Relevance of Efficient Market Hypothesis with Special Reference to BSE India

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The stock market efficiency is one of the important concerns as it performs a significant role in providing fair chance to the trading members by providing access to complete and accurate information and reflects fair current market prices. The present study has been conducted with the purpose of analyzing the efficiency in the context of Indian stock market. The objective is to analyze whether the prices in Indian stock market follow random walk movement and also to evaluate the efficiency of Bombay Stock Exchange on the basis of its index known as SENSEX. Runs test and Serial Correlation test have been used on the closing values of SENSEX for a period of five years i.e. December 2007 to December 2012. The results of Z test and t test help us conclude that BSE India is an inefficient and behavioral market rather than a rational one.

Keywords: *Efficient Market Hypothesis, SENSEX, Runs Test and Behavioral Market.*

INTRODUCTION

Market Efficiency is the efficiency and ability of the market to perform all the operations in an adequate manner and to depict the information in a quick and efficient manner. It is the analysis of the efficiency of capital markets. This looks at how fair are the current market prices for an asset, given in the current market situations. For example, if major news breaks out for a company, an analysis would occur on the stock's price to see how it should be valued and given in the news. Capital market efficiency measures the extent of the accuracy of the stock's price. Market Efficiency has been one of the important aspects of capital markets and a keen interest for the profitability of the investors as it affects the extent to which the investors can earn profits and can beat the market. On the basis of their nature, there are two types of market efficiency: informational and operational efficiency. Informational efficiency deals with the ability of the market to collect and depict the information in a quick and efficient manner. Operational efficiency states the capability of the market to perform the routine operations efficiently as the market is required to perform various operations like listing, clearing and other trading operations.

According to Efficient Market Hypothesis markets are rational and prices of stocks fully reflect all available information. The securities prices quickly adjust to new information as readily that information is available. But according to Behavioral Finance this kind of efficient market cannot explain the observed anomalies in Market anomalies, which are the unusual occurrences or abnormality in smooth patterns of the stock market. Different researchers exhibited the existence of observed anomalies with their evidences in different stock exchanges of the world. But yet the evidences on anomalies are debatable.

There are three major versions of the hypothesis: Weak, Semi-Strong, and Strong. In weak form of EMH, all the past information including past prices and returns is already reflected in the current prices of stocks. The assumption of weak form is consistent with Random Walk Hypothesis i.e. stock prices move randomly, and the price changes are independent of each other. So if the weak form holds, no one can predict the future on the basis of past information. And no one can beat the market by earning abnormal returns. Therefore, the Technical (trend) Analysis, wherein the analysts make the chart of past price movements of stocks to accurately predict future price changes, is of no use. However, one can beat the market and get abnormal returns on the basis of fundamental analysis or on the basis of private information.

In the semi strong form, current stock prices reflect all the publicly available information as well as the past information. So no one can make extra profit on the basis of fundamental analysis. However, one can beat the market by insider trading.

In the strong form of market efficiency, all relevant information including past, public and private information is reflected in the current stock prices. So if the strong form persists, then no one can beat the market in any way, not even by insider trading. It is clear that no market can attain full efficiency all the time. Changes in the share prices are always possible when they are caused by newly disclosed information.

REVIEW OF LITERATURE

The paper in hand tries to evaluate the efficiency of Bombay Stock Exchange Limited commonly known as BSE India established in 1875 which till now enjoys a status of repute. There are various studies which have been conducted on the various stock markets across the globe to analyze the efficiency.

Asma & Keavin (2000) tested weak-form market efficiency on Dhaka Stock Exchange. They took daily price indices of all listed securities of DSE for period from 1988 to 1997. The null hypothesis has been rejected by the parametric tests such as Auto-correlation, Auto-regression, and ARIMA model and the study revealed that emerging markets such as Dhaka Stock Exchange are weak-form efficient and investors can generate excessive returns.

