.914802
5	0.062980	92.56092	3.441694	1.182578	2.814805
6	0.067530	89.87707	5.007936	1.285298	3.829694
7	0.071705	86.93744	6.904513	1.304643	4.853406
8	0.075712	83.69416	9.218202	1.282202	5.805436
9	0.079590	80.36040	11.72187	1.243664	6.674061
10	0.083417	76.95072	14.41125	1.194920	7.443114
11	0.087172	73.62932	17.09730	1.143225	8.130148
12	0.090899	70.38924	19.78931	1.089306	8.732140
13	0.094568	67.32482	22.37082	1.036709	9.267651
14	0.098209	64.41157	24.86704	0.985325	9.736061
15	0.101792	61.69762	27.21236	0.936924	10.15309
16	0.105340	59.15295	29.43719	0.891030	10.51883
17	0.108829	56.79925	31.50659	0.848450	10.84571
18	0.112276	54.60755	33.44992	0.808625	11.13391
19	0.115663	52.58553	35.24971	0.771888	11.39288
20	0.119003	50.70796	36.93158	0.737727	11.62273

Source: Researchers' calculation

5. Conclusion

This study attempts to visualize the empirical linkage between the Dhaka stock exchange index and three designated macroeconomic factors, namely foreign exchange reserve, exchange rate, and crude oil price with monthly time series data ranging from July 2008 to October 2019. ADF and PP unit root tests were applied to ensure the same integrating order of the variables and for cross-checking of the outcomes. The Johansen Cointegration test was applied and found a long-run equilibrium linkage between the Dhaka stock exchange index, foreign exchange reserve, exchange rate, and crude oil price. It was observed that both foreign exchange reserves and crude oil prices have a significant negative consequence on the Dhaka stock exchange index in the long run, and the exchange rate was found to have a positive influence on the Dhaka stock exchange index, which was also statistically significant. This result confirms that the Dhaka stock exchange index can be projected by past data. The coefficient of ECT exposed that a 9.91 percent of disequilibrium in the long-run model is rectified per month as the Dhaka stock exchange index goes back to its equilibrium. The results of the Granger Causality test divulged a causal association running in one direction from the Dhaka stock exchange index to foreign exchange reserve and exchange rate, indicating that if there is any change in the index of DSE, it will affect in foreign exchange reserve and exchange rate. The impulse response function supported the long-run model of the study, and the outcomes of variance decomposition specified that the Dhaka stock exchange index is determined by foreign exchange reserve, exchange rate, and crude oil price.

From the above discussion, it can be said that the Bangladesh government, policymakers, and economists should be cautious in adopting any new economic policy as these selected macroeconomic factors have a significant consequence on the capital market of Bangladesh. For keeping the stock market afloat, the authorities need to be aware of economic progress, sound fiscal policy, and, above all, proper management of different macroeconomic factors that influence the stock market. Since the stock index has a deep connection with the exchange rate, and both importers and exporters are affected by it, the government should try to stabilize the exchange rate. The authority needs to adopt a policy that will stabilize the value of Bangladeshi taka against the US dollar, and at the same time, prevent unforeseen fluctuations in the stock market. Bangladesh is an oil-importing country, so it is time to think about how to reduce the dependence on crude oil and increase domestic energy production and become more dependent on renewable energy. The use of locally produced and renewable energy can improve the dynamics of the stock market by reducing the cost of production. This paper also discusses the detrimental

aspects of excess reserve that may create social and opportunity cost. The government should keep enough money from the foreign exchange reserve, and the rest should be used for filling the funding gap of the infrastructure of the country.

However, this study has uncovered some new avenues of future research for investigators. Only the detrimental aspects of the excess reserve are discussed, but no guidance has been given on how these excess reserves can be used in some productive sectors. Regarding the exchange rate, both positive and negative aspects of currency appreciation and devaluation are mentioned, but no guideline mentioned on what degree of appreciation and devaluation may be useful for the economy of a country like Bangladesh. So, there is a considerable scope to cover this area in the future.

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