The Journal of Sri Krishna Research & Educational Consortium

JOURNAL ON BANKING FINANCIAL SERVICES & INSURANCE RESEARCH

Internationally Indexed & Listed Referred e-Journal

TESTING RANDOM WALK HYPOTHESIS FOR BOMBAY STOCK EXCHANGE AND NATIONAL STOCK EXCHANGE

SURESH CH. DAS*; SUSHIL K. PATTANAIK**

*Assistant Professor, Department of Business Management,
C. V. Raman College of Engineering, Bhubaneswar.
**Lecturer, Department of Commerce,
KBDAV (A) College, Nirakarpur, Khurda, Orissa-752019.

ABSTRACT

The sole objective of this study is to test the weak form market efficiency of Bombay Stock Exchange and National Stock Exchange. A random walk test is performed for weak form efficiency. The testing of market efficiency of the market was executed by stock exchange's daily closing prices from April 1999 to April 2011. We accept that BSE and NSE are efficient because the levels of trade volume and market capitalization of shares are mostly high. In order to test weak form efficiency hypothesis, we analyzed runs tests. ACF test which is well known popular test for the testing of the market efficiency has also been tested. The run test is also used as a powerful tool to test of random walk in the stock market indices. In this paper, an analysis of two popular stock indices from each Stock Exchange is carried out to test the efficiency level in Indian Stock market and the random walk nature of the stock market by using the run test and the autocorrelation function ACF (k) for the period.

KEYWORDS: *Random Walk, Market Efficiency, Hypothesis testing, weak-form market efficiency.*

I. INTRODUCTION

The term efficiency in finance market operation is used to describe a market in which relevant information is impounded into the price of financial instruments. An efficient market is defined as a market where there are large numbers of rational, profit maximizers actively competing, with each trying to predict future market values of individual securities, and where important current information is almost freely available to all participants. Fama (1970) has been the first to develop the Efficient Markets Hypothesis. After more than two decades,

Fama (1991) reviews the voluminous theoretical and empirical work undertaken by numerous researchers on the informational efficiency of stock markets. The market efficiency theory has been intensely studied over the last 30 years. In this theory Fama put forward the principles of market efficiency (Fama1991). The main were consolidated in 1970 by Eugene Fama in his "Efficient Capital Markets: A Review of Theory and Empirical Work. This theory is well known today as the Efficient Market Hypothesis (EMH). Fama divided market into three which indicate the market efficiency levels: weak form, semi-strong form, and strong form.

The random walk theory asserts that price movements will not follow any patterns or trends and that past price movements cannot be used to predict future price movements. There are three forms of the efficient market hypothesis in finance literature:

1. The "Weak" form asserts that all past market prices and data are fully reflected in securities prices. In other words, technical analysis is of no use. The market said to be weak form efficient when prices of the securities instantly and fully reflect all information of the past prices, so the future price movements cannot be predicted by using past prices.

2. The "Semi strong" form asserts that all publicly available information is fully reflected in securities prices. In other words, fundamental analysis is of no use. In such case, the prices of securities or assets fully reflect all the publicly available information. Therefore, only investors with additional inside information could have advantage in the market.

3. The "Strong" form asserts that all information is fully reflected in securities prices. In other words, even insider information is of no use. In this category, the prices of securities fully reflect all the publicly available information along with private information (inside information).

Therefore, in such a case, no one can have advantage in predicting returns in the market, because there is no data that would provide additional value to the investors. Securities markets are flooded with thousands of intelligent, well-paid, and well-educated investors seeking under and over-valued securities to buy and sell. The more participants and the faster the dissemination of information, the more efficient a market should be. This study aims to test the weak-form efficiency hypothesis BSE and NSE using ACF test and runs test.

The rest of the paper is designed as follows: section II comprises the critical review of existing research on weak-form market efficiency; section III describes the research methodologies and Section IV narrates the sources of data collection; section V elaborates the empirical results and analysis; finally, section VI summarizes the paper along with contributions and implications.

