

MARKET EFFICIENCY IN EMERGING STOCK MARKETS: THE CASE OF DHAKA STOCK EXCHANGE (DSE)

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1. Introduction

Stock price behavior has long been of interest to researchers, economists and investors because of its implications on capital formation, wealth distribution and investors' rationality. Creation of wealth depends on the optimal allocation of investment capital. This allocation is most likely to be attained through securities markets. In this regard Keane (1983) has noted: 'If security prices can be relied upon to reflect the economic signals which the market receives then they can also be looked to in turn to provide useful signals to both suppliers and users of capital, the former for the purposes of constructing their investment portfolios, and the latter for establishing criteria for the efficient disposition of the funds at their disposal. it is important therefore to know whether the market's pricing mechanism is reliable, because, to the extent that it is, a set of decision-rules significantly different from those which are customarily advocated amongst market participators can be shown to be appropriate.' Accordingly, jargon of literatures has focused on the issue. Financial economists agree about the facts that the asset prices are volatile and that the volatility and returns are predictable over time. Although the sources of volatility are frequently found to be elusive, the role played by various information is of paramount importance. Thus, the concept of market efficiency based on the idea of incorporating information into the price has frequently been discussed by Fama (1970) and other researchers.

Emerging capital markets have become increasingly important in an international investment scene for their contribution in diversification. Some studies (e.g., Errunza, 1983; Divercha *et al.*, 1992; Wicox, 1992; Oppong, 1993) indicate that foreign equity investment in these markets has increased significantly in recent times. The number of international Emerging Market Funds and the volume of cross-border portfolio investment in emerging markets have increased substantially during 1990s (Calderon-Rossell, 1995). The weight of emerging markets capitalization in the total world capitalization has increased dramatically from 1% in 1985 to 13% in 1994 (IFC, 1995). While interest from investors in these markets has been growing, relatively very little research has been undertaken on these markets. More so is the case for Bangladesh stock market. There is a dearth of research on Bangladesh stock market efficiency. In view of the growing interest of foreign fund managers towards entering these markets the need for such studies can hardly be overemphasized. Accordingly, attempts have been made to fill up this gap by investigating the stock price behavior in Bangladesh market, which possesses most of the characteristics found in emerging markets

around the world. It is relatively thin with many inactive stocks. Market capitalization in relation to GDP and the number of stock investors in relation to total population are very small. Thus, indirect financing and a weak domestic capital base are dominating the capital market scene. Trading in the markets is subject to some regulations that insulate the exchange from competition from foreign investors. All these have effect on market efficiency.

Thus, the aim of this study is to examine the behavior of stock prices and to seek evidence supporting the existence of efficiency level using Ljung-Box statistic for the stocks traded on the DSE. It has particular relevance because the government efforts to develop the market since the early 1990s have significantly increased and the market size and activities have shown spectacular rise.

2. Concept of Efficient Market Hypothesis

Stock market efficiency considers the extent to which the price discovery process on a stock market is able to assign accurate relative values to the listed securities. This is important because these value rankings ensure channeling the rational savings to their most efficient users. Thus the effectiveness of price discovery process of the stock market determines the extent to which national savings are channeled to their most efficient users and enhances national economic growth. It follows that a stock market is said to be efficient if it speedily and correctly incorporates all the available and pertinent information into its prices (Fama, 1991). The quick adjustment of prices to any new information about the fundamentals of the listed companies ensures that no single investor, or group of investors, can repeatedly make abnormal returns on a market by using the same information set. This is because such information will have already been incorporated into the prices (Fama, 1965). The body of knowledge that explains the way in which market traders incorporate new information into prices is called Pricing Efficiency or the Efficient Market Hypothesis (EMH). There are three levels of EMH and they are Weak, Semistrong, and Strong Forms of Efficiency. A market is weak form efficient if prices on it speedily adjust to historic information. On such a market, one can't predict current returns from past ones. On a semi strong form of efficient market, the prices reflect all current and publicly available information. And in a strong form efficient market, the prices incorporate all available information; regardless of whether such information is public or private. Recently, Fama (1991) has

reclassified the market efficiency studies into three categories. The first category consists of the tests of returns predictability, the second group contains the event studies and the third group contains tests for private information.

