

# Testing Efficient Capital Market Model in Indian Sub- Continent

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The stock market efficiency is one of the significant and widely debated concepts of finance. It has its critics as well as advocates. The concept of market efficiency helps in developing understanding of the working of stock market. This study is intended to add to the reservoir of existing literature with empirical evidences by testing weak form of efficiency of Indian stock market. The present study documents the empirical evidence on price behavior by testing the appropriateness of random walk model in the Indian stock market for the period of 2001-2011. The study offers supportive evidence for rejection of weak form of efficiency in Indian stock market by endorsing absence of randomness and independence in selected return series. Thus, it reveals drifts in market efficiency which offers avenues for devising profitable trading strategies to market participants.

**Keywords:** Efficient Market Hypothesis, Random Walk Theory, Weak Form of Efficiency, Stock Market, Stock Market Efficiency.

## INTRODUCTION

Stock market is an integral part of financial system. It facilitates the primary function of capital market i.e. allocation of resources, by sending price signals. Stock market is said to be ideal, if prices provide accurate signals for resource allocation. It accomplishes this task by sending price signals through quotes and leads to a better psychology of expectations. Fama (1970) agreed that in an ideal market wherein firms can make production and investment decisions and investors can choose among the securities that represent ownership of firms' activities, security prices at any time "fully reflect" all available information. Realizing the significance of stock market efficiency in allocation of economy's capital stock, this study is intended to add to the reservoir of existing literature with empirical evidences by testing weak form of efficiency of Indian stock market.

### Concept of Stock Market Efficiency

The concept of stock market efficiency is widely debated. The most explicit and intuitively appealing explanation of stock market efficiency came in the form of efficient market hypothesis. The seeds of efficient market hypothesis

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Louis back in 1900 discovered speculation in a market as a fair price of a best unbiased future price.

After three Bachelier's Working (1934),

decades of contribution, Kendall

(1953), Roberts (1959) and Osborne (1959) also accepted independence of successive price changes. The economic justification for efficient market hypothesis was offered by Samuelson (1965) and Mandelbrot (1966) through the argument of 'fair game' during 1960's. But Fama was first to put forth the efficient market hypothesis in an explicit form. Fama (1965, a) gave an impetus to the studies of

market efficiency which flooded the capital market literature with empirical as well as theoretical evidences.

Fama (1970) described an efficient market as a market condition in which prices always ‘fully reflect’ all available information. On the basis of the set of information that is fully reflected in the security prices, three forms of market efficiency i.e. the weak, the semi-strong and the strong form of market efficiency have been explored by Fama (1965, a). Weak form of efficiency is a market condition wherein current security prices fully reflect all information contained in historical prices. Under semi-

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strong form of efficiency, prices reflect not only all information found in the record of past prices but also all other publicly available information and in strong form of efficiency, the security prices fully reflect all available information, whether available publicly or privately.

Fama (1965, b) has explained an “efficient” market 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. Thus, Fama (1965, b) based the notion of an efficient market on following set of assumptions:

- A. A large number of rational, profit maximizing investors are present in the market.
- B. In their pursuit to maximize profit, investors are actively competing with each trying to predict future market values of individual securities.
- C. Information is almost freely available to all participants.

Due to competition among market participants, in an efficient market full effects of new information on intrinsic values are instantaneously reflected in actual prices. But vagueness and uncertainty surrounding new information makes the successive price change in individual securities independent. A market where successive price changes in individual securities are independent characterize the random

walk theory which is the chief corollary of efficient market hypothesis. Fama (1965, a) explained that the theory of random walk in stock prices actually involves two separate hypotheses:

- (A) Successive price changes are independent and
- (B) The price changes conform to some probability distribution

Fama (1970) found that transaction costs, information that are not freely available to all investors and disagreement among investors about the implications of given information are not necessary but potential sources for market efficiency.