The aim of this paper is to find out a rigorous test of the random walk hypothesis on the Indian Stock Exchanges. A random walk test is performed for weak form efficiency. The testing of market efficiency of the market it was executed by taking stock exchange's daily stock returns for random walk over the period from April 1999 to April 2011.

II. LITERATURE REVIEW

The concept of efficient market hypothesis was firstly introduced by Samuelson (1965) that properly anticipated price of an asset fluctuate randomly. Fama (1970) presented a formal review of theory and evidence for market efficiency. To prove the theory in his empirical work he divided security prices into three information subsets first one was" week form test", second is " semistrong form test" and third one was " strong form test". He characterized an efficient capital market in which security prices fully reflect all available information and further revised his theory on the basis development research in 1991.

Murado lu and Ünal (1994) used daily data for a sample of 20 stocks traded on the Istanbul Stock Exchange over the period from the beginning of 1988 until the end of 1991 and carried out tests of independence, randomness and normality and found equity prices did not follow a random walk.

Sharma and Kennedy (1977) compared the behaviour of stock indices of the Bombay, London and New York Stock Exchanges during 1963-73 using run test and spectral analysis. Both run tests and spectral analysis confirmed the random movement of stock indices for all the three stock exchanges. They concluded that stock on the BSE obey a random walk and are equivalent in the markets of advanced industrialized countries.

Kulkarni (1978) investigated the weekly RBI stock price indices for Bombay, Calcutta, Delhi, Madras and Ahmedabad stock exchanges and monthly indices of six different industries of six different industries by using spectral method. He concluded that there is a repeated cycle of four weeks for weekly prices and seasonality in monthly prices. This study has thus rejected the hypothesis that stock price changes were random.

Smith, Jefferis and Ryoo (2002) applied the multiple variance ratio test on eight African stock market price indices(Botswana, Egypt, Kenya, Mauritius, Morocco, Nigeria, South Africa and Zimbabwe) during the period 1990-1998 and showed that only South Africa was weak-form efficient. Appiah-Kusi and Menyah (2003) tested weak-form market efficiency on eleven African stock markets but only five of them are proved to be weak-form efficient, namely Egypt, Kenya, Mauritius, Morocco and Zimbabwe.

III. METHEDOLOGY

Since the test of weak form of EMH, in general, has come from the random walk literature, hence this paper investigates whether or not successive price changes were independent of each other. This paper investigates weak-form efficiency of the stock markets in Africa by employing rigorous parametric and non-parametric tests of the Random Walk Hypothesis. Indeed, the hypothesis that a stock market price index follows a random walk is tested. Accordingly, the null and alternative hypotheses for weak-form market efficiency test are:

H0: Indian stock markets' price indices follow a random walk, i.e. Indian stock markets are weak-form efficient.

H1: Indian stock markets' price indices do not follow a random walk, i.e. Indian stock markets are not weak-form efficient.

This study employs multi-approach of statistical techniques, i.e., the use of more than two methods to investigate the research question in order to check the validity of the results from one method by cross-checking them with those from other methods. The methods employed are both parametric and non-parametric. The parametric tests include auto-correlation test and the nonparametric tests include the runs test.

3.1 AUTOCORRELATION ACF (K)

Autocorrelation is one of the statistical tools used for measuring the dependence of successive terms in a given time series. Therefore it is used for measuring the dependence of successive share price changes. It is the basic tool used to test the weak form of EMH. The autocorrelation function ACF(k) for the time series Y_t and the k-lagged series Y_{t-k} is defined as :-

$$ACF(k)= \frac{\Sigma^{n}_{(t=1-K)}(yt - \bar{y})(yt-k-\bar{y})}{\Sigma^{n}_{(t=1)} (yt - \bar{y})^2}$$

where $\bar{y}$ is the overall mean of the series with n observations.

