Market Proxies At BSE And Weak Form Efficiency

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INTRODUCTION

The Indian stock market has faced many challenges in last decade. **The efficiency of stock markets on all terms; operational efficiency, allocation efficiency and pricing efficiency; has increased during the financial sector reforms regime. The present study is confined to pricing efficiency, where the investors can earn purely risk-adjusted return from their investment and the stock prices are assumed to be moving in an unbiased manner.** The notion *"efficiency"* has been defined by many experts in different ways. The development of the theory of EMH took place in 1900, when **Bachelier** introduced the theoretical framework of EMH and he first modeled the random walk in security prices. Although his work did not get much attention, it took around 50 years to get his work rediscovered by various financial experts.

Fama (1965a) defined an *"efficient"* market as a market where there are large number of rational, profit-maximizers actively competing, with each trying to predict future market values of individual securities, and where important current information is almost freely available to all participants. **Formally, the efficient market hypothesis has been categorized into three forms on the basis of different information sets. (1)** The weak form of EMH asserts that prices fully reflect all information contained in the historical sequence of prices. Thus, an investor cannot devise an investment strategy to yield abnormal profits on the basis of an analysis of past price pattern (which is generally known as technical analysis). **(2)** The semi-strong form of EMH asserts that current stock prices reflect not only historical price information, but also all publicly available information relevant to the market as a whole or to any individual company's securities. If markets are efficient in this sense, then the analysis of historical performance, various corporate specific informations (earning disclosure, dividend announcements, announcements regarding bonus and stock-split, merger and takeover announcement, announcement regarding launch of new product etc.) and non-corporate announcements will not capitulate abnormal returns to the investors by devising a specific investment strategy. **(3)** The strong form of EMH affirms that all information that is known by any market participant is fully reflected in market prices. Therefore, even the insiders cannot make use of private information to develop superior investment strategy to earn abnormal returns.

The present study is destined to examine weak form of market efficiency on the Indian stock market. There are mixed evidences in the Indian stock market with respect to the prevalence of random behavior in the sequence of stock returns. The Bombay Stock Exchange has its own significance in the development of the Indian capital market. The other premier stock exchange in India is the National Stock Exchange. The present study has considered the market proxies at BSE to test the level of weak form efficiency in India for a study period of around ten years.

The next sections of the present study contain; Section-I contains An Overlook of the Bombay Stock Exchange, Section-II discusses the findings of Past Studies, Section-III contains Objectives and Hypothesis, Section-IV discusses the Research Methodology and Data Inputs, Section-V discusses the Empirical Evidences of Various Tests and, finally the Section-VI contains the Concluding Remarks.

I

AN OVERLOOK OF THE BOMBAY STOCK EXCHANGE

The Bombay Stock Exchange is the premier stock exchange in India and it is one of the fastest growing stock markets amongst the emerging markets. Further, it is also amongst the top 10 stock exchanges of the world. The market cap over the BSE has increased from 1, 75,093(₹ crore) in April 1993-94 to 71, 69,985 (₹ crore) in December 2007-08. [*Source RBI*]. Moreover, the total turnover over BSE has become five digits (at the time of initiation of

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reform regime) to seven digits (2007) [*Source: RBI*]. Further, during last decade, many structural changes have occurred in the Indian capital market to save the interest of common investors. The Security Exchange Board of India (SEBI) has put many rules and regulation to bring consistency and uniformity in the trading activities over the stock market. Many rules and by laws have been amended to increase the inflow of funds by foreign participants. The net investment by FIIs in the Indian capital market has increased from 422.23 (₹ Cr.) in December 1997 to 5054 (₹ cr.) in December 2007. [*Source: RBI*]. The traditional system of trading has been turned into an automated system. Further, to control the speculative activities and reduce the abnormal profits of the arbitrageurs, SEBI introduced the provision of rolling settlement for all stocks in January 2002, which reduced the number of delayed contracts resulting in increased liquidity over the stock exchanges and reduced risk for the investors. All changes were implemented to make the Indian stock exchanges equally compatible with global norms. When BSE is in its transitional phase, it requires relooking at the behavior of stock return sequence in its weak form. So, the present study is focused to examine the weak form efficiency of the BSE during the last decade.

