Test Of Weak Form Efficiency In The Indian Stock Market

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INTRODUCTION

The capital market is a perfect place to arrange funds for private entrepreneurs. The investors will put in their funds for these enterprises only if the securities listed on the stock exchanges are not mispriced. The exclusion of the notion of under pricing and overpricing of the securities on the stock exchanges leads to the prevalence of efficiency of the stock market. The notion- Efficient Market Hypothesis advocates a market place where all the information is instantaneously incorporated into the share prices and no market participant is in a position to earn abnormal returns. There are many studies which identified that capital markets are not efficient although they should be. The present study has studied the performance of equity capital market of India for a period of more than ten years (1997-2007). In the last decade, the Bombay Stock Exchange has faced all phases of bear and bull markets and the behavior pattern of stock prices have been examined through parametric and non parametric tests. So this study has made efforts to examine whether the long term analysis of the market results in support of increased efficiency or not. Granger and Morgenstern (1970) found some evidences of non randomness in the behavior of the stock prices even during very long period (fifty years). Seiler and Rom (1997) found evidences in favor of random character of the stock prices in US stock market over a very long time period. In India, studies done by Nath and Reddy (2002) and Gupta and Basu (2007) tested the Indian stock market over long periods and found clues of inefficiency in the Indian stock market. The studies conducted by Samanta (2004) stated that with the passage of time, the evidences of increased efficiency were found over the Indian stock market. So, there are mixed opinions regarding the prevalence of weak form efficiency in the capital markets of India as well as abroad. So a revisit has been made through this study to document the degree and character of randomness in the behavior of stock prices in India which may result into abnormal profits for the investors by developing their investment strategy on the basis of past information.

The rest of the study has been divided into various sections as under:

Section I gives a small picture of Indian Capital Market, Section II discuss the notion of Efficient Market Hypothesis, Section III provides Review of Literature of the EMH in its weak form, Section IV discusses Objectives and Hypotheses of the Study, Section V explains the Research Methodology and Data Inputs, Section VI studies the Empirical Results and Section VII ends with the Conclusion and Suggestions.

I : INDIAN CAPITAL MARKET

The efforts to transform the Indian capital market started taking place in 1990s with the reform era. The establishment of Security Exchange Board of India in 1992 gave a new shape to the spirit of effective implementation of reforms initiated earlier. The SEBI was established with a motive to protect the interest of investors and make continuous improvements for fair trading practices over the stock exchange. Added to this, the establishment of NSE in 1994 further added various benchmarks in trading practices for various stock exchanges in India. Many initiatives were taken to enhance the base of foreign capital inflow in India through the means of FDIs and FIIs. In 2001, many steps were taken to start uniform system of trading over various stock markets and finally in 2003, implementation of compulsory rolling settlement with t+2 days for settlement of contracts on all major stock exchanges in India took place. All these reforms were destined to stop unfair speculative and arbitrage activities in order to protect the interest of investors and as a tool of risk management which has increased a lot because of increasing volume of trading over the stock exchanges. Along with this regulation symmetry, the automation of stock exchanges with advanced means of communication and settlement system have made the Indian capital market as amongst the fastest growing emerging markets.

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II : EFFICIENT MARKET HYPOTHESIS

The levels of market efficiency are classified on the basis of type of information presumed to be reflected in the share prices.In its strong form, the share prices reflect all information and even insiders are not in a position to develop superior investment strategy resulting into abnormal profits. In a semi strong efficient market, it is historical information and publically made announcements which are reflected in the share prices. And the weak form efficiency says that all historical information are incorporated into the share prices and no technical analyst is in a position to predict the future returns on the basis of previous pattern of the stock prices. The present paper is focused to examine the notion of market efficiency in its weak form in the Indian stock market. During the last one decade, the Indian capital market has become stronger in terms of macro fundamentals as well as with a more powerful foundation of individual corporate in terms of their micro fundamentals. Various structural improvements have been made by Security Exchange Board of India to make the dealings over the stock markets more fair and transparent. The corporate governance and ethical laws are improved continuously to attract more domestic as well as foreign capital to strengthen the industrial base of the Indian economy. In India, the Bombay Stock Exchange has its historical significance. The movement in BSE Sensex is considered as the barometer of Indian economy. So, to test the level of efficiency of the Indian stock market, the present paper has considered the BSE as a sound base.