Finance theory generally assumes that there are no transaction costs, that all information is freely available and there is usual agreement on what that information means in describing market efficiency. Such a market does not exist in real world situation. However, they are relaxable in view of the realities and other conditions may be considered sufficient in order to enable the price of a security to fully reflect available information. The dominant necessary condition for an efficient market is the existence of investors, security analysts, brokers, financial journalists and market observers who are numerous, motivated and competent. They are supposed to discover which stocks are overvalued and which are undervalued. In their efforts to compete for information they make the current price to be at least close to the intrinsic price of securities. The absence of perfect conditions for efficiency in real world provides potential sources of inefficiency. Investors, therefore, try to find out overvalued and undervalued securities.

In an efficient market relevant information for pricing securities is rapidly reflected in the price of those securities. The market price is a good estimate of intrinsic value and additional security analysis is not supposed to produce returns better than a buy and hold strategy. It is often said that an efficient market is a fair market. That is, investors are not expected to continuously over- or underperform the market other than by laws of chance. If a price is too high, owners of those securities tend to sell but new investors are hesitant to buy at such high price and thereby presses the price downward. The opposite will happen when price is too low. In an efficient market there is no reward for research. However, depending upon the type of information used by investors efficient markets are divided into three levels mentioned above.

3. Some Related Works

We know the classification of market efficiency did not emerge until 1959 (Robert, 1959). Thereafter, we see a large volume of literatures on the subject using different models. The most general of these models is the 'fair game' model. The 'submartingale' and 'random walk' models are two special cases of the fair game

model. The submartingale model shows that the expected values of tomorrow's share price in an efficient market should be equal to or greater than today's price. The random walk model, more familiar in the area of efficient market research explains market efficiency in terms of lack of dependence between successive price movements.

According to Verrecchia (1979) the number of active traders affects market efficiency. Frequency of transactions also influences market efficiency (Goldman and Sosim, 1979). Hong (1978) reported that market size separated the more efficient from the less efficient markets in Asia. Palacios (1975) found that the ability of the mutual fund to beat the market over time decreased seems to be due to the activities of more security analysts employed by the same mutual funds. In smaller markets it may be easier for large traders to manipulate the market as privileged information channels exist, market thinness makes it hard for traders to gain from new information and there is often infrequent trading (Ang and Pohlman, 1978; Roux and Gilbertson, 1978; Sharma and Kennedy, 1977). Ang and Pohlman (1978) compared exchanges in Hong Kong, Japan, Philippines, Singapore and Australia with European exchanges of Solnik (1973). Although the Far Eastern exchanges are generally believed to be less developed than European exchanges, their price dependencies measured by serial correlations were similar to those of European stocks. The degree of organization may not be a requisite for an efficient market, they added. Sharma and Kennedy (1977) found little difference between stock price behavior of the Bombay Stock Exchange and those of London and New York Stock Exchanges.

The general consensus of a large number of studies of market efficiency is that the world's major exchanges, mainly New York Stock Exchange (NYSE) and London, are efficient markets in the weak form, and usually in the semi strong form (Fama *et al.*, 1969). According to them, market efficiency and asset pricing models are inseparable joint hypotheses and therefore are not testable. Rationality is not likely to be established by existing return predictability tests as a result of the joint hypothesis problem. He mentioned that event studies provide the most direct supportive evidence on market efficiency while evidence from tests for private information is not clear and clouded by the joint hypothesis problem. Less clear-cut are the findings of studies for the less developed exchanges including Europe (Solnik, 1973), Norway and Sweden (Jennergren, 1975; Jennergren and Korsvold 1975), Spain (Palacios, 1975), Singapore (D'Ambrosio, 1980), Europe, Asia and America (Sharma and Kennedy,

