

Testing of Efficient Market Hypothesis: a study on Indian Stock Market

Neeraj Gupta, Ashwin Gedam

(Lecturer, Amity Business School, Amity University, Gwalior, India)

(Student, MBA, Amity Business School, Amity University, Gwalior, India)

Abstract: *Market efficiency refers to the accuracy and quickness with which prices reflect market related information. In the weak form of the market, current price reflect all the information found in past prices and traded volumes. Further, prices cannot be predicted by analysis of past prices. Everyone has access to past prices even though some people can get these more easily than others. Liquidity traders may sell their stocks without considering the intrinsic value of the shares and cause price fluctuations. Buying and selling of the information traders lead the market price to align itself with the intrinsic value.*

The filter rule, runs test and serial correlation are adopted to find out market efficiency. In this paper runs test has been used to find out market efficiency. The stock price of the selected companies has been taken from NSE (National Stock Exchange).

Keywords: *Market efficiency, weak form, runs test, serial correlation, and stock prices.*

I. Introduction

An institution of considerable interest to the public and of importance to economists is the Stock Market. It is responsible for dealing with instruments that represents an assertion of right to the ownership of industrial, financial and service character. These claims are perceived by their owners as assets which are convertible into money and which in turn are offered for their purchase. The worlds' stock markets are the places which offer liquidity ability to the owners of the assets and contribute to the continuous and competitive determination of prices. Therefore, it is of great importance for stock markets to operate efficiently. In a general sense, an Efficient Stock Market is a place in which firms can make production investment decisions and investors can choose among the various securities that represent ownership of firms activities. The stock markets efficiency is a major area of research in financial economics, particularly as it relates to stock markets of developing economies. This is because of the significance of market efficiency to the functioning of the capital market; especially as it is responsible for stimulation of investor's interest in market activities. It is believed that the behavior of investor can be used to explain the behavior of stock market. Stock market forecasting is checked more by its failure than by its successes, since stock prices reflect the judgments and expectations of investors . Outstandingly, efforts have been made to apply econometric techniques of model building in the prediction of stock prices . Fama and French (1988) have argued that there are long-term pattern in stock prices with several years of upswing followed by more sluggish periods. According to Fama (1965; 1995), a stock market where successive price changes in individual securities are independent is by their definition, a random walk market. Specifically, stock prices following a random walk imply that the price changes are as independent of one another as the gains and losses. The independence assumption relating to the random walk hypothesis is valid as long as knowledge of the past behavior of the series of price changes cannot be used to increase expected gains. Also, if successive price changes for a given security are independent, then there is no problem in timing purchases and sales of the security. A simple policy of buying and holding the security will be as good as any more complicated mechanical procedure for timing purchase and sales. So, in all we can say that stock market is increasingly becoming one of the most popular investments outlet in recent times due to its high returns and the market has gradually become an integral part of the global economy to the extent that any fluctuation in this market influences personal and corporate financial lives as well as the economic health of a country. Furthermore, the stock market is crucial to the nation's economic development because it, along with other functions, performs the vital function of financial intermediation in the economy by taking money from the surplus units in the economy and channeling same to the required units in the economy. However, the ability of the stock market to perform its role effectively and assure investors of fair returns is contingent on the extent to which it can be said to be efficient. This underscores the essence of studies that seek to test stock market efficiency. If a market is not efficient then, stocks that outperform the market will inspire positive sentiments among investors while stocks that under-perform may induce panic. Consequently, stocks that under-perform at any given point in time relative to the market are more sensitive to new information (Lulia, 2009). In other words, there is a negative relationship between the measure of price sensitivity to news and the stock's performance relative to the market. On the other hand, panic drives the price sensitivity to new

information than the thrill of investing in a high-return stock does, or simply yet, the downside hurts investors more than the upside helps them (Lulia, 2009).

The Efficient Market Hypothesis (EMH) provides that the 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 as the information is disseminated to all. The assets price is reflective of all the available information available and anticipated risk. The only way an investor can possibly obtain higher returns is by purchasing riskier investments. The Random Walk Model asserts that all price changes are serially independent, which implies that future price changes are independent of past price changes. Samuelson (1965) and Fama (1970) indicates that the EMH supposes that share price adjust rapidly to the appearance of new information, and thus, current prices fully reflect all available information and should follow a random walk process (Awad and Daraghma, 2009). The levels of market efficiency was provided by Fama (1971), who argued that markets could be efficient at three levels, based upon what information was reflected in prices.

In this context, the present paper makes an earnest attempt to analyze the weak form market efficiency based on the theory of Efficient Market Hypothesis (EMH) (Fama 1965). In this the efficiencies of various top automobile and IT companies of India is tested in this study. The closing stock prices of these companies are taken from NSE (National Stock Exchange) and are then passed through necessary statistical tool to obtain whether successive price change is independent or not. The whole research is being carried out keeping in mind to draw the efficiency of the Indian Stock Market at weak form with the help of movement of the closing stock prices over a period of time.