The standard error of ACF(k) is given by:

$$Se_{ACF(k)} = \frac{1}{\sqrt{(n-k)}},$$

where n is sufficiently large (n≥50), the approximate value of the standard error of ACF(k) is given by:-

$$Se_{ACF(k)} = \frac{1}{\sqrt{(n)}}.$$

To test whether ACF (k) is significantly different from zero, the following distribution of 't' is used, i.e. $t=ACF(k)/ Se_{ACF(k)}$

For both random variable series and series with trends, ACF (k) are very high and decline slowly as the lag value (k) increases. At the same time the ACF (k) of the first difference series (price changes or returns) are statistically insignificant when the series is a random walk series. A random walk series drifts up and down over time. In some situation it may be difficult to judge whether a trend or drift is occurring. Hence to determine whether a series has significant trend or whether it is a random walk, the t-test is applied on the series of first differences.

3.2 RUN TEST

Run test is a non-parametric test. It depends only on the sign of the price changes but not on the magnitude of the price. It does not require the specification of the probability

distribution. It depends only on the sign of the price. They are essentially concerned with the direction of changes in the time series. The main drawback of using run test that it could not detect the amount of change from mean because it only looks at the number of positive or negative changes.

By comparing the total number of runs in the data with the expected number of runs under random walk hypothesis, the test of the random walk hypothesis may be constructed. Positive Z indicates that there are too many runs in the sample, negative value of Z that there are less runs that one would expect if the changes were random. The important advantages of this test are its simplicity and independence of extreme values in the sample (Bradley, J. 1968).

In order to compare the observed number of runs in the series, the expected number of runs is calculated according to the formula:

The standardized Z is defined as :

$$\text{Runs Test } Z = \frac{R - \bar{X}}{\sigma}$$

R= number of runs

$$\bar{X} = \frac{2\, n_1 n_2}{n_1 + n_2} + 1$$

$$\sigma^2 = \frac{2\, n_1 n_2 (2\, n_1 n_2 - n_1 - n_2)}{(n_1 + n_2)^2 (n_1 + n_2 - 1)}$$

Where, R is the real number of runs

$n_1 + n_2$ = number of observations in each category

σ = standard deviation

Z= Standard normal variate

IV. DATA

The sample period is April 1999 to April 2011. The data consist of daily closing values of four leading stock indices namely CNX Nifty, CNX Nifty Junior, BSE Sensex and BSE-100. The data have been collected from the official website of BSE and NSE. BSE Sensitive Index is commonly known as BSE-Sensex which comprises of top thirty companies of BSE. The Sensex is calculated through free float market capitalization method. S&P CNX Nifty comprises of 50 top most market capitalized companies in National Stock Exchange.

V. RESULTS AND DISCUSSION

5.1 AUTOCORRELATION FUNCTION

Autocorrelations of the weekly changes in the three stock indices are given in table-1:-

TABLE 1: AUTOCORRELATIONS OF DAILY CHANGES IN STOCK INDICES

Lag	NSE NIFTY	NSE NIFTY JUNIOR	BSE-SENSEX	BSE-100
1	.999	.999	.999	.999
2	.997	.997	.997	.997
3	.996	.996	.996	.996
4	.995	.994	.995	.995
5	.993	.993	.994	.994
6	.992	.992	.992	.992
7	.991	.991	.991	.991
8	.990	.989	.990	.990
9	.989	.988	.989	.989
10	.987	.987	.988	.988
11	.986	.985	.987	.986
12	.985	.984	.986	.985
13	.984	.982	.985	.984
14	.982	.981	.983	.983
15	.981	.980	.982	.981
16	.980	.978	.981	.980
Std error	0.018	0.018	0.018	0.018

Source: own compilation

For NSE NIFTY, NIFTY Junior, BSE-Sensex and BSE-100 the autocorrelation coefficient for lag 1 is 0.999 for each of them, which is very much larger than twice the standard error 0.036(2 x0.018). Thus the autocorrelation differ significantly from zero.

