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An Empirical Analysis of Weak Efficiency of Indian Stock Market

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Abstract: ***A stock market can be said efficient if all past information, new information and even hidden information reflect in the security prices. An effort is made during the study to see whether Indian stock markets are efficient or not. BSE index, BSE100 was used in the study to represent the Indian stock market. The daily closing points was taken for the sample period of ten years from January 2003 to December 2012. The data was collected from the official website of Bombay Stock Exchange i.e. www.bseindia.com. Different statistical tools were used like Unit Root test, Runs test and Kolmogorov–Smirnov test (K–S test) to analyze the data with the help of software Eviews5. The study revealed that Indian stock market does not move randomly it means there is dependency of current security prices on the past. It can be concluded that past information are not completely adjusted so Indian stock market is weak form efficient but it is not consistently following it.***

Keywords: BSE, BSE100, Weak Form Efficiency, Indian stock market.

I. INTRODUCTION

It is general notion in the market that stock markets are efficient and prices reflect all available information. There is extensive research literature available to see whether stock markets are efficient or not. Some academicians believe that stock market is weak efficient (Cootner, 1962; Fama, 1965; Kendall, 1953; Granger & Morgenstern, 1970). While some others have belief that stock markets are not weak efficient (Chaudhary, 1991; Subramanian, 1993). The present study is an attempt to see the efficient form of Indian stock market. Malkiel (1992), "A capital market is said to be efficient if it fully and correctly reflects all relevant information in determining security prices. Formally, the market is said to be efficient with respect to some information, if security prices would be unaffected by revealing that information to all participants. Moreover, efficiency with respect to information implies that it is impossible to make economic profits by trading on the basis of information."

II. LITERATURE REVIEW

Poshakwale **(1996)** provided empirical evidence on the weak form efficiency and the day of the week effect in Bombay Stock Exchange. They gave evidence of day of the week effect and that the stock market was not weak form efficient. The day of the week effect observed on the BSE pose interesting buy and hold strategy issues. ***Gupta and Basu (2007)*** explained that hypothesis of market efficiency is an important concept for the investors who wish to hold internationally diversified portfolios. They tested the weak form efficiency in the framework of random walk hypothesis for the two major equity markets in India and suggested that the series did not follow random walk and there was an evidence of autocorrelation in both markets. ***Sehgal and Gupta (2007)*** discussed that technical indicators do not outperform Simple Buy and Hold strategy on net return basis for individual stocks. They suggested that technical analysis provided statistically significant returns for all the nine technical indicator on gross return basis during the entire study period. ***Chander et al. (2008)*** documented extensive evidence on price behavior in the Indian stock markets. The random behavior of stock prices was quite visible, but could not undermine the noted drifts because randomness alone does not signify weak form market efficiency and vice-versa. ***Gupta (2010)*** examined the

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efficient market hypothesis and random walk characterization of returns. The validation of random walk implied that market was efficient and current prices fully reflected available information and hence there was no scope for any investor to make abnormal profits. They indicated that the Indian stock markets are weak form efficient and follow random walk. ***Srinivasan (2010)*** suggested that the Indian stock markets do not show characteristics of random walk and are not efficient in the weak form implying that stock prices remain predictable. This provides an opportunity to the traders for predicting the future prices and earning abnormal profits. ***Aggarwal (2012)*** found that Indian markets are random and successive index value changes were independent and the past index changes do not help the investor or analyst to forecast the future.

III. RESEARCH METHODOLOGY

The study explored the various studies relating to the efficiency of Indian stock markets. The objective of the study was developed to analyze the volatility of Indian Stock market taking sample of BSE100 of BSE. The data used in this study consisted of the daily closing points of BSE100 for the sample period of ten years from January 2003 to December 2012. The data was collected from the official website of the Bombay Stock Exchange i.e. www.bseindia.com. With this data set, we computed the daily returns as follows:

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

Where Rt is the return in period t, Pt and Pt-1 are the daily closing prices of the SENSEX at time t and t-1 respectively. **Augmented Dickey-Fuller and Phillips-Perron (PP)** was applied to test the null hypothesis of a unit root. The **Unit Root Test** is a necessary condition to check the stationarity of the data set used in the study. The results of ADF and PP test for a unit root for were presented in Data Analysis section.

