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An Empirical Examination of Random Walk Hypothesis for Chittagong Stock Exchange

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Abstract

A capital market will play as a strong catalyst in the industrialization and economic development of the country.The Chittagong Stock Exchange (CSE) is a new and emerging stock exchange located in the port city of Chittagong in southeastern Bangladesh. This paper investigates whether the stock price index in the Chittagong Securities Market meets the criterion of weak-form market efficiency. This study seeks evidence supporting the existence of market efficiency in the Chittagong Stock Exchange Ltd (CSE).In this paper; we have analyzed the behavior of daily return of Chittagong Stock Market indices. The sample includes the daily price indices of all securities listed on the CSE All Share Index, CSE 30 index, and CSCX indices listed in the Chittagong stock market. The results from the unit root test, the ADF test on CSE All Share Index, CSE 30 index, and CSCX provide evidence that the Chittagong stock exchange (CSE) is not efficient even in weak form and CSE does not follow the random walk model.

Key Words: Efficient Market Hypothesis, Random walk model, Chittagong Stock Exchange

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1.0 Introduction

A capital market will play as a strong catalyst in the industrialization and economic development of the country.The Chittagong Stock Exchange (CSE) is a new and emerging stock exchange located in the port city of Chittagong in southeastern Bangladesh. It was established in 1995 as the second stock exchange of the country, besides Dhaka Stock Exchange which has been functioning since 1976. The Chittagong Stock Exchange has also undergone significant changes contributing towards the development of Bangladesh capital market. Theoretical and empirical literature has shown that the prices of shares and other assets are an important part of the dynamics of economic activity of the country. The development of the capital market is crucial for capital accumulation, efficient allocation of recourses and promotion of economic growth. The capital market acts as an intermediary between surplus units and deficit units of an economy and facilitates savings into investments. In addition, by ensuring liquidity for the invested funds, the capital market ensures optimum allocation of resources. Bangladesh being a developing nation in South Asia and characterized by underinvestment and poor infrastructure development needs presence of organized and well–functioning financial markets that would facilitate investment in efficient and profitable ventures and promote economic advancement.

The term efficiency is used to explain a market in which relevant information is impounded into the price of financial assets. The Efficient Market Hypothesis (EMH) is the idea that market prices incorporate all information rationally and instantaneously. There are three forms of stock market efficiency, namely, the weak, the semi–strong and the strong form. The weak form of market efficiency uses information based on historical or past prices. In the weak form of market efficiency, the price of a security reflects all the available information about the economy, the market and the specific security, and that prices adjust immediately to new information. In addition, past values of the price series cannot be used to forecast the future values. In other words, prices of financial assets are said to follow random walk. The random walk model is one of the popular models proposed for stock price behavior, which states that future stock prices cannot be predicted based on past price movements i.e. the more efficient a market is the more random and unpredictable the market returns would be. In the weak form of EMH, past values of the index cannot be used to forecast the current values and it can be tested by unit root test i.e. if the index is I (1) it means that the market is efficient in the weak form. Algebraically Hatemi-j (2002) defined weak form of efficiencies as follows:

$$Pr\ (pt = \theta \parallel pt\text{-}1, pt\text{-}2, \ldots.) = Pr\ (pt = \theta) \quad (1)$$

On the right hand side of the equation there is an unconditional probability that the price today (pt) equals θ. The left hand side in equation (1) defines that the price today is conditional on past prices (pt-1, pt-2 …).

The current paper investigates whether the Chittagong Stock Exchange (CSE) can be termed as an efficient market. The main objective of this paper is to test the weak form efficiency hypothesis in Chittagong stock exchange (CSE) by using the unit root and augmented dickey fuller (ADF) test. Specifically, the paper address the following question; Does the Chittagong Stock Exchange (CSE) follow a random walk or is there a possibility of predicting stock price changes from previous prices?

The rest of the paper is organized as follows. Section 2 reviews the relevant literature and section 3 discusses data and descriptive statistics. Section 4 develops the methodological framework for the paper while section 5 presents the results and findings. Section 6 concludes the paper.

