Market Efficiency Level of Dhaka Stock Exchange Limited

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Abstract

Market efficiency is one of the important financial concepts. Market efficiency states that security prices fully reflect all the available information, thereby making it impossible for any investor to earn abnormal return. Such competitive capital market is crucial for any country's development. This study seeks to empirically examine the market efficiency level of Dhaka Stock Exchange Limited. In an attempt to do so, the random walk hypothesis is tested. The three previous indices of Dhaka Stock Exchange; one is DSE general index, the second one is DSE all share price index and the third one is DSE 20 index provided key input for the empirical data analysis. In this study both parametric test (ARIMA model) and non-parametric test (Kolmogrov-Smirnov goodness of fit test and runs test) are employed to find out the result. In all the tests the null hypothesis is rejected indicating DSE do not follow random walk model. The results of these tests confirmed that DSE is not weak form efficient. The result of this study provides a signal to regulatory authorities to reform country's one of the largest financial markets, so that it can contribute in overall economic development.

Keywords: Efficient market hypothesis, Random walk model, Dhaka stock exchange (DSE), Weak-form market efficiency, Capital market, Kolmogrov-Smirnov goodness of fit test, Runs test and ARIMA.

Introduction

In a country the economic condition is strengthened by facilitating smooth flow of funds among different parties. Ronald McKinnon and Edward Shaw (1973) argue that a financial system limited by government interventions and regulations cannot operate properly and thus cannot contribute satisfactorily on the socio-economic development of a country. The financial system consists of financial markets and institutions that provide service to individuals, businesses and government by providing the funds needed. Financial market has several categories; one of them is capital market. In Bangladesh mainly four financial markets are visible; money market, capital market, taka treasury bond market and foreign exchange market. In capital market, only those financial instruments are traded that have maturities greater than one year. Capital market mobilizes the needed fund to different parties, even when these parties are financially weak. Without the help of capital market, it will take time to gather the fund needed. Thus, capital market allows us to boost our current consumption but at the sacrifice of future consumption.

In a capital market, the price of an asset depends on different informations, such as it can be based on information regarding supply-demand. In an efficient market, the information is quickly incorporated with the price of an asset. In capital market the transfer of fund between surplus unit

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and deficit unit will take place smoothly only when the market is efficient. And because, the information is quickly absorbed by the market and reflected in the price, no investor can achieve abnormal gain from the market. Thus, investors feel safe to place their investment in an efficient market. Eugene Fama (1991) categorized market efficiency into three different levels, based on the information reflected in security price. Three levels of market efficiency are weak-form efficiency, semi strong-form efficiency and strong-form efficiency. Weak form efficiency states that current prices fully reflect all information about past price movements, rates of return and other market-generated information. So, in weak form efficient market an investor cannot earn abnormal return simply by analyzing historic price movements. Semi strong form efficiency states that current prices reflect all information publicly available. And, strong form efficiency states that current prices reflect both publicly and privately held information of a security. Random walk hypothesis is a financial theory that asserts chartist or technical procedures for predicting future stock price will result in vain. The theory states that stock price changes of individual securities are independent of each other. So, by analyzing the past data of a security an investor cannot gain abnormal return. There is a similarity between the random walk hypothesis and efficient market hypothesis. In this study the daily return of DSE is tested for weak form efficiency by using random walk hypothesis.

Scope of the study

Among the three different levels of market efficiency, the study is focused on testing the daily return of DSE for weak form efficiency. Because of data unavailability the daily return of DSE is not tested for semi-strong form and strong-form efficiency. The study uses data of DSE General Indices, DSE All Share Price Indices and DSE 20 Indices during the year 1993-2013. The daily observations have been collected from the Research and Library Centre of DSE.

Objective of the study

This paper attempts to find out whether the daily return of Dhaka Stock Exchange is weak form efficient or not. From the finding of this study, the dependency level of stock price on past information will be cleared.

Review of Literature

Huiwen Zou (2011) provided a strict definition of information in economics and studied the stock markets in China in order to figure out how optimal information efficiency can be achieved. The result suggests that a market's operation and information transmission mechanisms effectiveness can contribute toward optimal efficiency. Ingrid Formosa (2008) attempted to develop a market efficiency index of twenty six different European countries focusing on good market, labor market and financial market. The finding suggests that GDP per capita and economic resilience have positive relationship with market efficiency.