## REVIEW OF LITERATURE

The review of literature reveals that weak form efficiency in Indian stock market has been extensively researched. The studies conducted by Rao and Mukherjee (1971), Sharma and Kennedy (1977), Sharma (1983), Vidyanathan and Gali (1994), Mittal (1995), Poshakwale (1996), Ramashastri (1999-2000), Alimov, Chakraborty, Cox & Jain (2004), Chander, Mehta and Sharma (2008), Mittal & Jain (2009), Gupta (2010), Khan et. Al. (2011) and Kaur & Dhillon (2011) endorsed existence of weak form efficiency in Indian stock market whereas Ray (1976), Barua (1981), Yalawar (1988), Chaudhari (1991), Gupta and Basu (2007), Thomas & Kumar (2010) and and Gupta & Yung (2011) contradicted presence of weak form of efficiency in Indian stock market due to existence of interdependence in index/stock price series.

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But the result of Mahapatra and Biswasroy (2007) and Patel et.al.

(2011) are entirely different. Mahapatra and Biswasroy (2007) uncovered that with increase in the length of time interval efficiency increases in Indian stock market whereas Patel et.al. (2011) found Indian stock market weak form efficient only for a part of study period. Thus, contradictory results of different studies have become a cause for investigating weak form of efficiency further.

## SCOPE OF STUDY

This study intends to empirically investigate weak form of efficiency in Indian sub-continent by testing appropriateness of random walk model in the Indian stock market. For this purpose, Nifty was considered as a proxy of Indian stock market and daily closing price of S&P CNX Nifty (hereafter Nifty) for the period of 2001-2011 has been taken. Though study would add to the reservoir of existing literature with empirical evidences by testing weak form of efficiency of Indian stock market, yet findings cannot be generalized due to study being carried out in Indian stock market by taking Nifty as market proxy and not individual stock series. This also leaves scope for further studies open.

## OBJECTIVES OF STUDY

Markets that are more efficient attract investors, which translate into increased market liquidity (Fama, 1970). Realizing the significance of stock market efficiency, this study is intended to add to the reservoir of existing literature with empirical evidences by testing weak form of efficiency of Indian stock market. For empirical testing of weak form efficiency of Indian stock market, the present study documents evidence by testing the appropriateness of random walk model in the Indian stock market for the period of 2001-2011. The objectives that have been conceptualized to test random walk model are as following:

- To study whether the returns of Nifty are independent or random?
- To study whether returns of Nifty are normally distributed?

## HYPOTHESES

To document evidence on weak form of efficiency, the study intends to examine the validity of the following hypotheses to test whether the returns of Nifty are random or not:

$H_{01}$ : Returns of Nifty are random.

$H_{a1}$ : Returns of Nifty are not random.

And to test whether the price changes conform to some probability distribution, the study tests the validity of following hypotheses:

$H_{02}$ : Returns of Nifty are from a normal distribution.

$H_{a2}$ : Returns of Nifty are not from a normal distribution.

## DATA AND METHODOLOGY

For the purpose of study, Nifty was considered as a market proxy for comprehension and comparability of consequential trend/ randomness in stock returns and to test whether returns follow any probability distribution. As the underlying process of the time series under study is stock trading and generation of index is based on such trading, the use of index value at the end of each business day is appropriate for the purpose of this study. Thus, keeping in view the nature of study, daily closing price of S&P CNX Nifty for ten years has been taken. The data was compiled from official website of National Stock Exchange for the period beginning from since April 2001 till March 2011. The period of study comprises of both bearish phase and bull phase.

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To examine the validity of stated hypotheses, Runs Test and Jarque-Bera Test have been applied in this study. Runs test is used to check randomness and Jarque-Bera Test is used to test whether returns are normally distributed or not. These methods of statistical analysis have been applied on returns and not prices, as expected returns are more commonly used in asset pricing literature (Fama, 1998).

To calculate return on Nifty, the Log Random Walk (LRW) Model, being a suitable data transformation procedure, is used. Following is the mathematically testable form of LRW model:

$$\ln (P_t / P_{t-1}) = e_t \quad (1)$$

Wherein:

$\ln$  = Natural Log;  $P_t$  and  $P_{t-1}$  are the prices at time  $t$  and time  $t-1$  respectively

$e_t$  = the residual of the time series data at time  $t$ ,  $E(e_t) = 0$ , Covariance  $(e_t, e_{t-1}) = 0$  and all  $s \neq 0$ .