In Bangladesh, there are few studies have been conducted for market efficiency for Dhaka Stock Exchange (DSE).However, there is no further study was conducted on CSE. Hassan (1999) studied on time-varying risk return relationship for Bangladesh by utilizing a unique data set of daily stock prices and returns. He found that DSE equity returns held positive skewness, excess kurtosis and deviation from normality and the returns displayed significant serial correlation, implying the stock market is inefficient. Mobarec (2000) investigate that Dhaka Stock Exchange does not follow random walk model and there are significant autocorrelation at different lag causes to DSE is not week form efficient. Kader (2005) has no evidence that Dhaka Stock Exchange is weak form efficient by testing whether any technical trading strategy yielded abnormal profit or not by using technical trading rule (K% filter rule). Islam (2005) analyzed on the predictability of the share price in Dhaka Stock Exchange prior to the boom in 1996 and by using heteroscedasticity-robust tests found evidence in favour of short-term predictability of share prices in the Dhaka stock market prior to the 1996 boom, but not during the post-crash period. Uddin and Alam (2007) examines the linear relationship between share price and interest rate, share price and growth of interest rate, growth of share price and interest rate, and growth of share price and growth of interest rate were determined through ordinary least-square (OLS) regression. For all of the cases, included and excluded outlier, they found that Interest Rate has significant negative relationship with Share Price and

Growth of Interest Rate has significant negative relationship with Growth of Share Price in Dhaka Stock Market so that DSE is not weak form efficient. Alam, Alam and Uddin (2007) also shows that Dhaka Stock Exchange (DSE) is not weak form efficient through analyzing the randomness of market return, market risk-return relationships and the frequency of the market depth or liquidity. Uddin and Yasmin (2008) seeks evidence supporting the existence of market efficiency in the Dhaka stock exchange (DSE).The sample includes the daily price indices of all securities listed on the DSE for the period from January 01, 1994 to March 22, 2007. Again as a proxy of the of the movement of individual stock prices, daily closing prices of 18 companies operating in the Banks and Financial Institutions sector has been analyzed. This industry is chosen as this sector is rapidly growing in Bangladesh stock markets. The results from the unit root test, the ADF test on DSE price indices and also on individual stock prices of the proxy companies provide evidence that the Dhaka stock exchange (DSE) is not efficient even in weak form and DSE does not follow the random walk model.

2.0 CSE at a Glance

The Chittagong Stock Exchange (CSE) is a dynamic, automated, transparent stock exchange in Bangladesh. It works towards an effective, efficient and transparent market of international standard to serve and invest in Bangladesh in order to facilitate the competent entrepreneurs to raise capital and accelerate industrial growth for overall benefit of the economy and keep pace with the global advancements. The Chittagong Stock Exchange (CSE) began its journey in 10th October of 1995 from Chittagong City in Bangladesh. CSE started computerized screen-based system of trading enabling its member-brokers to trade from three major cities namely Dhaka, Chittagong and Sylhet simultaneously through its state-of-the-art wide area telecommunication network within less than three years of formation. Recently, the network has been further extended to three more cities namely Rajshai, Barisal and Coxesbazar through broker houses bringing thousands of investors to the investment net. CSE spearheaded many modern concepts in the Bangladesh capital market while implementing the automated screen based trading system such as Central Depository System (CDS), Securities Training Institute, Book building system etc. The CSE trading system CHITTRA has three modules such as Broker's Workstation, Market operations and Surveillance.

3.0 Data and Descriptive Studies

The sample includes total 2082 daily observations of CSE All share price index for the total sample period from January 01, 2001 to December 30, 2008 and the sample includes total 2082 daily observations of CSE 30 price index for the total sample period from January 01, 2001 to December 30, 2008 and the sample includes total 1812 daily observations of CSCX price index for the total sample period from January 01, 2002 to December 30, 2008. The all share price index covers all the stocks listed on the exchange and, therefore, provide a complete representation of the market.