II

FINDINGS OF PAST STUDIES

There are numerous studies available on the Efficient Market Hypothesis over the world markets. All of them have showed mixed results with regard to the existence of randomness in their stock returns over various phases of the market. A few of them have been cited as under. Early studies on testing weak form efficiency generally agree with the preposition of considering a low degree of serial correlation and transaction cost **(Kendall 1953; Cootner, 1962; Fama, 1965)**. All these studies support the proposition that price changes are random and past price changes were not useful in forecasting future price changes, particularly after transaction costs were taken into account. **Granger and Morgenstern (1970)** tested random walk theory, covering more than fifty stock market price series with differing sampling intervals. Various cues of randomness of short-term stock prices were found and some deviations from random walk were also noted in both high and low frequency regions of the spectrum. **Cooper (1982)** studied world stock markets using monthly, weekly and daily data for 36 countries. He examined the validity of the random walk hypothesis by employing correlation analysis, run tests and spectral analysis. With respect to the US and UK, the evidence supported the random walk hypothesis. For all other markets, the random walk hypothesis was rejected. **Seiler and Rom (1997)** examined the behavior of daily stock returns of the US market from February 1885 to July 1962, partitioned annually. Using Box-Jenkins analysis for each of the 77 years, they indicated that changes in historical stock prices were completely random. However, there are some studies, which found the predictability of share price changes **(e.g., Fama and French 1988)** in developed markets, but they did not reach to a conclusion about profitable trading rules. **Frennberg and Hansson (1993)** examined the random walk hypothesis using Swedish data from 1919 to 1990. The found that Swedish stock prices have not followed a random walk in that period. **Claessens, Dasgupta and Glen (1995)** found significant serial dependence in equity returns from 19 emerging markets and further explained the causes of this inefficiency in terms of operational inefficiencies. **Harvey (1995)** studied volatility shifts and return predictability of six Latin American, eight Asian, three European and two African emerging stock markets and found strong correlation in the stock return series, which made the cause of stock price predictability. **Parkinson (1987)** studied random walk model on Nairobi Stock Exchange using monthly prices. Under this study, he found that 49 companies out of 50 on NSE had fewer numbers of runs than expected and rejected hypothesis of random walk. **Nicolas (1997)** conceded that past returns have predictive power, but the degree o f predictability of return was not so high. Even the emerging markets have also shown strong evidences of comparatively less efficient markets. **Abeysekera (2001)** also examined a day-of -the-week and a month-of-the-year effect on the CSE, but neither effect was found to be on the stock market in Sri Lanka.

With regard to Indian capital market, wide researches have been made documenting strong evidences in favour of weak form efficiency. These studies include **Barua (1981, 1987), Rao and Mukharjee (1971), Sharma and Kennedy (1977), Sharma (1983), Gupta (1985), Ramachandran (1985), Dhankar (1991), Belgaumi (1995), Yalwar (1988), Mishra (2000), and Gupta (2001). Sharma and Kennedy (1977)** compared the behavior of stock indices of the Bombay, London and NYSE during 1963-73 using run test and spectral analysis. Both run tests and spectral analysis

