Efficiency Measures of Capital Market: A Case of Dhaka Stock Exchange

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Abstract

Dhaka Stock Exchange has experienced two market crashes since its inception (November 1996 and December 2010). The regulator tried to reform the market as an efficient market by taking various measures. This study is designed to measure market efficiency level of DSE; Market efficiency is used to explain the relationship between information and share price in capital market, following whether or not returns in a market follow a random walk process over a longer period of time. For testing of market efficiency, we conducted normality test along with serial dependencies of stock return from one period to another. The Result of the study indicates that the DSE is not 'Weak form of Efficient' and not follow 'Random Walk model'.

Keywords: Random walk, Efficient market hypothesis, Serial correlation, ARIMA

1. Introduction

Dhaka Stock Exchange was first incorporated as East Pakistan Stock Exchange Association Ltd in 28 April 1954 and started trading from year 1956. After the Liberation War in 1971 the trading was discontinued for five years. DSE again started its activities in 1976 with only 9 listed companies, having a total paid up capital of Tk. 137.52 million. The actual growth of the stock exchange in Bangladesh (the DSE) started since 1983, when the market capitalization was Tk. 812 million. In the Dhaka Stock Exchange (DSE), there were 412 securities listed as on December 2008, Dec'10, and June'11 there were 445 and 490 listed securities. Since its inception DSE faces tremendous ups and down, two market crashes, and so on. Regulators tried to improve its condition by imposing different rules and regulation. Along with recent crashes in capital market, DSE is not considered as efficient market and investors tend to lose their confidence on it.

Market Efficiency is defined by Fama (1970 and 1991) as a market in which prices always fully reflect all available information. He argues that the allocation of the ownership of the economy's capital stock, which represents the primary role of the capital market, is ideally fulfilled if the market is efficient, because prices from such a market provide accurate signals for resource allocation. The Efficient Market Hypothesis (EMH) does not say prices are random, but that price changes in an efficient market are random and independent. Efficiency is defined at three different levels, according to the level of information reflected in the prices - weak- form, semi-strong and strong form. Weak form version asserts that price of financial assets reflect all information contained in the past prices. Semi strong version postulated that prices reflect all the publicly available information where as strong form says that prices of financial assets reflect in addition to information on past prices and publicly as well as privately available information. The random walk hypothesis (Melkiel 1973) is a financial theory stating that stock market prices evolve according to a random walk and thus the prices of the stock market cannot be predicted. The theory states that stock price changes have the same distribution and are independent of each other, so the past movement or trend of a stock price or market cannot be used to predict its future movement. The EMH is also consistent with the random walk hypothesis. Because of data and information insufficiency, our study focuses on testing of weak form of efficiency. The main objective of our study would be to examine the capital market's efficiency following the random walk hypothesis or not.

The paper is organized as follows : section 1 presents the tests to identify different level of market efficiency in different countries; section 2 contains data and methodology; and the last section contains the empirical work for testing of efficiency of Dhaka stock exchange through normality test(following the random walk model or not) and the time series regression analysis such as Auto Regressive Integrative Moving Average Model (ARIMA) to examine the stock return series depend not only on its past values of the return series but also past and current disturbing terms.

2. Literature Review

A weaker version of the efficiency hypothesis brought into attention by Fama (1991) is that of Jensen (1978), according to which prices reflect information to the point where the marginal benefits of acting on information, do not exceed marginal costs. There are many research findings regarding weak form of efficiency on the market of developing and less developed markets. Hudson, Dempsey and Keasey (1994) found that the technical trading rules have predictive power but not sufficient to enable excess return in U.K. market. Nicolass (1997) conclude that past returns have predictive power in Australian market but the degree of predictability of return is not so high. Fama (1965, 1970) evidence that the market for developed economics are generally weak form efficient which means the successive returns are independent and follow random walk. Worthington and Higgs (2006) examines the weak-form market efficiency of Asian equity markets. The results shows that none of the emerging markets are characterized by random walks and hence are not weak-form efficient, only the developed markets in Hong kong, New Zealand and Japan are consistent with random walk criteria. Khababa (1998) has examined the behavior of stock price in the Saudi Financial market seeking evidence that for weak form efficiency and find that the market is not weak-form efficient. Chakraborty (2006) investigates the weak-form efficiency of the Pakistani stock market using daily closing prices from January 1st 1996 to 31st December 2000. Poshakwake S. (1996) finds the evidence of non-randomness stock price behavior and the market inefficiency on the Indian market.