1977) and Kuala Lumpur and Hong Kong (Dawson, 1981, 1984). Some of these studies for the smaller exchanges find evidence of market efficiency while others do not. Weak form efficiency is more likely to be detected than strong or semi strong form of efficiency. Common explanations for the less frequent findings of market efficiency include less stringent information disclosure requirements, the lower technical organization of the smaller markets where information distributors, such as ticker tapes, may be absent, less information released by companies and less rigorous account regulation. Cooper (1983) and Ayadi and Pyun (1994) have carried out major studies on the market efficiency of Korean stock markets using serial correlation test, runs test and variance ratio test. The results show that the Korean stock market is efficient in the weak and semi strong forms. More recent studies on market efficiency are also found in the literatures. Matome (1998) uses Ljung-Box statistic and variance-ratio tests for Namibian stock market. It provides evidence that the return data suffers severe heteroscedasticity and the results suggest weak form of efficiency. Das (1998) examined the Indian stock market efficiency and found the presence of long memory in daily, weekly and monthly stock returns implying inefficiency of the market. He applies a modified R/S (rescaled range) technique suggested by Lo (1991).

As far as Bangladesh stock market is concerned Chowdhury (1994) provides some evidence of positive autocorrelation and conditional heteroscedasticity. But he has considered the daily data only and the period covered is from December 1988 to May 1994. In this paper we have considered daily, weekly and monthly data and covered the period from January 1990 through April 2001.

4. Microstructure of Bangladesh Stock Market

Bangladesh stock markets are represented by two stock exchanges, viz., Dhaka Stock Exchange (DSE) and Chittagong Stock Exchange (CSE). Both DSE and CSE are corporate bodies under Companies Act 1994. Although DSE was first established in 1954, its activities were suspended for a brief period from 1971 to 1976 due to introduction of a socialistic approach of development during this period. DSE resumed its activities in the middle of 1976 with the change of government policy. DSE started functioning with 9 listed companies in 1976, however, the number has reached to 224 on 30 June 2001. CSE started its activities only recently in 1995. It is observed that CSE follows the tone and temperament of DSE. We have selected DSE for our

investigation considering its size and dominance in the securities markets of Bangladesh.

The Bangladesh government intended to open the capital market to foreign participation in order to attract foreign capital since 1994 along with easy convertibility of Taka into foreign currency. Investors were allowed to portfolio investment like the domestic investors. Government owned corporations are being privatized for the last decade although at a slow pace. Ahmed (2000) examined some statistical variable to show the spectacular growth of the DSE. Basically the growth of the market has been orchestrated by the government through various policies and programs.

Trading is conducted by the broker-members of the stock exchanges in Bangladesh. In order to execute an order to buy or sell securities on behalf of his client, a broker is supposed to provide services at the time of executing a sell order as well as provide services and funds for a buy order for commission. Thus, the stock markets in Bangladesh predominantly operate through the agents without any responsible market makers. The members of the DSE do not operate margin accounts for general investors. There is no provision in the Bye-laws of the Exchange for undertaking market making roles.

All securities traded on the stock exchange are subject to daily price limitations in an attempt to discourage speculative investors. The exchange sets maximum upper and lower limits on daily price movements and transactions by large shareholders. Sometimes, Securities and Exchange Commission (SEC) of Bangladesh also interferes in this process through regulating DSE activities. This practice can cause truncated returns and thus delay the effect of new information on stock prices.

Margin trading is limited to securities listed on the stock exchange and strictly guided. Margin requirements are changed from time to time as a tool for regulating the demand for stocks. The government also uses tax policy to regulate trading activities in the market. Within the provision of tax law, dividend and interest paid to investors are subject to withholding tax. Capital gains are exempted from tax if it is reinvested within certain period.