II. Review Of Literature

To test the weak form efficiency of Indian stock market there are various kinds of studies that had been conducted and some of them are given by-

Sharma and Kennedy (1977) compared the behavior of stock indices of the Bombay, London and New York stock exchanges during 1963-73 using run test and spectral analysis. Both test confirmed the random movement of stock indices for all the three stock exchanges. They concluded that stocks on the BSE (Bombay Stock Exchange) follow random walk and are weak- form efficient.

Ramachandran (1986) tested for the weak - form of Efficient Market Hypothesis using weekend prices of 60 scrips over the period 1976-81. He used filter rule tests in addition to runs test and serial correlation tests and found support for the weak - form of EMH.

Yalawar (1988) conducted an intensive study on the efficiency of BSE (Bombay Stock Exchange). He studied the month end closing prices of 122 stocks listed on the BSE during the period 1963-82. He used only the non-parametric tests, Spearman's rank correlation test and found the behaviour of stock prices to be random.

Poshakwale (1996) focused on the accelerating trend of investment in the stock market. He analyzed the weak form efficiency and day of the week effect on the Bombay Stock Exchange (BSE) using daily BSE National Index Data for the period 1987 to 1994. His study reveals that BSE supports the validity of day of the week effect and the Indian stock market is weak - form inefficient.

Seiler and Walter (1997) examined the degree of random walk. He analyzed the historical returns of all the stocks listed on the New York Stock Exchange (NYSE) from February 1885 to July 1962. His study concludes that changes in historical prices are completely random and this conclusion is consistent with modern efficient market studies.

Keasey and Mobarek (2000), in their paper investigated the weak-form efficiency of an emerging market by taking evidence from Dhaka Stock Market of Bangladesh over the period 1988 to 1997 by employing both parametric and non parametric tests. The study reveals that Dhaka Stock Market of Bangladesh is weak - form inefficient.

Pandey (2003) analyzed the efficiency of the Indian stock markets by using three Indian stock indices to test the efficiency level in Indian stock market and the random walk nature of the stock market by using the runs test and the Auto Correlation Function ACF (K) for the period from January 1996 to June 2002. The study found that the series of stock indices in the Indian stock market biased the random time series and do not confirm the Random Walk Theory.

Sharma et al. (2009) examined the weak-form efficiency of eleven (11) securities listed on the BSE using weekly data from July 2007 to October 2007 by employing runs test and auto-correlation tests. The study concludes that the BSE is weak-form efficient and the stock prices are having very scrimpy effect on future prices which implies that an investor cannot reap out abnormal profits as the current share prices already reflect the effect of past share prices.

Pradhan et al. (2009) in their paper tried to examine the Efficient Market Hypothesis (EMH) in its weak - form by employing the unit root test on the sample of daily stock returns of National Stock Exchange (NSE)

and Bombay Stock Exchange (BSE). The sample period lies between Jan. 2007 to Jul. 2009. The study reveals that Indian Stock market is not weak - form efficient.

Chigozie and Okpara (2009) examined the efficiency of Nigerian Stock Market over the period 1984 to 2006 by employing an advance test viz; GARCH (Generalized Autoregressive Conditional Heteroscedasticity) Model. The study reveals that Nigerian Stock market is weak form efficient. The result agrees with the findings of Samuels and Yacout (1981), Ayadi (1984), Olewe (1999) and Kukah (2007).

III. Objectives Of Study

- To find out whether the past prices of the stock are reflected on the future price
- To find out whether the weak form of efficient market holds true or not

IV. Research Methodology

- Period of study is from 1st January 2014 to 31st March 2014
- The stock prices were taken from the NSE (National Stock Exchange)
- Four companies each from Automobile Industry and IT industry has been selected
- The sources of data for the research paper are mainly secondary which is collected from the websites, documents, which are in printed form like annual reports etc.

V. Research Plan

5.1. Hypothesis testing:

While studying the efficient market hypothesis, hypothesis testing has been taken into account. The hypothesis which is tested under the assumption that it is true is called null hypothesis and is denoted by H₀. The hypothesis which differs from a given null hypothesis, H₀ and is accepted when H₀ is rejected is called an alternative hypothesis and is denoted by H₁.

Thus, in context of this research we have,

H₀: Past prices are not reflected on the present prices.

H₁: Past prices are reflected on the present prices.

5.2. Data Analysis method:

The study seeks to test the efficient market hypothesis, by employing Runs Test. Runs Test is a non-parametric test, which is used to test the randomness of the series which auto correlation fails to do. Runs Test is a traditional method used in the random walk model and ignores the properties of distribution. It has been used to judge the randomness in the behaviour of Indian Stock market.