Also, several studies were performed on Dhaka Stock Exchange in recent years and majority of them are with market efficiency analysis. Hussain, Chakraborty and Kabir (2008) try to evaluate the efficiency of Dhaka Stock Exchange through the application of statistical tools and technical trading rule, namely the Moving Average Rule. They have concluded that the inefficiency of DSE is diminishing after the market crash of 1996. But still DSE is not efficient enough at its weak form. They suggested some action that can improve the efficiency of the market. These are ensuring asymmetric information among all investors, proper implication of rules of regulatory commission and introducing sophisticated means of investment and tools. Mobarek, Mollah, Bhuyan (2008) seeks evidence on whether the return series on Bangladesh's Dhaka Stock Exchange (DSE) is independent and follows the random walk model. Using both non-parametric (Kolmogrov-Smirnov: normality test and run test) and parametric test (Auto-correlation test, Auto-regressive model, ARIMA model) for the period of 1988 to 2000 (DSE Daily price Index), they found that the security return do not follow random walk model and the significant auto-correlation coefficient at different lags reject the null hypothesis of weak-form efficiency. Alam, Yasmin, Rahman, and Uddin (2011) try to find evidence supporting the impact of continuous policy reforms on the market efficiency on the Dhaka Stock Exchange. The overall findings tell that the frequency distribution of the stock prices in DSE does not follow a normal or uniform distribution. In overall analysis, it is observed that all of the existing policy of DSE and SEC cannot ensure market efficiency, not even weak form. Continuous and frequent policy changes have no impact on market efficiency in DSE. Present policies of DSE can not ensure proper return in the market.

3. Data and Methodology

The study uses both the indices of Dhaka Stock exchange - All Share Price Indices and DSE General Indices respectively for the period of January 1, 1993 to June 30, 2011 and the data of January 2002 to June 30, 2011. The whole sample of daily observations that have been collected form the Research and Library Centre of DSE. The daily market returns are calculated from the daily price indices without adjustment of dividend. Because in recent years many analysts have claim that trader paying more attention to information related to recent trends in return instead of information related to future dividend (Fishe et. at 1993); (Linkonishok and Smidt 1988). Daily Market returns (Rm) are calculated from the daily price indices as follows:

$$Rm = Ln\ (PI_t / PI_{t-1})$$

Where, Rm measures market return in period t; PI_t indicates price indices at day t and PI_{t-1} follows the price index at time period t-1. Ln = natural log, Logarithmic returns are more likely to be normally distributed which is prior condition of standard statistical techniques (Strong 1992; Mubarak 2000; Hossain 2010). If the market follows a hypothesis of weak form efficient then stock prices should be random walk. The Null and Alternative hypothesis of the study would be-

H_o: DSE returns series follow the random walk model.

H_I: DSE returns series do not follow the random walk model.

One of the basic assumptions of random walk model is that the distribution of return series should be normal. To test the normality pattern of DSE returns series, we conducted Q-Q probability chart and Kolmogrov-Smirnov Goodness of Fit test. Q-Q (Quantile-Quantile) plot is a graphic method to test whether or not a dataset follows a given distribution. Q-Q plot is against the standard normal distribution. The Normal probability plot is used to test whether or not a dataset follows a given distribution. It shows a graph with observed cumulative percentage on X axis and expected cumulative percentage on Y axis. If all the scatter points are close to the reference line, we can say that the dataset follows the given distribution. Kolmogrov-Smirnov Goodness of Fit test is another non parametric test and is used to determine how well a random sample of data fit to a particular distribution.