confirmed the random movement of stock indices for all the three stock exchanges. **Kulkarni (1978) and Chaudhary (1991)** did not support the hypothesis of random walk. **Ranganatham and Subramanian (1993)** studied weak form of market efficiency and noted prominent spikes at lower frequency range through spectral analysis. It noted presence of periodic cycles in the movement of share prices, which is against the assertion of the weak form of EMH. **Bhaumik (1997)** identified that the stock prices closely represent a random variable. He examined the efficiency of Indian capital market by using Sensex as a barometer of the Indian capital market for a short period of 115 days. **Gupta and Gupta (1997)** opined that phenomenon of large departures from random price behavior might have been due to structural transformation taking place in the Indian Capital Market. **Mohanty (2001)** documented the evidences in favor of random walk model in his study which considered Sensex, BSE-100 and BSE-200 during April 1996 to June 2001. Although the results of unit root test supported the null hypothesis, but the variance ratio test was rejected. The study also showed that there were significant first order autocorrelation in daily returns. **Nath and Reddy (2002)** documented the non random movement in the sequence of Nifty index for the period July 1990 to November 2001. **Deb (2003)** tested weak form efficiency using both parametric and non-parametric tests across five major market indices of Indian stock market. It depicted that price in the Indian stock market does not follow random walk model except for BSE 100 indices, which endorse efficiency for the variance ratio test. **Gupta and Basu (2007)** in their research, on two major equity markets in India for the period of 1991 to 2006, finds that the series do not follow random walk model and there is an evidence of autocorrelation in both markets rejecting the weak form efficiency hypothesis. **Samanta (2004)** used spectral analysis on daily observations of BSE-100 for a time period of 7 years (January 1993 to December 2001). He divided the whole study period into 18 sub periods and tested each sub-period separately. Till July 1996, the market showed remarkable inefficiency and a high level of efficiency during July 1996 to Dec. 1999. And at later stages, the efficiency improved but at a relatively lower level, except some deviations during 2000. **Khaled and Islam (2005)** studied efficiency on Dhaka stock exchange and made a comprehensive analysis by studying the structural changes in the economy and accepted the hypothesis for monthly data and the same was rejected for weekly and daily data. **Hussan et al. (2006)** studied efficiency on seven European emerging markets and majority of the emerging markets under study were found unpredictable. **Rahman and Hossain (2006)** examined the efficiency of Dhaka Stock Exchange by using both non-parametric tests (Kolmogrov-Smirnov goodness of fit test) run test and parametric test on daily prices of All-Share Price Indices (ASPI) and DSE General Price Indices (DES-GEN) for 12 years ranging from 1994-2005. Run test and auto-correlation results reject the randomness of the returns series of DSE and the same thing resulted from Kolmogorov-Smirnov (K-S) test. Overall conclusion can be made that Dhaka Stock Market of Bangladesh is not efficient in Weak-form. **Verma and Rao (2007)** examined the companies included in the BSE100 index and applied serial correlation and run test for a period of three years from 1998 to 2001 and found mixed results about the Indian capital market. For the year 1998-99 and 1999-00, market was not weak form efficient, but for the year 2000-01, the market was concluded to be weak form efficient. **Ray and Sharma (2008)** studied the efficiency of the Indian capital market and described what kind of performance of efficiency the Indian capital market follows. Their research shows that only companies in the index show efficiency, not the index as a whole. But overall, they have concluded that the Indian capital market is efficient and there is no unfair advantage to any person. Accordingly, we can see that an uninterrupted research is being done on the efficient market hypothesis. As the financial environment is in quite a turmoil due to the liberalization and globalization of world economies, therefore, the non-randomness may prevail in the stock return series on the stock markets. So, the present study has made an attempt to re-examine the randomness in stock returns sequence over the Bombay Stock Exchange.

III

OBJECTIVES AND HYPOTHESIS

❁OBJECTIVES

The main objective of the present study is to examine whether the BSE is weak form efficient during the study period. Further, the study is focused to find out whether all indices selected follow the random walk hypothesis. More specifically, the study is directed to meet the following objectives:

❁ To determine whether the Indian stock market is weak form efficient or follows a random walk model and the investors cannot earn abnormal returns on the basis of historical information of the stocks.

❁ If so, further, to examine the consistency of efficient market behavior during different time segments.

❁HYPOTHESIS

To meet the above objectives, the following hypotheses are tested :

H_{01}: That there is independence in the sequence of stock return series which do not give any predictive power to the investors in order to earn abnormal returns.

H_{02}: That the efficiency over the Indian market is liberated from market cycles.

IV

RESEARCH METHODOLOGY AND DATA INPUTS

In order to examine the validity of above stated hypotheses, the present study has considered 2622 daily observations of three market proxies (BSE Sensex, BSE 100, BSE 500) at Bombay Stock Exchange for a period of 10 years and 6 months (From July 1997 to December 2007). The overall study period has further been divided into three alternate phases of the market to examine the random character of stock indices return series during the bull and bear market phenomenon. The required data for the present study was obtained from Prowess database provided by CMIE.

The daily adjusted closing prices are transformed into stock return series by using the formula:

$$R_t = Ln\ (P_t/P_{t-1})*100$$

Where, Ln is natural log, P_t is the price of stock on the day t and P_{t-1} is the price of the day on day before the day t. As stated in the objectives, the purpose of the study is to examine the random character of stock returns and to check level of dependence in the sequence of stock returns over the study period; two most commonly used methods, i.e., Autocorrelation and Unit root test are used. The autocorrelation test statistics are widely used to notice any perceptible trend in stock prices is serial correlation matrices that measures correlation between price changes in consecutive time periods and is a measure of how much price change in any period depends upon price change over the previous time period. A serial correlation of zero would imply that price changes in consecutive time periods are uncorrelated with each other, and can thus be viewed as a rejection of hypothesis that investors can learn about future price changes from the past ones. A positive and statistically significant serial correlation could be viewed as evidence of price momentum in markets, and would suggest that returns in a period are more likely to be positive (negative) if the prior period returns were positive (negative). Similarly, a negative and statistically significant serial correlation could be evidence of price reversals, and would be consistent with a market where positive returns are more likely to follow negative returns and vice versa. In a more precise way, serial correlation coefficients provide a measure of relationship between value of a random variable (X) in time t and its value k-period earlier. It indicates whether t price changes in the week t are influenced by price changes occurring k-day earlier, where k = 1, 2, 3....n. In the present study, we have considered time lag of 1, 2, 3... 16 weeks. The autocorrelation matrix is estimated by:

$$R_k = C_k/C_o$$

Wherein,

$$C_k = 1/n \sum_{t=1}^{n-k} (Xt-\mu)(X_{t+k}-\mu) \qquad k=0, 1, 2...n \qquad \mu = 1/n \sum_{t=1}^{n} X_t$$