In runs test we consider a series of price changes over a certain period of time and each price change is either designated as a plus (+) if it is an increase in price or a minus(-)if it is a decrease in price. A run exist when two consecutive changes are the same (i.e., ++or--). When price changes in a different direction, such as +-or-+

The run ends and a new run may begin .To test for independence, the number of runs for a given series of price changes are compared with the number of runs for a given series of price changes compared with the number in a table of expected values for the number of runs that should occur in a random series.

To test the independence of the prices, we require:

Total Number of Runs:	(r)
Number of Positive Price Changes:	(n ₁)
Number of Negative Price Changes:	(n ₂)

Once we have the data, the mean and the standard deviation of the mean are calculated by using the formula given below:

$$\text{Mean, } \mu(r) = \frac{2n_1n_2}{n_1+n_2} + 1 \quad (1)$$

$$\text{Standard deviation, } \sigma(r) = \sqrt{\frac{2n_1n_2(2n_1n_2 - n_1 - n_2)}{(n_1+n_2)^2(n_1+n_2-1)}} \quad (2)$$

5.3 Level of significance:

To test the weak form of efficiency of the stock market ,the Runs Test is applied at 5% significance level where z=1.96

5.4 Calculating lower limit and upper limit:

Here,

Lower limit : { $\mu - 1.96 * (\sigma)$ } (3)

Upper limit : { $\mu + 1.96 * (\sigma)$ } (4)

Where μ =mean σ =standard deviation

VI. Data Analysis

Table 1 showing the Result of Hypothesis testing:

Company's Name	n1	n2	μ	σ	Upper Limit	Lower Limit	Observed Runs	Hypothesis testing at a given level of significance
EICHER MOTORS	29	33	31.87	3.80	39.31	24.42	30	H0 accepted
ASHOK LEYLAND	29	30	30.49	3.80	37.93	23.04	30	H0 accepted
MAHINDRA and MAHINDRA	33	29	31.87	3.88	39.47	24.26	34	H0 accepted
TATA MOTORS	34	28	31.70	3.86	39.26	24.13	36	H0 accepted
TATA CONSULTANCY SERVICES	30	31	31.50	3.87	39.08	23.91	30	H0 accepted
TECH MAHINDRA	31	31	32.00	3.90	39.64	24.35	41	H1 accepted
INFOSYS	36	26	31.19	3.80	38.63	23.74	25	H0 accepted
PERSISTENT TECHNOLOGIES	34	28	31.70	3.86	39.26	24.13	34	H0 accepted

VII. Runs Test Analysis

Table 2 showing the monthly closing stock value and applied runs test of EICHER MOTORS

Date	Closing price	Price change	Date	Closing price	Price change
1 st jan2014	5001.95		26 th feb2014	5012.60	+
2 nd jan2014	4982.85	-	28 th feb2014	5140.30	+
3 rd jan2014	4968.95	-	3 rd mar2014	5187.05	+
6 th jan2014	4985.95	+	4 th mar2014	5426.10	+
7 th jan2014	4993.10	+	5 th mar2014	5599.15	+
8 th jan2014	5074.90	+	6 th mar2014	5510.35	-
9 th jan 2014	5042.55	-	7 th mar2014	5434.10	-
10 th jan2014	5009.05	-	10 th mar2014	5560.00	+
13 th jan2014	5055.00	+	11 th mar2014	5504.40	-
14 th jan2014	5012.55	-	12 th mar2014	5494.00	-
15 th jan2014	4937.35	-	13 th mar2014	5547.45	+
16 th jan2014	4953.05	+	14 th mar2014	5571.35	+
17 th jan2014	4945.75	-	18 th mar2014	5564.40	-
20 th jan2014	5059.15	+	19 th mar2014	5740.50	+
21 st jan2014	5085.75	+	20 th mar2014	5726.45	-
22 nd jan2014	5041.45	-	21 th mar2014	5763.35	+
23 th jan2014	5044.85	+	22 st mar2014	5718.05	-
24 th jan2014	4921.80	-	24 nd mar2014	5795.35	+
27 th jan2014	4840.15	-	25 th mar2014	5951.50	+
28 th jan2014	4808.15	-	26 th mar2014	5776.75	-
29 th jan2014	4725.20,	-	27 th mar2014	5919.15	+
30 th jan2014	4688.90	-	28 th mar2014	5832.05	-
31 st jan2014	4646.10	-	31 st mar2014	5961.50	+
3 rd feb2014	4563.40	-			
4 th feb2014	4555.30	-			
5 th feb2014	4542.95	-			
6 th feb2014	4504.05	-			
7 th feb2014	4426.00	-			
10 th feb2014	4430.90	-			
11 th feb2014	4417.80	-			
12 th feb2014	4437.55	+			
13 th feb2014	4818.65	+			
14 th feb2014	4849.50	+			
17 th feb2014	4904.35	+			
18 th feb2014	4920.00	+			
19 th feb2014	4899.90	-			
20 th feb2014	4901.80	+			