A number of studies conducted in India reveal contradictory results. The study by Poshakwale (1996) argued that the efficiency of the emerging markets is of much greater importance. His study provided empirical evidence on weak form efficiency in Bombay Stock Exchange over a period of 1987-1994.The Serial Correlation Coefficients Test and Runs test have been applied to the selected data. The results concluded that the market is not weak form efficient. On the other hand, Pant and Bishnoi (2001) found that the Indian stock market was weak form efficient using Dickey Fuller Test. The similar results were achieved by Mall, Pradhan, and Mishra (2011) who used daily returns data from June 2000 to May 2011 and found that the Indian stock market is weak form efficient. Harper and Jin (2005) tried to determine whether the Indian the stock market is an efficient market and the stock returns followed a random walk. They used autocorrelation, Box-Ljung test statistics and the run test and concluded that the Indian stock market was not efficient in the weak form during the testing period. The stock prices did not reflect all the information and abnormal returns could be achieved by the investors exploiting the market inefficiency. Gupta and Basu (2007)

evaluated market efficiency in the Indian stock market from 1991 to 2006. They used the Augmented Dickey-fuller test, Phillip Perron, and KPSS procedures to test for unit roots. The results indicated that Indian Stock Markets do not follow a random walk. Thomas and Kumar (2010) used the runs test and Kolmogorov- Smirnov test and found the similar results for daily returns in the Indian Stock Market from 2004 to 2009. Mahindra and Sharma (2009) tested the efficiency hypothesis of the stock market by taking the data of various companies like ACC, Bajaj, Bharti airtel, Dr.Reddy, Grasim, HDFC, Hindalco, Maruti Suzuki etc.

In their study, Akber and Muhammad attempted to seek evidence for weak-form of market efficiency for KSE 100 Index. Index returns have been studied from 1st January, 1992 to 30th April, 2013 using Non-Parametric tests (Kolmogrov-Smirnov goodness of fitness test, Runs test and Phillips-Perron test) and Parametric tests (Auto-correlation test, Box-Pierce (Q) statistic test, Ljung and Box (Q) Statistic test, Augmented Dickey-fuller test, Dickey-fuller GLS test, Jarque-Bera test, Kwiatkowski, Phillips, Schmidt and Shin test, Auto-regression and ARIMA model). The study concluded that KSE 100 Index has found to be weak-form inefficient, but the last 4 years have shown some signs of efficiency. Companies return series from KSE 30 Index are found to be more random than companies return series from KSE100 Index.

Chung (2006) examined Efficient Market Hypothesis on two major Chinese stock markets Shanghai and Shenzhen for the period from 1992 to 2005. The study used autocorrelation test, runs test, unit root test and multiple variance ratio. The results revealed that the two major Chinese stock markets are not weak-form efficient markets.

Chakraborty (2006) analyzed the weak-form efficiency of the Pakistani market using daily closing prices for the period from January 1st 1996 to 31st December 2000. Applying the serial correlation and variance tests, the study rejected the random walk behavior in stock price movement and considered the stock market inefficient. Rabbani et al. (2013) analysed weak-form market efficiency hypothesis emerging stock market Karachi stock exchange Pakistan. Secondary data has been taken for twelve years from January 1999 to December 2010 of KSE 100 Index. This time period is divided into four groups including three years each. Weak-form efficiency tests such as Augmented Dickey-fuller test, Auto-correlation function test, Phillip Perron test and Runs test are applied to analyze the data. All these tests rejected efficient market hypothesis (EMH) in its weak-form except Runs test , which suggested weak-form market efficiency for two groups of years 1999-2001 and 2005-2007.Overall KSE of Pakistan is weak-form inefficient and investors are compensated for taking augmented risk.