Additionally to confirm return series following the past values or not, statistical time series analysis Serial Correlation, Auto correlation and ARIMA are conducted. Serial Correlation is often found in repeating patterns when the level of a variable affects its future levels. Serial correlation is used to determine how well past price of a security predicts the future prices. If no correlation was found in a series then the series is said to be random.

Auto correlation test is a reliable measure for testing of either dependence or independence of random variables in a series. The Autocorrelation test evident the ACF's and PACF's whether significantly different form zero. Results close to plus or minus one indicate strong correlation between the return series. The lags having values outside the limits should be considered to have significant correlation. The Ljung–Box test is used to test whether any of a group of autocorrelation of a time series is different from zero. It tests the overall randomness based on a number of lags. For a large sample the Ljung- Box statistics follows the chi- Square distribution

$$Q = n(n+2)\sum_{k=1}^{h}\frac{\hat{\rho}_k^2}{n-k}$$

Where n is the sample size, $\hat{\rho}_k$ is the sample autocorrelation at lag k, and h is the number of lags being tested. The Ljung–Box test is commonly used in Auto Regressive Integrated Moving Average (ARIMA) modeling. It is applied to the residuals of a fitted ARIMA model the hypothesis actually is being tested to find out the residuals from the ARIMA model have no autocorrelation. Autoregressive Integrated Moving Average model introduced by Box and Jenkins (1976) includes autoregressive as well as moving average parameters, and explicitly includes differencing in the formulation of the model. Specifically, the three types of parameters in the model are: the autoregressive parameters (p), the number of differencing passes (d) and moving average parameters (q). A given time series process $\{y_t\}$, A first order auto regressive process is denoted by ARIMA (1, 0, 0) or simply AR (1) and is given by

$$[y_t = \mu + \alpha_t y_{t-1} + \varepsilon_t]$$

And a first order moving average process is denoted by ARIMA (0, 0, 1) or simply MA (1) and is given by

$$[y_t = \mu - \theta_t \varepsilon_{t-1} + \varepsilon_t]$$

The ARIMA model is combination of both the equation –

$$[y_t = \alpha_1 y_{t-1} + \alpha_2 y_{t-2} + --- + \alpha_n y_{n-1} - \theta_1 \varepsilon_{t-1} - \theta_2 \varepsilon_{t-2} - \ldots\ldots\ldots - \theta_n \varepsilon_{n-2} + \varepsilon_t]$$

ARIMA models are used for observable non-stationary processes $\{y_t\}$, have some clearly identifiable trends:

- constant trend (i.e. zero average) is modeled by $d = 0$
- linear trend (i.e. linear growth behavior) is modeled by $d = 1$
- quadratic trend (i.e. quadratic growth behavior) is modeled by $d = 2$

The error term ϵ_t are generally assumed to be independent, identical distribution variable sample from a normal distribution with zero mean. t = 1, 2, ------------, n. Where 'μ' is the constant term, it is the average difference in y; α_i is the parameters of autoregressive part of model; Θ_i are the parameters of moving average part; ϵ_t are error terms. Under the random walk model, ARIMA model is (0, 1, 0) where future values of share return s cannot be determined on the basis of past information. For our study purposes we let $\{y_t\} = PI_t$

4. Empirical analysis and Findings

4.1 Tests for Normal Distribution

One of the basic assumptions for testing the random walk model and therefore, EMH is that return series should be normal. If the series is not normal, it has to be transformed into a normal series either through log transformation or difference. The test of normality is done through Q-Q probability chart, Kolmogrov-Smirnov Goodness of Fit test. From Table -1, it can be clearly concluded that the variability between the indices are not similar. The skewness for ASPI is near to unity and DSEGI shows more than the unity. It is evident that for a distribution following a normal distribution, the skewness should be zero. Also in a Gaussian distribution, one expect that the data to have a kurtosis coefficient of 2.902. Kurtosis indicates the extent to which, for a given standard deviation, observations cluster around a central point. The Values of Kurtosis for both indices are much higher. The returns of both ASPI and DSEGI are leptokurtic (the cases within a distribution cluster more than those in the normal distribution that is more peaked).

