academicresearchJournals

Vol. 3(2), pp. 6-12, March 2015
DOI: 10.14662/IJEBM2015.002

ISSN: 2384-6151
http://www.academicresearchjournals.org/IJEBM/Index.htm

International Journal of Economic and Business Management

Full Length Research

The Indian Stock Market – is it a Random Walk?

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Accepted 16 March 2015

Efficiency in stock markets has been the subject of study in developed and developing financial markets globally in recent times. Liberalization of financial markets in developing economies has made them attractive to the international investors wherein the structural reforms and increased liquidity have a bearing on efficiency. Stock market efficiency suggests that stock prices factor in all relevant information when that information is readily available and widely circulated, which implies that there is no systematic way to exploit trading opportunities and gain excess profits. Studies conducted on the stock exchanges in the developed markets have found them to be efficient in terms of valuation of stock prices and hence earning returns from undervalued stocks becomes difficult and this is important to the investors who wish to hold internationally diversified portfolios. The Indian markets have become most sought-after around the globe by the international investing community. Research conducted on the Indian stock markets panning the 1990s to now suggests inefficiency in the Indian bourses shows that there is an opportunity to earn more than fair returns. In this paper we test the weak form efficiency in the framework of random walk hypothesis for the National Stock exchange in India for the period March 2003 to February 2015. The tests conducted include tests for stationarity and normality. The test results of the data series of NSE S & P 500 Index series and daily returns from the index show that the NSE mostly follows a random walk.

Keywords: Efficient Market Hypothesis, Random Walk, NSE, Normality, Stationary

Cite This Article As: Suri D (2015). The Indian Stock Market – is it a Random Walk?. Inter. J. Econ. Bus. Manage. 3(2): 6-12.

INTRODUCTION

Market efficiency has an influence on the investment strategy of an investor because if market is efficient, trying to pickup winners will be a waste of time. In an efficient market there will be no undervalued securities offering higher than deserved expected returns, given theirrisk. On the other hand if markets are not efficient, excess returns canbe made by correctly picking the winners (Pandey, 2003). The idea is that in asset markets that have good regulations and market makers and developed markets that have a lot of depth and liquidity, the prices are perfect indicators of true value of the security. In other words, efficient market says that the market efficiently incorporates all information and the prices are the best information about the value of the assets. In other words, efficient markets hypothesis states: trust markets, don't trust people. The accepted view was that when new information emerges, the news spreads very quickly and is incorporated into the prices of securities without delay. The stock prices are the result of the equilibrium of supply and demand—however, it is actually the instantaneous supply and demand that determines actual prices, and at any given time, the supply and demand will differ simply due to chance.

In the weak form, only past market trading information, such as stock prices, trading volume, and short interest are considered. Hence, even the weak form of the EMH implies that technical analysis is really ineffective since it relies exclusively on past trading data to forecast future price movements.

The semi-strong form extends the information to public information other than market data, such as news, accounting reports, company management, patents, products of the company, and analysts' recommendations.

The strong form extends the information further to include not only public information, but also private information, typically held by corporate insiders, such as officers and executives of the corporation (Fama, 1970).

EMH postulates that it is impossible to "beat the market" because stock market efficiency causes existing share prices to always incorporate and reflect all relevant information. According to the EMH, stocks always trade at their fair value on stock exchanges, making it impossible for investors to either purchase undervalued stocks or sell stocks for inflated prices. As such, it should be impossible to outperform the overall market through expert stock selection or market timing, and that the only way an investor can possibly obtain higher returns is by purchasing riskier investments.

Although much research has been conducted on EMH, the findings have been controversial and often argued upon. Believers argue it is pointless to search for undervalued stocks or to try to predict trends in the market through either fundamental or technical analysis.

In India, the functioning of the stock markets has evolved over the last two decades due to reforms, liberalization that not only enhanced the functioning of the markets but also brought in enough liquidity and also regulations. These factors should have steered our stock markets towards efficiency, wherein the ability of a few to make higher returns than the market allows is a non event. Hence analyzing the Indian bourses to unearth its efficiency in terms of Efficient Market Hypothesis is more so relevant today.

LITERATURE REVIEW

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 place in the future. In other words, in an efficient market at any point in time the actual price of a security will be a good estimate of its intrinsic value (Fama, 1970).

Thus, neither technical analysis, which is the study of past stock prices in an attempt to predict future prices, nor even fundamental analysis, which is the analysis of financial information such as company earnings, asset values, etc., to help investors select "undervalued" stocks, would enable an investor to achieve returns greater than those that could be obtained by holding a randomly selected portfolio of individual stocks with comparable risk (Malkiel, 2003).