Suleman et al. (2010) conducted a study to test the weak-form market efficiency of the stock market returns of Pakistan, India, Sri Lanka, China, Korea, Hong Kong, Indonesia, Malaysia, Philippine, Singapore, Thailand, Taiwan, Japan and Australia. Monthly observations are taken for the period January 2004 to December 2009. Autocorrelation, Ljung-Box Q-statistic Test, Runs Test, Unit Root Test and the Variance Ratio are used to test the hypothesis that the stock market follows a random walk. Monthly returns are not normally distributed, because they are negatively skewed and leptokurtic. In aggregate we concluded that the monthly prices do not follows random walks in all the countries of the Asian-Pacific region. The investors can take the stream of benefits through arbitrage process from profitable opportunities across these markets.

Khan et al. (2011) interpreted the theory and evidence on market efficiency. The paper comprised of the Analysis of BSE and NSE with the help of Run Test. This paper tested the market efficiency of Indian Capital Market in its weak form based on the indices of two major stock exchanges of India viz; National Stock Exchange (NSE) and Bombay Stock

Exchange (BSE). The efficiency of the Indian capital market is tested using the daily closing values of the indices of NSE and BSE over the period of ten years.

Patel, Radadia and Dhawan (2012) investigated the weak form of market efficiency of Asian four selected stock markets. This paper took a daily closing price of stock markets under the study ten years and also divided full sample in three interval periods, and applied various test The paper concluded that BSE Sensex has given the highest mean returns to the investor followed by SSE Composite and Hangseng. This study considered BSE Sensex as high risk markets as it reported the highest Standard Deviation.

Nisar and Hanif (2012) examined the weak form of efficient market hypothesis on the four major stock exchanges of South Asia including, India, Pakistan, Bangladesh and Sri Lanka. Historical index values on a monthly, weekly and daily basis for a period of 14 Years (1997-2011) were used for analysis. Applying runs test, serial correlation, unit root and variance ratio test, findings suggested that none of the four major stock markets of south-Asia follows Random-walk and hence all these markets are not the weak form of efficient market.

The perusal of the literature reveals that till today, EMH is considered as a puzzle as its relevance with reference to the capital markets has not been studied thoroughly. In order to analyze that perspective of EMH, effort has been made by the present study. The usability of the parameters and the time period considered can be taken as foundation factors for the research gap between the studies which were conducted earlier and the present study.

DATA AND METHODOLGY

The objective of the study is to analyze the efficiency of BSE India on the basis of Runs test and Serial Correlation Test on closing values of Sensex from December 2007 to December 2012. Runs test is a non-parametric test, which is used to test the randomness of the series which auto correlation fails to do. Runs Test is a traditional method used in the Random Walk model and ignores the properties of distribution. It has been used to judge the randomness in the behavior of Indian Stock market. It determines whether successive price changes are independent. In this test, actual number of runs is compared with the expected number of runs. If the actual number of runs is not significantly different from the expected number of runs, then the price changes are considered independent, and if this difference is significant then the price changes are considered dependent. The Runs test provides the systematic interpretation to the movement of the prices as it analyses the upswings and downswings of the value. The expected number of runs can be obtained by applying the following formula:

$$E(r) = \frac{2(n_1 n2)}{n_1 + n_2 + 1}$$

Where, $E(r)$ = Expected number of runs.
n_1 = Number of positive runs.
n_2 = Number of negative runs.

The standard error of the expected number of runs of all signs may be obtained as-

$$S.E = \sqrt{\frac{2n1n2\,(2n1n2-n1-n2)}{(n1+n2)2\,(n1+n2-1)}}$$

Where, S.E = Standard Error

Daily closing values of Sensex for a period of five years from December 2007 to December 2012 have been used. Considering the movements in the prices, runs are calculated. The number of positive and negative runs is calculated which further serves as the basis for calculating the mean of runs. Then the standard error of the runs distribution is found. In order to find out the limit range which can be used to determine the efficiency and inefficiency of the market, t-test, Z test or F test has been applied. If the number of total runs lies in the range given by the test, market is said to be in weak form of efficiency and if it lies outside of the range, it is said to be inefficient.

