01 Introduction

Many studies have been done on stock market interdependence. Most of this research has focused on the international stock markets (Kasa, 1992; Chen et al. 2002; Paramati, Gupta and Roca, 2015). However, the research on the domestic stock markets is very scant. Therefore, this study focuses on the interdependent relationship between domestic stock markets by examining the two stock markets of Bangladesh – Dhaka Stock Exchange (DSE) and Chittagong Stock Exchange (CSE).

The DSE, the first stock exchange of Bangladesh, was incorporated on April 28, 1954. However, the trading began in 1956. At that time, there were only 196 listed securities (Narayan, Smyth and Nandha, 2004) that were traded in this exchange. Due to the liberation war of 1971, the trading activities were discontinued till 1976. The activities of buying and selling of stocks recommenced in 1976, but the number of listed securities was reduced to only nine (Chowdhury, 1994). Recently, the number of listed securities has reached 375 (May 2021). The total market capitalization of the DSE is USD 46.2 billion (October 2020).

CSE was inaugurated on April 1, 1995, in the port city of Chittagong, and started trading on October 10, 1995. Currently, 250 companies are listed on this exchange with a total market capitalization of USD 38.10 billion (2020).
The continuously increasing pattern of trading of these two exchanges has captivated us to examine the interdependent relationship between the DSE and the CSE. This study is helpful to policymakers in making appropriate decisions regarding the further development of the stock market. This study is also crucial for both domestic and international investors to make decisions about the diversification of their investments.

The remaining sections of this paper comprise the objectives, the literature review, the methodology for conducting the research, the details of the data, analysis of the results and findings, and finally, the conclusion.

02 Objectives

The main objective of this study is to identify the interdependent relationship between DSE and CSE. To fulfill this main objective, we first try to identify any short- or long-run association between the DSE and the CSE markets. Next, any causal influence between DSE and CSE, the response of one market – DSE or CSE to the innovation of another market – CSE or DSE, and finally, the percentage amount of variability in one market – DSE or CSE – explained by the other market – CSE or DSE, are determined.

03 Literature Review

There is a myriad of research on the interdependent relationship among stock markets in the field of financial literature. It is noticed that a group of researchers have argued that stock markets are interdependent on each other, whereas another group of researchers have argued against this. It is also noticed that most of the research in this regard has focused on the international stock markets. However, attention to the domestic stock markets is rare.

Early studies on the stock market interdependence followed Grubel's research (1968), whose work focused on the relationship among different national stock markets. Among these studies, Sarnat (1970), Robichek, Cohn and Pringle (1972), Agmon (1972), Lessard (1974; 1976), Stehle (1977), Panton, Lessing and Joy (1976), Hilliard’s (1979) works are mentionable. All of these studies came incongruent with the evidence of low and insignificant relationship among returns in national stock markets. For example, using a regression equation on sample data of the share price index, Agmon (1972) showed a low significant relationships among the stock markets of the USA, UK, Japan, and Germany. Similarly, Hilliard (1979) found that the international markets were unrelated. Though these studies have been able to show some relationships, these relationships are spurious because of the use of the non-stationary nature of data in these studies (Granger and Newbold, 1974; Phillips, 1986). In addition to this, studies have employed correlation techniques which result in inappropriate relationships in stock markets. Financial economists have argued that different series of financial data should be used to achieve a justifiable statistical inference because this type of series can overcome the spurious correlation.

To overcome the problem of fake relationships, Engle and Granger (1987) developed the cointegration with error correction model. According to Engle and Granger (1987), if two variables share a common trend in the long run, then the residuals of these variables must be integrated to order zero, and therefore, there exists some linear combination between these variables. These combinations result in cointegration between these two variables.

Taylor and Tonks (1989), Chan Gup and Pan (1992), Arshanapalli and Doukas (1993), Clare, Maras and Thomas (1995), and Ghosh, Saidi and Johnson (1999) used...
Engle and Grangers’ (1987) approach to cointegration using diverse countries’ stock market index prices. For example, Ghosh, Saidi and Johnson (1999) applied the Engle-Granger approach to investigate the long-run relationship between the developed markets of the USA and Japan and the less developed markets of nine Asia-Pacific countries, including Singapore, Hong Kong, Thailand, Korea, Taiwan, Philippines, Malaysia, Indonesia, and India. They found that Korea, Malaysia, Hong Kong, and Indian markets were related to the US market and the Philippines, Singapore, and Indonesian markets were related to the Japanese market in the long-run.