Run test is a non-parametric test. A run is defined as a sequence of price changes of same sign, preceded or followed by price changes of different signs. Under the hypothesis that the successive price changes are independent and the sample proportions of positive, negative and no change runs are unbiased estimates of the population proportions, the expected number of runs can be computed by using the following formula proposed by Wallis and Roberts(1956).

$$M = \frac{N(N+1) - \sum_i^3 n_i^2}{N}$$

Where, M= Expected number of runs, n_i = Number of price changes of each sign(i=1,2,3) and N = Total number of price changes.

In statistics, the Kolmogorov–Smirnov **test (K–S test)** is a nonparametric test for the equality of continuous, one dimensional probability distributions that can be used to compare a sample with reference probability distribution (one-sample K–S test), or to compare two samples (two-sample K–S test). The empirical distribution function F_n for n iid observations, X_i is defined as

$$F_n(x) = \frac{1}{n}\sum_{i=1}^{n} I_{X_i} \leq x$$

where $I_{X_i} \leq x$ is the indicator function, equal to 1 if $I_{X_i} \leq x$ and equal to 0 otherwise.

Variance Ratio Test (Lo and MacKinlay1988) is used to measure the randomness of markets pre and post liberalization. The test is based on one of the properties of the random walk process, specifically that the variance of the random walk increments must be a linear function of a time interval, say q. A variance ratio that is greater than one suggests that the returns series is positively serially correlated or that the shorter interval returns trend within the duration of the longer interval. The variance ratio is calculated as:

$$VR(q) = \frac{Var(r_{t(q)})}{qVar(r_r)}$$

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IV. Data Analysis and Interpretation

The data analysis of BSE100 of Bombay Stock Exchange is done with the help of above mentioned tools and some techniques which is represented as follow:

A. *Descriptive Statistics of Daily Returns of BSE100*

A summary of descriptive statistics for returns series of BSE100 of Bombay Stock Exchange for the sample period of ten years from January 2003 to December 2012 are presented in Table I. This includes mean, maximum, minimum value, standard deviation, skewness, kurtosis and jarque-bera test. BSE100 index has the average returns of .0731%. As far as volatility is concerned the standard deviation of BSE100 was 1.6449. The coefficient of the skewness was found to be significant and negative for all the returns. The coefficient of kurtosis was found to be positive and is significantly higher than 3, indicating highly leptokurtic distribution compared to the normal distribution for all the returns.

TABLE I: Descriptive Statistics of BSE100
(January 2003 to December 2012)

Variables	BSE100
Mean	0.0731
Median	0.1709
Maximum	15.4903
Minimum	-11.936
Std. Dev.	1.6449
Skewness	-0.28
Kurtosis	10.7211
Jarque-Bera	6195.17

The jarque- bera test was applied to know whether the return series is normally distributed or not. The null hypothesis is that the series is normally distributed. The above Table I showed that the p-value (0.0000) was less that .01 at 1% significance level so null hypothesis was rejected and hence the return series of BSE100 was not normally distributed.

B. *Analysis of Unit Root Test*

The results of ADF test for a unit root for BSE100 of Bombay Stock Exchange are presented in Table II. The p-value for BSE100 for was significant at 1% level, so null hypothesis that series has a unit root problem was rejected. It means the series was stationary and therefore it can be concluded that this market does not have random walk and is not weak form of efficient.