III : LITERATURE REVIEW

There is a vast amount of researches available which tested EMH in its various variants. The history of random walk model originated in 1900; when Bachalier developed the mathematical model of random walk. But it was only after 1950s, the researches were made very frequently to examine the degree and level of efficiency in the stock price behavior in the capital markets world over.Early studies on testing weak form efficiency generally agree with the preposition 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. Alexander (1961) documented violation in the random process of the stock return series with the help filter rules. Fama and Blume (1966**)** further added evidences of using filter rule and found that there was a very small amount of dependence in the price changes. 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. They 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 returns 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 at Nairobi Stock Exchange using monthly prices. Under this study, he found that 49 companies out of 50 on NSE had fewer number of runs than expected and rejected hypothesis of random walk. Nicolas (1997) conceded that past returns have predictive power but the degree of predictability of return was not so high. Even the emerging markets have also shown strong evidences of comparatively less efficient markets.

With regard to the 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 runs 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. Belgaumi (1995) conducted a study on 70 stocks of Group A listed on BSE. He used serial correlation and runs test to identify the random process in the behavior of stock return series and documented the evidences in favour of weak form efficiency in India.

Poshakwale (1996) used filter test, serial correlation and runs test to examine the null hypothesis of randomness in the stock return series over BSE. The results of his study rejected the null hypothesis. Bhaumik (1997) identified that the stock prices closely represent a random variable. He examined the efficiency of Indian capital market by using the 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 during the variance ratio test it 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 the 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. 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 with 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. Gupta and Basu (2007) in their research on two major equity markets in India for the period of 1991 to 2006, stated that the stock return series did not follow random walk model and there is an evidence of autocorrelation in both markets rejecting the weak form efficiency hypothesis. Verma and Rao (2007) examined the companies included in the BSE100 index and applied serial correlation and runs 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, market is 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 Indian capital market follows. Their research showed that only companies in the index showed 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.

Above are quoted the results of only a few studies from the huge literature on Random Walk and Efficient Market Hypothesis. The assorted results depicted by the above mentioned studies motivated the researchers to empirically test the Indian Stock Market yet again to generalize the status of increased or reduced efficiency in its weak form to make out whether the securities are fairly priced on the stock exchange or not.

IV : OBJECTIVE AND HYPOTHESIS OF THE STUDY

OBJECTIVE OF THE STUDY

As discussed above that the Indian capital market has seen many facets of development, all the efforts taken to liberalize and globalize the stock exchanges were destined to increase the inflow of funds over the capital market and increasing the liquidity position by motivating the healthy investment activities rather than creating a place for

speculation. So, the present study is destined to examine whether the practice followed during the last decade has caused amplified level of efficiency in the stock price behavior in India in its in weak form. To be more specific, the present study is focused to achieve the following objectives.

- To examine whether there is any level of dependence in the successive stock return series on its previous value.
- To examine whether the investor is able to forecast the future trends in the intrinsic value of the stocks by identifying non random pattern in the previous movements of stock return.
- To examine whether the movement in the stock return series follows a specific distribution pattern over a long period of time.

HYPOTHESIS

In order to conquer the above stated objectives, the following hypotheses are tested through various analytical tools.

H_{01}: That there is independence in the successive movement of stock return series from its past movements.

H_{02}: That the daily stock returns series follow random process.

H_{03}: That the patterns and spread of the daily stock returns are fit to normal distribution.

