Testing Random Walk Hypothesis: A Study on Indian Stock Market

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Abstract: *The efficient market hypothesis states that asset prices in financial markets should reflect all available information; as a consequence, prices should always be consistent with 'fundamentals'. The efficiency of stock market in economic development cannot be overemphasized. Efficient Stock Markets provide the vehicle for mobilizing savings and investment resources for developmental purposes. They afford opportunities to investors to diversify their portfolios across a variety of assets. This has the potential to reduce the cost of capital through lower risk premiums demanded by supplier of capital. In general, ideal market is the one in which prices provide accurate signals for resource allocation so that firms can make productive investment decision and investors can choose among the securities under the assumption that securities prices at any time fully reflect all available information. A market in which prices fully reflect all available information is called efficient. This paper takes into consideration eight stocks of National Stock Exchange and tries to investigate the efficiency of Indian stock market. Runs test has been applied to test the random walk hypothesis i.e., weak form efficiency.*

Keywords: *Efficient Market Hypothesis, Random Walk Hypothesis, Hypothesis Testing.*

1. INTRODUCTION

The efficient market hypothesis is one of the most controversial market theories in finance, which was developed in the 1960s by Eugene Fama. An efficient market is defined as a market where there are large number 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. In an efficient market competition among the many intelligent participants leads to a situation where, at any point in time, actual prices of individual securities already reflect the effects of information based both on events that have already occurred and on events which, as of now, the market expects to take in the future.

The behaviour of stock market returns is a central issue to the theory and practice of asset pricing, asset allocation and risk management. The supporters of the efficient market hypothesis (EMH) claim that stock price indices are basically random and as such any speculation based on past information is fruitless. This paper investigates the Random Walk (RW) behaviour of stock market returns of India.

Efficient market theory states that the share price fluctuations are random and do not follow any regular pattern. Market efficiency refers to the expectations of the investors regarding the future cash flows being translated or reflected on the share

prices. The accuracy and quickness in which the market translates the expectations in to prices are also termed as market efficiency. The basic idea underlying market efficiency is that competition will drive the price to reflect all information. In the financial market, the maximum price that investors are willing to pay for a financial asset is actually the current value of future cash payments that are discounted at a higher rate to compensate for the uncertainty in the cash flow projections. Therefore, investors trade information as a commodity in financial markets. All assets will be appropriately priced in the market offering optimal reward to risk. Hence, in an efficient market an optimal investment strategy will be to concentrate on risk and return characteristics of the asset and/or portfolio. However, if the markets were not efficient an investor would be better off trying to spot winners and losers in the market and correct identification of miss-priced assets to enhance the overall performance of the portfolio.

In 1965 Nobel prize winner Paul Samuelson supported the efficient market hypothesis and endorsed the concept of random walk. Fama (1965) defined the term efficient market as one in which security prices fully reflect all available information so that old information cannot be used to foretell future price movements. As an extension of the EMH he re-endorsed the Random Walk Theory which states that stock prices are absolutely independent and they cannot form a proper base for taking an investment decision. The random walk model of asset prices is an extension of the EMH, as are the notions that the market cannot be consistently beaten, arbitrage is impossible and free lunches are generally unavailable.

There exist three versions of EMH depending on the level of available information. The weak form, semi strong form and strong form. The weak form of the Random Walk Theory suggests that future prices cannot be predicted by analyzing the prices from the past. The semi strong form EMH states that all publicly available information is similarly already incorporated into asset prices. In other word, all publicly available information is fully reflected in a security‟s current market price. The public information includes not only past prices but also data reported in a company‟s financial statements, company‟s announcement, economic factors and others. It implies that no one should be able to outperform the market using something that everybody else knows. This indicates that a company‟s financial statements are of no help in forecasting future price movements and securing high investment returns. The strong form EMH stipulates that private information or insider information too is quickly incorporated by market prices and therefore cannot be used to reap abnormal trading profits. Thus, all information, whether public or private, is fully reflected in a security‟s current market price. That means, even the company‟s management (insider) are not able to make gains from inside information they hold. They are not able to take the advantages to profit from information such as take over decision, which has been made ten minutes ago, as dissemination of information is immediate. A large amount of research exists on the

EMH in developed countries however not much work exist in developing capital markets especially in the Indian context. As the stage of the market whether weak, semi-strong or strong has important implications for investors, it becomes necessary to study the EMH theory in the Indian context fund managers and analysts. The present paper is an attempt to study the Random Walk Theory with respect to scrips in S&P CNX Nifty Index to identify whether it is weak form efficient or not.

2. OBJECTIVES OF THE STUDY

The movement of the stock market provides an insight to investors who buy and sell shares and securities with the aim of making profits. The present study tests the market efficiency of the Indian Capital Market in its weak form of Efficient Market Hypothesis (EMH).

The objectives of the study are:

i. To examine the pattern of the movement of share prices in the Indian Stock market, i.e., whether they move in an independent manner or not.

ii. To test whether the Indian Capital market follow random walk model or not.