4.0 Methodology

An important implication of the efficient market hypothesis (EMH) is that stock prices should follow a random walk, where the future price changes should be - for all practical purposes – random and therefore unpredictable (Mishkin, 1998). The random walk hypothesis is associated with the weak form of the efficient market hypothesis. This asserts that all the information contained in the history of yesterday's stock prices are reflected in today's stock prices. Usually time series analysis considers stationary time series in empirical studies. If the series is non-stationary, the relationship between the independent and dependent variables may exhibit misleading inferences leading for spurious regression. A series said to be stationary if the mean and auto covariance of the series does not depends on time. In order to examine whether each variable's time series is integrated and has a unit root, the study has considered two widely used popular unit root tests- ADF test and PP test. Both the tests use the null hypothesis that the series does contain a unit root (non-stationary variable) against a stationary variable in the alternative hypothesis. If the calculated test statistics is higher than the critical value then one does not reject the null hypothesis and the concerned variable is non-stationary, if not that is stationary. To test the EMH (Efficient Market Hypothesis) of DSE, the tools of stationarity of share prices are tested by using daily market returns. DSE prepares daily price index from daily weighted-average price of daily transaction of each stock. Daily market returns (R_t) are calculated from the daily price indices such as follows:

$$R_t = Ln\,(PI_t \;/\; PI_{t-1}) \qquad (2)$$

Where,

R_t = market return at period t;

PI_t = price index at period t;

PI_{t-1}= the price index at period t-1 and

ln = natural log.

This calculation of market return (Eq-1) is used in the efficiency test. The reasons to take logarithm returns are justified by both theoretically and empirically. Theoretically, logarithmic returns are analytically more tractable when linking returns over longer intervals. Empirically, logarithmic returns are more likely to be normally distributed which is a prior condition of standard statistical techniques (Strong 1992). The equation of unit root test is,

$$Y_t = a + Y_{t-1} + \mu_t \qquad (3)$$

Where μt, is the error term with zero mean, constant variance and α is the intercept. Now run a regression based on equation,

$$Y_t = a + \varrho\, Y_{t-1} + \mu_t \qquad (4)$$

In this regression it is assumed that, ϱ = 1 means unit root is present and the series are random walk implying non-stationarity. If Y has a unit root, then ΔY will be stationary for this reason.

$$\Delta Y_t = a + (\varrho-1)Y_{t-1} + \mu_t \qquad (5)$$

For simplicity,

$$\Delta Y_t = a + \delta\, Y_{t-1} + \mu_t \qquad (6)$$

Where δ = (ϱ-1) and Δ is the difference.

This might be solved by modifying equation (5) by adding lagged difference terms and obtaining:

$$\Delta Y_t = a + \delta Y_{t-1} + ai \sum \Delta Y_{t-1} + \varepsilon_t \qquad (7)$$

Where, $\Delta Y_{t-1} = Y_{t-1} - Y_{t-2}$ etc, ϱ =1 and δ =0. Than proceed to add enough lagged difference terms until the error term, εt, becomes serially independent. This modification is the augmented Dickey-Fuller (ADF) test.

Ho: Stock returns follow random walk (Non-stationary)

H_1: Stock returns do not follow random return (stationary)

The critical values of the tests are simulated under the null that y_t is a drift-less random walk. Moreover, the critical value will change depending on (1) if both α and t is included, (2) if only α is included, and (3) no constant or time trend is included. This test is very sensitive to deviations from y_t being a random walk. If Ho is rejected, it would be simple be conclude that y_t does not contain a unit root.

5.0 Empirical Result and Analysis

Table 1 presents a summary of descriptive statistics of the daily returns for the Sunday, Monday, Tuesday, Wednesday and Thursday. Sample means, maximums, minimums, standard deviations, skewness, kurtosis. The lowest mean returns are in Sunday indices while the highest mean returns are for Wednesday indices. The lowest minimum returns are in Monday indices [-0.00014685] and the highest maximum returns are in Thursday indices (0.16017). The lowest standard deviations of returns are in Monday and the highest standard deviations of returns are in Thursday indices.