V: RESEARCH METHODOLOGY AND DATA INPUTS

The present study has considered daily observations of 133 stocks of Group A listed on Bombay Stock Exchange for an uninterrupted duration of 10 years and 6 months starting from July 1997 to December 1997. The Group A consists of around 200 companies (approximately, as there is always a possibility of switching over of the stocks in this group). The final selection of the sample was made on the basis of availability of data for a consistent period taken in the study. The required data is obtained from the Prowess database provided by CMIE. The various companies taken in the study represent 20 sectors of the economy. The sector wise weightage of the stocks in the sample is shown in the following table. A list of the names of these companies with their codes used in the study has been provided in Table 6. The following classification has been made according to the sectors specified for the companies on Bombay Stock Exchange.

Table 1 : Sector Wise Classification Of The Sample Stocks

S.No	Name of Sector	No. of Companies	S.No	Name of Sector	No. of Companies
1	Agriculture	3	11	Media & Publishing	1
2	Capital Goods	9	12	Metal, Metal Products & Mining	10
3	Chemical & Petrochem.	5	13	Miscellaneous	3
4	Consumer Durables	1	14	Oil & Gas	10
5	Diversified	5	15	Power	4
6	Finance	10	16	Telecom	2
7	FMCG	11	17	Textile	6
8	Healthcare	21	18	Tourism	2
9	Housing Related	3	19	Transport Equipments	12
10	IT	13	20	Transport Services	2
	Total	**133**			

[Source: website of Bombay Stock Exchange (www.bseindia.com)]

Further, to examine the validity of the hypotheses of the present study, various parametric and non parametric tests are applied. In the category of parametric tests, the tests used to examine the dependence in the stock return series, i.e., Autocorrelation coefficients are calculated for each stock and to have more accurate interpretation, the joint hypothesis have been tested with Q-statistic given by BoxLjung. The daily observations of stock prices are transformed into return series by taking the natural log difference of the stock price at time t from its previous value.

The autocorrelation test statistics 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 gain knowledge of 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

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

(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, we test joint hypothesis that all ρ_k to certain lags are simultaneously equal to zero. This is obtained by using Q statistic developed by Box and Pierce (1970) and is defined as:

$$Q = n \sum_{K=1}^{m} \rho_k^2$$

(Wherein, ρ_k = auto-correlation coefficient at lag k, n = is sample size, and m = lag length.)

The Q statistic is often used as a test of whether a time series is white noise. In large samples, it is approximately distributed as chi-square distribution with m degree of freedom. In case computed Q exceeds its critical value on chi-square distribution at given significance level (0.01, 0.05), null hypothesis is rejected that all (true) ρk are zero; at least some of them must be nonzero. The present study has used the Q statistic given by BoxLjung. For a large sample, BoxLjung Q statistic follows chi-square distribution with m degrees of freedom:

$$\text{Box Ljung Q statistic} = n(n+2) \sum_{K=1}^{m} (\rho_k^2 / n-k) \sim \chi^2 m$$

To test the second hypothesis of random character of stock return series, the most prominently used Runs Test has been used. This non-parametric test is appreciated for no assumptions regarding the distribution pattern of the sample observations and it considers the direction of movement in the stock return series. The Runs test is another approach to test and detect statistical dependencies (randomness) which may not be detected by the autocorrelation test. The null hypothesis of the test is that the observed series is random variable. The number of runs is computed as a sequence of the price changes of the same sign (such as; + +, - -, 0 0) (Siegel 1956). When the expected number of runs is significantly different from the observed number of runs, the test rejects the null hypothesis. A lower than expected number of runs indicates the market's overreaction to information, subsequently reversed, while higher number of runs reflects a lagged response to information. Either situation would suggest an opportunity to make excess returns (Poshakwale 1996). Under the null hypothesis that successive outcomes are independent, and assuming that N1>10 and N2>10, the number of runs is asymptotically normally distributed with :

Mean: $E(R) = (2N_1N_2/N) + 1$

Variance: $\sigma^2_R = (2N_1N_2(2N_1N_2 - N)) / ((N)^2(N-1))$

(Where, N= total number of observations, N1= number of + symbols, N2= number of symbols,

R= number of runs)
The null hypothesis of randomness is sustainable if R lies in the following confidence interval and rejects the null hypotheses otherwise (Gujrati 2003):

$$\text{Prob}\,(E(R) - 1.96\,\sigma_R \leq R \leq E(R) + 1.96\,\sigma_R) = 0.95$$

The runs test converts the total number of runs into a Z-statistic. For large samples the Z-statistic gives the probability of difference between actual and expected number of runs. If the Z value is greater than or equal to ±1.96, the null hypothesis is rejected at 5 percent level of significance (Sharma and Kennedy 1977).