(Wherein, C_o = Variance of X, and N= number of observation)

Statistical testing of auto correlation matrices requires standard error of estimated matrices (S.E. (k)), which is obtained as:

$$S.E.\ (k) = 1/\ (n-k)^{1/2}$$

When n is sufficiently large (n>50), approximate value of the standard error of estimated (S.E.(k)) matrices is given by:

$$S.E.\ (k) = 1/\ (n)^{1/2}$$

Instead of testing significance of any individual autocorrelation matrix, the researchers tested joint hypothesis that all ρ_k to certain lags are simultaneously equal to zero.

UNIT ROOT TEST

The unit root test checks whether a series is stationary or not. Stationary condition has been tested using Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) Test. (Dickey and Fuller 1979, 1981, Gujarati 2003, Phillips-Perron 1988, Enders 1995). The ADF test makes a parametric correction in Dickey-Fuller (DF) test for higher-order correlation by assuming that the series follows an AR (p) process. The ADF approach controls for higher-order correlation by adding lagged differences terms of the dependent variable to the right-hand side of the regression. The ADF test has following specification:

$$\Delta y = \lambda y_{t-1} + \sum_{i-1}^{p} \gamma_i \Delta y_{t-1} + u_t$$

To test for stationary, the null hypothesis is: $H_0: \lambda = 0$

And alternative hypothesis is: $H_1: \lambda < 0$

In the present study, above ADF equations to test the series for stationary have been used. We noticed that the results are invariant to the model specification except minor differences in ADF values. Phillip-Perron proposed a non parametric method for controlling higher-order serial correlation in a series. The PP test makes a correction to the t-statistic of the coefficient from the AR (1) regression to account for the serial correlation in u_t. The advantage of the PP test is that it is free from parametric errors. In view of this, PP values have also been checked for stationarity.

Decision rule: If t* > crtitical value, ==> not rejecting null hypothesis, i.e., unit root exists.
If t* < critical value, ==> reject null hypothesis, i.e., unit root does not exist.

V

EMPIRICAL EVIDENCES

To examine the level of dependence in the daily return series of the BSE Sensex, BSE 100 and BSE 500 indices, the autocorrelation coefficients from lag 1 to 16 were calculated. As autocorrelation is an effective tool to measure the level of independence in the successive returns of daily observations of the stock index, a value near to zero shows that there is higher degree of independence in the successive daily return series and it is not possible to predict the future on the basis of past trends. As reported in *Table-1*, in case of BSE Sensex, out of 16 lags, eight lags have negative autocorrelation coefficients. Lags 1, 4, 6, and 9 have shown significantly different from zero autocorrelation coefficient at 5 percent level of significance and there were only two (at lags 1 and 9) significant coefficients showing dependence in the stock index return series on these values. Although the autocorrelation results did not fully support the weak form efficiency, but it gave strong evidences in favor of independence in the daily return series of BSE Sensex index. And in case of daily return series of BSE 100 Index, the autocorrelation coefficients were insignificantly different from zero at both levels of significance of the study and during all lags, except at lag 1 and lag 9. Despite these two lags, all the lags strongly validated the statement of null hypothesis of independence in the successive movement of the stock index return series from its previous ones. Out of 16 lags, there were 7 lags (1, 5, 6, 8, 10, 12, 16) that have

Table 1 : Results of Autocorrelation Test for Overall Duration And BSE Indices (7/1997-12/2007)

Lags	BSE SENSEX	BSE100	BSE500	Lags	BSE SENSEX	BSE100	BSE500
1	0.0603	-0.1946	0.1231	9	0.0643	0.083	0.0702
2	-0.033	0.0013	-0.0303	10	0.0248	-0.0092	0.0681
3	0.0084	0.0174	0.0108	11	-0.025	0.0217	-0.0153
4	0.0432	0.0077	0.0619	12	-0.015	-0.0128	-0.0052
5	-0.018	-0.0116	0.0097	13	0.0106	0.0026	0.042
6	-0.045	-0.0042	-0.0471	14	0.0242	0.018	0.044
7	-0.009	0.0133	-0.0096	15	-0.015	0.0204	-0.0151
8	0.0177	-0.0324	0.005	16	-0.014	-0.034	-0.028