Table 4.1 Runs taken by BSE SENSEX from December 2007 to December 2012

Month	Positive Runs (N1)	Negative Runs (N2)	Number of Runs (N or r)
Dec-07	3	4	7
Jan-08	5	5	10
Feb-08	5	4	9
Mar-08	4	4	8
Apr-08	4	4	8
May-08	5	5	10
Jun-08	4	4	8
Jul-08	5	6	11
Aug-08	5	4	9
Sep-08	4	5	9
Oct-08	3	3	6
Nov-08	3	4	7
Dec-08	5	6	11
Month	Positive Runs (N1)	Negative Runs (N2)	Number of Runs (N or r)
Jan-09	6	5	11
Feb-09	5	5	10
Mar-09	5	6	11
Apr-09	3	3	6
May-09	5	5	10
Jun-09	7	7	14
Jul-09	5	5	10
Aug-09	6	5	11
Sep-09	3	4	7
Oct-09	6	5	11
Nov-09	5	6	11
Dec-09	7	6	13
Jan-10	4	3	7
Feb-10	5	6	11
Mar-10	5	4	9
Apr-10	4	4	8
May-10	6	6	12
Jun-10	6	6	12
Jul-10	6	7	13
Aug-10	7	7	14
Sep-10	4	4	8
Oct-10	7	7	14
Nov-10	6	6	12
Dec-10	6	5	11
Jan-11	4	4	8
Feb-11	4	5	9
Mar-11	5	4	9
Apr-11	3	3	6
May-11	5	7	12
Month	Positive Runs (N1)	Negative Runs (N2)	Number of Runs (N or r)
Jun-11	5	4	9
Jul-11	5	6	11
Aug-11	4	4	8
Sep-11	6	5	11
Oct-11	5	5	10
Nov-11	4	5	9
Dec-11	5	5	10
Jan-12	5	5	10
Feb-12	5	4	9
Mar-12	5	6	11
Apr-12	6	5	11
May-12	5	6	11
Jun-12	5	4	9
Jul-12	4	5	9
Aug-12	6	5	11
Sep-12	4	5	9
Oct-12	7	7	14
Nov-12	4	3	7
Dec-12	5	6	11
Total	300	303	603

Analysis by Run Test:

Total number of Runs (r): 603

Number of Positive Runs (n1): 300

Number of Negative Runs (n2): 303

Mean (μr)

$$E(r) = \frac{2(n_1 n_2)}{n_1 + n_2 + 1}$$

$$\frac{2(300)(303)}{603+1}$$

$$= 301.49 + 1 = 302.49$$

And Standard Error (σr)

$$\sqrt{\frac{2n_1n_2\,(2n_1n_2 - n_1 - n_2)}{(n_1+n_2)2\,(n_1+n_2-1)}}$$

$$= \sqrt{\frac{2(300)(303)\,(2(300)(303)\,603}{(603)^2\,(603-1)}} = 150.49$$

Standard Error (σr) = $\sqrt{150.49}$ = 12.267

To test the randomness of the prices, a two tail test has been used as:

Null Hypothesis (H_0): Market is operating in weak form of efficiency

Alternate Hypothesis (H_1): Market is Inefficient

Calculation of Limits using t Stat:

Test at 5% significance level or at α = 0.05, using t-table at 10 degrees of freedom

The Lower Limit: μ(r) - t*σr

302.49 2.228 (12.267) = 275.15

The Upper Limit: μ(r) + t*σr

302.49 + 2.228 (12.267) = 329.82

Thus the limit range comes out to be: 275.15 to 329.82. As observed, the value of r or N = 603, does not lie in these limits, so null hypothesis is rejected.