On the other hand, in another study, Chan, Gup and Pan (1992) found no long-run relationship between the US market and the major Asian markets by using the Engle and Granger cointegration approach.

Arshanapalli and Doukas (1993) studied the stock markets of the USA, France, Germany, the UK and Japan during the crisis period of 1987. They found pairwise cointegration between the US and German Markets; France and the UK markets in the second sub period of the post-crash period. However, they found no relationship with the Japanese market.

Using the Engle and Granger method, Dwyer and Hafer (1988) evinced the lack of a long-run relationship among the stock markets of the UK, Germany, the USA, and Japan. However, they found some temporary interaction among these countries’ markets.

Relaxation in the financial regulations in Asian emerging markets has been influencing international investors to diversify their investments into these emerging markets with the aim of gaining more profit (Wilcox, 1992; and Harvey, 1995). This situation captivated research to study these stock markets of emerging countries. For example, Masih and Masih (1997) investigated the association between the stock markets of four Asian Newly Industrialized Countries (NIC) – Taiwan, Hong Kong, Singapore, and South Korea, and the stock markets of the four established countries – the USA, the UK, Germany, and Japan. They found a common cointegrating vector among all of these markets by using Johansen and Juselius’ (1990) multiple cointegration test.

Lamba (2005) considered the emerging South Asian stock markets in investigating the linkage between the stock markets of developed countries’ and those of these South Asian countries (Sri Lanka, Pakistan, and India). He found a cointegrating relationship among these markets.

Narayan, Smyth and Nandha (2004) found evidence of long-run affinity among the four South Asian stock markets of Pakistan, Bangladesh, India and Sri Lanka. They also showed that in the long-run, the Pakistani stock market was Granger Caused by the Sri Lankan, Bangladeshi and Indian markets. It was also observed that the Bangladeshi market was the most exogenous market among all of the four South Asian markets.

Recently, Paramati, Gupta and Hui (2016) have studied the stock markets of Australia and its trading partners. They found a long-run relationship between the stock market of Australia and its major and medium partners. However, they found no association between the stock market of Australia and its trading partners in the short run.

From the literature study, it is observed that most of the studies focused on the stock markets of different countries, whereas the focus on the Bangladeshi market is very rare. In addition to this, the study of stock markets within a country is absent. Therefore, this paper contributes to the field of stock market interdependence by highlighting the two
stock markets – Dhaka Stock Exchange (DSE) and the Chittagong Stock Exchange (CSE) of Bangladesh.

04 Methodology

In this section, the details of the statistical and econometric techniques are outlined that have been used to achieve the objective of the study. These techniques include – unit root test, Engle and Grangers’ cointegration technique with error correction model, Granger Causality test, Variance Decomposition analysis, and Impulse Response Function.

04.1 Unit-root Test

Financial researchers have come to the common conclusion that financial data is embraced with unit roots (Nelson and Plosser, 1982; Lee and Jeon, 1995; Neih and Chang, 2003). Data series with unit roots become non-stationary series that lead to spurious regression (Harris, 1994). To detect cointegration relationship, it is required that the data series should be integrated of order one, which can be achieved through a unit root test.

To test unit roots that exist in data series, both Augmented Dickey Fuller (ADF) (1981) and Phillips and Perron (PP) (1988) tests are used. Under both tests, the null hypothesis is assumed as the data series contains a unit root against the alternative hypothesis with stationarity in the data series.

04.4 Impulse Response Function Analysis

In order to test these causal effect the following equations are used considering the long-run relationship between the two domestic exchanges – Dhaka Stock Exchange Broad Index (CASPI) for the CSE – were collected. These statistics were gathered over a six-year period, from March 1, 2014, to June 30, 2020.

\[ X_t = \alpha + \beta Y_t + \mu_t \]  
(1)

Therefore, according to Engle and Granger (1987), Xt and Yt will be cointegrated if \( \mu \) is stationary, that is, integrated of order zero (Brooks 2014). In order to test the cointegration, both ADF and PP test statistics are employed to test the null hypothesis of non-cointegration.