To confirm the normality pattern of stock market return series Q –Q plots are drawn for both indices (Figure 1 and Figure 2). The Data do not cluster around the straight line. So it can be conclude that the both the indices follows the non- normality patterns. Additionally Kolmogrov Smirnov Goodness of Fitness test is used to provide further evidence on normality test for return series of ASPI and DSEGI (Table -2). The two-tailed significance of the test statistic is very small (.000), meaning it is significant. From the test statistic it is clearly evident that a 0.000 probability for the Z indicates that the daily return series do not fit to normal distribution.

4.2 Tests for Serial Dependence

The Serial correlation coefficient measure the relationship between a random variables at time‘t’ and its value in the previous pried. The Durbin- Watson and Autocorrelation are reliable measure for testing of dependence/ independence of random variable in a series. If the test statistics is two or near to two then the series have no autocorrelation (Table 3). The results of Durbin- Watson test statistics show that both the indices have significant autocorrelation for each stock return series, which indicates the non random nature of series and reject the null hypothesis.

The Autocorrelation test evident the ACF’s whether significantly different form zero. We compute the first order autocorrelation and return series of both ASPI and DSEGI show strong presence of non-zero auto correlation. Figure 3 and Figure 4 showing the ACF Market Return Series for Both Indices. By referring to Figure 3 and Figure 4, it is clearly evident (ACF) that there is significant positive auto correlation presence on first lag for both indices. As we know if no auto correlations are found in a series the series is said to be purely random (Poshakwale 1996). The Ljung-Box Q statistics, significant at 5% level, with degrees of freedom of 30 (lags) shows that the return series do not follow the random walk model. All the probability falls below the level of 0.05. Rejecting the null hypothesis, we can conclude that the DSE return series is not random.

4.3 ARIMA (Auto Regressive Integrated Moving Average)

Under the random walk model, the ARIMA model needs to be fitted in to (0, 1, 0). The results of ARIMA are presented in the Table 4 evident that the return series for both indices are highly insignificant. For ARIMA (0, 1, 0) the coefficient (0.0000002 and 0.000005) with T-ratio of (0.00917 and 0.01372) reject the null hypothesis with a probability of 0.99 for both indices. For ARIMA (1, 0, 1) the estimated values for AR1 and MA1 are found best fitted model for 1% level of significance. Additionally ARIMA (1, 0, 0) is to calculated for both indices to examine the auto- regression coefficient is equal to unity. The Auto regression is equal to unity indicates the changes of return form one period to another due to current disturbance terms. The coefficient showing for both indices AR1 (0.171 and 0.071) indicates the changes in the return series do not depend on past information.

5. Conclusion

This study was designed to provide evidence on weak form of efficiency concentrating on following the random walk model for Dhaka Stock Exchange. The results of the study conclude that the return series of both indices of Dhaka Stock Exchange do not follow the normal distribution; the result is further confirmed by K-S test, which is against the random walk model. The result of serial correlation and auto correlation test also indicates the non random nature of return series for both indices. Lastly, ARIMA (time series) forecasting strengthens the non-random nature of Dhaka stock Exchange. The resulting situation by rejecting the hypothesis would be that the investors can not gain a fair return by holding a well diversified portfolio. Along with this reason there are other factors such as weak regulation, lack of supervision, lack of market transparency which may influence the efficiency level of capital market; even recent market scam report also indicate these factors as vital for stock market crashes.

References

A.C.Worthington. H.Higgs. Weak-Form Market Efficiency in Asian Emerging and Developed Equity Markets: Comparative Tests of Random Walk Behavior. [Online] Available: *http://ro.uow.edu.au/commpapers/114*.

Alam Md. Mahmudul, Yasmin Shakila, Rahman Mahmudur and Uddin Md. Gazi Salah. (2011). Effect of Policy Reforms on Market Efficiency: Evidence from Dhaka Stock Exchange. *Hindawi Publishing Corporation, Economic Research International*, Volume 2011, Article ID 864940, 8 pages.

