

**TESTING RANDOM WALK HYPOTHESIS OF INDIAN STOCK
MARKET RETURNS: EVIDENCE FROM THE NATIONAL STOCK
EXCHANGE (NSE)**

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ABSTRACT

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) behavior of stock market returns of India. The naïve random walk model was estimated using Ordinary Least Squares (OLS) method over the period 1st January, 2008 to 31st December, 2009. The data are obtained from the National Stock Exchange (NSE) website, Mumbai. The study result reveals that the return series is insignificantly different from zero, which is consistent with the random walk hypothesis. It can be, therefore, the present study suggests that the Indian stock market is found to be efficient and supports the random walk behaviour.

Keywords: Indian Stock Exchange, Random Walk Hypothesis, OLS

JEL Classification: C22, C52, G10, G15

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Section-1: Introduction

The term market efficiency in capital market theory is used to explain the degree to which stock prices reflect all available, relevant information. The concept of Efficiency Market Hypothesis (EMH) is based on the arguments put forward by Samuelson (1965) that anticipated price of an asset fluctuate randomly. Fama (1970) presented a formal review of theory and evidence for market efficiency and subsequently revised it further on the basis of development in research (Fama 1991). Efficiency of equity markets has important implications for the investment policy of the investors. If the equity market in question is efficient researching to find miss-priced assets will be a waste of time. In an efficient market, prices of the assets will reflect markets' best estimate for the risk and expected return of the asset, taking into account what is known about the asset at the time. Therefore, there will be no undervalued assets offering higher than expected return or overvalued assets offering lower than the expected return. 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 will be better off trying to spot winners and losers in the market and correct identification of miss-priced assets will enhance the overall performance of the portfolio Rutterford (1993). EMH has a twofold function - as a theoretical and predictive model of the operations of the financial markets and as a tool in an impression management campaign to persuade more people to invest their savings in the stock market (Will 2006). The understanding of efficiency of the emerging markets is becoming more important as a consequence of integration with more developed markets and free movement of

investments across national boundaries. Traditionally more developed Western equity markets are considered to be more efficient. Contribution of equity markets in the process of development in developing countries is less and that resulted in weak markets with restrictions and controls (Gupta, 2006). In the last three decades, a large number of countries had initiated reform process to open up their economies. These are broadly considered as emerging economies. Emerging markets have received huge inflows of capital in the recent past and became viable alternative for investors seeking international diversification. Among the emerging markets India has received more than fair share of foreign investment inflows since its reform process began. One reason could be the Asian crisis which affected the fast developing Asian economies of the time (also some times collectively called „tiger economies“). India was not affected by the Asian crisis and has maintained its high economic growth during the period (Gupta and Basu 2005).

Today India is one of the fastest growing emerging economies in the world. The reform process in India officially started in 1991. As a result, demand for investment funds is growing significantly and capital market growth is expected to play an increasingly important role in the process. The capital market reforms in India present a case where a judicious combination of competition, deregulation and regulation has led to sustained reforms and increased efficiency (Datar and Basu 2004). At this transitional stage, it is necessary to assess the level of efficiency of the Indian equity market in order to establish its longer term role in the process of economic development. However, studies on market efficiency of Indian markets are very few. They are also dated and mostly inconclusive. The objective of this study is to test whether the Indian equity markets are weak form efficient or not. EMH, similar to other theories that require future

expected prices or returns, use past actual prices or returns for the tests. Sets of share price changes are tested for serial independence. Random walk theory for equity prices show an equities market in which new information is quickly discounted into prices and abnormal or excess returns can not be made from observing past prices (Poshakwale 1996).