*Significant at 1% and **Significant at 5% Level of Significance

shown negative autocorrelation coefficients, showing over expectations of the investors. The BSE 500 is perhaps the ideal benchmark to interpret the Indian capital market. The results of autocorrelation analysis statistic with regard to BSE 500 index are reported in *Table-2*. The autocorrelation results were significant at lag 1, 4, 9, and 10 when tested at 1 percent level of significance. At 5 percent level of significance, there were 7 lags out of 16 showing autocorrelation coefficients significantly different from zero. Moreover, out of 16 lags, there were 7 lags having negative autocorrelation coefficients. The behavior pattern of autocorrelation coefficients throughout various lags have also been depicted through correlograms. The overall results showed prevalence of inefficiency in the daily returns series of all the market proxies. But the results depicted through unit root test were not perfectly consistent with what has been reported by the autocorrelation test. The unit root tests negated the possibility of any non-stationarity in the daily return series of the stock indices. *Table-2* has shown the findings of unit roots tests for all these indices.

Table 2: Results of Unit Root Tests For BSE Indices

Indices →	Sensex		BSE100		BSE500	
	ADF t-value	Philips-Perron t-value	ADF t-value	Philips-Perron t-value	ADF t-value	Philips-Perron t-value
07/1997-12/2007	-48.191	-48.145	62.339	-62.588	-41.746	-41.736
Critical Values at 5% and 1% Levels	-2.86 & -3.43					

*Significant at 1% and **Significant at 5% Level of Significance

EMPIRICAL EVIDENCES DURING DIFFERENT PHASES OF THE MARKET

❁ FIRST PHASE (JULY 1997-MARCH 2000)

The results of autocorrelation test for this phase have been reported in *Table-3*. Out of 16 lags, the BSE Sensex have reported nine lags that have negative autocorrelation coefficients showing various types of reversals in the movement of stock index return series. But even a single significant coefficient was not found having its closer to one to reject the statement of null hypothesis. All the autocorrelation coefficients were having their values significantly near to zero, showing higher level of independence in the stock index return series from its previous values. The BSE 100 index also reported the results in consistency with the BSE Sensex, i.e., autocorrelation coefficients were insignificant during all 16 lags. Out of these 16 lags, 7 lags had positive autocorrelation coefficient and the rest 9 lags had negative autocorrelation coefficients. Despite over expectations of the investors, the irrationality in their behavior which was reflected through the daily price movement was not found significant in statistical figures. The autocorrelation results showed a high level of independence in the return series of BSE 100 index.

Table 3: Results of Autocorrelation Test For First Phase (7/1997-03/2000) and BSE Indices

Indices→ Lag↓	BSE Sensex	BSE100	BSE500	Indices→ Lag↓	BSE Sensex	BSE100	BSE500
1	-0.014	-0.372	0.015	9	0.0974	0.0972	0.13807
2	0.0045	0.029	0.07258	10	0.0054	-0.046	0.07522
3	0.0438	0.0254	-0.0086	11	-0.017	0.0408	-0.0447
4	0.0277	-0.016	0.04545	12	-0.017	-0.014	0.03348
5	-0.041	-0.017	0.00803	13	-0.024	-0.011	0.04386
6	-0.04	0.0115	-0.1253	14	-0.016	0.0062	-0.0018
7	0.0174	0.0283	0.00808	15	-0.062	0.0292	-0.1233
8	0.0125	-0.064	-0.0442	16	-0.034	-0.049	-0.1256

*Significant at 1% and **Significant at 5% Level of Significance

The autocorrelation results of BSE 500 index were strongly supporting the existence of weak form efficiency in the Indian capital market as all the coefficients during all the lags had shown autocorrelation coefficients insignificantly different from zero at 5 percent and 1 percent level of significance. Amongst 16 lags, the lags 3, 6, 8, 11, 14, 15, and 16 have shown negative sign, but these over expectations of the investors were not significant to produce irrationality in

the market causing inefficiency. Added to this, the results reported by unit root tests have also strengthened the results produced by previous tests. It also validated the statement in favor of random walk model in the daily return series of the stocks. The spread of all autocorrelation coefficients through various lags for all the three indices have been depicted through the correlogram. The findings of the unit root test further supported a stationary time series with random character in the stock indices daily return series.