KOLMOGOROV-SMIRNOV (K-S) TEST

Further to build up the final comments, the sample stocks are tested through another non-parametric test called Kolmogorov-Smirnov statistic. It will help to validate or invalidate the third hypothesis of the study. The K-S test was originally proposed in the 1930s (Kanji 1999). K-S is one of the best known and most widely used goodness-of-fit tests. It is based on the empirical distribution function and converge uniformity to the population cumulative distribution function with probability measure one. The one sample K-S test procedure compares the observed cumulative distribution which may be normal, uniform, Poisson, or exponential. The K-S z coefficient is computed from the largest difference (in absolute value) between the observed and theoretical cumulative distribution functions. This goodness-of-fit test checks whether the observations could reasonably have come from the specified distribution or not.

VI : EMPIRICAL RESULTS

RESULTS OF PARAMETRIC TESTS

AUTOCORRELATION TEST

The results of autocorrelation for 133 companies are summarized in Table- 2 for the whole study period. There were 2128 autocorrelation matrices for the whole study period. To test the independence of the successive stock return series the autocorrelation co- efficient up to lag 16 are examined throughout the study period. Out of 2128 autocorrelation matrices; there were 360 (16.92%) coefficients which showed their value significantly different from zero throughout various lags for all 133 companies at 5% level of significance and the number of these significant autocorrelation coefficients have fallen substantially to 162 (7.61%) when the level of significance has come down to 1%. So, the results when analyzed for the whole study period strongly supported the successive independence of the daily stock return series of the sampled companies when examined at higher level of confidence level. As depicted in the Table-2, it was at lag 1 where the highest number of significant autocorrelation coefficients were found. These were around 25 per cent and 43 per cent at 5% and 1% level of significance respectively. The other lags which showed comparatively higher order of autocorrelation coefficients significantly different from zero lied at lag 2, 5, 6, 9, and 10 at both levels of significance. So, the autocorrelation analysis showed some dependence in the sequence of stock return series resulting into a lower degree of efficiency in the weak form.

To have more stiffness in the interpretation of autocorrelation results, an analysis has been made for the sectors which caused highest level of dependence in their stock return series. Table-3 showing detail of various sectors showing significant autocorrelation coefficient is given hereunder. From the Table-3, it is quite clear that the performance of pharmaceutical companies as under the head Healthcare Sector has shown highest biasness in the behavior of their stock return series. This sector has caused 15%-16% share in overall significant coefficients. Further, the magnitude of biasness in Healthcare sector was followed by FMCG, Finance and Transport Equipment sector. Further, before giving final comments about the level of non randomness on sector specific basis, we examined the weightage of specific sector in the sample size and its weightage in the significant coefficients resulting into decreased efficiency in the behavior pattern of stocks related to that sector. Despite the above stated four sectors, it was in case of Diversified and Information Technology related stocks which have shown the premier level of biasness in the movement of sequence of stock returns. In this sense, the capital goods sector and Oil and Gas sector stocks have shown relatively better results. The results reported by Autocorrelation analysis have identified some clues of dependence in the behavior of daily return series of the sampled stocks.