Section-2: Review of Literature

The efficient market hypothesis is related to the random walk theory. The idea that asset prices may follow a random walk pattern was introduced by Bachelier in 1900 (Poshakwale 1996). The random walk hypothesis is used to explain the successive price changes which are independent of each other. Fama (1991) classifies market efficiency into three forms - weak, semi-strong and strong. In its weak form efficiency, equity returns are not serially correlated and have a constant mean. If market is weak form efficient, current prices fully reflect all information contained in the historical prices of the asset and a trading rule based on the past prices can not be developed to identify miss-priced assets. Market is semi-strong efficient if stock prices reflect any new publicly available information instantaneously. There are no undervalued or overvalued securities and thus, trading rules are incapable of producing superior returns. When new information is released, it is fully incorporated into the price rather speedily. The strong form efficiency suggests that security prices reflect all available information, even private information. Insiders profit from trading on information not already incorporated into prices. Hence the strong form does not hold in a world with an uneven playing field. Studies testing market efficiency in emerging markets are few. Poshakwale (1996) showed that Indian stock market was weak form inefficient; he used daily BSE index data

for the period 1987 to 1994. Barua (1987), Chan, Gup and Pan (1997) observed that the major Asian markets were weak form inefficient. Similar results were found by Dickinson and Muragu (1994) for Nairobi stock market; Cheung et al (1993) for Korea and Taiwan; and Ho and Cheung (1994) for Asian markets. On the other hand, Barnes (1986) showed a high degree of efficiency in Kuala Lumpur market. Groenewold and Kang (1993) found Australian market semi-strong form efficient. Some of the recent studies, testing the random walk hypothesis (in effect testing for weak form efficiency in the markets) are; Korea (Ryoo and Smith, 2002; this study uses a variance ratio test and find the market to follow a random walk process if the price limits are relaxed during the period March 1988 to Dec 1988), China, (lee et al 2001; find that volatility is highly persistent and is predictable, authors use GARCH and EGARCH models in this study), Hong Kong (Cheung and Coutts 2001; authors use a variance ratio test in this study and find that Hang Seng index on the Hong Kong stock exchange follow a random walk), Slovenia (Dezlan, 2000), Spain (Regulez and Zarraga, 2002), Czech Republic (Hajek, 2002), Africa (Smith et al. 2002; Appiah-kusi and Menyah, 2003) and the Middle East (Abraham et al. 2002; this study uses variance ratio test and the runs test to test for random walk for the period 1992 to 1998 and find that these markets are not efficient).

Section-3: Methodology and Data

To test historical market efficiency one can look at the pattern of short-term movements of the combined market returns and try to identify the principal process generating those returns. If the market is efficient, the model would fail to identify any pattern and it can be inferred that the returns have no pattern and follow a random walk process. In essence the assumption of random walk means that either the returns follow a

random walk process or that the model used to identify the process is unable to identify the true return generating process. If a model is able to identify a pattern, then historical market data can be used to forecast future market prices, and the market is considered not efficient. There are a number of techniques available to determine patterns in time series data. Regression, exponential smoothing and decomposition approaches presume that the values of the time series being predicted are statistically independent from one period to the next. Some of these techniques are reviewed in the following section and appropriate techniques identified for use in this study.

Runs test (Bradley 1968) and LOMAC variance ratio tests (Lo and MacKinlay 1988) are used to test the weak form efficiency and random walk hypothesis. Runs test determines if successive price changes are independent. It is non-parametric and does not require the returns to be normally distributed. The test observes the sequence of successive price changes with the same sign. The null hypothesis of randomness is determined by the same sign in price changes. The runs test only looks at the number of positive or negative changes and ignores the amount of change from mean. This is one of the major weaknesses of the test. LOMAC variance ratio test is commonly criticised on many issues and mainly on the selection of maximum order of serial correlation (Faust, 1992). Durbin-Watson test (Durbin and Watson 1951), the augmented Dickey-Fuller test (Dickey and Fuller 1979) and different variants of these are the most commonly used tests for the random walk hypothesis in recent years (Worthington and Higgs 2003; Kleiman, Payne and Sahu 2002; Chan, Gup and Pan 1997). Under the random walk hypothesis, a market is (weak form) efficient if most recent price has all available information and thus, the best forecaster of future price is the most recent price. In the

most stringent version of the efficient market hypothesis, ε_t is random and stationary and also exhibits no autocorrelation, as disturbance term cannot possess any systematic forecast errors.