Alkhatib and Harasheh (2014) examined seven indices of Palestine Exchange to decide whether the market efficiency level is weak or not. The random walk hypothesis is used to make decision about weak form efficieny. They applied serial correlation, Augmented Dickey-Fuller test and

runs test to analyze the random walk model. The results suggest that the stock market is inefficient at the weak-form level. Amalendu Bhunia (2012) did not only measure the market efficiency level of National Stock Exchange (NSE), India but at the same time tried to see the relationship between risk and return involved with stock investment in stock . The study applied capital asset pricing model to examine the relationship between risk and return and found positive relationship between risk and return. To measure the efficiency level T-test and F-test are applied and the result indicates the NSE is not strong form efficient. Tamara Backović Vulić tested New Montenegrin Stock Exchange (NEX Montenegro) for weak form efficiency. The Augmented Dickey-Fuller test, Run test and Autocorrelation Function (ACF) test confirmed that New Montenegrin Stock Exchange (NEX Montenegro) is not weak from efficient. In addition to this, the paper examined some of the well known anomalies of efficient market hypothesis. These anomalies are January effect, Monday effect, Holiday effect and turn-of-the-month effect. The results suggest that only turn-of-the-moutn effect exist in New Montenegrin Stock Exchange (NEX Montenegro). Kristoufek and Vosvrda (2012) attempted to measure capital market efficiency of thirty eight countries on forty one stock indices. They introduced a new measure which is correlation structure of the returns and local herding behavior. According to their finding Japanese NIKKEI is the most efficient market. Birakwate Francis Grier (2008) used random walk hypothesis to test weak form efficiency of Uganda Securities Exchange. The normality test and runs test result indicate the market is not efficient in the weak-form. Mahmood et al. (2010) wanted to measure Chinese stock market efficiency and the impact of global financial crisis on efficiency of Chinese stock market. After implementing runs test, LOMAC variance ratio test, Durbin-Watson test and Augmented Dickey Fuller test they found Chinese stock market is weak form efficient and global financial crisis has no significant impact on efficiency of Chinese stock market. Amna (2011) used unit root test, runs test and autoregressive integrated moving average (ARIMA) on Pakistani stock market. The finding suggests that the market is inefficient in the weak form. Seiler and Rom (1997) used random walk hypothesis to investigate the existence of weal form efficiency. The result of ARIMA method confirmed that New York Stock Exchange (NYSE) is efficient in the weak form.

Chaity and Sharmin (2012) used random walk hypothesis in order to test Dhaka Stock Exchange for weak form efficiency. The result of Kolmogrov-Smirnov Goodness of Fit test, Auto-correlation function test and ARIMA method confirmed that Dhaka Stock Exchange does not follow random walk hypothesis hence it is not efficient in weak form. Hussain et al. (2008) used moving average rule to make decision about weak form efficiency of Dhaka Stock Exchange. The study result suggests that the Dhaka Stock Exchange is not weak form efficient. Hasan et al. (2011) tried to measure Dhaka Stock Exchange efficiency through the application of stochastic frontier production function. They concluded that the market is inefficient in general but group A companies are least inefficient compare to group B and Z companies. Mobarek and Keasey (1997) investigated the weak form efficiency of Dhaka Stock Exchange by using random walk hypothesis. The study applied Kolmogrov-Smirnov Goodness of Fit test, run test, Auto-correlation test, Auto-regression and ARIMA model. The study result suggests that the Dhaka Stock Exchange does not follow random walk hypothesis and is not efficient in weak form.