According to Engle and Granger (1987), if two variables are cointegrated, then there exists an error correction model which can be written as –

\[ \Delta X_t = \alpha_1 \Delta Y_t + \alpha_2 (X_{t-1} - \tau Y_{t-1}) + \varepsilon_t \]  
(2)

or,

\[ \Delta Y_t = \beta_1 \Delta X_t + \beta_2 (Y_{t-1} - \gamma X_{t-1}) + \delta_t \]  
(3)

Equation (2) and (3) are termed as equilibrium or error correction model. The term \( (X_{(t-1)} - \tau Y_{(t-1)}) \) and \( (Y_{(t-1)} - \gamma X_{(t-1)}) \) are known as error correction terms. In both the terms, \( \tau \) and \( \gamma \) are cointegrating coefficients of the lagged variable of Y and X respectively. These coefficients describe the long-run association between variables. If \( Y_{t} \) and \( X_{t} \) are cointegrated, the error correction term will be stationary. \( \alpha_{-1} \) and \( \beta_{-1} \) indicate the short-term relationship between changes in X and Changes in Y. \( \alpha_{-2} \) and \( \beta_{-2} \) are described as adjustment speed that corrects disequilibrium back into the equilibrium.

04.3 Granger Causality Test

Whether there exists cointegration between variables or not, Granger (1988) identified the existence of a causal relationship between two variables at least in one direction. Hence, the Granger causality test is employed to test the causal effect with direction between two variables considering short-run lagged

\[ \text{MSE}(Y_{t}, X_{t}) = \text{MSE}(Y_{t}, X_{t-1}); \text{MSE}(X_{t}, Y_{t}) = \text{MSE}(X_{t}, Y_{t-1}) \]
values of variables (Pesonen, 1999; Tabak and Lima, 2003).

In order to test these causal effect the following equations are used considering two variables – CSE and DSE price indexes.

\[ \Delta X_t = \sum_{j=1}^{k} \alpha_j \Delta X_{t-j} + \sum_{j=1}^{k} \beta_j \Delta Y_{t-j} + \varepsilon_t \]

\[ \Delta Y_t = \sum_{j=1}^{k} \omega_j \Delta X_{t-j} + \sum_{j=1}^{k} \theta_j \Delta Y_{t-j} + \theta_t \]

If \( \beta_{-j} \) and \( \omega_{-j} \) are statistically significant and different from zero, then it is assumed that both of the variables hold some past information that affects each other in a uni- or bi-directional way.

### 04.4 Impulse Response Function Analysis

The Granger Causality test measures the effect and direction of one variable which is influenced by another endogenous variable (Lütkepohl 2005). However, there are some exogenous variables which can also influence these causal relationships (Lütkepohl 2005). This influence of the exogenous variables can be measured by using the impulse response function, which can be written as the following moving average form.

\[ Y_t = u + \sum_{i=0}^{\infty} \Phi_i u_{t-i} \]

Where, \( \Phi_i \) is the coefficient matrix that contains information about the impulse response of a stock market in the system to a unit shock of the other stock market.

### 04.5 Variance Decomposition Analysis

Variance decomposition identifies the proportion of the movement of a market which is influenced by the shock of the exogenous market (Brook, 2014; Elyasiani, Perera, and Puri 1998). This proportion can be determined by the following equation –

\[ \omega_{ijh} = \frac{\sum_{i=0}^{\infty} (e_i' \theta_i q)^2}{\text{MSE}(Y_{ij}(h))} \]

Where \( \omega \) is the potential shocks or innovation and \( \text{MSE}(Y_{ij}(h)) \) is the mean squared error of \( Y_{ij}(h) \). The denominator term is regarded as the contribution of innovation or shock to the stock market.

### 05 Details of Data

In order to examine the interdependent relationship between the two domestic stock markets of Bangladesh, the daily closing prices of the indices of these two exchanges – Dhaka Stock Exchange Broad (DSEB) for the DSE and CSE All Share Price Index (CASPI) for the CSE – were collected. These statistics were gathered over a six-year period, from March 1, 2014, to February 28, 2020. This long period of data is suitable for discovering a consistent relationship (Yang, Khan and Pointer, 2003). However, there is no strict rule for selecting the time period. All of these prices are denominated in the local currency of Bangladesh (BDT) and are collected from the official website of the concerned exchanges.