21 st feb2014	4884.00	-			
24 th feb2014	4820.20	-			
25 th feb2014	4916.15	+			

Evaluation of EICHER MOTORS:

Total runs (r) =30

Number of positive changes (n1) =29

Number of negative changes (n2) =33

Mean (μ) =31.87

Standard deviation (σ)=3.80

Upper limit=39.31

Lower limit=24.42

Inference:

Since the Observed number of runs falls within the upper and the lower limit, we can conclude that that the prices are independent at 5% level of significance (H_0 is accepted).

Thus, the market is weakly efficient.

Table 3 showing the monthly closing stock value and applied runs test of ASHOK LEYLAND

Date	Closing price	Price change	Date	Closing price	Price change
1 st jan2014	17.20		26 th feb2014	15.70	+
2 nd jan2014	17.75	+	28 th feb2014	15.65	-
3 rd jan2014	18.90	+	3 rd mar2014	15.55	-
6 th jan2014	18.70	-	4 th mar2014	15.60	+
7 th jan2014	18.35	-	5 th mar2014	16.15	-
8 th jan2014	18.25	-	6 th mar2014	16.00	-
9 th jan 2014	17.90	-	7 th mar 2014	17.15	+
10 th jan2014	17.20	-	10 th mar2014	18.10	+
13 th jan2014	17.10	-	11 th mar2014	17.55	-
14 th jan2014	17.40	+	12 th mar2014	17.75	+
15 th jan2014	17.25	-	13 th mar2014	17.45	-
16 th jan2014	17.00	-	14 th mar2014	17.45	
17 th jan2014	16.85	-	18 th mar2014	17.50	+
20 th jan2014	16.80	-	19 th mar2014	17.65	+
21 st jan2014	16.80	+	20 th mar2014	17.70	+
22 nd jan2014	17.25	+	21 th mar2014	18.50	+
23 th jan2014	17.70	+	22 st mar2014	18.50	
24 th jan2014	17.05	-	24 nd mar2014	19.35	+
27 th jan2014	16.50	-	25 th mar2014	20.30	+
28 th jan2014	16.35	-	26 th mar2014	22.60	+
29 th jan2014	16.30	-	27 th mar2014	22.10	-
30 th jan2014	16.15	-	28 th mar2014	22.85	+
31 st jan2014	16.45	+	31 st mar2014	23.65	+
3 rd feb2014	15.90	-			
4 th feb2014	16.45	+			
5 th feb2014	16.00	-			
6 th feb2014	15.95	-			
7 th feb2014	16.10	+			
10 th feb2014	15.65	-			
11 th feb2014	15.70	+			
12 th feb2014	15.60	-			
13 th feb2014	15.50	-			
14 th feb2014	15.60	+			
17 th feb2014	15.35	-			
18 th feb2014	15.35	+			
19 th feb2014	15.65	+			
20 th feb2014	15.65	+			
21 st feb2014	15.70	+			
24 th feb2014	15.50	-			
25 th feb2014	15.50				

Evaluation of ASHOK LEYLAND:

Total runs (r) =30

Number of positive changes (n1) =29

Number of negative changes (n2) =30

Total mean (μ) =30.49

Standard deviation (σ) =3.80
 Upper limit=37.93
 Lower limit=23.04

Inference:

Since the Observed number of runs falls within the upper and the lower limit, we can conclude that that the prices are independent at 5% level of significance (H0 is accepted). Thus, the market is weakly efficient

Table 4 showing the monthly closing stock value and applied runs test of MAHINDRA AND MAHINDRA