Thereafter, ADF Unit Root Test has been applied to test stationarity of data. The objective of this test is to test the null hypothesis that return series contains a unit root against the alternate hypothesis that the return series is stationary. The ADF unit root test here estimates the following regression equation:

$$\Delta Y_t = \alpha + \beta T + \delta Y_{t-1} + \gamma_i \sum \Delta Y_{t-1} - \varepsilon_t \quad (2)$$

Thus, the hypotheses to be tested are:

$H_0$ : The return series of Nifty contains a unit root.

$H_{a2}$ : The return series of Nifty is stationary.

After testing the stationarity of return series, Runs Test is used to test randomness of return series. It ignores the absolute values in a time series and deals only with the signs to test the presence of randomness in return series. It involves comparison of the observed number of runs (O) in the sample against its sampling distribution. If the observed number of runs is statistically significant from the expected number of runs (E), the test will reject the null hypothesis that daily index returns are random and independent. The runs test variables are converged into Z statistics to test significance of randomness in index returns. To test the null hypothesis of randomness, the expected number of runs are computed in the framework given below:

$$E(R) = [2n_1n_2/n_1+n_2] + 1 \quad (3)$$

For the given test the standard error of the number of runs SE (R) is calculated as:

$$SE(R) = [2 n_1n_2 (2 n_1n_2-n) / n^2(n-1)]^{1/2} \quad (4)$$

To test whether the time series is random or not, Z statistics is computed as follows:

$$Z = [R - E(R) / SE(R)] \sim N(0,1) \quad (5)$$

Wherein:

R= Number of actual runs in the sample,

Z= Standard normal variate,

SE(R) = Standard error of the number of runs and

E(R) = Expected number of runs.

The null hypothesis of randomness will be rejected at 0.05 level of significance in favor of alternate hypothesis (non-randomness hypothesis) if observed value of  $|Z| > 1.96$  and vice-versa.

To know whether return series follow normal distribution, the Jarque-Bera Test (Jarque & Bera

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1987) has been applied. The Jarque-Bera statistic is computed from skewness and kurtosis and asymptotically follows the chi-squared distribution with two degrees of freedom. The Jarque-Bera test is used to test the null hypothesis that the data are from a normal distribution. The test statistic is:

$$JB = \frac{n}{6} \left[ S^2 + \frac{(K-3)^2}{4} \right] \sim \chi_2^2 \quad (6)$$

Where:

n = the sample size

S = skewness

K = kurtosis

## RESULTS & ANALYSIS

The results of ADF Unit Root Test applied affirm that return series of Nifty is stationary, being computed ADF test-statistic (-47.31956) smaller than the critical values – (-2.567322, -2.862492 and -3.432763) at 10%, 5%, 1% significant level, respectively (See table No. 1). Therefore the study rejects the null hypothesis that return series contains a unit root against the alternate hypothesis that the return series is stationary and concludes that return series of Nifty is stationary.

**Table 1 Augmented Dickey Fuller Unit Root Test On S&P Nifty**

Null Hypothesis: The return series of Nifty has a unit root			
Lag Length: 0 (Automatic based on SIC, MAXLAG=26)			
		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-47.31956	0.0001
Test critical values:	1% level	-3.432763	
	5% level	-2.862492	
	10% level	-2.567322	

To determine whether day-to-day returns follow a random walk or are independent, runs test has been applied to S&P Nifty Index for the period of study and test results (as shown in table no. 2) reject the null hypothesis of randomness in return series of Nifty, being standardized value z significant at five percent level of significance. Thus, the results of runs test affirm the absence of independence by



rejecting the null hypothesis of randomness in return series. On the basis of the results of runs test, the study rejects the first hypothesis of random walk theory i.e. independence in successive price changes.

**Table 2 Results of Runs Test**

Test Value <sup>a</sup>	0.0010
Cases < Test Value	1177
Cases >= Test Value	1334
Total Cases	2511
Number of Runs	1187
Z	-2.589
Asymp. Sig. (2-tailed)	0.010

<sup>a</sup>Median

The numerical and graphical results of Jarque-Bera Test, as shown in table no. 3 and figure no. 1, rejects the null hypothesis that returns of Nifty follow normal distribution. As per numerical results shown in table no. 3, p value of Jarque-Bera test is 0.000000 which is less than 0.05 at 5% level of significance. Therefore Jarque-Bera test offers an evidence to reject the null hypothesis Besides this the value of skewness is -0.443211. It shows that distributions are skewed to left and endorses non-normality of distribution. The value of kurtosis in the test is 12.22464 which is more than 3. It indicates a higher peak and thin tail compared to normal distribution.