Chakraborty, M. (2006). Market Efficiency for Pakistan Stock Market: Evidence from Karachi Stock Exchange. *South Asia Economic Journal*, 7, no.1, pp.67-81. http://dx.doi.org/10.1177/139156140500700104

D' Agosgtino, Ralph B, Albert Belanger and Ralph B. D'Agustino Jr. (1990). A suggestion for using powerful and informative test of normality. *American Statistician,* 44(4).316-321.

Fama, E (1970). Efficeint Capital Market: A Review of theory and Empirical Work. *Journal of Finance*, 25, no.2, pp.387-417. http://dx.doi.org/10.2307/2325486

Fama, Eugene F. (1991). Efficient Capital Markets II. *Journal of Finance*, 46, pp.1575-1617. http://dx.doi.org/10.2307/2328565

Fishe, R., T.Gosnell and D.Lasser. (1993). Good news, bad news, volume and the Monday effect. *Journal of Business Finance & Accounting*, 20(6):881-92. http://dx.doi.org/10.1111/j.1468-5957.1993.tb00299

Hudson, Robert. Dempsey, Michael and Keasey, Kevin. (1994). A note on the weak form efficiency capital markets: The application of simple technical trading rules to UK stock price – 1935 to 1994. *Journal of Banking and Finance*, vol.20, pp.1121-1132. http://dx.doi.org/10.1016/0378-4266(95)00043-7

Hussain, T., Chakraborty, L., and Kabir, M. A. (2008). Is Dhaka Stock Exchange Efficient? An application of Technical Trading Rule. *International Conference on Recent Development in Statistical Sciences (ICSS)*, BCFCC, Dhaka, Bangladesh.

Lakonishok, J., and S. Smidt. (1988). Are seasonal Anomalies Real? A Ninety Year Perspective. *Review of Financial Studies*, 1(4):402-25. http://dx.doi.org/10.1093/rfs/1.4.403

Mills, Terence C. (1990). *Time Series Techniques for Economist.* Cambridge University Press.

Mobarek Asma, Mollah A. Sabur., & Bhuyan Rafiqul. (2008). Market efficiency in Emerging Stock Market: Evidence from Bangladesh. *Journal of Emerging Market Finance*, 7:17-41. http://dx.doi.org/10.1177/097265270700700102

Nicolaas Groenewold. (1997). Share market efficiency: Test using daily data for Australia and New Zealand. *Applied financial Economics*, vol.7. pp.645-657. http://dx.doi.org/10.1080/758533856

Nourrendine Khababa. (1998). Behavior of stock prices in the Saudi Arabian Financial Market: Empirical research findings. *Journal of Financial Management & Analysis*, Volume 11(1), Jan-June, pp.48-55.

Poshakwale S. (1996). Evidence on the Weak-form efficiency and the day of the week effect in the Indian Stock Market. *Journal of Business Finance and Accounting*, Volume 5(2), pp.223-232.

Strong, N. (1992). Modeling Abnormal Returns: A Review Article. *Journal of Business Finance and Accounting*, 19(4):533-53. http://dx.doi.org/10.1111/j.1468-5957.1992.tb00643

Table 1. Descriptive Statistics

Statistic	All Share Price Index (ASPI)	DSE General Index (DSEGI)
N	4363	2433
Mean	0.000528	0.000831
S.D.	0.01597	0.014
Skewness	0.859 (0.037)	1.238 (0.050)
Kurtosis	44.918 (0.074)	28.209 (0.099)
Variable : Daily Market Return Series for ASPI and DSEGI		

Table 2. Kolmogrov Smirnov Test of Normality for Daily Market Return Series

Selected Index	Extreme Differences			K-S Statistic (Z)	Asymp. Sig (2tailed)
	Absolute	Positive	Negative		
ASPI	0.099	0.091	-0.099	12.201	0.000
DSEGI	o.185	0.170	-0.185	4.907	0.000

*at 5% level of significance.