Table 4 : Results of Unit Root Tests For First Phase And BSE Indices

Indices →	Sensex		BSE100		BSE500	
	ADF	Philips-Perron t-value	ADF	Philips-Perron t-value	ADF	Philips-Perron t-value
7/1997-03/2000	-26.344	-26.6449	-24.414	-40.5499	-16.605	-16.641
Critical Values at 5% and 1% Levels	-2.86 & -3.43					

*Significant at 1% and **Significant at 5% Level of Significance

❁SECOND PHASE (APRIL 2000-MARCH 2003)

When BSE Sensex was tested through autocorrelation test, it did not show any biasness in the movement of its daily return series. It showed complete independence in the successive movements of the daily returns from its past values. Although more than half of the autocorrelation coefficients were with a negative sign showing over expectations of the investors, but these were also statistically insignificant, causing no change in the results interpreted before. Same results were depicted for daily return series of BSE 100 index. All the autocorrelation coefficients were insignificant to reject the null hypothesis throughout various lags considered in the study. Some over expectations were also found in the behavior of investors through negative autocorrelation coefficients during various lags as noticed in previous index return series, but it did not result into significant difference in the return series. The autocorrelation test accepted the null hypothesis at 5 percent and 1 percent level of significance.

Table 5 : Results of Autocorrelation Test For Second Phase (04/2000-03/2003) and BSE Indices

Indices→ Lag↓	SENSEX	BSE100	BSE500	Indices→ Lag↓	SENSEX	BSE100	BSE500
1	0.1219	0.1392	0.1505	9	0.0517	0.0708	0.0674
2	-0.014	-0.016	-0.0146	10	-0.018	0.0134	0.0154
3	-0.054	-0.033	-0.0137	11	-0.06	-0.023	-0.0195
4	0.0272	0.0229	0.0363	12	-0.037	-0.034	-0.0373
5	-0.005	0.0095	0.0241	13	-0.029	-0.027	-0.018
6	-0.031	0.0071	0.0138	14	0.0219	0.0468	0.0591
7	-6.00E-04	0.0056	0.0064	15	0.0341	0.0221	0.0199
8	0.0284	0.0451	0.0443	16	0.0281	0.0286	0.0301

*Significant at 1% and **Significant at 5% Level of Significance

The BSE 500 index reported negative autocorrelation coefficients at lags, 2, 3, 11, 12, and 13 and rest all the lags of the study have shown positive autocorrelation coefficients.

Table 6 : Results of Unit Root Tests For First Phase And BSE Indices

Indices →	Sensex		BSE100		BSE500	
Unit Root Tests→	ADF t-value	Philips-Perron t-value	ADF t-value	Philips-Perron t-value	ADF t-value	Philips-Perron t-value
04/2000-03/2003	-24.137	-24.0241	-23.731	-23.696	-23.862	-23.909
Critical Values at 5% and 1% Levels	-2.86 & -3.43					

*Significant at 1% and **Significant at 5% Level of Significance

Regarding the significance test of these positive and negative autocorrelation coefficients, none of these coefficients have their value significantly different from zero and throughout all lags, the autocorrelation test has accepted the statement of null hypothesis at 5 percent and 1 percent levels of significance. The unit root tests have also shown consistent results and the findings of both the unit root tests are reported in *Table-6*. The spread of autocorrelation throughout various lags for all the three indices have also been depicted through correlograms.

❁THIRD PHASE (APRIL 2003-DECEMBER 2007)

In case of all the three indices, the autocorrelation coefficients were found insignificantly different from zero at all 16 lags resulted into independence of the stock indices return series from its past values. At some places, the market seemed to behave irrationally when examined closely. Although there were 9 autocorrelation coefficients during various lags which showed negative sign, but the insignificance of their value resulted into some immaterial reversals in the stock daily return series of BSE 100 index. The independence reported in daily return series of all the indices was really in high order and caused acceptance of null hypothesis at 5 percent and 1 percent level of significant. The *Table-7* has reported these results. Similar results were reported by Augmented Dickey Fuller and Phillip Perron's unit root tests in the *Table-8*. The spread of autocorrelation coefficients throughout various lags of the study under consideration can be clearly noticed through their correlograms shown in Figures 10- 12.