5.2 DESCRIPTIVE STATISTICS

INDEX	N	Mean	Minimum	Maximum
NSE NIFTY	3003	2745.5815	854.20	6312.45
NSE NIFTY JUNIOR	3003	5118.3380	1046.70	13555.15
BSE SENSEX	2999	9104.6994	2600.12	21004.96
BSE-100	2999	4729.5015	1216.37	11509.96

Source: own compilation

It is quite evident from the above table that the mean index value of NSE Nifty from 1999 to 2011 is 2745.58 pts and that of BSE Sensex is 9104.6994. In Jan, 2008 the Sensex went upto 210004.96 but due to failure of IPOs and economic meltdown it went down. But from 2009 onwards all the indices have recovered.

5.3 RESULT OF RUNS TEST

ITEM	NSE NIFTY	NSE NIFTY JUNIOR	BSE SENSEX	BSE-100
Test Value	2745.5815	5118.3380	9104.6994	4729.5015
Cases< Mean Value	1716	1789	1730	1734
Cases>= Mean Value	1287	1214	1269	1265
Total Cases	3003	3003	2999	2999
Number of Runs	2405	2213	2432	2428
Z	-0.53952	-0.54014	-.53912	-.53912

Source: own compilation

According to the probability theory, 95 per cent of the area under normal curve lies within + 1.96 standard deviation of the mean. Since the calculated value of Z of all the indices i.e., -0.53952, -0.54014, -0.53912, -0.53912 is less than -1.96, the runs have been occurred by chance. The results show that all indices of NSE and BSE show a weak form of market efficiency.

VI. CONCLUSION

The study examines the behavior of prices of four indices i.e., NSE Nifty, NSE Nifty Junior, BSE Sensex and BSE-100. The primary goal of the paper was to analyze the weak

form efficiency of these indices. Two tests have been performed for testing weak form efficiency, the first test is ACF test the other one is the run test. The hypothesis of the randomness of the stock returns are rejected for stock price index changes at all frequencies using both ACF Test and Run Tests. The assumption that the stock prices are random is basic to the efficient Market Hypothesis and Capital Asset Pricing Models. The study carried out in this paper has presented the evidence of the inefficient form of the Indian Stock Market. From autocorrelation analyses and runs test we are able to conclude that the series of stock indices in the India Stock Market are biased random time series. The auto correlation analysis indicates that the behavior of share prices does not confirm the applicability of the random walk model in the Indian stock market. Thus there are undervalued securities in the market and the investors can always make excess returns by correctly picking them.

REFERENCES

1. Appiah-Kusi, J., & Menyah, K. (2003). Return predictability in African stock markets. Review of Financial Economics, 12(3), pp.247–270.

2. Bradley, J. (1968), Distribution-free statistical tests. Englewood Cliffs, NJ: Prentice-Hall.

3. Cootner P. H., (1962)- Spring, Stock prices: RAndom vs. Systematik changes, Industrial Management Review.

4. Fama E. F. , (1965), Random Walks In Stock Prices, Financial Analyst Journal, Vol.21, No.5, pp.55-59 (reprinted January-February 1995).

5. Fama F. E., Laffer A. B., (1971), Information And Capital Markets, The Journal of Business, Vol.44, No.3, pp. 289-301.

6. Kulkarni, S.N. [1978] "Share Price Behaviour in India: A spectral Analysis of RandomWalk Hypothesis", Sankhya, Vol. 40, series D, Pt. II, pp.135-162

7. Murado_lu, G. and Ünal, M. (1994) Weak form of efficiency in the thinly traded Turkish stock exchange, The Middle East Business and Economic Review, 6, pp 37–44.

8. Sharma J. L. and Robert E. Kennedy [1977] "A Comparative Analysis of Stock Price Behaviour on the Bombay, London and New York Stock Exchanges", Journal of Financial and Quantitative Analysis Sep 1977.

9. Smith, G., Jefferis, K., & Ryoo, H-J. (2002). African stock markets: multiple variance ratio tests of random walks. Applied Financial Economics, 12 (7), pp.475-484.