3. HYPOTHESIS

Runs test is used in the random-walk model because the test ignores the properties of distribution. The null and alternative hypotheses for weak-form market efficiency test are;

H0: Indian stock market‟s price indices follow a random walk, i.e. Indian stock markets are weak-form efficient; The S&P CNX Nifty Index stock prices do not follow a random pattern.

H1: Indian stock market‟s price indices do not follow a random walk, i.e. Indian stock markets are not weak-form efficient; The S&P CNX Nifty Index is not weak form efficient.

4. IMPORTANCE OF THE STUDY

The concept of efficient market hypothesis (EMH), which suggests that "an efficient market impounds new information into prices quickly and without bias," is of prime importance to the accounting field for determining the managers' performance and the effectiveness of having fully disclosed financial statements. EMH stakeholders can determine the effectiveness of the appointed management by observing the stock price. "In major stock markets...a rational consensus will be reached as to the share prices which best reflect the prospects for future cash flows..." In an efficient stock market, information disclosure is a key requirement. If the managements want the stock market to correctly value the company's shares, they must ensure that they provide sufficient information in a timely manner to allow the market to do so. The concept of EMH is important to the accounting world because it provides a feedback measure to manager performance

and displays the effectiveness of full disclosure on financial statements.
This study will be useful to the investors, Brokers, Stock market regulators, students of finance specialization and many other participants of capital market in India.

5. REVIEW OF LITERATURE

A run is defined by **Siegal,** as a succession of identical symbols which are followed or preceded by different symbols or no symbol at all. The number of runs is computed as sequence of the price changes of the same sign (such as; ++, _ _, 0 0). When the expected number of runs is significantly different from the observed number of runs, the test rejecst the null hypothesis that the daily returns are random.

Fama propounded his famous efficient market hypothesis for US securities, a number of empirical research have been carried out to test its validity, mainly in the developed countries with booming financial markets **(Summers; Fama and French, Lo and Mackinlay).**

Fama classified stock market efficiency into three forms. They are namely „weak form", „semi-strong form" and „strong form". The classification depends upon the underlying assumptions relating to information set available to market participants. Each set of information here is more comprehensive than the previous one. Weak Form Efficient Market Hypothesis, which is also known as Random Walk Hypothesis (RWH) states that present prices of securities fully reflect information contained in the their historical price. Therefore, the best predictor of the future price is the present price. **Fama (1991)** renamed the market efficiency studies into three categories. The first category involves the tests of return predictability; the second group contains event studies and the third tests for private information.

Cootner (1962) on testing the weak form efficiency on the developed stock markets generally agreed with the weak-efficiency of the market considering a low degree of serial correlation. **Porterba and summers (1988)** confirmed the presence of mean reverting tendency and absence of random walk in the **U.S. Stocks. Lo and McKinney (1988)** proposed variance ratio test to test random walk hypothesis. Their findings provided the evidence against random walk hypothesis for the entire sample period of 1962 to 1985.

Fama and French (1988) discovered that forty percentage of variation of longer holding period returns were predictable from the information on past returns for U.S. Stock markets. **Cambel (1991)** used variance decomposition method for stock return and concluded that the expected return changes in persistent fashion. **Kim, Nelson and Startz (1991)** examined the random walk pattern of stock prices by using weekly and monthly returns in five Pacific-Basin Stock Markets. They found that all stock markets except Japanese stock market did not follow random walk. **Pope (1989)** noted that the traditional tests of random walk model such as serial correlation and Runs Test are susceptible to

error because of spurious autocorrelation induced by non-synchronous trading.

Shiller and Perron (1985) and summer (1986) have shown that such tests have relatively little power against interesting alternative hypothesis of market efficiency. **Culter, Porterba and summer (1990)** found evidence of the mean reversion and Predictability of the US stock market return. **David Walsh (1997)** employed variance ratio test to test the null hypothesis of random walk in the Australian Stock Exchange covering various sampling intervals and data period during January 1980 to December 1995. His result suggested that many indices of the stock exchange returned to random walk during October Crash 1987.

As defined by **Poshokwale,(1996),** a lower than expected number of runs indicates market‟s overreaction to information, subsequently reversed, while higher number of runs reflected a lagged response to information; either situation would suggest an opportunity to make excess returns. The Runs Test converts the total number of runs into Z statistic. For large samples the Z statistic gives the probability of difference between the actual and expected number of runs. The Z value greater than or equal to ± 1.96 rejects the null hypothesis at 5% level of significance (Sharma and Kennedy, 1977). **Madhusudan (1998)** found that NSE nifty and national indices did not follow random walk. Using correlation analysis on monthly stock returns data over the period January 2009 to November 2012, **Olowe (1999)** shows that the Nigerian stock market is weak form efficient. **Bhanu Pant and T.R.Bishnoy (2001)** analyzed the behaviour of the daily and weekly returns of five Indian stock market indices for random walk during April 1996 to June 2001.They found that Indian Stock Market Indices did not follow random walk.

