Global Journal of Enterprise Information System

Market efficiency in India: A study of Random Walk Hypothesis of Indian Stock Market(BSE)

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Abstract

As long as financial markets are concerned, for many years' economists, statisticians and financial analyst have been interested in developing and testing models of stock price behaviour and their forecast. This study examines whether the Indian stock market is efficient if the stock returns follow a random walk. The study employs daily closing prices of SENSEX (Sensitivity Index of BSE of India) for a time period of 01 July 1997- 03 Dec 2014. The existence of random walk for BSE Index has been examined through autocorrelation, the Box- Ljung test statistics and the run test and finds that the Indian stock market was not efficient in the weak form during the testing period. The results suggest that the stock prices in India do not reflect all the information in the past stock prices and abnormal returns can be achieved by investors exploiting the market inefficiency.

Keywords: Autocorrelation tests, runs test, random walk hypothesis, Bombay Stock Exchange

1. Introduction

The weak form says that the current prices of stock already fully reflect all the information that is contained in the historical sequence of prices. Therefore, there is no benefit, as far as forecasting the prices/returns behaviour of the capital markets is concerned, in examining the historical sequence of the prices. If a market is efficient, stock price movements should follow a random walk and the price movements in the past should be not related to future price movements. But if the market is not efficient and price movements are not random, some investors can exploit the inefficiency by gaining abnormal returns. They may be able to correctly predict the future price movements by examining the historical price movements. There have been some studies testing the Efficient Market Hypothesis (EMH) in regards to the India stock market but the results have been inconclusive.

This study analyzes the daily index returns from 01 July 1997 to 03 December 2014 by using some commonly used methodologies to determine whether the Indian market is efficient in the weak form. The Bombay Stock Exchange was established in 1875 is one of the largest exchanges in Asia and in the world. More than 5000 companies are listed on BSE making it world's No. 1 exchange in terms of listed members. The companies listed on BSE Ltd command a total market capitalization of USD 1.32 Trillion as of January 2013. It is also one of the world's leading exchanges (3rd largest in December 2012) for Index options trading. BSE is the first exchange in India and second in the world to obtain an ISO 9001:2000 certification. It is also the first Exchange in the country and second in the world to receive Information Security Management System Standard BS 7799-2-2002 certification for its On-Line trading System (BOLT). It operates one of the most respected capital market educational institutes in the country (the BSE Institute Ltd.). BSE also provides depository services through its Central Depository Services Ltd. (CDSL) arm.

2. Literature Review

The concept of market efficiency is based on the arguments put forward by Paul A. Samuelson (1965) that anticipated price of an

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asset fluctuate randomly. Prof Eugene Fama[4] presented a formal review of theory and evidence of market efficiency and subsequently revised in 1991. He developed the three forms of market efficiency: weak form, semi-strong form and strong form. Since then many studies have been done to examine whether some markets are efficient in the weak form. For instance, Chan, Gup, and Pan[3] analyzed the weak form hypothesis in Hong Kong, South Korea, Singapore, Taiwan, Japan, and the United States. Their findings indicate that stock prices in these major Asian markets and the United States are efficient in the weak form. Vaidyanathan and Gali (1994) also found that the Indian capital market is weak form efficient using a filter rules test. Ayadi and Pyun[1] acknowledge that the variance ratio test is more appealing than the traditional test for random walk. They also showed that South Korean market does not follow random walk when tested under homoscedastic error term assumption and follows random walk when the test statistic is corrected for heterocsedasticity. Lo and MacKinlay[10] use a variance ratio test to analyze the weekly returns of both the equally weighted and value weighted CRSP indices and find that stock prices do not follow a random walk. Ming, Nor & Guru[12] showed that variance ratio and multiple variance ratio tests reject random walk for Kuala-Lampur stock exchange .

Gu[7] also studied the weak form efficiency of the NASDAQ composite index by using of the variance ratio test from 1971 to 2001. Using daily returns, he finds evidence that the daily returns of the NASDAQ are not weak form efficient. In contrast, Seiler and Rom[14] study the random walk hypothesis by using the Box-Jenkins methodology from 1885 to 1962 and find that historical stock price movements are random.

Several researchers have examined market efficiency in India but got the For example, Gupta and Basu[6] evaluated market efficiency in the Indian stock market from 1991 to 2006. They use the ADF, PP, and KPSS procedures to test for unit roots. Their results indicate that Indian Stock Markets do not follow a random walk. Thomas and Kumar[15] use the runs test and Kolmogorov-Smirnov test and find the same results using daily returns in the Indian Stock Market from 2004 to 2009. Borges[2] tests the existence of the random walk and EMH for European stock markets, namely UK, France, Spain, Germany, etc by using ADF tests, variance ratio and correlation tests for monthly stock prices. In one more study, Khan, Ikram and Mehtab[9] used a runs test to analyze the daily returns from the BSE Sensex, the S&P CNX Nifty and various publications of the Reserve Bank of India from April 2000 to March 2010. The runs test indicated that both the NSE and BSE do not follow a random walk. However in an earlier study Pant and Bishnoi[13] found that the Indian stock market in weak form was efficient when using the Dickey Fuller Test. Another study by Hamid, Suleman, Shah and Akash[8] tested the weak form of efficiency for the case of Asia Pacific Markets which included 14 countries such as India, Pakistan, Japan, Australia, Taiwan among others. Mall, Pradhan, and Mishra[11] use daily data from June 2000 to May 2011 and found that the Indian capital market is weak form efficient.