Date	Closing price	Price change	Date	Closing price	Price change
1 st jan2014	948.00		26 th feb2014	964.70	+
2 nd jan2014	936.10	-	28 th feb2014	974.50	+
3 rd jan2014	900.25	-	3 rd mar2014	952.25	-
6 th jan2014	895.40	-	4 th mar2014	955.80	+
7 th jan2014	903.10	+	5 th mar2014	948.55	-
8 th jan2014	908.60	+	6 th mar2014	955.35	+
9 th jan 2014	894.35	-	7 th mar2014	983.55	+
10 th jan2014	874.55	-	10 th mar2014	1015.85	+
13 th jan2014	888.25	+	11 th mar2014	994.50	-
14 th jan2014	891.05	+	12 th mar2014	991.25	-
15 th jan2014	904.90	+	13 th mar2014	1016.05	+
16 th jan2014	892.65	-	14 th mar2014	1027.00	+
17 th jan2014	899.55	+	18 th mar2014	1009.60	-
20 th jan2014	906.75	+	19 th mar2014	980.45	-
21 st jan2014	903.60	-	20 th mar2014	978.30	-
22 nd jan2014	916.45	+	22 th mar2014	970.45	-
23 th jan2014	890.10	-	22 nd mar2014	973.90	+
24 th jan2014	884.80	-	24 nd mar2014	987.80	+
27 th jan2014	866.85	-	25 th mar2014	973.40	-
28 th jan2014	875.10	+	26 th mar2014	958.95	-
29 th jan2014	861.94	-	27 th mar2014	964.85	+
30 th jan2014	867.90	+	28 th mar2014	968.25	+
31 st jan2014	890.20	+	31 st mar2014	980.70	+
3 rd feb2014	884.85	-			
4 th feb2014	853.75	-			
5 th feb2014	878.35	+			
6 th feb2014	896.95	+			
7 th feb2014	895.56	-			
10 th feb2014	894.20	-			
11 th feb2014	897.05	+			
12 th feb2014	895.50	-			
13 th feb2014	906.65	+			
14 th feb2014	904.40	-			
17 th feb2014	928.10	+			
18 th feb2014	935.15	+			
19 th feb2014	943.20	+			
20 th feb2014	929.95	-			
21 st feb2014	930.00	+			
24 th feb2014	944.10	+			
25 th feb2014	943.90	-			

Evaluation of MAHINDRA AND MAHINDRA:

Total run (r) =34
 Number of positive price changes (n1) =33
 Number of negative price changes (n2) =29
 Mean (μ) =31.87
 Standard deviation (σ) =3.88
 Upper limit=39.47
 Lower limit=24.26

Inference:

Since the Observed number of runs falls within the upper and the lower limit, we can conclude that that the prices are independent at 5% level of significance (H0 is accepted). Thus, the market is weakly efficient.

Table 1.5 showing the monthly closing stock value and applied runs test analysis of TATA MOTORS

Date	Closing price	Price change	Date	Closing price	Price change
1 st jan2014	192.20		26 th feb2014	195.90	+
2 nd jan2014	189.70	-	28 th feb2014	204.15	+
3 rd jan2014	188.00	-	3 rd mar2014	199.45	-
6 th jan2014	187.80	-	4 th mar2014	198.80	-
7 th jan2014	188.15	+	5 th mar2014	195.85	-
8 th jan2014	190.90	+	6 th mar2014	197.30	+
9 th jan 2014	188.60	-	7 th mar2014	202.25	+
10 th jan2014	189.85	+	10 th mar2014	196.50	-
13 th jan2014	195.15	+	11 th mar2014	197.60	+
14 th jan2014	195.10	-	12 th mar2014	192.50	-
15 th jan2014	196.20	+	13 th mar2014	191.70	-
16 th jan2014	194.10	-	14 th mar2014	194.70	+
17 th jan2014	192.45	-	18 th mar2014	190.10	-
20 th jan2014	193.95	+	19 th mar2014	191.00	+
21 st jan2014	197.25	+	20 th mar2014	188.20	-
22 nd jan2014	198.20	+	21 st mar2014	190.60	+
23 th jan2014	195.10	-	22 nd mar2014	190.70	+
24 th jan2014	186.85	-	24 th mar2014	190.25	-
27 th jan2014	177.70	-	25 th mar2014	190.35	+
28 th jan2014	181.10	+	26 th mar2014	194.50	+
29 th jan2014	177.00	-	27 th mar2014	194.20	-
30 th jan2014	177.80	+	28 th mar2014	196.30	+
31 st jan2014	174.90	-	31 st mar2014	202.40	+
3 rd feb2014	170.05	-			
4 th feb2014	173.30	+			
5 th feb2014	177.90	+			
6 th feb2014	175.45	-			
7 th feb2014	179.00	+			
10 th feb2014	182.05	+			
11 th feb2014	187.75	+			
12 th feb2014	191.05	+			
13 th feb2014	191.85	+			
14 th feb2014	195.15	+			
17 th feb2014	194.50	-			
18 th feb2014	195.80	+			
19 th feb2014	195.00	-			
20 th feb2014	194.05	-			
21 st feb2014	196.05	+			
24 th feb2014	196.40	+			
25 th feb2014	194.70	-			

Evaluation of TATA MOTORS:

Total runs(r) =36

Number of positive price changes (n1) =34

Number of negative price changes (n2) =28

Mean (μ) =31.70

Standard deviation (σ) =3.86

Upper limit=39.26

Lower limit=24.13

Inference:

Since the Observed number of runs falls within the upper and the lower limit, we can conclude that the prices are independent at 5% level of significance (H0 is accepted).

Thus, the market is weakly efficient.