Calculation of Limits using Z Stat:

Test at 5% Significance Level or at α = 0.05, using Z table where the Value of Z statistic is = 1.96 in Two Tail Test:

The Lower Limit: μ(r) - Z*σr

302.49 1.96 (12.267) = 280.26

The Upper Limit: μ(r) + Z*σr

302.49 + 1.96 (12.267) = 324.71

Thus the Limit Range comes out to be: 280.26 to 324.71. As observed the Value of r or N = 603, does not lie in these limits, so Null Hypothesis is Rejected.

The market efficiency on the basis of run test has been analyzed using Z and t test, using five years data ranging from December 2007 to December 2012. Analysis reveals the null hypothesis was rejected which leads to the acceptance of the alternate hypothesis that market is inefficient. The analysis of the market efficiency using Z test presented the same results when the two tailed test was applied to the runs of Sensex.

Serial Correlation Test

In Serial Correlation test two series of prices is taken to identify the degree of association between the prices at different points of time. As for the existence of efficiency, the correlation (r) between the prices should be zero. If r is zero, it depicts the absence of association in prices, indicating that prices are moving in an independent manner. Thus it provides the evidence that market is operating in Weak Form of Efficiency. In this test, Karl Pearson's Coefficient of Correlation was found between two price chains by using the formula as:

$$r = \frac{N(\Sigma xy) - (\Sigma x)(\Sigma y)}{\sqrt{[N\Sigma x^2 - (\Sigma x)^2][N\Sigma y^2 - (\Sigma y)^2]}}$$

Correlation Analysis between closing values of 2009 and 2010:

In the efficient market, there should be no correlation between the price movements of different time periods. In this it has been analyzed by taking different price series at different points of time.

Table 2 Closing values of 2009 and 2010			
Date	Close Value	Date	Close Value
01-01-2009	9,903.46	04-01-2010	17,558.73
02-01-2009	9,958.22	05-01-2010	17,686.24
05-01-2009	10,275.60	06-01-2010	17,701.13
06-01-2009	10,335.93	07-01-2010	17,615.72
07-01-2009	9,586.88	08-01-2010	17,540.29
09-01-2009	9,406.47	11-01-2010	17,526.71
12-01-2009	9,110.05	12-01-2010	17,422.51
13-01-2009	9,071.36	13-01-2010	17,509.80
14-01-2009	9,370.49	14-01-2010	17,584.87
15-01-2009	9,046.74	15-01-2010	17,554.30

Source: http/www/bseindia.com/
Coefficient of Correlation (r) = 0.768843

Table 3 Closing values of 2010 and 2011			
Date	Close Value	Date	Close Value
04-01-2010	17,558.73	03-01-2011	20,561.05
05-01-2010	17,686.24	04-01-2011	20,498.72
06-01-2010	17,701.13	05-01-2011	20,301.10
07-01-2010	17,615.72	06-01-2011	20,184.74
08-01-2010	17,540.29	07-01-2011	19,691.81
11-01-2010	17,526.71	10-01-2011	19,224.12
12-01-2010	17,422.51	11-01-2011	19,196.34
13-01-2010	17,509.80	12-01-2011	19,534.10
14-01-2010	17,584.87	13-01-2011	19,182.82
15-01-2010	17,554.30	14-01-2011	18,860.44

Source: http/www/bseindia.com/
Coefficient of Correlation(r) = 0.639683

Table 2 reveals that in the price series of January 2009 and January 2010, there exists a positive correlation between the prices of different time periods. Thus market is inefficient as association between the prices indicates the non randomness in the movement of the prices.

Correlation Analysis between values of 2010 and 2011

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CONCLUSIONS OF THE STUDY

The theoretical and empirical studies of the efficient market hypothesis have made an important contribution to the understanding of the stock market, although the present state of understanding of the issue, especially in the emerging financial markets, is far from being conclusive. The present study used runs test to analyze whether the market is operating in the weak form of efficiency or not. The results of the present study show that there is an association between the prices which indicate that the prices are not moving randomly, hence the market is inefficient which suggests that the investors can earn abnormal profits by following certain strategies on the basis of the movement of the market.

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