It is noticed that due to the holidays and official off days of the exchanges, some data is missing. In this case, the data series is arranged by considering the latest values of the ending days as values for the missing days (Schöllhammer and Sand, 1985; Arshanapalli and Doukas, 1993). Therefore, 1,565 observations are determined for each data series.

### 06 Result and Discussion

#### 06.1 Unit Root Test Result

Figure 01 represents the evidence of the non-stationarity in the price index of the selected stock markets. Because it is observed that both of the diagrams are featured with fluctuation having no specific trend around the mean or variance. Therefore, the unit root test is conducted at both level and first difference of the data series. The results of the unit root of the price index of both CSE and DSE are
presented in Table 01 and Table 02. To find these results, both ADF and PP techniques were applied.

The results are represented by considering intercept, intercept and trend, and without intercept and trend, while in Table 01 the at level result is shown, and Table 02 shows the first differences.

The null hypothesis—price index data has a unit root—cannot be rejected at level (Table 01) because the t-statistic is less than the critical value in all cases under

Figure 01: Non-stationarity of Price Index of both CSE and DSE at Level

PRINCASPI

PRINDSEBROAD

PRINCASPI and PRINDSEBROAD stand for Price Index of CSE and Price Index of DSE respectively.
both the ADF and the PP tests. These results indicate that both the CSE and DSE price index data are not stationary at level. At first difference (Table 02), the null hypothesis – price index data has a unit root – can be rejected without considering the trend and intercept. The t-statistic values (−32.42 for CSE and −32.40 for DSE under ADF and −32.40 for CSE and −32.70 for DSE under P-P test) are greater than the critical values without considering the trend and intercept. Though the

**Table 01: Unit Root Test Result of Price Index at Level**

<table>
<thead>
<tr>
<th>Price Index</th>
<th>Technique</th>
<th>With Intercept</th>
<th>With Trend and Intercept</th>
<th>Without Trend and Intercept</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>t-statistic</td>
<td>p-Value*</td>
<td>t-statistic</td>
</tr>
<tr>
<td>CASPI</td>
<td>ADF test</td>
<td>−1.3413</td>
<td>0.6121</td>
<td>−1.0225</td>
</tr>
<tr>
<td></td>
<td>P-P test</td>
<td>−1.3923</td>
<td>0.5875</td>
<td>−1.0718</td>
</tr>
<tr>
<td>DSEB</td>
<td>ADF test</td>
<td>−1.3717</td>
<td>0.5975</td>
<td>−1.0260</td>
</tr>
<tr>
<td></td>
<td>P-P test</td>
<td>−1.4303</td>
<td>0.5687</td>
<td>−1.0911</td>
</tr>
</tbody>
</table>

*Mackinnon (1996) one-sided P-values

**Critical Value at Level**

<table>
<thead>
<tr>
<th>Significance level</th>
<th>With Intercept</th>
<th>With Trend and Intercept</th>
<th>Without Trend and Intercept</th>
</tr>
</thead>
<tbody>
<tr>
<td>1%</td>
<td>−3.4343</td>
<td>−3.9639</td>
<td>−2.5664</td>
</tr>
<tr>
<td>5%</td>
<td>−2.8632</td>
<td>−3.4127</td>
<td>−1.9410</td>
</tr>
<tr>
<td>10%</td>
<td>−2.5677</td>
<td>−3.1283</td>
<td>−1.6165</td>
</tr>
</tbody>
</table>

t-statistic for the other two other cases that are with intercept and with trend and intercept, are greater than the critical values, these trend and intercept are not statistically significant because the p-values for these trends and intercepts are greater than 5% significance value.