Table 6 showing the monthly closing stock value and applied runs test analysis of Tata Consultancy Services

Date	Closing price	Price change	Date	Closing price	Price change
1 st jan2014	2153.30		26 th feb2014	2182.15	-
2 nd jan2014	2153.30		28 th feb2014	2275.75	+
3 rd jan2014	2222.20	+	3 rd mar2014	2240.05	-
6 th jan2014	2239.60	+	4 th mar2014	2240.65	+
7 th jan2014	2206.15	-	5 th mar2014	2251.90	+
8 th jan2014	2232.65	+	6 th mar2014	2240.75	-
9 th jan 2014	2241.95	+	7 th mar2014	2228.50	-
10 th jan2014	2280.90	+	10 th mar2014	2142.65	-

13 th jan2014	2368.75	-	11 th mar2014	2151.65	+
14 th jan2014	2326.75	-	12 th mar2014	2179.45	+
15 th jan2014	2353.60	+	13 th mar2014	2149.55	-
16 th jan2014	2350.30	-	14 th mar2014	2139.55	-
17 th jan2014	2213.05	-	18 th mar2014	2122.00	-
20 th jan2014	2338.20	+	19 th mar2014	2039.40	-
21 st jan2014	2280.30	-	20 th mar2014	2108.20	+
22 nd jan2014	2274.05	-	21 st mar2014	2127.00	+
23 th jan2014	2252.45	-	22 nd mar2014	2128.25	+
24 th jan2014	2248.70	-	24 th mar2014	2152.60	+
27 th jan2014	2229.60	-	25 th mar2014	2146.65	-
28 th jan2014	2212.35	-	26 th mar2014	2093.50	-
29 th jan2014	2209.80	-	27 th mar2014	2094.25	+
30 th jan2014	2217.60	+	28 th mar2014	2102.10	+
31 st jan2014	2241.05	+	31 st mar2014	2133.15	+
3 rd feb2014	2194.45	-			
4 th feb2014	2151.35	-			
5 th feb2014	2194.40	+			
6 th feb2014	2175.25	-			
7 th feb2014	2144.40	-			
10 th feb2014	2093.55	-			
11 th feb2014	2101.70	+			
12 th feb2014	2105.45	+			
13 th feb2014	2133.75	+			
14 th feb2014	2167.90	+			
17 th feb2014	2165.40	-			
18 th feb2014	2166.00	+			
19 th feb2014	2197.95	+			
20 th feb2014	2189.35	-			
21 st feb2014	2205.70	+			
24 th feb2014	2177.90	-			
25 th feb2014	2188.90	+			

Evaluation of TCS:

Total runs(r) =30

Number of positive runs (n1) =30

Number of negative runs (n2) =31

Mean (μ) =31.5

Standard deviation (σ) =3.87

Upper limit=39.08

Lower limit=23.91

Inference:

Since the Observed number of runs falls within the upper and the lower limit, we can conclude that that the prices are independent at 5% level of significance (H0 is accepted).

Thus, the market is weakly efficient.

Table 7 showing the monthly closing stock value and applied runs test analysis of TECH MAHINDRA

Date	Closing price	Price change	Date	Closing price	Price change
1 st jan2014	1828.10		26 th feb2014	1820.95	-
2 nd jan2014	1816.10	-	28 th feb2014	1867.25	+
3 rd jan2014	1835.50	+	3 rd mar2014	1906.45	+
6 th jan2014	1815.85	-	4 th mar2014	1900.00	-
7 th jan2014	1804.05	-	5 th mar2014	1903.85	+
8 th jan2014	1840.60	+	6 th mar2014	1923.20	+
9 th jan2014	1829.05	-	7 th mar2014	1836.00	-
10 th jan2014	1878.90	+	10 th mar2014	1799.60	-
13 th jan2014	1884.50	+	11 th mar2014	1781.75	-
14 th jan2014	1893.25	+	12 th mar2014	1802.75	+
15 th jan2014	1884.05	-	13 th mar2014	1780.55	-
16 th jan2014	1866.25	-	14 th mar2014	1785.25	+
17 th jan2014	1775.25	-	18 th mar2014	1794.35	+
20 th jan2014	1828.70	+	19 th mar2014	1777.50	-
21 st jan2014	1828.65	-	20 th mar2014	1822.15	+
22 nd jan2014	1842.15	+	21 st mar2014	1808.95	-
23 th jan2014	1830.65	-	22 nd mar2014	1819.65	+
24 th jan2014	1793.55	-	24 th mar2014	1844.30	+