TABLE II: Unit Root Test of BSE100
(January 2003 to December 2012)

Variable	BSE100
ADF test	-45.363
p- value	0.0001*

**Indicates significance at 1% level of significance*

C. *Analysis of Kolmogorov-Smirnov Test*

The results of the Kolmogorov-Smirnov Test of return series of BSE100 of Bombay Stock Exchange is presented in Table III. K-S test null hypothesis is return series are normally distributed. K-S stats was significant at 1% level which means null hypothesis was rejected. It can be concluded that the present market under study does not follow normal distribution.

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TABLE III:Kolmogorov-Smirnov Test of BSE100
(January 2003 to December 2012)

VARIABLE	BSE100
Absolute	0.077
Positive	0.068
Negative	-0.077
K-S-Z	3.843
P-Value	0.000*

D. Analysis of Runs Test

The results of Runs Test for returns series of BSE100 of Bombay Stock Exchange for the entire are presented in Table IV. The Table IV shows that p-value was lesser than .01 at 1% significant level and lesser than .05 at 5% significant level. The p-value of BSE100 has 0.001, so null hypothesis that further price changes are not dependent and move randomly, was rejected. It means price changes are dependent and random walk is not followed so BSE100 is not weak form efficient which means all past prices of a stock are reflected in current stock price.

TABLE IV: Runs Test of BSE100
(January 2003 to December 2012)

VARIABLE	BSE 100
K=Mean	0.00073
Cases < K	1156
Cases >= K	1325
Total Cases	2481
Number of Runs	1153
Z- Statistic	-3.339
p-value	0.001*

E. Analysis of Variance Ratio Test

The results of the Variance Ratio Test of return series of the BSE100 of Bombay Stock Exchange is presented in Table V. The null hypothesis of random walk is rejected if it is rejected for some *k* value. Under null hypothesis the variance ratio should be approximately equal to 1. If the value is not equal to one then it means that the series is auto correlated in first-order and the variance ratio is sum of first-order autocorrelation coefficient estimator and unit value.

TABLE V: Variance Ratio Test for BSE100
(January 2003 to December 2012)

BSE100			
Lags	VR Ratio	z-Stats	p-value
2	0.53	-13.55	0.00
3	0.33	-12.99	0.00
4	0.24	-11.76	0.00
5	0.21	-10.34	0.00
6	0.19	-9.42	0.00
7	0.17	-8.76	0.00
8	0.16	-8.22	0.00
9	0.17	-7.57	0.00
10	0.17	-7.1	0.00
11	0.16	-6.82	0.00
12	0.16	-6.47	0.00

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The Table V shows that variance ratio was less than one and p-value for BSE100 was significant at 1% level. Therefore, null hypothesis that variance ratio should be equal to one can't not be accepted. All this points out that variance ratio was less than 1 and hence series were auto correlated. It was also seen that as VR ratio increased, z-stats also increased which means the chances of rejection becomes even stronger. From the above results it can be said that BSE100 under study does not follow random walk and is not weak form efficient.

V. Conclusion

In the present study, the predictability of returns of Indian stock market was analyzed. To test this, BSE100 of Bombay Stock Exchange was considered for the sample period of ten years from January 2003 to December 2012. Various statistical tools were used like Unit Root Test, Runs test, Kolmogorov-Smirnov Test, Autocorrelation, L-Jung Box Test and Variance Ratio Test to see how informational efficient Indian stock market was. The results did not show evidence of random walk which means that the information regarding yesterday's indices are not effectively absorbed by today's indices. The results showed that those serial dependencies are not consistent across the sample period for the index. In other words, the Indian stock market is not weak form efficient but not all the time.

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Dr. Ravi Kumar Gupta is presently Professor & Head, Department of Management Studies, Vaish College of Engineering Rohtak, Haryana. He has teaching experience of 16 years. He has published over 50 research papers in the Journals of National & International repute and edited 3 books. His area of interest includes Multinational Financial Management, Security Analysis & Portfolio Management, Financial Derivatives, Financial Services & Business Environment.

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