Examining market efficiency in India: An empirical analysis of the random walk hypothesis

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ABSTRACT

This study tries to determine whether the Indian stock market is efficient by examining if the stock returns follow a random walk. Following previous studies, we use autocorrelation, the Box-Ljung test statistics and the run test and find 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, stock index, India

INTRODUCTION

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 July 1997 to December 2011 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. As of December 2011, the market capitalization on the Indian stock exchanges was $1.015 trillion, 5,112 companies were listed in the exchange with over 20 million shareholders.

The paper is organized as follows. Section II provides a brief review of the literature. Section III provides the data, while section IV discusses the methodology. The paper concludes with the empirical results which are then followed by the conclusion.

LITERATURE REVIEW

The study of market efficiency can be traced to the seminal works of Fama (1970). 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 (1992) 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.

But, Lo and MacKinlay (1998) 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. Gu (2004) 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 (1997) 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 conflicting results. For example, Gupta and Basu (2007) 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 (2010) 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. In a more recent study, Khan, Ikram and Mehtab (2011) 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 (2001) found that the Indian stock market was weak form efficient

when using the Dickey Fuller Test. Vaidyanathan and Gali (1994) also found that the Indian capital market is weak form efficient using a filter rules test. Mall, Pradhan, and Mishra (2011) use daily data from June 2000 to May 2011 and found that the Indian capital market is weak form efficient.

DATA

The data used in this study consisted of index returns for the Bombay Stock Exchange. The data is retrieved from Yahoo! Finance from July 1997 to December 2011. 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:

$R_t = Log_{pt} / Log_{pt-1}$

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.

METHODOLOGY

In testing the market efficiency of the Bombay Stock Exchange, an autocorrelations and runs test is employed. Both the autocorrelations test and run test examine if time series data exhibits randomness. The methodology used in this study is similar to Thomas and Kumar (2010) and Khan, Ikkram, and Mehtab (2011). But this study uses the more current daily price data from July 1997 to December 2011. 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.

RESULTS

Table 1 (all tables are in the Appendix) illustrates the calculation of a summary of 3,196 daily statistics. The returns range from -5.1 to 6.9%, and exhibit more kurtosis than a normal distribution and a sample standard deviation of .75%. The returns have a negative skewness of-.093 and a reported kurtosis of 5.675. A kurtosis of 3 is considered to be associated with a normal distribution. In this case the kurtosis is 5.675 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 .071, a standard error of.018 and a Box-Lung value of 16.258 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, 3,5,6,11,12, and 14 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 (2010). 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 -3.609 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. (2011). 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.

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 fin 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 July 1997 to December 2011. 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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APPENDIX

Table 1: Descriptive Statistics of Indian Stock Market

	N	Min	Max	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
India	3196	-.0513	.0694	.000226	.0074570	-.093	.043	5.675	.087
Valid N (listwise)	3196								

Table 2: Autocorrelations

Series:India

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	Df	Sig.[b]
1	.071	.018	16.258	1	.000
2	-.032	.018	19.573	2	.000
3	-.008	.018	19.781	3	.000
4	.019	.018	20.954	4	.000
5	-.028	.018	23.406	5	.000
6	-.062	.018	35.626	6	.000
7	.021	.018	36.995	7	.000
8	.044	.018	43.192	8	.000
9	.039	.018	48.033	9	.000
10	.017	.018	48.956	10	.000
11	-.023	.018	50.638	11	.000
12	-.004	.018	50.687	12	.000
13	.015	.018	51.402	13	.000
14	.038	.018	55.948	14	.000
15	-.014	.018	56.588	15	.000
16	.000	.018	56.588	16	.000

a. The underlying process assumed is independence (white noise).

b. Based on the asymptotic chi-square approximation.

Table 3: Runs Test

	India
Test Value[a]	.0005
Cases < Test Value	1598
Cases >= Test Value	1598
Total Cases	3196
Number of Runs	1497
Z	-3.609
Asymp. Sig. (2-tailed)	.000

a. Median