The market operates through 'an open outcry' with broker-members seated around a table with no access to outsiders. Dealing prices are recorded with a chalk on a black board by a member of the stock exchange staff. By the standards of large stock exchanges in developed countries, the technology is simple and not subject to

technological failure. For a market of this size, the trading arrangements can, by and large, serve the purpose. However, computerization of trading system and introduction of a central depository system (CDS) are going to be implemented. In view of the growing size of the market, frequent allegations about the market manipulation, and recent upsurges followed by sharp downswings, the credibility of the system as a whole has been brought into question. It is expected that computerization of the trading system and introduction of a CDS can bring improvement of the situation. Since physical delivery of share certificates is not permitted under CDS, people will be discouraged to go to the kerb market and thereby the dominance of this market is expected to be reduced to a large extent. Order flows are generated, although at least partially, by subtle interactions of human activities on the floor, including behavior of the rivals, floor atmosphere, floor gossips and so on. All these can hardly be held by computer implying 'overshooting' or 'undershooting' in prices if traders are just reacting to price moves on the screen without well understanding the reasons behind such moves. The system, therefore, needs to combine the advantages of the technology - efficiency, accuracy and speed - with those of human interaction, visibility and information exchangeability on the trading floor so that better market coordination with less price volatility can be ensured.

The widespread view is that most of the equities are tightly held by the families, relatives and friends. The shares of Multinational Companies (MNCs) are owned by foreign parents and government who usually tend to decline to sell their shares in the local markets. Different informal estimates suggest that between 50-70% of equity is tightly held by families, relatives and friends. Institutions appear to be less dominant in stock exchange trading, although no reliable figures are available. According to informal estimates this share accounts for about 20% (Ahmed, 2000). Anyway, all these estimates should be treated with caution.

Table 1: Market capitalization and turnover (In million Taka)

Year	Market capitalization (year end)	Turnover	Turnover: market capitalization (%)
1984-85	2,256		
1985-86	3,493	34.3	0.98
1986-87	5,731	152.4	2.66
1987-88	12,671	120.8	0.95
1988-89	13,557	154.3	1.14
1989-90	12,018	187.7	1.56
1990-91	10,775	100.4	0.93
1991-92	12,879	261.0	2.03
1992-93	15,391	403.6	2.62
1993-94	31,992	2,442.9	7.64
1994-95	47,890	4,660.8	9.73
1995-96	65,026	8,199.1	12.61
1996-97	105,018	35,413.5	33.72
1997-98	60,527	12,616.9	20.85
1998-99	49,065	51,893.8	105.75
1999-00	54,004	27,696.0	51.29
2000-01	72,168	49,094.0	68.03

Source: Compiled from DSE Monthly Review, various issues.

Market activities can be visualized from the following Tables. Year wise market capitalization and turnovers are presented at Table 1. Market capitalization also include corporate bonds and mutual funds which are very limited in number and preference shares are yet to be issued by any company. It appears that the ratio between market capitalization and turnover has been below 3 till 1992-93. However, rapid growth of turnover is observed in 1993-94 and since then it is more than 7. The Table gives the impression that the Bangladesh markets maintain a low ratio of market capitalization and turnover in general compared with other emerging markets. Besides, total market capitalization of DSE was \$1.04 billion while it was \$ 127.51 billion for India, \$12.26 billion for Pakistan, \$191.78 billion for South Korea and \$ 199.28 billion in Malaysia (Emerging Stock Market Fact Book, IFC, 1995). These low figures suggest a small share of equity markets and a low level of market activity. In more recent years the ratio is significantly increasing. It is as high as more than 105% in 1998-99. Introduction of netting system in trading is believed to be one of the main reasons behind this.