Table 3. Durbin-Watson Test Statistics

Selected Index	Test Statistics
ASPI	1.65
DSEGI	1.85

Table 4. ARIMA test statistics

Selected Index	**Model**	**Parameters**	**Coefficient**	**Standard Error**	**T-Statistics**	**Probability**
ASPI	(0,1,0)	Constant	0.000002	0.00031	0.00917	0.9926
	(1,0,1)	AR1	-0.19298	0.07397	-2.60865	0.00912
		MA1	-0.37930	0.069767	-5.43667	0.00001
		Constant	0.00052	0.000274	1.9282	0.05389
	(1,0,0)	AR1	0.17121	0.014920	11.4748	0.0000
		Constant	0.000529	0.000287	1.84099	0.06569
DSEGI	(0,1,0)	Constant	0.000005	0.00039	0.01372	0.98910
	(1,0,1)	AR1	-0.46112	0.15501	-2.9747	0.00296
		MA1	-0.54803	0.14613	-3.7502	0.00018
		Constant	0.000830	0.00029	2.7730	0.00559
	(1,0,0)	AR1	0.071067	0.02023	3.5123	0.00045
		Constant	0.00083	0.00030	2.7250	0.00647

*at 1% level of significant

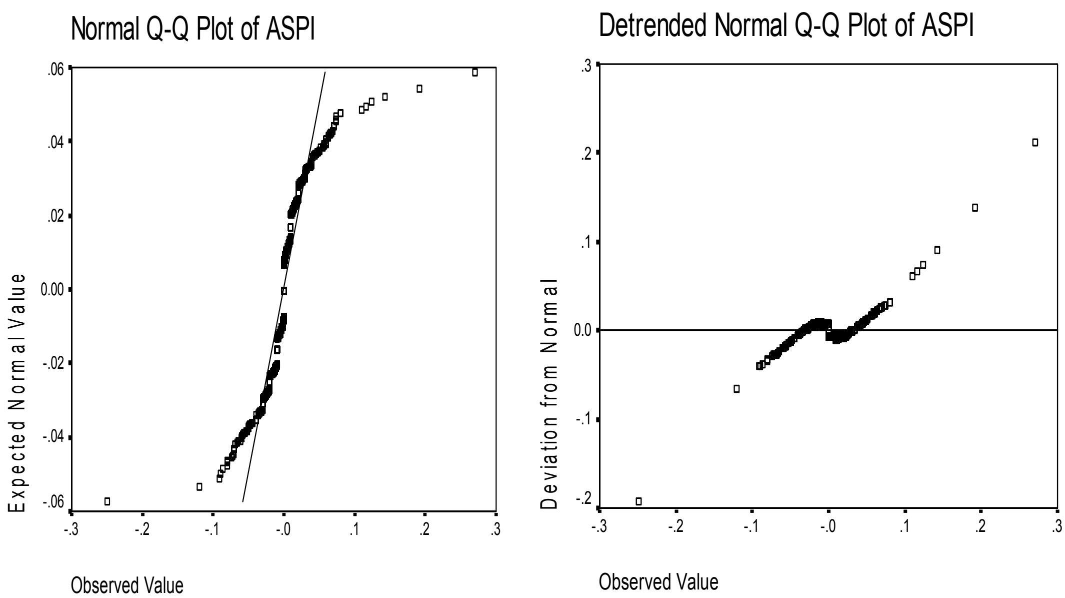

Figure 1. Q-Q plots of Daily Market Return Series of All Share Price Index

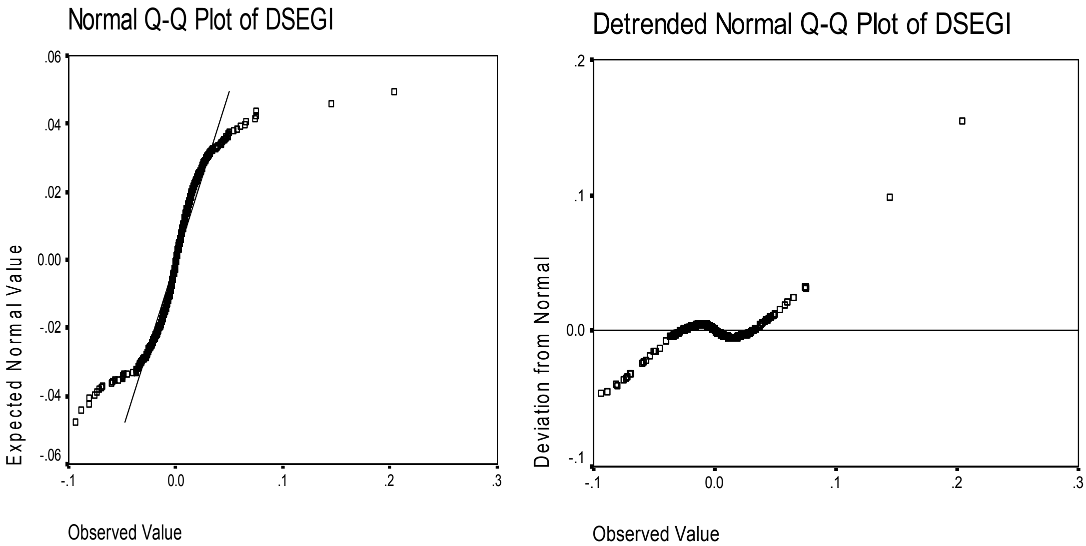

Figure 2. Q-Q plots of Daily Market Return Series of DSE General Index

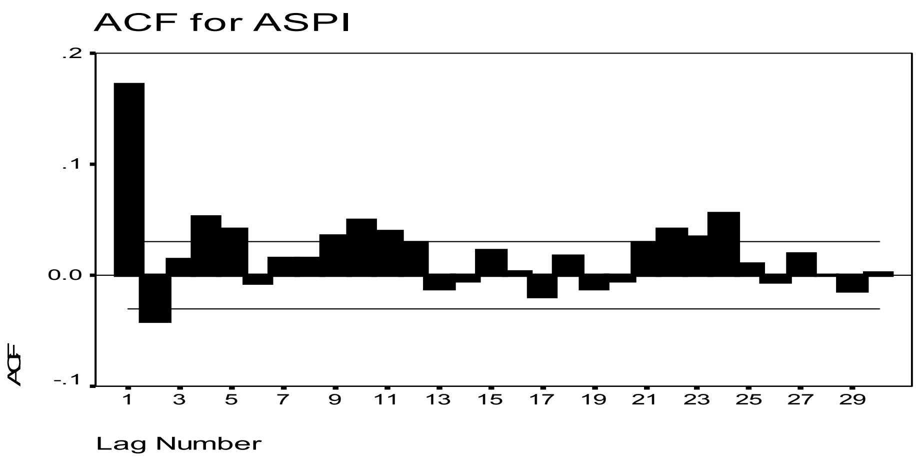

Figure 3. ACF of Market Return Series for All Share Price Index

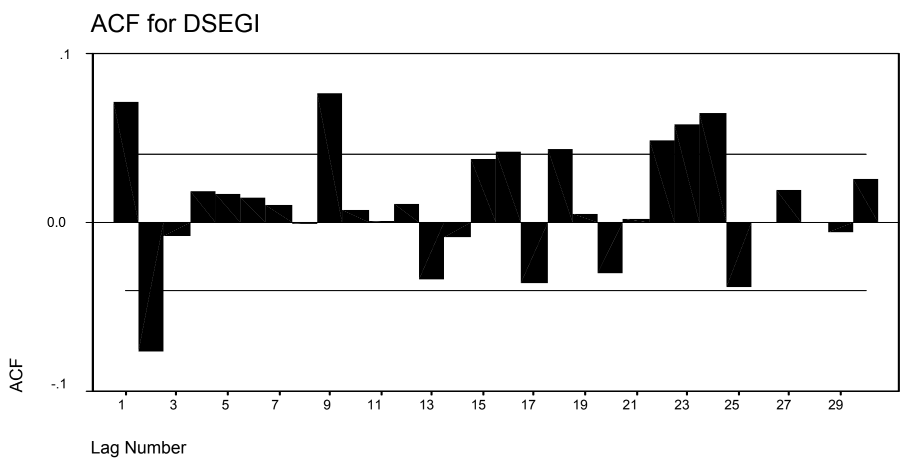

Figure 4. ACF of Market Return Series for DSE General Index