Table-2: Summary Of Significant Coefficients At 5 Percent And 1 Percent Level Of Significance

Lags	Codes of Companies Having Significant Autocorrelation Coefficients at 5% Level of Significance	Codes of Companies Having Significant Autocorrelation Coefficients at 1% Level of Significance
1	4,6,7,9,10,12,15,16,17,18,19,2123,25,26,28,29,32,35,37,39,41,42,43,45,46, 50,52,53,54,56,57,58,59,60,61,67,68,69,70,71,72,73,74,76,77,78,79,80,81, 82,83,84,85,86,87,88,89,90,93,94,95,96,97,9,8,99,100,102,103,104,105,10 6,108,110, 111,112,115,116,119,120,121,122,123,125,126,128,130, 131, 133	4,6,7,9,10,12,15,18,21,23,25,26,28,29,37,39,41,45, 46,50,52,53,54,56,58,60,61,67,68,69,70,72,74,76,77, 78,79,81,83,85,86,87,88,89,90,94,95,96,97,98,99, 100,102 ,103,105,106,108,110,112,115,116,117,121,122,123,125,1 28,130,131,133
2	13,17,20,3032,33,34,40,41,43,47,50,56,62,66,68,71,73,74, 76,79,81,84,90,93,106,114,120,123,125,128,129,130	13,17,30,33,34,41,47,56,62,68,71,79,81,84,106,123,125
3	3,45,47,53,56,57,58,59,64,76,77,79,84,116,132	47,57,77,
4	2,22,25,26,36,50,54,7,5,76,79,85,97,100,105,111,113,117, 123,125	22,25,26,75,76,105,117
5	4,10,14,19,21,26,30,44,54,59,62,68,72,78,80,93,104,109, 115,117,120,123	10,19,26,54,59,115,117,120,123
6	5,7,9,20,25,33,40,50,62,63,69,70,77,79,80,84,93,94,97,98, 99,110,113,117,121,122	25,33,40,62,63,70,97,99,113,121
7	7,34,43,52,53,62,63,70,72,78,80,92,112,117,131	7,43,52,63
8	27,33,47,50,66,74,75,78,79,92,108,110,113,116,130,131	27,33,47
9	4,5,9,12,15,16,25,26,30,46, 48,50,53,54,69,74,83,85,86,90, 98,101, 106,108,116,118,122,123,128,130,131,133	4,9,26,46,54,101,108,118,122,123,131,1334,39,44, 69,84,114,118,130
10	4,12,19,33,34,39,42,44,45,69,83,84,112,114,117,118,123, 124,130,133	4,39,44,69,84,114,118,130
11	23,26,37,40,44,64,70,90,99,116,117,118,130,131	40,70,90,118,130
12	25,27,33,55,65,72,88,89,06,120	25,33,88,72,120
13	11,24,34,53,67,76,90,94,100,108,121	11,67,76
14	16,19,26,33,43,54,61,70,75,76,84,88,89,94,112,121	84,88,121
15	16,38,40,59,76,84,88,90,99,107,118	16,40,
16	18,38,44,65,77,83,84,87,98,103,104	38
Total	**360**	**162**

But the results depicted by Q statistic were harsher. A summarized report of results of BoxLjung Q statistic is given in Table-4. From the Table 4, it is clear that the test for joint hypothesis of random behavior of stock return series simultaneously is rejected by Q statistic. The overall significant coefficients in a matrix of 2128 coefficients were 1524 (at 5% level) and 1274 (at 1%) which gave a concrete reason to reject the hypothesis of independence in the stock return series. Despite this, the lag wise number of significant coefficients was also depicted with their percentage to total sample size. It ranged from 67% to 74% at 5 percent level and the range at 1 percent level is 53%-63% which was really expanded to shake the previous assertion made by autocorrelation results.

Table 3 : Sector Wise Significant Autocorrelation Coefficients

Sr. No.	Sector	Share In Total Sample	At 5%	In %	At 1%	In %
1	Agriculture	2.2556	8	2.2	2	1.23
2	Capital Goods	6.7669	18	5	5	3.09
3	Chemical & Petrochemical	3.7594	11	3.1	5	3.09
4	Consumer Durables	0.7519	0	0	0	0
5	Diversified	3.7594	18	5	12	7.41
6	Finance	7.5188	31	8.6	15	9.26
7	FMCG	8.2707	32	8.9	15	9.26
8	Healthcare	15.789	59	16	25	15.4
9	Housing Related	2.2556	7	1.9	2	1.23
10	Information Technology	9.7744	47	13	22	13.6
11	Media & Publishing	0.7519	3	0.8	2	1.23
12	Metal, Metal Products & Mining	7.5188	26	7.2	8	4.94
13	Miscellaneous	2.2556	5	1.4	2	1.23
14	Oil & Gas	7.5188	21	5.8	8	4.94
15	Power	3.0075	13	3.6	9	5.56
16	Telecom	1.5038	4	1.1	2	1.23
17	Textile	4.5113	19	5.3	10	6.17
18	Tourism	1.5038	3	0.8	2	1.23
19	Transport Equipments	9.0226	27	7.5	15	9.26
20	Transport Services	1.5038	8	2.2	1	0.62
	Total	**100**	**360**	**100**	**162**	**100**