3. Data

The data used in this study consisted of index returns for the Bombay Stock Exchange. The data is retrieved from BSE official website www.bseindia.com from 01 July 1997 to 03 December 2014. The index returns is then transformed to natural logs with a one period lag. Index closing prices are adjusted to reflect dividends and stock splits. The stock returns are defined as follows:

$$R_t = \text{Log}_{pt} / \text{Log}_{pt-1}$$

Where, R_t is the return at time t on the Bombay Stock Exchange, Log_{pt} is the logarithmic price at time t and Log_{pt-1} is the logarithmic at time, t-1. The reason for transforming time series is to ensure that the data is stationary. Working with non-stationary data can cause model misspecifications. The analysis is done using SPSS 20.0.

4. Methodology

In testing the market efficiency of the Bombay Stock Exchange, autocorrelations and runs test are employed. Applied methods autocorrelations test and run test examine if time series data exhibits randomness. The methodology used in this study is similar to Thomas and Kumar[15] and Khan, Ikkram, and Mehtab[9]. But this study uses the more current daily price data from 01 July 1997 to 03 December 2014. The autocorrelation test is a parametric test that makes assumptions about the normality of data. This study also uses a non-parametric procedure to examine randomness, the runs test. We seek to test the hypothesis that the series of returns are i.i.d. (independently and identically distributed) random variables.

If significant autocorrelations are found in times series data, stock returns do not follow a random walk and the market can be considered as inefficient in the weak form because it would be possible to make accurate predictions about the future price movements based on past price movements. However, if stocks returns do follow a random walk, then investors may not be able to successfully predict future returns because future price movements are related to past price movements.

5. Results

Table 1 illustrates the calculation of a summary of 4306 daily statistics. The returns range from 0.98% to 1.02%, and exhibit more

Table 1. Descriptive Statistics of Bombay Stock Exchange

Descriptive Statistics												
	N	Min	Max	Sum	Mean		Std. Dev	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
BSE 30	4306	.986157	1.01699	4306.21	1.00004	.000027	.001819	.000	-.121	.037	5.606	.037

Table 2a. Autocorrelations

Series: BSE 30					
Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		Sig.[b]
			Value	df	
1	.071	.015	21.697	1	.000
2	-.037	.015	27.738	2	.000
3	.002	.015	27.753	3	.000
4	.018	.015	29.197	4	.000
5	-.023	.015	31.559	5	.000
6	-.051	.015	42.674	6	.000
7	.015	.015	43.588	7	.000
8	.040	.015	50.594	8	.000
9	.047	.015	60.064	9	.000
10	.010	.015	60.482	10	.000
11	-.019	.015	61.980	11	.000
12	-.003	.015	62.031	12	.000
13	-.002	.015	62.054	13	.000
14	.038	.015	68.152	14	.000
15	-.022	.015	70.229	15	.000
16	.000	.015	70.229	16	.000

a.The underlying process assumed is independence (white noise).
b.Based on the asymptotic chi-square approximation.

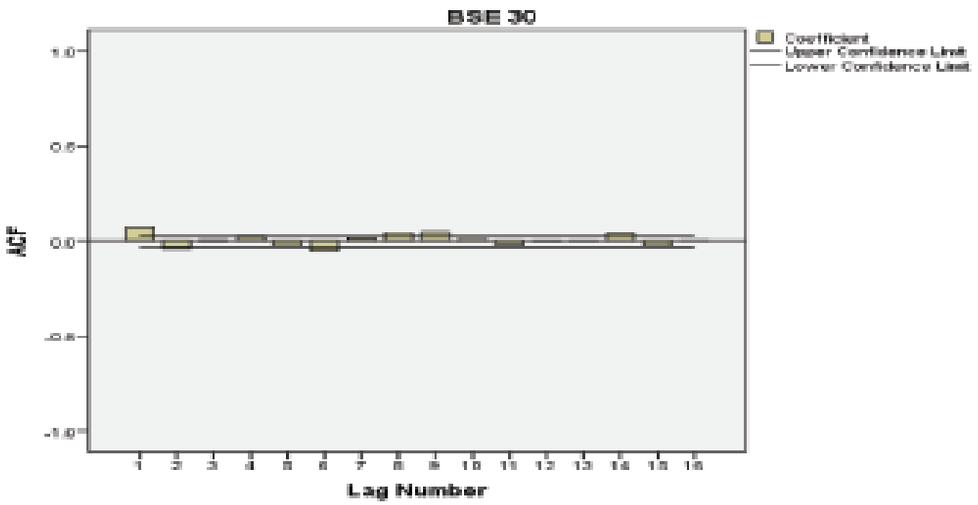

Figure 1a. Autocorrelation.