Dhaka Stock Exchange at a Glance

The necessity to establish a stock exchange was felt in the year 1952. The restriction of transaction imposed by the then Calcutta Stock Exchange forced the authority to establish a stock exchange of their own. On 28th April, 1954 a stock exchange was established namely East Pakistan Stock Exchange Association Ltd. The trading was started about two years later in 1956. Later this name was changed into Dhaka Stock Exchange Ltd (DSE) on 14th May, 1964. In 1971, Dhaka Stock Exchange was closed due to liberation war and then opened again five years later. To protect the interest of investors, a commission was formed in the year 1993. Bangladesh Securities and Exchange Commission (BSEC) is the regulator of the country's capital market. Dhaka Stock Exchange had three indices namely Dhaka Stock Exchange General Index, Dhaka Stock Exchange All Share Price Index and Dhaka Stock Exchange 20 Index. But, after the market crash experienced in December 2010, DSE went through several reforms. In January 28, 2013 Dhaka Stock Exchange introduced DSE Broad Index (DSEX), DSE 30 Index (DS30) and DSE Shariah Index (DSES). There are five categories of instruments available in DSE namely A, B, G, N and Z category. Group A companies are punctual in arranging annual general meeting and provided at least 10% dividend in the last year. Group B companies do make annual general meeting regularly but failed to provide at least 10% dividend in the last year. Group G companies (green-field companies) are listed with DSE and declare the first year of dividend before beginning of commercial operation. Group N companies are newly listed companies other than the green-field companies. Group Z companies are not sincere in holding annual general meeting and declaring dividend. Companies that discontinued operation for more than six months and whose accumulated loss is more than paid up capital are also considered as Group Z.

Data and Methodology

Data Set

The three previous indices of Dhaka Stock Exchange namely; DSE General Indices, DSE All Share Price Indices and DSE 20 Indices provided key input to test the daily return of DSE for weak form efficiency. The sample period is November 27, 2001 to July 31, 2013 for DSE General Indices; January 2, 1993 to January 27, 2013 for DSE All Share Price Indices and January 1, 2001 to January 27, 2013 for Dhaka Stock Exchange 20 Indices. The sample size is 2926, 4846 and 3047 daily observations respectively for DSE General Indices, DSE All Share Price Indices and DSE 20 Indices. To get the appropriate result the daily price indices is converted into daily market return by using this formula:

$$Rmt = Ln (PIt / PIt\text{-}1)$$

Where, Rmt = market return in period t;
PIt = price index at day t;
PIt-1 = price index at time period t-1;
Ln = natural log.

Hypothesis
The efficient market hypothesis and random walk hypothesis both are closely related. The goal of this study is to check DSE for weak form efficiency. If the result indicates random walk model exist in DSE, then it is said to be efficient in weak form. Hence, the hypothesis is as follows:
H0: Daily market returns of DSE follow the random walk model.
H1: Daily market returns of DSE do not follow the random walk model.

Methodology
The hypothesis stated above can be tested by using several methodologies. The methodologies can be divided into two basic categories, namely parametric test and non-parametric test. In this study two non-parametric tests are used they are, Kolmogrov-Smirnov goodness of fit test and runs test. In addition to this one parametric test is used that is ARIMA (Auto Regressive Integrated Moving Average). All these tests were previously used by researchers for the same purpose. Hence the result of this study should be statistically valid.

Runs Test
It is a nonparametric test that can be used to find out whether a given observation tends to follow random order or not. Runs test gets the result by using a cut point, which can be mean, median, mode or any other custom values. It then counts how many runs are available above or below the specified cut point to know the observation is positively serially correlated or negatively serially correlated.

Kolmogrov-Smirnov Goodness of Fit Test and Q-Q plots
The stock price cannot be predicted by analyzing past price movements if the distribution of return series is normal (Melkiel 1973). To test whether a data set follows normal distribution or not, Kolmogrov-Smirnov Goodness of Fit test and Q-Q plots are applied. Kolmogrov-Smirnov Goodness of Fit test is a non parametric procedure that can be used to see whether the observations follow normal distribution, poisson distribution, uniform distribution etc. In Q-Q plots if all the data falls close to the reference line forming a 45° upward slopping diagonal line the data said to be approximately normally distributed.

ARIMA
Autoregressive Integrated Moving Average (ARIMA) model was introduced by Box and Jenkins (1976). This model can be used to project the future values of a series with the help of previous data available. The model includes three types of parameters: the autoregressive parameters (p), the number of differencing phases (d) and moving average parameters (q). The autoregressive parameters (p) indicate dependency among successive observations. The differencing phase (d) is necessary to make a non-stationary time series stationary. The moving average parameter (q) implies the persistence of random shock from one observation to the next.