Table 4 : Summary Of Significant Coefficients In Boxljung Q Statistic

Lags	At 5 Percent Level Of Significance		At 1 Percent Level Of Significance	
	No. Of Companies With Significant Co-efficient (Q Statistic)	In Percentage (of 133 Cos.)	No. Of Companies With Significant Co-efficient (Q Statistic)	In Percentage (of 133 Cos.)
1	89	67	71	53
2	95	71	80	60
3	95	71	78	59
4	93	70	71	53
5	96	72	76	57
6	97	73	84	63
7	95	71	84	63
8	95	71	83	62
9	96	72	82	62
10	98	74	83	62
11	98	74	84	63
12	93	70	81	61
13	97	73	79	59
14	97	73	80	60
15	96	72	79	59
16	94	71	81	61
Total	**1524 (72%)**		**1276 (60%)**	

Table 5: Results of Runs Tests

	Significant At 1% Level Of Significance	Significant At 5% Level Of Significance
Company Codes	11,25,26,27,29,42,49,57,58, 72,75,79,83,89,90,95,111, 112,116 ,118, 121,124	1,11,16,22, 23, 25, 26, 27, 29, 34, 42, 49, 50,52,57, 58, 61, 72, 73,74, 75, 76, 79,, 83, 89, 90, 95,105,108, 111, 112, 116, 118, 120,121, 124, 126,131,