Table 2: Trends of transaction volume (Figures in thousand)

Year	Volume		Value	
	No. of shares and debentures	Annual growth (%)	Amount in Taka	Annual growth (%)
1984-85	380	-	22,510	-
1985-86	670	76.32	34,375	52.71
1986-87	1,929	187.91	152,445	343.47
1987-88	1,077	-44.17	120,877	-20.71
1988-89	1,666	54.69	154,366	27.70
1989-90	2,693	61.64	187,783	21.65
1990-91	2,251	-16.41	141,289	-24.76
1991-92	3,824	69.88	261,077	84.78
1992-93	4,319	12.94	403,608	54.59
1993-94	11,560	167.65	2,442,873	505.26
1994-95	25,947	124.45	4,660,800	90.79
1995-96	44,799	72.66	8,199,095	75.92
1996-97	119,313	166.33	35,413,534	331.92
1997-98	98,292	-17.62	12,616,940	-64.37
1998-99	1,331,246	1,254.38	51,893,777	311.30
1999-00	657,985	50.57	27,696,000	46.63
2000-01	1,088,537	65.43	49,094,000	77.26

Source: Compiled from DSE Monthly Review, various issues.

Table 2 provides the statistics of annual volume and value of transactions in DSE. It is to be kept in mind that a considerable volume of transactions will be 'forced sales' for meeting some investors' need for cash. The rest may be considered in response to the changing risk (market and unique) perceptions of the investors. As Table 2 shows, transactions, both in terms of volume and value, have recorded a phenomenal upsurge in most of the years except 1987-88, 1990-91 and 1997-98. The average annual rate of increases in value is much higher than that of volume. The years 1986-87, 1993-94, 1996-97 and 1998-99 recorded an increase of more than 300% of their respective preceding years in terms of value although the rate of increases is less than 200% in most cases except 1998-99 in terms of volume. The implication is that in the years of rapid upswing in the stock market, the price of stock rises more than the volume. On the other hand, the downswing in price may entail larger volume than price increase. However, stock price manipulations are also found frequently associated with these situations.

5. Model Specification and Data Source

This study concentrates on investigating the successive price dependence on DSE via testing for the presence of 'weak form efficiency' of EMH. This is because the characteristics of the microstructure of such emerging markets are likely to render it either weak form inefficient or, only just (marginally) efficient in the weak sense (Barnes, 1986). Accordingly, the null hypothesis is:

$$\begin{array}{ll} H_N & \rho = 0 \\ H_A & \rho \neq 0 \end{array}$$

This means that we are investigating the extent to which successive price changes are independent of one another. Beginning by investigating this lowest level of efficiency appears to be logically premised (Matome, 1998).

For the purpose of this study DSE index data was collected for the period from January 1990 through April 2001. We have estimated the results for a full period in Table 3. In order to test the consistency of the results we have broken the sample period into two and performed Ljung-Box (LB) statistic for each sub-period. The first sub-period is from January 1990 through December 1994 while the second sub-period runs from January 1995 through April 2001. These results are presented in Table 4 and Table 5 respectively. We have trimmed the index data for the period of 9 months from August 1996 through April 1997 due to abnormal market behavior during this period. Accordingly, the number of observations for daily index for 3 sample periods is 2737, 1308 and 1429 respectively. The number of observations for weekly data for these three periods is 543, 259 and 284 while that of the monthly observations are 125, 59 and 66 respectively. We have considered up to 30 lags for daily data and 10 lags for weekly and monthly data. The data used in this study are the first differences of the natural logarithms of the daily, weekly and monthly levels of DSE Overall Index. We have used natural logarithm rather than the absolute value of the index because such approach is recommended by several other studies (Fama, 1995; Lo and MacKinlay, 1988; Cochran and DeFina, 1995 and Strong, 1992). Thus, the return series is calculated as

$$R_t = \ln P_t - \ln P_{t-1} \quad (1)$$

where $\ln P_t$ and $\ln P_{t-1}$ are the natural logarithms at the end of periods 't' and 't-1' respectively.

Price index data without adjusting dividends is used for 'total return' due to lack of such data. Other studies in this area that followed such approach include Cooper (1982), Cochran and DeFina (1995) and Matome (1998). Emerging markets like Bangladesh are mainly considered 'capital gains' markets because of the exceptionally low dividend yields in these markets in general (Matome, 1998). The daily closing index is used to calculate R_t and the weekly index levels used in this study are the Thursday closing levels for the stated period. The monthly data are constituted by the index value of the last working day of the month.