Results and Analysis

Runs test is conducted on the daily market return of three indices of Dhaka Stock Exchange; DSE 20 index, DSE all share price index and DSE general index. The cut point used in this study is the median. To judge whether the daily market return is random or not p-value is used. If p-value is greater than 0.05 then the data is said to be random. The SPSS result of DSE 20 Index is shown in table-1, and the p-value is 0.000 that is less than 0.05. The SPSS result of DSE All Share Price Index is shown in table-2, the test result confirms p-value is 0.000 that is less than 0.05. The SPSS result of DSE General Index is shown in table-3, and it indicates p-value is 0.000 that is less than 0.05. So, the null hypothesis is rejected.

Table-1: DSE 20 Index

Runs Test

	Daily Market Return
Test Value[a]	.00000664
Cases < Test Value	2423
Cases >= Test Value	2423
Total Cases	4846
Number of Runs	1938
Z	-13.964
Asymp. Sig. (2-tailed)	.000

a. Median

Table-2: DSE All Share Price Index

Runs Test

	Daily Market Return
Test Value[a]	.00000000
Cases < Test Value	1518
Cases >= Test Value	1529
Total Cases	3047
Number of Runs	1253
Z	-9.838
Asymp. Sig. (2-tailed)	.000

a. Median

Table-3: DSE General Index

Runs Test

	Daily Market Return
Test Value[a]	.00051038
Cases < Test Value	1463
Cases >= Test Value	1463
Total Cases	2926
Number of Runs	1247
Z	-8.025
Asymp. Sig. (2-tailed)	.000

a. Median

If the return series follow random walk hypothesis, then it has to be normal. To test normality pattern of DSE 20 index, DSE all share price index and DSE general index; Kolmogrov-Smirnov goodness of fit test and Q-Q plots are used. Table-4 presents the result of Kolmogrov-Smirnov goodness of fit test applied on DSE 20 Index. The result indicates p-value is 0.000, so the return series does not fit by normal distribution. The Kolmogrov-Smirnov goodness of fit test result of DSE All Share Price Index is presented in table-5. The test result indicates p-value is 0.000, so the return series of DSE All Share Price Index does not fit by normal distribution. Table-6 presents result of Kolmogrov-Smirnov goodness of fit test applied on DSE General Index. The result indicates p-value is 0.000, so the return series does not fit by normal distribution.

Table-4: DSE 20 Index
One-Sample Kolmogorov-Smirnov Test

		Daily Market Return
N		3047
Normal Parameters	Mean	.0003196199
	Std. Deviation	.01367038405
Most Extreme Differences	Absolute	.084
	Positive	.075
	Negative	-.084
Kolmogorov-Smirnov Z		4.660
Asymp. Sig. (2-tailed)		.000

Table-5: DSE All Share Price Index
One-Sample Kolmogorov-Smirnov Test

		Daily Market Return
N		4846
Normal Parameters	Mean	.0004656734
	Std. Deviation	.01839728893
Most Extreme Differences	Absolute	.161
	Positive	.161
	Negative	-.155
Kolmogorov-Smirnov Z		11.227
Asymp. Sig. (2-tailed)		.000

Table-6: DSE General Index
One-Sample Kolmogorov-Smirnov Test

		DSEGENI
N		2926
Normal Parameters	Mean	.0005737914
	Std. Deviation	.01506587866
Most Extreme Differences	Absolute	.096
	Positive	.084
	Negative	-.096
Kolmogorov-Smirnov Z		5.183
Asymp. Sig. (2-tailed)		.000

In Q-Q plots if all the data falls close to the reference line forming a 45° upward slopping diagonal line the data said to be approximately normally distributed. The Q-Q plots for three indices are shown in figure-1, figure-2 and figure-3, which show that data do not cluster around the reference line for all the three indices. So, the data fails to form a 45° upward slopping diagonal line. And as a result, it can be clearly concluded, that the three indices of Dhaka Stock Exchange do not follow normal distribution. Hence, the three indices of DSE do not follow random walk model and are not efficient in weak form.