Table 7 : Results of Autocorrelation Test

Indices→ Lag↓	SENSEX	BSE100	BSE500	Indices→ Lag↓	SENSEX	BSE100	BSE500
1	0.0706	0.1032	0.1327	9	0.0344	0.0213	0.0226
2	-0.093	-0.096	-0.105	10	0.0621	0.0579	0.0741
3	0.0153	0.0165	0.0185	11	-0.03	-0.042	-0.036
4	0.06	0.0716	0.0808	12	-0.01	-0.013	-0.02
5	-0.012	-0.005	0.000	13	0.0632	0.0633	0.0724
6	-0.065	-0.059	-0.059	14	0.0457	0.0307	0.043
7	-0.04	-0.036	-0.037	15	-0.021	-0.01	-0.008
8	-0.003	-0.013	-0.025	16	-0.043	-0.037	-0.042

*Significant at 1% and **Significant at 5% Level of Significance

Table 8 : Results of Unit Root Tests And BSE Indices

Indices →	Sensex		BSE100		BSE500	
	ADF t-value	Philips-Perron t-value	ADF t-value	Philips-Perron t-value	ADF t-value	Philips-Perron t-value
04/2003-12/2007	-25.98	-32.1045	-25.77	-31.009	-25.76	-30.063
Critical Values at 5% and 1% Levels	-2.86 & -3.43					

***Significant at 1% and **Significant at 5% Level of Significance.**

VI

CONCLUDING REMARKS

The study period considered under the present study consists of the time when the Indian stock market gained momentum and all experiments were done to make it as standardized as any other developed market. The trading norms were made transparent so that all market participants could have access to all relevant information. The purpose was clear, i.e., to remove all factors causing inefficiency at the market place. The present study also made an attempt to identify the clues of random walk in the behavior of sequence of stock returns. As depicted in the previous sections, the results are assorted. On the one hand, the autocorrelation function of stock return series shows, not perfect but, strong evidences of independence of successive stock return series. The findings of the test say that there is least possibility to develop predictable pattern of stock return from its past values. And no market participant is in a position to devise a superior investment strategy resulting into abnormal returns to them.

Although the study period considered under the study is very long as Indian capital market has seen a complete trading cycle during this period and last four years of the study period (2003-07) has shown consistent rise with high growth rate, but the swiftness in increased efficiency is not in the same amount. **Gupta and Gupta (1997)** found evidences of non random pattern in the behavior of sequence of stock returns and stated that the structural changes may cause inefficiency in the Indian stock market. Further, **Verma and Rao (2007)** also documented the mixed evidences of weak form efficiency over the Indian stock market. But today, the Indian stock market is very compatible to the global standards and norms of trading. All these things must have resulted into increased efficiency of the Indian stock market over the long term. The reason of inefficiency can be various other informations, rather than historical information only, that may influence the behavior of investors resulting into non-random behavior of stock prices.

The irrationality may occur because of a variety of fundamental factors used by market participants like, Policy regarding foreign capital, market turnover and capitalization, various other factors determining the worth of growth and value stocks, various macro and macro announcement etc. These are known as the anomalies of the stock market. So some more rigorous models should be applied to test the anomalous pattern of the stock returns to have healthier remarks on the weak form efficiency of the Indian stock market.

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(Bibliography Contd. On Page 34)

CORRELOGRAMS FOR BSE INDICES (7/1997-12/2007)

FIGURE 1

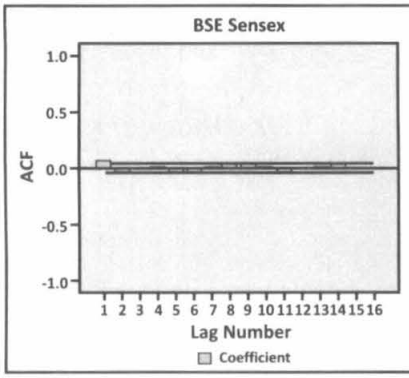


FIGURE 2

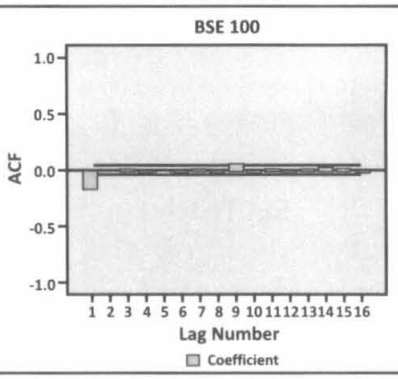
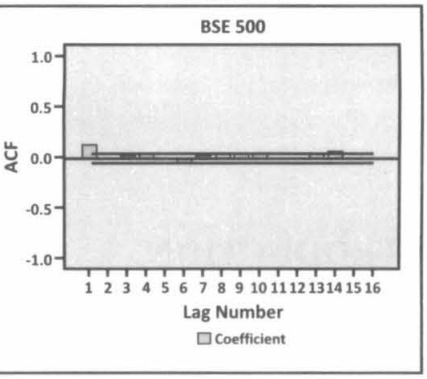


FIGURE 3



CORRELOGRAMS FOR BSE INDICES (7/1997-03/2000)