27 th jan2014	1760.25	-	25 th mar2014	1828.80	-
28 th jan2014	1738.75	-	26 th mar2014	1815.35	-
29 th jan2014	1749.55	+	27 th mar2014	1833.45	+
30 th jan2014	1718.30	-	28 th mar2014	1836.75	+
31 st jan2014	1786.95	+	31 st mar2014	1795.35	-
3 rd feb2014	1763.10	-			
4 th feb2014	1770.85	+			
5 th feb2014	1839.85	+			
6 th feb2014	1845.50	+			
7 th feb2014	1823.15	-			
10 th feb2014	1832.15	+			
11 th feb2014	1861.70	+			
12 th feb2014	1875.65	+			
13 th feb2014	1813.80	-			
14 th feb2014	1831.85	+			
17 th feb2014	1823.75	-			
18 th feb2014	1822.05	-			
19 th feb2014	1842.85	+			
20 th feb2014	1832.25	-			
21 st feb2014	1848.20	+			
24 th feb2014	1831.45	-			
25 th feb2014	1839.60	+			

Evaluation of TECH MAHINDRA:

Total runs(r) =41

Number of positive price changes (n1) =31

Number of negative price changes (n2) =31

Mean (μ) =32

Standard deviation (σ) =3.90

Upper limit=39.64

Lower limit=24.35

Inference:

Since the Observed number of runs doesn't falls within the upper and the lower limit, we can conclude that that the prices are not independent at 5% level of significance (H1 is accepted)

Thus, the market is weakly inefficient.

Table 8 showing the monthly closing stock value and applied runs test analysis of INFOSYS

Date	Closing price	Price change	Date	Closing price	Price change
1 st jan2014	3468.00		26 th feb2014	3807.50	+
2 nd jan2014	3480.55	+	28 th feb2014	3824.85	+
3 rd jan2014	3565.15	+	3 rd mar2014	3798.25	-
6 th jan2014	3517.90	-	4 th mar2014	3799.55	+
7 th jan2014	3457.15	-	5 th mar2014	3821.70	+
8 th jan2014	3428.10	-	6 th mar2014	3831.90	+
9 th jan 2014	3450.80	+	7 th mar2014	3740.30	-
10 th jan2014	3551.25	+	10 th mar2014	3671.60	-
13 th jan2014	3665.00	+	11 th mar2014	3675.35	+
14 th jan2014	3686.75	+	12 th mar2014	3671.30	-
15 th jan2014	3712.05	+	13 th mar2014	3357.60	-
16 th jan2014	3725.05	+	14 th mar2014	3394.15	+
17 th jan2014	3729.75	+	18 th mar2014	3350.55	-
20 th jan2014	3749.30	+	19 th mar2014	3271.75	-
21 st jan2014	3758.35	+	20 th mar2014	3303.05	+
22 nd jan2014	3765.90	+	21 st mar2014	3305.65	+
23 th jan2014	3792.50	+	22 nd mar2014	3296.05	-
24 th jan2014	3758.15	-	24 th mar2014	3275.80	-
27 th jan2014	3732.20	-	25 th mar2014	3254.40	-
28 th jan2014	3675.10	-	26 th mar2014	3248.90	-
29 th jan2014	3717.80	+	27 th mar2014	3231.05	-
30 th jan2014	3704.25	-	28 th mar2014	3262.60	+
31 st jan2014	3701.10	-	31 st mar2014	3282.80	+
3 rd feb2014	3629.15	-			
4 th feb2014	3561.10	-			
5 th feb2014	3581.25	+			
6 th feb2014	3563.70	-			
7 th feb2014	3566.55	+			
10 th feb2014	3573.80	+			
11 th feb2014	3596.25	+			

12 th feb2014	3600.10	+			
13 th feb2014	3585.80	-			
14 th feb2014	3644.30	+			
17 th feb2014	3658.15	+			
18 th feb2014	3682.00	+			
19 th feb2014	3753.40	+			
20 th feb2014	3711.25	-			
21 st feb2014	3750.70	+			
24 th feb2014	3749.90	-			
25 th feb2014	3782.90	+			

Evaluation of INFOSYS:

Total runs(r) =25

Number of positive price changes (n1) =36

Number of negative price changes (n2) =26

Mean (μ) =31.19

Standard deviation (σ) =3.80

Upper limit=38.63

Lower limit=23.74

Inference:

Since the Observed number of runs falls within the upper and the lower limit, we can conclude that that the prices are independent at 5% level of significance (H0 is accepted). Thus, the market is weakly efficient.