There are detractors of this theory who especially after the recent financial crisis who cite earlier examples of bubbles to substantiate their claim that the market is predictable to some degree, prices may move in trends and that the study of past prices can be used to forecast future price direction. Martin Weber, on observing the stock market for ten years found certain trends: stocks with high price increases in the first five years tended to become under-performers in the following five years, stocks that have had an upward revision for earnings outperform other stocks in the forthcoming six months. And hence he concluded that there are trends and other tips to predicting the stock market.

Professors Andrew W. Lo and Archie Craig MacKinlay (2002), professors of Finance at the MIT Sloan School of Management and the University of Pennsylvania, respectively, have also tried to prove the random walk theory wrong. They wrote the book A Non-Random Walk Down Wall Street, which goes through a number of tests and studies that try to prove there are trends in the stock market and that they are somewhat predictable.

There is a third view that believes markets may not be quick enough to process new information and moreover it is not always easy to make profits from opportunities from the market and that cost of trading is vital to making profits (Treynor, 1981).

Evidence suggests that markets are to a certain extent predictable but this does not mean that there are opportunities for arbitrage though, because these would soon be exploited and then vanish. In the real world (with taxes, transaction costs etc.) you can have some predictability without there being profitable opportunities. It seems that stocks do approximately follow a random walk, but there are other factors, such as those discussed by Fama and French (1995), which appear to affect stock prices as well (Dupernex, 2007).Fama and French, 1993, suggest that there is an economic story behind size and book to market effects in average stock returns and are related to profitability and growth that could be risk factors in returns.

Efficiency tested in emerging economies

Studies on testing of market efficiency of Asian emerging stock markets are also surprisingly few. Chan, Gup, and Pan (1992), show that there is no evidence that the stock prices in major Asian Markets and U.S. markets are weak form efficient individually and collectively in the long run. Dickinson and Muragu (1994) provide evidence of market efficiency in Nairobi Stock Exchange. They conclude that small market such as Nairobi Stock Exchange provides empirical results consistent with weak-form efficiency. Cheung, Wong and Ho (1993) report inefficiency of stock markets of Korea and Taiwan on the basis of weak theoretical form of Capital Asset Pricing Model in both the markets.

Cheung et al (1994) study the seasonal pattern in volatility of Asian Stock Markets. Using Levene (1960) test, they report that there exist day-of-the-week variations in volatility in most of the emerging Asian markets. Barnes (1986) tests the weak form market efficiency of the Kuala Lumpur Stock Exchange and concludes that the stock exchange exhibited and surprisingly high degree efficiency, in spite of thinness of the market (Poshakwale, 1996).

Stock exchanges in the Central and Eastern Europe Countries did improve their efficiency for the test period 1996 – 2003. The tests of evolving market efficiency suggest that at the end of the sample period the markets converge to some common level of efficiency. The evidence of evolving efficiency suggests that the economic fundamentals and the recent decrease of the transaction costs dominate the decline of the capital markets in the three countries (BechevI, 2003).

Efficiency tested in India

Many studies have been undertaken for testing the efficient market hypothesis in the Indian stock market. In a study conducted by Mishra et al (2009) to test EMH in the context of global financial crisis, they found that the share prices may not necessarily reflect the true valueof stocks leading to companies with low true values being able to mobilise a lot of capital thus disrupting the investment scenario of the country as well as the total productivity.

The Bombay Stock Exchange (BSE) does not exhibit the weak form efficiency for investors as they cannot adopt a ‘fair return for risk’ strategy, by holding a well diversified portfolio while investing in the Indian stock market. What will be the appropriate investment strategy for an international investor for investing in Indian market and how efficiency/inefficiency will influence his choice of investments are the issues worth researching. Also the day of the week effect observed on the BSE pose interesting buy and hold strategy issues (Poshakwale, 1996).

Bishnoi & Pant (2002) analyzed the behaviour of daily and weekly returns of five Indian stock market indices for random walk during April-1996 to June-2001 rejected the random walk hypothesis for daily and weekly market indices returns. The results confirm the mean reverting behaviour of stock indices and over reaction of stock prices in unitary direction in India. This provides an opportunity to the traders for predicting the future prices and earning abnormal profits.

Gupta & Basu (2007) examined the weak form efficiency in two of the Indian stock exchanges and the results support the common notion that the equity markets in the emerging economies are not efficient and to some degree can also explain the less optimal allocation of portfolios into these markets.