Shigguang Ma and Michelle Barnes (2001) tested both Shanghai and Shenzen stock market for efficient market hypothesis using serial correlation, runs and variance ratio test to index and individual share data for daily, weekly and monthly frequencies and found that Chinese stock markets were not weak form efficient. **Osei (2002)** investigated the asset pricing characteristics and response to annual earnings announcement of the Ghana Stock market. He concluded that Ghana Stock Market is not efficient with respect to annual earnings information releases to the Ghanian Market. **Madhumita Chakraborty (2006)** investigated the stock price behaviour using daily closing figures of Milanka Price Index during January 1991 to December 2001 and daily closing prices of twenty-five underlying individual companies included in the index from July 1991 to May 1999. The study found that stock market in Srilanka did not follow random walk, while results of weak form efficient market hypothesis in twenty-five companies showed mixed outcome**. Daniel Simon and Samuel Laryea (2006)** examined the weak form of efficient market hypothesis for four African stock markets-Ghana, Mauritius, Egypt and South Africa. Their results implied that South African market was weak form

efficient, whereas that of Ghana, Mauritius and Egypt were weak form inefficient.

6. RESEARCH METHODOLOGY

6.1 Data

The data analyzed in this paper has been collected from a wide range of reliable sources. The data has been collected basically from the official website of NSE i.e., www.nseindia.org. The Data consists of daily closing prices of eight major companies of India from 1st January 2018 to 30th June 2021.

6.2 Methodology

The study seeks to test the weak form market efficiency test of Indian Capital market especially by employing Runs Test. Since the test of weak form of EMH, in general, has come from the random walk literature, this project investigates whether or not successive price changes were independent of each other.

Runs Test: Runs 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 Runs 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 indicates that there are less runs than 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.

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:

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

R= number of runs

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

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

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

7. DATA ANALYSIS

The companies which have been taken into account are Reliance industries, Infosys, ITC, ONGC, NTPC, SBI, Wipro and TCS. Table 1 describes the total number of positive observation, total number of negative observation and the total number of runs from 1st January 2018 to 30th June 2021.

TABLE 1: NUMBER OF RUNS IN THE PERIOD 1ST JANUARY, 2018 TO 30TH JUNE, 2021

S.No	Company	Total No.Of Runs (R)	Total No. of Positive Observation(N1)	Total No. of Negative Observation (N0)
1	Reliance Industries	501	461	511
2	Infosys	485	505	468
3	ITC	484	509	462
4	ONGC	492	475	499
5	NTPC	504	471	503
6	SBI	456	510	462
7	WIPRO	496	525	447
8	TCS	473	499	473

Source: Compiled from MS Excel

As shown in the formula n1 stands for positive observations and n0 indicates negative observations. NTPC is having the highest runs in this period; Wipro is showing the highest positive observations while Reliance Industries is showing the highest negative observations.

Table-2 depicts the calculated Z-value and P-values which are quite significant to investigate the randomness and efficiency of stock market.

Table 2: Z Values of Companies under Observation

S.No.	Company	Z-Value	P- Value
1	Reliance Industries	0.9836	0.837344
2	Infosys	-0.1154	0.454064
3	ITC	-0.0876	0.465097
4	ONGC	0.276	0.608726
5	NTPC	1.061	0.855655
6	SBI	-1.9186	0.027517
7	WIPRO	0.7836	0.783362572
8	TCS	-0.8767	0.190324803

Source: calculated and complied with Excel

According to the probability theory, 95 per cent of the area under normal curve lies within $\pm$ 1.96 standard deviation of the mean. All the companies that have been studied are having z values within the area. This implies that the runs have been occurred by chance. The results show (table-2) that all the companies show a weak form

of market efficiency. P-values are the normal distribution of z values which states the likelihood of happening. These values also support the weak form efficiency.

8. CONCLUSION

The behaviour of stock market returns is a central issue to the theory and practice of asset pricing, asset allocation, and risk management. The supporters of the efficient market hypothesis (EMH) claim that stock price indices are basically random and as such any speculation based on past information is fruitless. The EMH, especially its weak-form, has been subject to intensive empirical research and the empirical studies around this area in developed and emerging markets are enormous. The ability of equity markets to play their critical role in channelling funds, a strong motivation to further investigate the weak-form informational efficiency of stock exchanges in African emerging markets arises. This study has addressed the subject by testing the Random Walk Hypothesis and to some extent tries to formulate hypothesis by taking into account the daily prices of eight stocks.

More specifically, practitioners claim that "*the inadequate information flow into the stock market, the inefficient communication system, the inadequate understanding of financial information by local investors, the inadequate skills among some stockbrokers, and the low level of automation and the interference of regulatory authorities in the determination of assets' prices*" are all problems that hamper the Indian stock market from being information efficient, at least in the weak form.

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