FIGURE 4

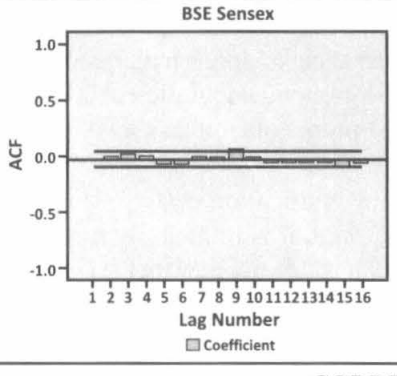
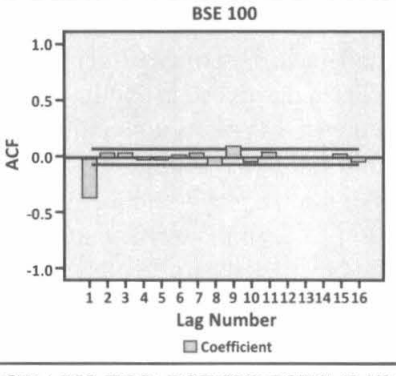


FIGURE 5



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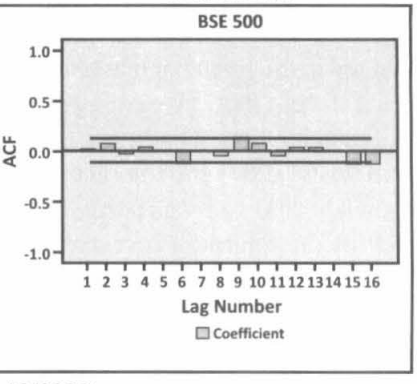

CORRELOGRAMS FOR BSE INDICES (04/2000-03/2003)

FIGURE 7

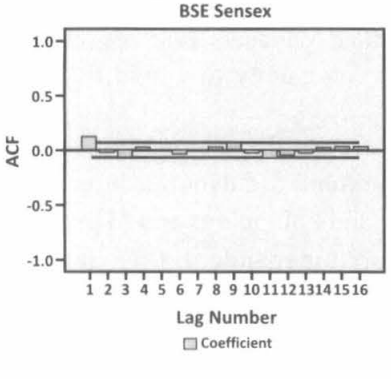

FIGURE 8

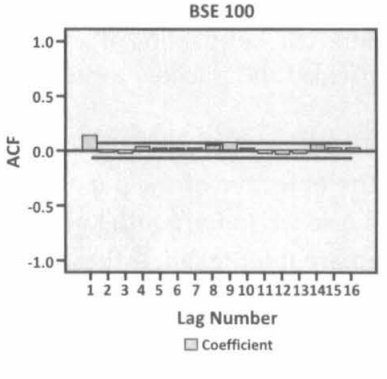

FIGURE 9

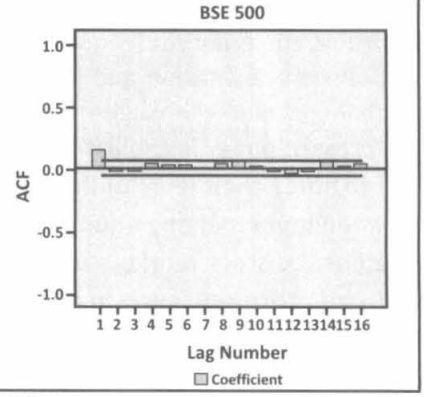

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FIGURE 10

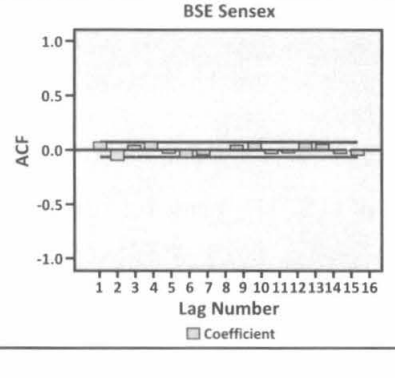

FIGURE 11

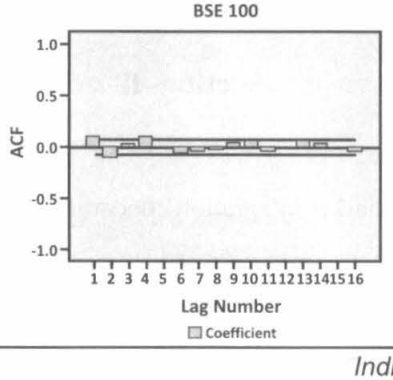

FIGURE 12