Therefore, both of the price index data are stationary at the first difference, without trend and intercept.
Table 02: Unit Root Test Result of Price Index at First Difference

<table>
<thead>
<tr>
<th>Price Index</th>
<th>Technique</th>
<th>With Intercept</th>
<th></th>
<th>With Trend and Intercept</th>
<th></th>
<th>Without Trend and Intercept</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>t-statistics</td>
<td>p-Value*</td>
<td>t-statistics</td>
<td>p-Value*</td>
<td>t-statistics</td>
<td>p-Value*</td>
</tr>
<tr>
<td>CASPI</td>
<td>ADF test</td>
<td>– 31.2111</td>
<td>0.0000</td>
<td>(0.8719 )</td>
<td>– 31.2242</td>
<td>0.0000</td>
<td>(0.4615 )</td>
</tr>
<tr>
<td></td>
<td>P-P test</td>
<td>– 31.4948</td>
<td>0.0000</td>
<td>(0.8719 )</td>
<td>– 31.4967</td>
<td>0.0000</td>
<td>(0.3459 )</td>
</tr>
<tr>
<td>DSE B</td>
<td>ADF test</td>
<td>– 32.0041</td>
<td>0.0000</td>
<td>(0.8916 )</td>
<td>– 32.0186</td>
<td>0.0000</td>
<td>(0.3284 )</td>
</tr>
<tr>
<td></td>
<td>P-P test</td>
<td>– 32.2663</td>
<td>0.0000</td>
<td>(0.8916 )</td>
<td>– 32.2691</td>
<td>0.0000</td>
<td>(0.3284 )</td>
</tr>
</tbody>
</table>

The values within parentheses indicate the p-values for intercept and trend.

Figure 02: Stationarity of Price Index of both CSE and DSE at First Difference

DPRINCASPI
From Figure 02, it is observed that both series have mean reversion around zero. That is, both price index series are stationary at first difference, with no intercept and trend.

06.2 Cointegration Test Result

In this section, the cointegration results are presented in Table 03. The foremost condition of the Engle and Granger Cointegration is that the variables must be stationary with first-order integration, which is represented in the above two tables. Since the variables are stationary at the first difference, in the next step, the residuals of one variable on another variable are determined by considering CASPI and DSEB price index data as dependent and independent variables alternately. Therefore, then the unit-roots of these residuals at level are examined, and the result of which is shown in the following Table 03.

Table 03: Unit Root Test Result of Residuals at Level

<table>
<thead>
<tr>
<th>Price Index</th>
<th>Technique</th>
<th>With intercept</th>
<th>With intercept and trend</th>
<th>Without intercept and trend</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>t-statistic</td>
<td>p-value</td>
<td>t-statistic</td>
<td>p-value</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CASPI as</td>
<td>ADF test</td>
<td>3.3519</td>
<td>0.0129 (0.7616)</td>
<td>0.0156 (0.1093)</td>
</tr>
<tr>
<td>dependent</td>
<td>PP test</td>
<td>6.1625</td>
<td>0.0000 (0.9900)</td>
<td>0.0000 (0.0000)</td>
</tr>
<tr>
<td>variable</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DSEB as</td>
<td>ADF test</td>
<td>3.3679</td>
<td>0.0123 (0.7639)</td>
<td>0.0124 (0.0852)</td>
</tr>
<tr>
<td>dependent</td>
<td>PP test</td>
<td>5.3443</td>
<td>0.0000 (0.9101)</td>
<td>0.0000 (0.0000)</td>
</tr>
<tr>
<td>variable</td>
<td>3.8236</td>
<td>0.0156 (0.0610)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3.8970 (0.0124)</td>
<td>0.0000 (0.0532)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6.1496 (0.0000)</td>
<td>0.0000 (0.0000)</td>
</tr>
</tbody>
</table>
From the above table, it can be noticed that the t-statistic values under both the ADF test and PP test are greater than the critical values in all cases. It can also be clearly noticed that the p-values are less than $\beta$-values (1%, 5%, and 10%) without considering intercept and trend. These results clearly show that the residual values that are derived from the regression of the CASPI and DSEB price indexes are stationary at level without trend and intercept. These imply that both CASPI and DSEB are cointegrated. Therefore, it can be concluded that there is a long-run relationship between these two stock markets. Hence, any change in stock prices in one market (CSE or DSE) can be used to predict the stock price in the other market (DSE or CSE). This means both of the markets are not efficient.

**06.3 Error Correction Model**

Since both CASPI and DSEB are cointegrated, the error correction model is conducted by using equations (2) and (3). The test results are shown in the following Table 04 and Table 05.