Efficient Market Hypothesis in the weak form puts forward that past values of the data series cannot be used to forecast future values hence it is not possible for investors to able to spot undervalued stocks based on such analysis. Random Walk hypothesis, in the same vein, says that all subsequent price changes represent random departures from previous prices. Tests for random walk are stationarity tests. A data series having a unit root is one where mean and variance does not remain the same with time. When the mean and variance does not remain the same it means that the linear relations a not possible and hence forecasting becomes difficult and the series is said to a random walk and efficient in the weak form. The weak form of the EMH says that past prices, volume, and other market statistics provide no information that can be used to predict future prices. This means that one cannot outperform the market in the long run by using historical prices. One may analyze past prices and see that on a Monday, stocks usually rise by 2% and there can be some money made out of the market. The point is that all the investors have knowledge of past prices and will try to make money that way and hence the price would already reflect the expected rise.

OBJECTIVE

Literature and studies conducted on the Indian stock markets do suggest that the Indian bourses are not weak form efficient; however studies in other emerging markets do suggest efficiency. With liberalization in the financial markets, the effects of regulations and reforms, increased liquidity and depth may have led our market performance towards weak form efficiency. The objective of this paper is to test the weak form hypothesis for the Indian stock market i.e. the National Stock Exchange (NSE) by testing the index and returns there from for the efficiency.

The efficient market hypothesis is closely connected to the idea of a “random walk,” which signifies a price series where all subsequent price changes represent random departures from previous prices. The logic of the random walk idea is that if the flow of information is unimpeded and information is immediately reflected in stock prices, then tomorrow's price change will reflect only tomorrow's news and will be independent of the price changes today. But news is by definition unpredictable and, thus, resulting price changes must be unpredictable and random. As a result, prices fully reflect all known information, and even uninformed investors buying a diversified portfolio at the tableau of prices given by the market will obtain a rate of return as generous as that achieved by the experts (Malkiel, 2003).

DATA, METHODOLOGY AND RESULTS

Data has been collected from the Reserve Bank of India website. The series selected to run the tests is the daily closing index values of the NSE S&P 500 Index series from March 2003 to February 2015.

Analysis of Unit Root Test

The first test is the unit root test to assess the stationarity of the time series. A stationary time series is one whose mean, variance and auto covariance (at various lags) remain the same no matter at what point we measure them, that is they are time invariant. Most business and economic time series are far from stationary when expressed in their original units of measurement, and even after deflation or seasonal adjustment they will typically still exhibit trends, cycles, random-walking, and other non-stationary behaviour.

The share price of today will differ from tomorrows by an unanticipated shock that means the series follows a Random walk.The test of stationary being, $Y_t = \varphi Y_{t-1} + e_t$, wherein if $\varphi < 1$ would prove stationary and that the series follows the tested distributions. If $\varphi = 1$, the series is non-stationary and the data can be considered as not following the tested distributions and $\varphi = 1$ is the proof for non-stationary i.e. Random Walk.

Hence to prove whether the NSE index follows a Random Walk, we need to find the value of φ in the data.

In the Dicker Fuller test, test is for gamma:

$Y_t = \varphi Y_{t-1} + e_t$
$Y_t – Yt_{-1} = \varphi Yt_{-1} – Y_{t-1} + e_t$
$\Delta\ Y_t = (\varphi -1)\ Y_{t-1} + e_t$
$\Delta\ Y_t = \text{gamma}\ Y_{t-1} + e_t$
The null hypothesis for the test is that the series has a unit root ($\varphi = 1$).

Table 1 shows that the NSE S&P 500 Index is non-stationary as the null hypothesis could not be rejected showing the NSE index series does not follow a stochastic path and hencethe Random Walk Hypothesis (RWH) cannot be rejected in the daily NSE S&P 500 Index.

Analysis of daily returns from NSE S&P 500 Index

To analyse the returns from the scrips listed on the NSE on daily basis the following series is computed based on the daily closing values for NSE S&P 500 Index:

$Rt = (\log NSE_{\ t} – \log NSE_{\ t\text{-}1}) * 100$

Where Rt is the return in period t, log NSE_t and log $NSE_{\ t\text{-}1}$ are the log values of daily closing prices of the NSE Index at time t and t-1 respectively.
Descriptive Statistics of Daily Returns (Table 2):

Summary of descriptive statistics for returns series of NSE S&P 500 Index of National Stock Exchange for the sample period of March 2003 to February 2015 are given below. The returns on an average on the NSE are 0.0754 per cent; the volatility shown by the standard deviation was 1.57. The coefficient of the skewness was found to be significant and negative for all the returns. The coefficient of kurtosis was found to be positive and is significantly higher than 3, indicating highly leptokurtic distribution compared to the normal distribution for all the returns.