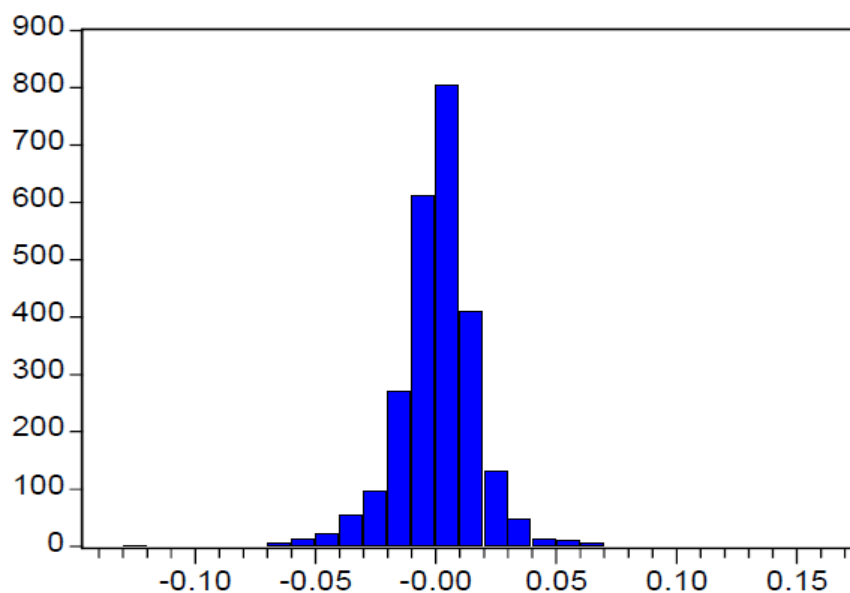
**The study rejects the first hypothesis of random walk theory i.e. independence in successive price changes.**

**Table 3 Results Of Jerque-Bera Test**

Sample 1	2513
Observations	2511
Mean	0.000658
Median	0.001000
Maximum	0.163000
Minimum	-0.131000

Std. Dev.	0.016928
Kurtosis	12.22464
Jarque-Bera	8985.167
Probability	0.000000

The histogram of residuals being more leptokurtic discloses the fact that returns of Nifty are not normally distributed (See Figure No. 1). Thus, both numerical and graphical results of Jarque-Bera Test affirm that returns of Nifty are not normally distributed.



**Figure 1 Normality Plot**

## CONCLUSIONS & SUGGESTIONS

The study investigates the weak form efficiency in National Stock Exchange, the biggest stock exchange of Indian stock market. The Runs Test and Jarque-Bera Test applied to test the random walk theory in Indian stock market, rejects the both hypothesis of random walk theory. Runs test reject the first hypothesis of independence in successive price changes and Jarque-Bera Test rejects the second hypothesis of random walk theory due to not being the distribution of returns normal. Thus, on the basis of the results of tests, the study concludes that that Indian stock market is not weak form efficient which confirms the common notion that the equity markets in the emerging economies are not efficient and to some extent can also explain that the Indian stock market is not efficient in price formation process.

This is a sign of drifts in market efficiency and offers avenues for devising profitable trading strategies to market participants by trading on past information.

As an efficient market fuels economic development by performing price formation process efficiently.

**To improve efficiency of Indian stock market, potential sources of market inefficiency i.e. transaction costs, information that are not freely available to all investors and disagreement among investors about the implications of given information should be squarely addressed.**

This improves the allocation of investment resources. Necessary measures must be taken to root out inefficiencies from Indian stock market. An inefficient price formation process would have adverse affect on working of stock market by less optimal allocation of portfolios. To improve efficiency of Indian stock market, potential sources of market inefficiency i.e. transaction costs, information that are not freely available to all investors and disagreement among investors about

the implications of given information should be squarely addressed. Besides this more and more participation of investors with ready accessibility to information and ability to take account of all available information should also be facilitated to improve market efficiency.

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