A simple formal statistical test was introduced by Durbin and Watson (1951). Durbin-Watson (DW) is a test for first order autocorrelation. It only tests for the relationship between an error and its immediately preceding value. One way to motivate this test is to regress the error of time t with its previous value. DW test can not detect some forms of residual autocorrelations, e.g. if $\text{corr}(u_t, u_{t-1}) = 0$ but $\text{corr}(u_t, u_{t-2}) \neq 0$, DW as defined earlier will not find any autocorrelation. Therefore, we do not use the DW test in our study. An alternative model which is more commonly used is Random Walk Model (RW) and AR(1)-OLS model. These RW and AR(1)-OLS model could also be estimated via unit root tests such as Augmented Dickey Fuller test (ADF test) and Philips-Perron test (PP test). Three regression models (with drift, with drift and trend and without drift and trend) are used in this study to test for unit root in the research, (Chan, Gup and Pan 1997; Brooks 2002).

Examining the efficient market hypothesis in its weak form in the context of Indian stock market being the objective, this paper selects the leading stock exchange of India, viz., National Stock Exchange (NSE) because of their undoubted popularity across the globe so as to represent the Indian stock market. The study uses the daily closing price returns of S&P CNX Nifty for the analysis. The sample period spans from the period 1st January, 2008 to 31st December, 2009. All data are retrieved from the website of National Stock Exchange, Mumbai.

Section-4: Empirical Results and Discussions

This study conducts a test of random walk for the NSE market in India. It employs unit root tests (Augmented Dickey-Fuller (ADF)). We perform ADF test with intercept, with intercept and trend and without an intercept and trend. We further test the series using the Phillips-Perron test for a confirmatory data analysis.

Table-1: Results of Augmented Dickey Fuller Test

Variable	With Intercept	With Intercept & Trend	Without Intercept & Trend	Remarks
NSE Nifty Index	-24.688470*	-22.037463*	-28.056034*	<i>Reject the Null Hypothesis of Presence of Unit Root</i>
Note: *-denotes the significance of one per cent level. ADF critical values with an intercept, with Intercept and trend and without Intercept and trend are: -3.435, -2.863 and -2.567 at 1%, 5% and 10% levels; with intercept and trend are: -3.966, -3.414 and -3.129 at 1%, 5% and 10% levels; and without Intercept and trend are -2.569, -1.941 and -1.616 at 1%, 5% and 10% respectively.				

Table-2: Results of Phillips-Perron Test

Variable	With Intercept	With Intercept & Trend	Without Intercept & Trend	Remarks
NSE Nifty Index	-42.098237*	-40.109485*	-45.876012*	<i>Reject the Null Hypothesis of Presence of Unit Root</i>
Note: *-denotes the significance of one per cent level. PP critical values with an intercept, with Intercept and trend and without Intercept and trend are: -3.435, -2.863 and -2.567 at 1%, 5% and 10% levels; with intercept and trend are: -3.966, -3.414 and -3.129 at 1%, 5% and 10% levels; and without Intercept and trend are -2.569, -1.941 and -1.616 at 1%, 5% and 10% respectively.				

The results of unit root tests (ADF & PP tests) of random walk model are presented in Table-1 and Table-2 respectively. From the table, the Augmented Dickey-Fuller clearly reveals that the null hypothesis of unit root is strongly rejected at one per cent level, suggesting that the NSE market do show characteristics of random walk and as such it is efficient in the weak form. We also test using Phillip-Perron test for confirmatory data analysis and find the series to be stationary. Results are presented in

Table-4. The result is consistent with the findings of ADF test, suggesting the market is weak form efficient.

To conclude, the results of the present study suggest that the market is weak form efficient. This provides no opportunity to the traders for predicting the future prices and earning abnormal profits. The implication of weak form efficiency of Indian stock market for the investors is that they cannot better predict the stock price movements, by holding a well diversified portfolio while investing in the Indian stock market.

Section-5: Concluding Remarks

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) behavior of stock market returns of India. The Augmented Dickey-Fuller test and Phillip-Perron test was estimated using Ordinary Least Squares (OLS) method over the period 1st January, 2008 to 31st December, 2009. The data are obtained from the National Stock Exchange (NSE) website, Mumbai. The study result reveals that the return series is insignificantly different from zero, which is consistent with the random walk hypothesis. It can be, therefore, the present study suggests that the Indian stock market is found to be efficient and supports the random walk behavior. This provides no opportunity to the traders for predicting the future prices and earning abnormal profits. The implication of rejection of weak form efficiency for investors is that they cannot better predict the stock price movements, by holding a well diversified portfolio while investing in the Indian stock market.

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