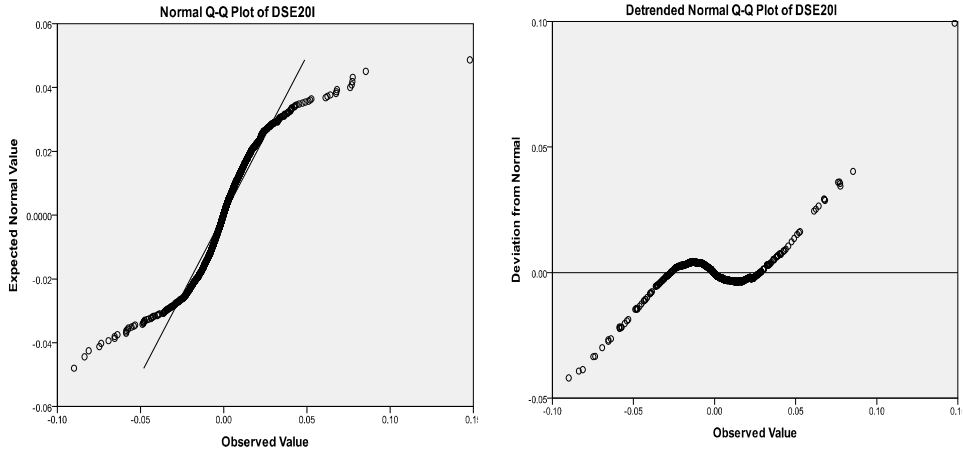

Figure-1: Q-Q plots of DSE 20 Index

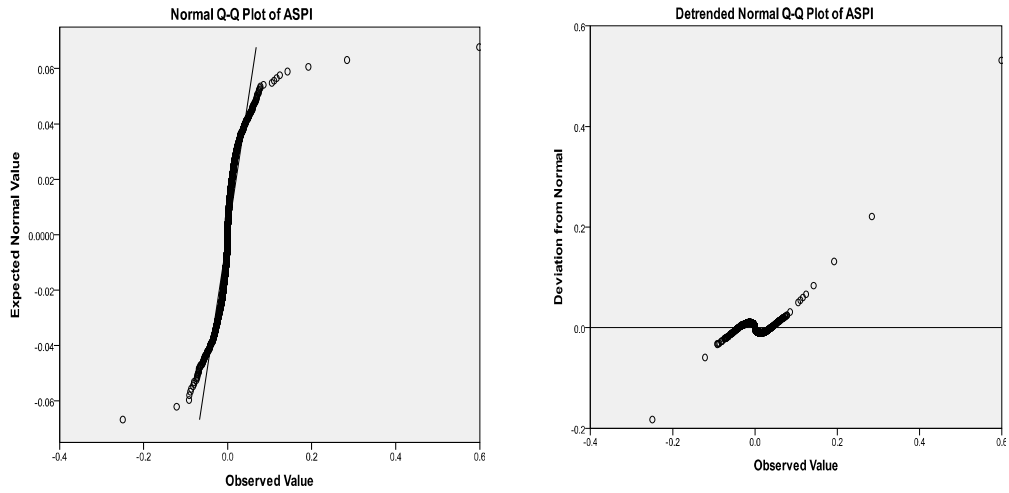

Figure-2: Q-Q plots of DSE All Share Price Index

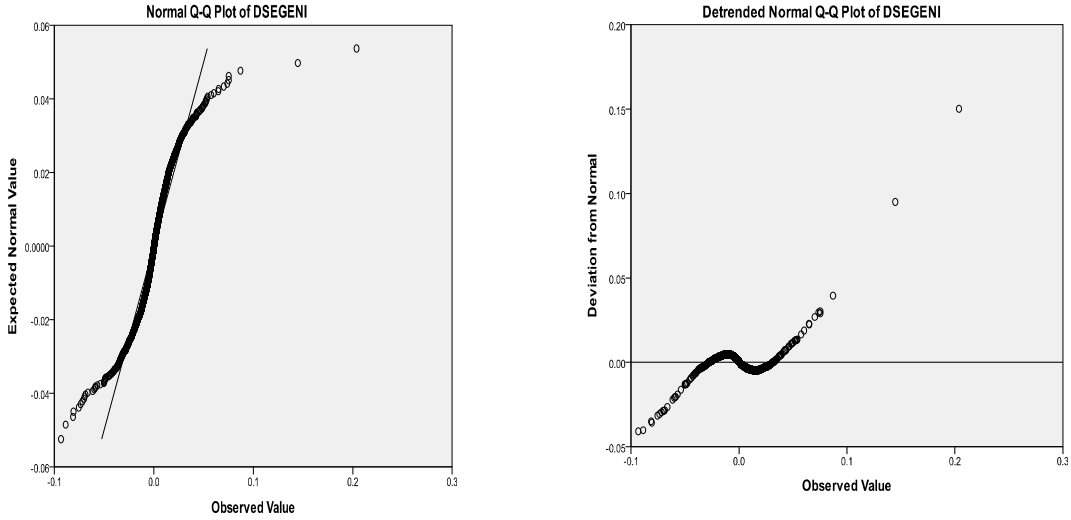

Figure-3: Q-Q plots of DSE General Index

ARIMA is used to find out whether the daily market return of three indices of Dhaka Stock Exchange follow the random walk model or not. If the daily market return of three indices follows the random walk model, then it has to be fitted in to the ARIMA model (0, 1, 0). Table-7, table-8 and table-9 contain model description and model statistics data of DSE 20 index, DSE All Share Price Index and DSE general index respectively. The model statistics show stationary R-squared value is (-3.803E-15) for DSE 20 index, (-1.216E-15) for DSE all share price index,

(-1.752E-15) for DSE general index. The stationary R-squared value for all the three indices is very poor and negative. It simply means that the chosen ARIMA model (0, 1, 0) fits the data poorly. So, the model cannot explain the observed variations in the series. The Ljung-Box statistic shows the significance value is 0.000 for all the three indices. As a result, there is structure in the observed series which is not accounted for by the model. So, the null hypothesis is rejected.

Table-7: ARIMA model description and model statistics of DSE 20 Index

Model Description

			Model Type
Model ID	Daily Market Return	Model_1	ARIMA(0,1,0)

Model Statistics

Model	Number of Predictors	Model Fit statistics	Ljung-Box Q(18)			Number of Outliers
		Stationary R-squared	Statistics	DF	Sig.	
Daily Market Return-Model_1	0	-3.803E-15	709.797	18	.000	0

Table-8: ARIMA model description and model statistics of DSE All Share Price Index

Model Description

			Model Type
Model ID	Daily Market Return	Model_1	ARIMA(0,1,0)

Model Statistics