Table 04: Error Correction Model (Dependent Variable – CASPI)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>t-Statistic</th>
<th>Prob.</th>
<th>R-squared</th>
<th>Durbin-Watson stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>– 0.0912</td>
<td>– 0.1593</td>
<td>0.8735</td>
<td>0.9528</td>
<td>2.5006</td>
</tr>
<tr>
<td>D(DSEB)</td>
<td>2.9727</td>
<td>177.6330</td>
<td>0.0000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residual(-1)</td>
<td>– 0.0436</td>
<td>– 5.9364</td>
<td>0.0000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 05: Error Correction Model (Dependent Variable – DSEB)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>t-statistic</th>
<th>Prob.</th>
<th>R-squared</th>
<th>Durbin-Watson Stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.0230</td>
<td>0.1224</td>
<td>0.9026</td>
<td></td>
<td>2.5448</td>
</tr>
<tr>
<td>D(CASPI)</td>
<td>0.3205</td>
<td>177.6306</td>
<td>0.0000</td>
<td>0.9529</td>
<td></td>
</tr>
<tr>
<td>Residual(-1)</td>
<td>– 0.0468</td>
<td>– 6.1623</td>
<td>0.0000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Tables 04 and 05 show that the coefficient values are negative (– 0.0436 and – 0.0468) and statistically significant (p-values less than $\beta$-value). It implies that there is a significant long-run relationship between CSE and DSE. It is also found that there is a significant short-run relationship between these two markets (2.9727 and 0.3205). However, the constant terms are not significant in both cases. The R-squared values are less than the Durbin-Watson statistic (0.9528 versus 2.5006 and 0.9529 versus 2.5448). This means that both of the models are not spurious.

**06.4 Granger Causality Test Result**

According to Granger (1988), cointegration is sufficient, but of relatively little significance to estimate any causal effect between variables. Here, the unrestricted Vector autoregression (VAR) model is used to test the causal effect between these two markets. For this estimation, at first, the optimal number of lags is determined, which is shown in Table 06, and then, the result of the Granger Causality test is shown in Table 07. Table 06 represents the number of lags under AIC (Akaike Information Criterion), SIC (Schwarz Information Criterion) and
shows that the null hypothesis – the price DSE price index is presented. The value with an asterisk (*) indicates the optimal lag of the variables. In this test, it is found that the optimal lag number is two under all the information criteria (AIC – 18.4993; SIC – 18.5341; HQIC – 18.5123).

### Table 06: Optimal Lag

<table>
<thead>
<tr>
<th>Lag</th>
<th>AIC</th>
<th>SIC</th>
<th>HQIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>27.0475</td>
<td>27.0544</td>
<td>27.0501</td>
</tr>
<tr>
<td>1</td>
<td>18.9901</td>
<td>19.0107</td>
<td>18.9977</td>
</tr>
<tr>
<td>2</td>
<td>18.8405</td>
<td>18.8749</td>
<td>18.8533</td>
</tr>
<tr>
<td>3</td>
<td>18.8229</td>
<td>18.8710</td>
<td>18.8408</td>
</tr>
<tr>
<td>4</td>
<td>18.8068*</td>
<td>18.8687*</td>
<td>18.8298</td>
</tr>
<tr>
<td>5</td>
<td>18.7967</td>
<td>18.8723</td>
<td>18.8248</td>
</tr>
<tr>
<td>6</td>
<td>18.7894</td>
<td>18.8787</td>
<td>18.8226*</td>
</tr>
<tr>
<td>7</td>
<td>18.7867</td>
<td>18.8898</td>
<td>18.8251</td>
</tr>
<tr>
<td>8</td>
<td>18.7885</td>
<td>18.9053</td>
<td>18.8319</td>
</tr>
</tbody>
</table>

In Table 07, the test result of the Granger causality in pairwise between the CSE and DSE price index is presented. Table 07 shows that the null hypothesis – the price index of the DSE does not Granger Cause the price index of the CSE – is rejected because the probability value of the F-Statistic (0.0014) is less than the ř value of 5%. This means that the DSE market can influence the CSE market (Figure 03). However, the CSE market cannot influence the DSE market because the null hypothesis – the price index of the CSE does not Granger Cause the price index of the DSE – can not be rejected since the probability value (0.1448) is greater than the ř value of 5%.