Ljung-Box Statistic: As noted earlier the econometric test applied in this study is the Ljung-Box (LB) test that was developed in 1978. This test is an improvement on the Box-Pierce Q Statistic of 1970. The LB test statistic sets out to investigate whether a set of correlation coefficients calculated at various lags for a returns time series may be deemed to be simultaneously equal to zero (Gujarati, 1995). This LB statistic is based on autocorrelation coefficients. The k-th order autocorrelation function (ACF) is

$$\rho_k = \frac{\delta_k}{\delta_0}$$

$$\Rightarrow \rho_k = \frac{\text{Covariance at lag } k}{\text{Variance}} \quad (2)$$

Since both covariance and variance are measured in the same units of measurement, ρ_k is unit less, or, pure number. It lies between -1 and $+1$, as any correlation coefficient does. The covariance at lag k and the variance can be computed as follows:

$$\delta_k = \frac{\sum_{t=1}^n (R_t - \bar{R})(R_{t+k} - \bar{R})}{n-1} \quad (3)$$

and

$$\delta_0 = \frac{\sum_{t=1}^n (R_t - \bar{R})^2}{n-1} \quad (4)$$

where, R_t is the return over period "t";

R_{t+k} is the return for the period that comes k-holding periods after period "t";

\bar{R} is the mean return of the period over which the LB statistic is being computed.

The ACFs calculated at each lag are then compared to the critical values for the 5% level of significance. This is to establish whether the individually calculated ACFs are statistically significant. The critical values for a 95% confidence interval calculated are as follows:

$$CL = \frac{1}{\sqrt{n}} \pm 1.96 \quad (5)$$

where n is the total number of observations used in calculating the ACFs and $1/n$ is the standard error.

Thus, if the ACF for the lag length falls outside the interval, then that value is deemed to be statistically significant, meaning that the successive returns in the series are not independent of one another.

The model used for calculating the Ljung –Box test statistic is given below:

$$LB = n(n+2) \sum_{k=1}^m \left[\frac{\rho_k^2}{n-k} \right] \quad (6)$$

where n is the total number of returns observations used;
 k is the lag length for which the ACF is calculated;

ρ_k	is the k-th order ACF of the return series;
m	is the maximum lag-length employed in the calculation of the statistic.

The L. B. statistic follows a chi-square distribution with m degrees of freedom. If the computed LB statistic exceeds the critical value from the chi-square table at the chosen level of significance, one can reject the null hypothesis that all ρ_k are all zero; at least some of them are non-zero.

Since this test is easy to understand and used in other studies on emerging markets, it is more acceptable. Besides, it is non-parametric (Ljung and Box, 1978). Added to these, the data from such relatively small emerging markets has been found not to conform to a normal distribution (Roux and Gibertson, 1978). All these reasoning have motivated us to use it.

6. Analysis and Interpretation of Results

First we discuss the result for the full sample period from January 1990 through April 2001 in Table 3. In this Table we see that the computed LB statistic is 106.62 for daily, 8.37 for weekly and 6.04 for monthly data. Since all these values are significantly greater than the relevant critical values, the results reject the null hypothesis at 95% confidence level that the overall ACF is zero.

Table 3: Results for Ljung-Box Tests on the DSE Daily, Weekly and Monthly Data for the Period from January 1990 to April 2001

Return Horizon	Observations	LB	Four Highest ACF				Lowest ACF	ACF Sign		No. of significant ACF
			1 st	2 nd	3 rd	4 th		+ve	-ve	
Daily Data	2737	106.62	L2 -.154	L1 -.083	L12 -.05	L4 .041	L3 -.001	15	15	4
Weekly Data	543	8.37	L3 -.088	L1 .049	L9 .052	L2 -.041	L10 .002	7	3	1
Monthly Data	125	6.04	L8 .106	L9 .101	L1 -.097	L5 .075	L7 -.002	5	5	0

LB: Estimated Ljung-Box Statistic

ACF: Autocorrelation coefficient factor

L1-30: Lag 1-30 (maximum number of Lag considered here is 10 for weekly and monthly data and 30 for daily data).