Table 6: List Of Companies With Codes

Co. Code	Company Name	Co. Code	Company Name	Co. Code	Company Name
1	A B B Ltd.	46	Gillette India Ltd.	91	National Aluminium Co.
2	A C C Ltd.	47	Glaxosmithkline Consumer Healthcare	92	Nestle India Ltd.
3	Abbott India Ltd.	48	Glaxosmithkline Pharmaceuticals Ltd.	93	Nicholas Piramal India
4	Aditya Birla Nuvo Ltd.	49	Grasim Industries Ltd.	94	Nirma Ltd.
5	Alfa Laval (India) Ltd.	50	Great Eastern Shipping Co. Ltd.	95	Novartis India Ltd.
6	Alok Industries Ltd.	51	Gujarat Gas Co. Ltd.	96	Oil & Natural Gas Corpn.
7	Apollo Hospitals Enterprise Ltd.	52	Gujarat Industries Power Co. Ltd.	97	Orchid Chemicals & Pharmaceuticals Ltd.
8	Apollo Tyres Ltd.	53	Gujarat Narmada Valley Fertilizers Co. Ltd.	98	Oriental Bank Of Commerce
9	Arvind Mills Ltd.	54	H C L Infosystems Ltd.	99	Pfizer Ltd.
10	Ashok Leyland Ltd.	55	H D F C Bank Ltd.	100	Pidilite Industries Ltd.
11	Asian Paints Ltd.	56	Hero Honda Motors Ltd.	101	Procter & Gamble Hygiene & Health Care Ltd.
12	Aventis Pharma Ltd.	57	Hexaware Technologies	102	Punjab Tractors Ltd.
13	B A S F India Ltd.	58	Hindalco Industries Ltd.	103	Ranbaxy Laboratories Ltd.
14	Bajaj Auto Ltd.	59	Hindustan Lever Ltd.	104	Raymond Ltd.
15	Ballarpur Industries	60	Hindustan Petroleum Corpn. Ltd.	105	Reliance Capital Ltd.
16	Bharat Forge Ltd.	61	Hindustan Zinc Ltd.	106	Reliance Energy Ltd.
17	Bharat Heavy Electricals Ltd.	62	Housing Development Finance Corpn. Ltd.	107	Reliance Industries Ltd.
18	Bharat Petroleum Corpn. Ltd.	63	I C I India Ltd.	108	Rolta India Ltd.
19	Bombay Dyeing & Mfg. Co. Ltd.	64	I N G Vysya Bank Ltd.	109	S K F India Ltd.
20	Bongaigaon Refinery & Petrochemicals Ltd.	65	I T C Ltd.	110	Satyam Computer Services
21	Britannia Industries	66	India Cements Ltd.	111	Shipping Corpn. Of India
22	C E S C Ltd.	67	Indian Hotels Co. Ltd.	112	Siemens Ltd.
23	C M C Ltd.	68	Indo Rama Synthetics (India) Ltd.	113	State Bank Of India
24	Castrol India Ltd.	69	Industrial Development Bank Of India Ltd.	114	Steel Authority Of India
25	Century Enka Ltd.	70	Infosys Technologies Ltd.	115	Sterling Biotech Ltd.
26	Century Textiles & Inds. Ltd.	71	Ingersoll-Rand (India)	116	Sterlite Industries (India)
27	Chambal Fertilisers & Chemicals Ltd.	72	Ipca Laboratories Ltd.	117	Sun Pharmaceutical Inds.
28	Chennai Petroleum Corpn. Ltd.	73	Ispat Industries Ltd.	118	T V S Motor Co. Ltd.
29	Cipla Ltd.	74	J B Chemicals & Pharmaceuticals	119	Tamil Nadu Newsprint & Papers
30	Colgate-Palmolive (India) Ltd.	75	J S W Steel Ltd.	120	Tata Chemicals Ltd.
31	Crompton Greaves Ltd.	76	Jindal Saw Ltd.	121	Tata Elxsi Ltd.
32	Cummins India Ltd.	77	Kotak Mahindra Bank	122	Tata Motors Ltd.
33	Dabur India Ltd.	78	L I C Housing Finance	123	Tata Power Co. Ltd.
34	Dena Bank	79	Larsen & Toubro Ltd.	124	Tata Steel Ltd.
35	Dr. Reddy'S Laboratories Ltd.	80	Lupin Ltd.	125	Tata Tea Ltd.
36	E I H Ltd.	81	Mahanagar Telephone Nigam Ltd.	126	Thermax Ltd.
37	Escorts Ltd.	82	Maharashtra Seamless	127	Titan Industries Ltd.
38	Essel Propack Ltd.	83	Mahindra & Mahindra	128	Torrent Pharmaceuticals
39	Exide Industries Ltd.	84	Mangalore Refinery & Petrochemicals Ltd.	129	United Phosphorus Ltd.
40	F D C Ltd.	85	Mastek Ltd.	130	Wipro Ltd.
41	Federal Bank Ltd.	86	Merck Ltd.	131	Wockhardt Ltd.
42	Finolex Cables Ltd.	87	Micro Inks Ltd.	132	Wyeth Ltd.
43	Finolex Industries Ltd.	88	Mirc Electronics Ltd.	133	Zee Entertainment Enterprises Ltd.
44	G A I L (India) Ltd.	89	Moser Baer India Ltd.		
45	G T L Ltd.	90	Mphasis Ltd.		

RESULTS OF NON PARAMETRIC TESTS

Runs Test is one of the most popular non-parametric tests, and has showed the results contrary to the results documented by BoxLjung statistic. The summarized results reported for the whole study period (July 1997-Dec. 2007) are shown in Table-5. There were 2621 cases for the whole study period. During the whole sampled period**,** all 133 companies have more number of cases with less than mean returns than the cases with larger than mean returns. It gives an overall generalization of runs test and Kolmogorov-Smirnov z Test at both levels of significance, i.e., 5% and 1%. Out of 133 stocks, 38 stocks have significant coefficient at 5per cent level which is around 29% and at 1 per cent level there are around 17% companies which have a significant Z-value resulting into 83% stocks into acceptance area (Refer to Table 5).