### Table 07: Pairwise Granger Causality Test

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>F-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRINDSE  B does not Granger Cause PRINCASPI</td>
<td>4.4495</td>
<td>0.0014</td>
</tr>
<tr>
<td>PRINC ASPI  does not Granger Cause PRINDSEB</td>
<td>1.7116</td>
<td>0.1448</td>
</tr>
</tbody>
</table>
Figure 03 shows the causal influence of one market on another market. The solid blue line from DSE to CSE indicates the influence of the DSE market on the CSE market. On the other hand, the dashed blue line from CSE to DSE indicates that there is a causal effect from the CSE market on the DSE market.

06.5 Impulse Response Function Test Result

In this section, the result of the impulse response of one stock market (CSE or DSE) to the shocks in other markets (DSE or CSE) is represented through both table and graph. This Impulse Response Function (IRF) graph is used to examine the strength of the Granger causality in relative form (Narayan, Smyth and Nandha, 2004). From both Table 08 and Figure 04, it is observed that the impulse responses of the CSE to the shocks in the DSE market gradually increased from day one (0.0000) to day four (15.0559). Thereafter, the response of CSE to DSE decreases to negative. The response of the CSE market to its own shocks has increased from day one to all the periods. On the other hand, the response of the DSE market to the shocks of the CSE market is almost flattening (32.6993 to 40.0631). The response of the DSE market to its own market increased from day one (6.9937) to day four (8.5764) and thereafter, decreased to 0.6532 on day 30.

### Table: 08 Response of One Market to the Shock in Another Market

<table>
<thead>
<tr>
<th>Period</th>
<th>Response of CSE to</th>
<th>Response of DSE to</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DSE</td>
<td>CSE</td>
</tr>
<tr>
<td>1</td>
<td>0.0000</td>
<td>100.8175</td>
</tr>
<tr>
<td>2</td>
<td>9.0733</td>
<td>124.7313</td>
</tr>
<tr>
<td>3</td>
<td>12.0418</td>
<td>125.6279</td>
</tr>
<tr>
<td>4</td>
<td>15.0559</td>
<td>132.2147</td>
</tr>
<tr>
<td>5</td>
<td>13.1282</td>
<td>134.3363</td>
</tr>
<tr>
<td>10</td>
<td>8.7959</td>
<td>133.3017</td>
</tr>
<tr>
<td>15</td>
<td>4.5257</td>
<td>131.6421</td>
</tr>
<tr>
<td>20</td>
<td>0.6253</td>
<td>129.9549</td>
</tr>
<tr>
<td>25</td>
<td>–2.9176</td>
<td>128.2700</td>
</tr>
<tr>
<td>30</td>
<td>–6.1321</td>
<td>126.5894</td>
</tr>
</tbody>
</table>
06.6 Variance Decomposition Analysis

In this section, the result of the decomposition of forecast error variance of the stock markets is presented in the following Table 09.
The most important finding of this study is that there is a long-run relationship

Table 09 shows that the proportion of variance in the DSE market is explained by its own market, which accounts for 4.37% to 1.58% from day one to day thirty, and the proportion of variance in the DSE market is explained by the CSE market by more than 95% from day one to day thirty. However, all of the variance of the CSE is explained by its own market (more than 99%) and a small percentage is explained by the DSE market.

### 07 Conclusion

This examination of stock market linkage is always lucrative for researchers, policymakers, and practitioners. This is because of the unpredictable features of the stock markets. Therefore, in this study, the interdependent relationship between the two stock markets of Bangladesh is examined by considering the daily stock price indices of both exchanges.

The most important finding of this study is that there is a long-run relationship
between the DSE and the CSE that both of the markets are cointegrated. This implies that both markets are not efficient (Palace-McMiken, 1997). The second finding is that, in the short run, there is a causal effect in a one-way direction from DSE to CSE. This implies that stock prices in the DSE markets can influence the stock prices in the CSE markets in the short run. From the impulse response function analysis, it is observed that the CSE market quickly responds to the shock of its own market on day one to two. However, this feedback from the DSE market is almost absent from the shock created in the CSE market. From the variance decomposition analysis, it is found that almost all percentages (99.99%) of the innovations in the CSE market are determined by its own market. On the other hand, small percentages of shocks in the DSE market are explained by its own market and around 97 percent of shocks in the DSE market are explained by the CSE market.

Overall, it is concluded from all of the test results that both DSE and CSE markets are interdependent, though there is a low short-run influence from the DSE market on the CSE market.

References