Table 1
Descriptive Statistics
Output for the All share index

Descriptive Factors	***Sunday***	***Monday***	***Tuesday***	***Wednesday***	***Thursday***
Maximum	0.019093	0.013658	0.031195	0.080243	0.045979
Minimum	-0.013954	-0.021119	-0.028859	-0.061393	-0.029180
Mean	-0.00080092	-0.00014685	0.0028846	-0.00095755	0.0030788
Standard Deviation	0.0055701	0.0053604	0.010042	0.011840	0.012595
Skew ness	0.65502	-0.85335	-0.20201	0.88783	0.49892
Kurtosis	1.1230	2.8407	0.38148	17.011	0.80189
Observation	153	158	155	156	152

The daily data set consists of Chittagong stock market general indices and top 30 indices for Bangladesh. In order to obtain a better understanding of the behavior of stock process, a preliminary analysis of the data carried out in this section. Table 2 contains the statistical representation of CSE 30 index.

Table 2
Descriptive Statistics
Output for the CSE-30 index

Descriptive Factors	***Sunday***	***Monday***	***Tuesday***	***Wednesday***	***Thursday***
Maximum	0.022240	0.018962	0.043247	0.17938	0.047122
Minimum	-0.019593	-0.039435	-0.044869	-0.15530	-0.027774
Mean	-0.0010609	-0.00015473	0.0028393	-0.00088023	0.0027870
Standard Deviation	0.0065199	0.0064086	0.011874	0.020984	0.013424
Skew ness	0.57967	-1.3078	-0.051986	1.4860	0.44101
Kurtosis	1.4493	8.7019	1.9345	50.828	0.30574
Observation	153	158	155	156	152

The lowest mean returns are in Monday indices while the highest mean returns are for Tuesday indices. The lowest minimum returns are in Monday indices [-0.00015473] and the highest maximum returns are in Thursday indices (0.0028393). The daily standard deviation for the Sunday, Monday, Tuesday, Wednesday and Thursday are positive. The lowest standard deviations of returns are in Tuesday and the highest standard deviations of returns are in Wednesday indices.

The daily data set consists of Chittagong stock market general indices and top CSCX for Chittagong Stock Exchange (CSE), Bangladesh. In order to obtain a better understanding of the behavior of stock process, a preliminary analysis of the data carried out in this section. Table 3 contains the statistical representation of CSCX index.

Table 3
Descriptive Statistics
Output for the CSCX

Descriptive Factors	***Sunday***	***Monday***	***Tuesday***	***Wednesday***	***Thursday***
Maximum	0.018493	0.012520	0.032710	0.088066	0.036088
Minimum	-0.016431	-0.021885	-0.038242	-0.067854	-0.027886
Mean	-0.00064204	-9.8315e-005	0.0029394	-0.0010552	0.0027572
Standard Deviation	0.0055381	0.0047778	0.010301	0.012107	0.011774
Skew ness	0.014621	-0.65917	-0.44290	1.3809	0.17422
Kurtosis	2.1339	2.6110	1.3232	22.400	-0.0017963
Observation	99	158	155	156	152

Table 3 shows the statistical representation of CSCX index for CSE. The lowest mean returns are in Monday indices while the highest mean returns are for Tuesday [0.0029394] indices. The daily standard deviation for the Sunday, Monday, Tuesday, Wednesday and Thursday are positive. The lowest standard deviations of returns are in Monday [0.0047778] and the highest standard deviations of returns are in Wednesday [0.012107] indices.

Table 4
Output for Unit Root Test on All share index Day wise Return
Unit Root Tests: Augmented Dickey Fuller (ADF, Constant)
Null Hypothesis: The Variable contains a Unit Root

Day	***Lag 1***	***Lag 2***	***Lag 3***	***Lag 4***	***Lag 5***
Sunday	-7.478**	-5.653**	-4.775**	-4.590**	-3.913**
Monday	-8.578**	-6.020**	-5.710**	-5.720**	-4.264**
Tuesday	-7.674**	-6.233**	-5.569**	-5.068**	-4.480**
Wednesday	-8.529**	-6.906**	-5.798**	-5.442**	-4.882**
Thursday	-8.198**	-5.531**	-5.117**	-4.906**	-4.210**

Table 5
Output for Unit Root Test on CSE-30 index Day wise Return
Unit Root Tests: Augmented Dickey Fuller (ADF, Constant)
Null Hypothesis: The Variable contains a Unit Root