The above are the figures in statistical terms. When convoluted conceptually, the results did not favor the existence of weak form efficiency very strongly. At 5% level, the results are more robust as only 71% of the sampled companies showed the prevalence of random process in their daily stock return series. The majority of the companies having significant coefficient were from four major sectors. These sectors are Metal, and Metal Products and Mining, Information Technology, Healthcare and Capital goods. Although the companies from other sectors of the economy were also showing non-random behavior in their daily return series, but their weightage in overall causes of biasness were comparatively lesser. There were nine companies from Metal, Metal Products & Mining sector out which 7 companies were showing non-random pattern in their daily return series when examined at 95% confidence level and this number was four when examined at 99% level of confidence. Further, out of 12 companies from IT sector, the number of the companies with non random character of their stock return behavior at 5 percent and 1 percent level of significance was 6 and four respectively. Similarly, the number of companies showing biasness in their daily return series from Healthcare sector was 4 and 3 respectively. So we can say that the results portrayed above partially favor the inefficiency existing on the Bombay Stock Exchange. And the causes of non-randomness were also resulted due to unequal performance of various sectors.

Further**,** the findings of Kolmogorov-Smirnov test for goodness of fit should be considered to supplement the elucidations made above. The K-S statistic clearly rejected the null hypothesis of normal distributional presumptions. At 5 per cent level**,** all the sampled companies have shown significant coefficient and there were only two exceptions (Companies with codes as 113 and 122) in case of 1 per cent level, rest all 131 companies have reported less than normally distributed pattern of their daily stock returns.

VII: CONCLUSION AND DISCUSSIONS

The results reported through all the methodological inputs gave some evidences of prevailing inefficiency over the Indian stock market in its weak form. But the degree of efficiency (inefficiency) depicted by all the parametric and non-parametric tests was not same. The magnitude of inefficiency was comparatively more when examined through BoLjung Q statistic and K-S z statistic. The inefficiency portrayed in the above section showed that investors took the advantage of historical prices to earn abnormal returns. But the structural changes that occurred in the Indian economy resulted into apparent differences in the performance of various sectors of the economy. So**,** it also caused preference of the investors for some specific sectors which showed more potential for growth than the other sectors. The tendency in the biasness of daily return series of the stocks of Healthcare Sector, Information Technology Sector, and FMCG Sector were comparatively higher than the other sectors. Another apparent characteristic of the daily return series was the overreaction of the investors towards the various historical informations. The empirical evidences showed many negative significant autocorrelation coefficients and actual number of runs was found less than expected number of runs showing various reversals in the stock return behavior as a result of over expectation from past performance of the companies. Added to this, many sectors like Tourism, Transport Equipments, Agriculture, Oil and Gas and Chemical & Petrochemicals etc., showed more evidences in favor of random character in their stock return series. The sector wise analysis showed that because of uneven growth of the various sectors of the economy, the degree of non-randomness was found higher in some sectors than others. Even after such a long time, the Indian capital market is not showing clear evidences of market efficiency. The biasness in the stock return series may be because of many micro and macro factors. The present paper has considered only weak form efficiency of EMH, but there are two other types of EMH which are affected by a mixture of corporate and non-corporate announcements and by the role of insiders. So, these factors can also be a cause of prevailing inefficiency over the stock market. Without testing the impact of

micro and macro announcement on the movement of stock return series, a generalization cannot be made. Despite the above stated factors, a cross examination should also be made by studying the anomalous pattern of these stock return series over various trading days.

As the Indian capital market has shown consistency during last four years of the study period (2003-2007), and during this time period all major stock exchanges were following uniform and consistent pattern of trading policies, so a separate study can be made on a comparatively shorter period to examine the actual status of increased or decreased efficiency of the Indian stock market over the time. As all efforts made by the regulatory bodies and global practices are intended to make the capital markets a podium where the securities are fairly priced, so, the above suggested measure should be considered while testing the level of efficiency over the stock market.

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