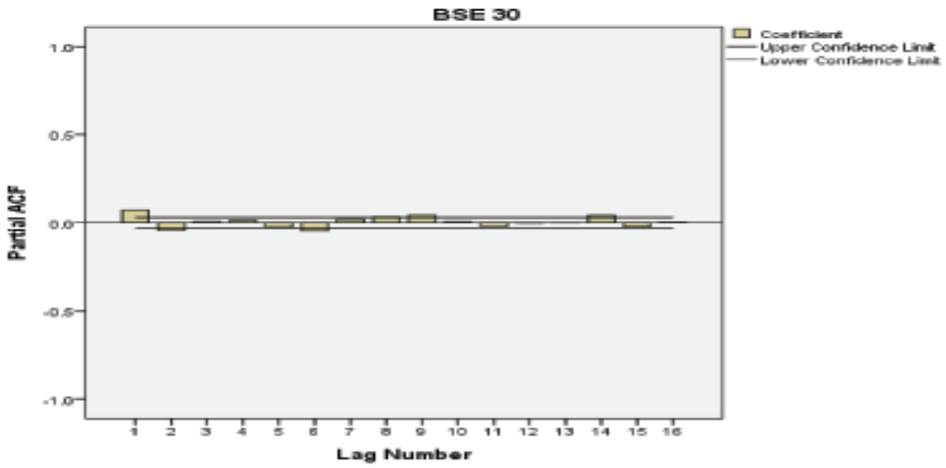

Figure 1b. Partial autocorrelation.

kurtosis than a normal distribution and a sample standard deviation of .18%. The returns have a negative skewness of 0.121 and a reported kurtosis of 5.606. A kurtosis of 3 is considered to be associated with a normal distribution. In this case the kurtosis is 5.606 and indicates probable tail risk. Tail risk is risk that occurs infrequently; however, when tail risk does occur, the returns are often associated with significant volatility. Kurtosis explains where the standard deviation originates.

Table 2 illustrates the results of the autocorrelations test. There are 16 lag periods associated with the autocorrelation test. The first lag depicts an autocorrelation of 0.071, a standard error of 0.015 and a Box-Ljung value of 21.697 and is significant at the 95% confidence level. This indicates that the stock returns of the Indian stock market do not follow a random walk. Lags 2, 5, 6,11,12,13 and 15, all exhibit negative autocorrelations, however, the p value is .000 and is significant again at the 95% confidence level that stock returns on the Indian stock market are not random. The results are consistent with the results by Thomas and Kumar[15]. The implication is that investors may be able to predict future returns by analyzing the past price movements and thus renders the market inefficient in the weak form. The autocorrelations test is a parametric test and assumes that the data is normally distributed. In order to be scientifically sound, a runs test is conducted which is a non-parametric test that does not assume normality in the data.

Table 3 shows the results of the Runs test. This study finds the Z value to be -4.999 and lie outside of the range of 95% confidence level that stock returns follow a random walk. Also, the P value is .000 and is significant at the 95% confidence level. Our results are consistent with the findings by Khan et al.[9]. The findings from the runs test indicate that the Indian stock market does not follow a random walk and the market can be classified as weak form inefficient.

Table 2b. Partial autocorrelations

Series: BSE 30		
Lag	**Partial Autocorrelation**	**Std. Error**
1	.071	.015
2	-.043	.015
3	.008	.015
4	.016	.015
5	-.026	.015
6	-.046	.015
7	.020	.015
8	.034	.015
9	.044	.015
10	.007	.015
11	-.020	.015
12	-.003	.015
13	-.002	.015
14	.043	.015
15	-.024	.015
16	.003	.015

6. Conclusion

Many studies have been done to test the efficiency of Indian market in the weak form but the results have been inconclusive. Some studies find the market efficient in the weak form but others find the market inefficient in the weak form. In this study, we use autocorrelation and runs test to analyze daily index returns of the Bombay Stock Exchange from 01 July 1997 to 03 December 2011.

Table 3. Runs test

Runs test	
	BSE 30
Test Value[a]	1.00010955110
	4
Cases < Test Value	2153
Cases >= Test Value	2153
Total Cases	4306
Number of Runs	1990
Z	-4.999
Asymp. Sig. (2-tailed)	.000

a. Median

The results of the autocorrelation and runs test indicate that the Indian stock market is not efficient in the weak form during our testing period and imply that it is possible to achieve abnormal returns by predicting the future price movements based on past stock price movements.

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