Model	Number of Predictors	Model Fit statistics	Ljung-Box Q(18)			Number of Outliers
		Stationary R-squared	Statistics	DF	Sig.	
Daily Market Return-Model_1	0	-1.216E-15	985.960	18	.000	0

Table-9: ARIMA model description and model statistics of DSE General Index

Model Description

			Model Type
Model ID	Daily Market Return	Model_1	ARIMA(0,1,0)

Model Statistics

Model	Number of Predictors	Model Fit statistics	Ljung-Box Q(18)			Number of Outliers
		Stationary R-squared	Statistics	DF	Sig.	
Daily Market Return-Model_1	0	-1.752E-15	662.509	18	.000	0

Conclusion

The capital market, one of the categories of financial markets, has the ability to change the economic condition of a country. A capital market that brings together buyers and sellers of financial instruments together and facilitates a complete exchange between them is desirable. The study attempts to find out the existence of weak form efficiency in country's one of the largest capital markets, Dhaka Stock Exchange. If a capital market is not efficient in weak form then an investor can earn abnormal return by analyzing past prices. Such vulnerable capital market cannot achieve the reliability of investors and unable to make successful contribution toward economic development. The methodologies used in this study indicate that the return of Dhaka Stock Exchange is not weak form efficient. The finding of this study is similar with the findings of other studies conducted on the same issue on Dhaka Stock Exchange. The result of this study can also explain the stock market crash that occurred in Bangladesh in December, 2010. The study sends a message to the regulators of Dhaka Stock Exchange to make a fundamental change. So, the Dhaka Stock Exchange can attract investors and can make favorable contribution toward economic development of the country.

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