Day	***Lag 1***	***Lag 2***	***Lag 3***	***Lag 4***	***Lag 5***
Sunday	-7.182**	-5.400**	-4.649**	-4.160**	-3.974**
Monday	-9.567**	-6.512**	-6.053**	-5.683**	-4.565**
Tuesday	-7.926**	-5.713**	-5.162**	-4.815**	-4.146**
Wednesday	-11.05**	-8.264**	-6.979**	-6.254**	-5.594**
Thursday	-8.086**	-5.396**	-4.930**	-4.756**	-4.433**

Table 6
Output for Unit Root Test on CSCX Day wise Return
Unit Root Tests: Augmented Dickey Fuller (ADF, Constant)
Null Hypothesis: The Variable contains a Unit Root

Day	***Lag 1***	***Lag 2***	***Lag 3***	***Lag 4***	***Lag 5***
Sunday	4.907**	-3.918**	-3.832**	-3.220*	-2.890
Monday	-7.310**	-5.580**	-5.829**	-5.114**	-4.374**
Tuesday	-7.540**	-6.531**	-6.204**	-5.325**	-4.515**
Wednesday	-8.660**	-7.026**	-6.122**	-5.756**	-4.935**
Thursday	-8.323**	-5.386**	-5.055**	-4.796**	-4.383**

For Table 4, 5 and 6, we examine day wise stock returns for Chittagong Stock Exchange using PC-Give 10+ updated software. The result of analysis is compared for the significant 5% and 1% with Augmented Dickey-Fuller Test statistics table values. A problem arises in determine the optimal number of lags of the dependent variables. If the data are day wise, use more lags. The data covers only 78 weeks (less than 2 years).

The analysis the of the ADF result are using by 5 lags. The ADF test is taken by only constant with which is representing in the table 4, 5 and 6. CSE all share index and CSE 30 and CSCX indices day wise (ADF t-value) value are comparing with the MacKinnon Critical Values at the 1% and 5% level of significance. The statistical output of unit root test for market return series suggests that there are serial dependencies of return

Chittagong Stock Exchange. ADF calculated values are significant at 1% or 5% significance levels for all 5 degrees of freedom (lags) suggests that the return series does not follow random walk model (Table 4, 5 and 6) that means CSE is not efficient in weak form. The statistical output of unit root test for market return series suggests that there are serial dependencies of return of Chittagong Stock Exchange.

6.0 Conclusion

The primary objective of the paper was to analyze the weak form efficiency of CSE all share index and CSE 30 index and CSEX index Day Wise index (Sunday, Monday, Tuesday, Wednesday and Thursday). The result presented in the study shows that the hypothesis of the randomness of the stock returns are rejected for stock price index changes at all frequencies using Augmented Dickey-Fuller test. Basic assumptions of Efficient Market Hypothesis are violated for Chittagong Stock Exchange that means the CSE market is not efficient even in the weak form. The rejection of null hypothesis of random walk can be interpreted by the mean reverting tendency of stock market prices.

The reason for the market inefficiency is also the poor institutional infrastructure, weak regulatory framework, Lack of supervision, and a lack of accountability, poor corporate governance, slow development of the market infrastructure, and low level of capacity of major market players, and lack of transparency of market transactions. The study provides the time series behavior of a less developed market. The processing of new information in Bangladesh is rather weak, and may result from the persistent large number of non-actively traded shares, and the limited role of mutual funds and professionally managed investment and broker houses. As a institutional policy to improve the capital market, the timely disclosure and dissemination of information to the shareholders and investors on the performance of listed companies should be emphasized. The traders make their living by analyzing historical returns of the stocks. Using this information to project future returns the traders may be able to earn abnormal profits. The implication of the rejection of weak form efficiency for investors is that they cannot adopt a 'fair return for risk' strategy, by holding a well-diversified portfolio while investing in the Dhaka stock market.. However, in the absence sufficiently large number of investors and analysts in Bangladesh capital market, it might have reflected the investor's reaction in reverse direction. The absence of qualified analysts and institutional investors is a well-known fact in the emerging markets like Bangladesh

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