For daily data fifteen of the thirty ACFs have negative values and four of them are statistically significant. Among the significant values three are found to be negative. For weekly data seven of the ten ACFs have positive signs and one of them is found to be statistically significant, which is negative. As for monthly data five of the ten ACFs have positive signs. In this case there is no statistically significant value.

These findings indicate the behavior of Bangladesh stock prices can't be described as obeying the random walk theory, but rather that price behavior follows some dependencies. These may also suggest the possibility of most of the dependencies are adjusted before the completion of a month.

The LB test results of the first sub-period and second sub-period are presented in Table 4 and 5 respectively. Although the LB statistic rejects the null hypothesis in all periods, the test produces mixed results with respect to the signs of ACFs. In the first sub-period from 1990 through 1994 the null hypothesis is rejected in all return horizons. This means that the rejection of the null hypothesis is due to autocorrelation in the data. The number of positive values of ACFs is seventeen out of thirty for daily, seven out of ten for weekly and eight out of ten for monthly data in this period. Among the four highest ACFs, dominance of positive values is observed. For daily data five values are found to be statistically significant and three are positive among them. For weekly data one value is found statistically significant, which is also positive.

Table 4: Results for Ljung-Box Tests on the DSE Daily, Weekly and Monthly Data for the Period from January 1990 to December 1994

Return Horizon	Observations	LB	Four Highest ACF				Lowest ACF	ACF Sign		No. of significant ACF
			1 st	2 nd	3 rd	4 th		+ve	-ve	
Daily Data	1308	107.90	L1 -.227	L10 .09	L2 .053	L21 -.052	L3 .001	17	13	5
Weekly Data	259	23.72	L1 259	L9 .113	L2 .059	L3 .049	L5 .008	7	3	1
Monthly Data	59	6.69	L7 .174	L4 -.162	L1 -.127	L10 .088	L6 .033	8	2	0

Unlike the first period negative ACEs dominate the second period. The results of this period are consistent with the full sample period discussed above. The predominance of negative ACFs implies a strong possibility of over-reaction or over-shooting behavior in the stock market (Matome, 1998). The dominance of negative autocorrelation function also indicates the mean reversion behavior of security price

return. This shows the changing market behavior with the passage of time. The changing market behavior may be attributed to the introduction of different policy measures emphasizing the market economy promoting private sectors, particularly liberalizing the capital markets and encouraging foreign investors during the early 1990s¹.

Table 5: Results for Ljung-Box Tests on the DSE Daily, Weekly and Monthly Data for the Period from January 1995 to April 2001

Return Horizon	Observations	LB	Four Highest ACF				Lowest ACF	ACF Sign		No. of significant ACF
			1 st	2 nd	3 rd	4 th		+ve	-ve	
Daily Data	1429	100.71	L2 -.243	L12 -.073	L4 .049	L13 -.03	L10 00	12	18	3
Weekly Data	285	9.31	L3 -.142	L2 -.083	L1 -.035	L4 .03	L5 -.001	4	6	1
Monthly Data	66	8.76	L7 -.174	L6 -.147	L8 .141	L1 -.088	L10 -.009	4	6	0

We find relatively small values of LB statistic with respect to monthly and weekly data for different periods and relatively large values for daily data. This means that the level of weak form of efficiency is enhanced as the return horizon is increased. This means also that an increase in the level of return horizon permits more time for the fundamentals' information to be incorporated into prices. In other words, it may take close to one month (four weeks) for new information to be completely and correctly incorporated into prices. This is consistent with some other similar results for other emerging markets (Solnik, 1973 and Matome, 1998).