Table 9 showing the monthly closing stock value and applied runs test analysis of Persistent Technologies

Date	Closing price	Price change	Date	Closing price	Price change
1 st jan2014	979.65		26 th feb2014	1120.70	-
2 nd jan2014	968.05	-	28 th feb2014	1134.05	+
3 rd jan2014	975.35	+	3 rd mar2014	1128.40	-
6 th jan2014	988.85	+	4 th mar2014	1133.00	+
7 th jan2014	991.20	+	5 th mar2014	1119.70	-
8 th jan2014	1020.90	+	6 th mar2014	1179.10	+
9 th jan 2014	1018.85	-	7 th mar2014	1127.05	-
10 th jan2014	1004.40	-	10 th mar2014	1092.55	-
13 th jan2014	1037.50	+	11 th mar2014	1094.95	+
14 th jan2014	1015.50	-	12 th mar2014	1111.30	+
15 th jan2014	1023.35	+	13 th mar2014	1085.30	-
16 th jan2014	1019.35	-	14 th mar2014	1072.15	-
17 th jan2014	990.20	-	18 th mar2014	1059.40	-
20 th jan2014	1006.20	+	19 th mar2014	1026.15	-
21 st jan2014	990.95	-	20 th mar2014	1053.75	+
22 nd jan2014	999.40	+	21 st mar2014	1075.60	+
23 th jan2014	999.90	+	22 nd mar2014	1082.10	+
24 th jan2014	1008.20	+	24 rd mar2014	1086.55	+
27 th jan2014	990.05	-	25 th mar2014	1073.05	-
28 th jan2014	999.50	+	26 th mar2014	1076.00	+
29 th jan2014	992.45	-	27 th mar2014	1057.50	-
30 th jan2014	980.80	-	28 th mar2014	1041.70	-
31 st jan2014	965.20	-	31 st mar2014	1049.45	+
3 rd feb2014	968.35	+			
4 th feb2014	940.10	-			
5 th feb2014	944.70	+			
6 th feb2014	928.90	-			
7 th feb2014	956.60	+			
10 th feb2014	986.75	+			
11 th feb2014	1025.45	+			
12 th feb2014	1020.15	-			
13 th feb2014	1003.65	-			
14 th feb2014	990.85	-			
17 th feb2014	993.45	+			
18 th feb2014	1002.50	+			
19 th feb2014	1011.20	+			
20 th feb2014	1046.60	+			
21 st feb2014	1069.50	+			
24 th feb2014	1124.60	+			
25 th feb2014	1151.30	+			

Evaluation of PERSISTENT TECHNOLOGIES:

Total runs(r) =34

Number of positive changes (n_1) =34

Number of negative changes (n_2) =28

Mean (μ) =31.7

Standard deviation (σ) =3.86

Upper limit=39.26

Lower limit=24.13

Inference:

Since the Observed number of runs falls within the upper and the lower limit, we can conclude that the prices are independent at 5% level of significance (H_0 is accepted).

Thus, the market is weakly efficient.

VIII. Limitations

- The findings are on the basis of run test hence findings are subject to the limitation of non parametric test
- Findings are applicable in the situations which prevail during the year 2014. Hence, it should be taken in light of the above fact.

IX. Conclusions

In the above study, almost in all the cases except Tech Mahindra, the stock prices are independent of the past prices. Mostly the null hypothesis is being accepted. The market is weakly efficient in most of the cases except Tech Mahindra in which the alternate hypothesis is being expected. In most of the cases the number of observed runs is falling between the upper and lower limit. Also, at universal level, the evidences do not reject the null hypothesis and therefore favor the random walk theory.

References:

- [1]. Christos Alexakis (1992), thesis work on “an empirical investigation of the efficient market hypothesis: the case of the Athens stock exchange”, University of York, England.
- [2]. Jayaraman, Ramaratnam (2011), a study on testing of efficient market hypothesis with special reference to selective indices in the global context: an empirical approach, Vol.2, No.1; Jan 2012.
- [3]. Khan, Ikram, Mehtab (2011), testing weak form market efficiency of Indian capital market: a case of National stock exchange(NSE) and Bombay stock exchange(BSE), African journal of marketing management, Vol.3(6); June 2011, pp 115-127.
- [4]. Osayuwu, Ajao(2012), testing the weak form of efficient market hypothesis in Nigerian capital market, Vol.1, No.1; May 2012.

Books:

- [5]. Ram Prasad & Sons, Mathematical Statistics, Ray, Sharma, Chaudhary (11th edition 2006).

Reference links:

<http://theses.whiterose.ac.uk/>

<http://faculty.ksu.edu.sa/>

<http://www.sciedu.ca/journal/index.php/afr/article/viewFile/1084/>

http://www.researchersworld.com/vol2/PAPER_03.pdf/

<http://www.academicjournals.org/>

<http://www.zenithresearch.org.in/>

<http://ijrcm.org.in/>

<http://www.cmrcetmba.in/>

<http://www.investopedia.com/terms/e/efficientmarkethypothesis.asp>

<http://www.researchgate.net/>

<http://www.academia.edu/>

<http://www.garph.co.uk/IJARMSS/Nov2013/13.pdf>

<http://www.fastgraphs.com/>

<http://ngam.natixis.com/cs/us/investor/Render.jsp>

<http://www.stern.nyu.edu/>