The Jarque Bera test is a test for normality. The results show whether the returns series is normally distributed or not. The null hypothesis is that the series is normally distributed. The Table 2 shows that the p-value (0.0000) was less that .01 at 1% significance level so null hypothesis is rejected and hence the return series of NSE S&P 500 Indexis not normally distributed. This shows that future predictions cannot be made on the returns from the NSE S&P 500 Index.
The test statistic for the Kolmogorov-Smirnov test for normality shows p-value of less than 0.05 per cent at 0.00. The Null hypothesis of the Kolmogorov-Smirnov test is that the series follows a normal distribution. Based on the results, given blow in Table 3, the null hypothesis is rejected. The NSE S & P 500 Index returns series does not follow a normal distribution.

Analysis of Variance Ratio

Martingale model belongs to the earliest models of financial asset prices. Its origin lies in the birth of probability theory and in the history of games of chance. It follows the principle of a fair game, i.e. the game which is neither in one's favour nor one's opponent's.

Table 1: Analysis of Unit Root tests of NSE S&P 500 Index series: March 2003 to February 2015

	Augmented Dickey Fuller		**Phillips Perron**	
		Level		
Variable	Constant Without Trend	Constant With Trend	Constant Without Trend	Constant With Trend
NSE S&P 500 Index	-0.657456 (17)	-2.408287 (17)	-0.321558 [11]	-1.890734 [11]

Note: The figure in parenthesis (…) represents optimum lag length selected based on Akaike Information Criterion. The figure in bracket […] represents the Bandwidth used in the KPSS test selected based on Newey-West Bandwidth criterion.

Table 2: Descriptive statistics of NSE S&P 500 Index returns series

Mean	0.075427	Jarque-Bera	7290.081
Median	0.000000	Probability	0.000000
Maximum	15.00000		
Minimum	-13.00000	Sum	225.0000
Std. Dev.	1.578913	Sum Sq. Dev.	7434.029
Skewness	-0.456084		
Kurtosis	10.60401	Observations	2983

Table 3: Tests of Normality of returns series ofNSE S&P 500 Index

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
returns	.193	2983	.000	.897	2983	.000

a. Lilliefors Significance Correction

Martingale is stochastic process $\{P_t\}$ which satisfies the condition:

$E[P_t/P_{t-1}, P_{t-2}, ...] = P_t$, (1)
Equivalently, it is possible to write
$E[P_t-P_{t-1}/P_{t-1}, P_{t-2}, ...] = 0$. (2)

If P_t is the asset's price at time t, the martingale hypothesis means that tomorrow's price is expected to be equal to today's price under the condition of the entire history development of the asset's price. The forecasting meaning follows: the martingale hypothesis implies that the "best" forecast (from the point of view of mean square error) of tomorrow's price is simply today's price.

One of the most important aspects of the martingale hypothesis is that nonoverlapping price changes are uncorrelated at all leads and lags. This means that there is not any systematic movement in price changes which would make effective the linear forecasting rule.

The martingale is strongly linked to hypothesis of efficient market. This signifies that the information contained in past asset's prices is completely reflected in the current price. Making gains based on the information contained in the asset's price history is not possible under the efficient market hypothesis. Martingale also is basis for the development of a closely related model which is called random walk (Arlt and Arltová, 2000).

The null hypothesis of random walk for the variance ratio test is rejected if it is rejected for some k value and the variance ratio should be close to 1. If variance ratio is less than one than the series is said to be mean reverting and if variance ratio is greater than one than the series is said to be persistent.

Table 4 shows the results of the variance ratio test. The variance ratio at all lags has value of less than unity. The null hypothesis of Random walk is rejected. Variance ratio of less than unity signifies mean reversion. This means that a stock's price will tend to move to the average price over time. The time it takes to revert is often referred to as the time to reversion. If the process is very persistent, it might take a long time to revert to the

Table 4: Variance Ratio Test for returns series NSE S&P 500 Index March 2003 to February 2015

Lags	2	3	4	5	6	7	8	9	10	11	12
Variance Ratio	0.54	0.36	0.26	0.22	0.19	0.15	0.13	0.12	0.11	0.1	0.09
z-Statistic	-13.7	-13.1	-12.2	-11.4	-10.7	-10.3	-9.8	-9.4	-9.1	-8.7	-8.5
Probability	0	0	0	0	0	0	0	0	0	0	0

mean. The key difference between a mean-reverting process and a random-walk is that after the shock, the random-walk price process does not return to the old level. From the above results it can be said that returns series NSE S&P 500 Index under study does not follow random walk and is not weak form efficient.

CONCLUSION

This paper studies the NSE S&P 500 Indexfor weak form efficiency to discern the possibility of making above normal returns on the stock market. The predictability of the returns is tested through tests for normality and stationarity. The tests show that the NSE S&P 500 Index follows a Random Walk i.e. a shock to the index today has an effect on periods to come. Hence the NSE S&P 500 Index is efficient in the weak form. The returns on the NSE S&P 500 Index also show tendency of Random walk however the variance does exhibit mean reverting behaviour.

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