The economic interpretation of the results here is that autocorrelation is present in Bangladesh stock price series during these sample periods. Liu and He (1991) say that there are several alternative explanations for autocorrelation in time series like stock prices. They indicate that stock price overshooting and undershooting, risk aversion and government intervention in the market are possible explanations. According to Bark (1991) and Ayadi and Pyun (1994), theoretically, there are possibly two sources of spurious autocorrelation in our original data. The practice of setting

¹ Securities and Exchange Commission (SEC) Act, 1993; Securities and Exchange (Amendment) Act, 1993; Companies Act, 1994; easy convertibility of Taka and various other guidelines and regulations issued by the SEC are noteworthy.

price limits can induce autocorrelation in stock market data. The other source is from non-synchronous trading.

If we consider the results of the two sample periods (full period and second sub-period) the tabulated outcome shows that most of the statistically significant ACFs are negative. Accordingly, following Debondt and Thaler (1985), we can say that there is a possibility of 'contrarian investment strategies'² in DSE. But the result of the first sub-period shows dominance of positive ACFs. The significance of partial autocorrelation coefficients (PACFs) supports this finding. This PACF concept can be used to compare the daily, weekly and monthly return series output³. Month-end return is unlikely to reflect any information supplied at the beginning of the month because the information at a given time is adjusted within a month. Accordingly, monthly return seems to be independent of each other. Since the different sub-periods generate contradictory results, we cannot precisely claim that the 'contrarian investment strategies' will work in the market environment of DSE.

7. Concluding Remarks

This paper applies the test of LB statistic to investigate the behavior of stock prices listed on DSE for the period from January 1990 through April 2001. It is found that the random walk hypothesis is rejected at the 95% level of significance to the sample period as well as to the two sub-sample periods. Stock returns in Bangladesh are, therefore, predictable using past information. The tests suggest that they are due to autocorrelation. A further examination of LB test results provides evidence showing the predominance of negative values of autocorrelation for most of the highest four autocorrelations, especially for full period and second sub-period. However, the first sub-sample period is characterized with majority of positive autocorrelation in contrast

² The reversal effect (contrarian effect), in which losers rebound and winners fade back, suggests that the stock market overreacts to relevant news. After the overreaction is recognized, extreme investment performance is reversed.

³ The PACF measures the correlation between (time series) observations that are k time periods apart after controlling for correlations at intermediate lags value (i.e., lag less than k). In other words, PACF is the correlation between Y_t and Y_{t-k} after removing the effect of the intermediate lag between Y_t 's.

to other two periods. Anyway, the LB results for different time horizons (daily, weekly and monthly) show that the level of weak form efficiency is enhanced as the return horizon is increased. It means that it may take close of one month for new information to be completely incorporated into prices. Dominance of positive autocorrelations implies that rejection of random walk may be associated to the undershooting phenomenon while that of the negative values may be attributed to the overshooting. However, due to contradictory results for different sub-periods, 'contrarian investment strategies' may not precisely be considered to work effectively. This contradictory result may be attributed to some characteristics of emerging markets like Bangladesh. Sudweeks (1989) and Errunza *et al.* (1994) have shown that institutional investors trade infrequently in an emerging market. When they trade, they buy and sell in large volume influencing significant price changes. Moreover, with the liberalization of the market, foreign investors with their domestic counterparts may influence the prices usually at their advantage. The relative small size of the stock market and limited number of market participants are likely to constrain the free market play and thereby impacting on usual price behavior of the market and economic growth in Bangladesh.

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Abstract

This article examines the stock price behavior on the Dhaka Stock Exchange (DSE). This is done via tests of daily, weekly and monthly returns predictability on the Overall Index on this exchange. For this purpose the Ljung-Box statistic is used for the period from January 1990 through April 2001 and also for two sub-periods. The results indicate that the behavior of Bangladesh stock prices can't be described as obeying the random walk theory: rather they follow some dependencies. The first sub-period is characterized with positive autocorrelation in contrast to the second sub-period and full period where dominance of negative autocorrelation is observed. However, Ljung-Box statistic for different return horizons (daily, weekly and monthly) shows that the level of weak form efficiency is enhanced as the return horizon is increased. The results also suggest that it may take close to one month for new information to be completely incorporated into stock prices on DSE.