

# Empirical Evidence On Weak Form Efficiency in Indian Stock Market

Amit Kumar Mishra\*, Vandna Misra\*\* and Sanjay Rastogi\*\*\*

## Abstract

Realizing the significance of stock market efficiency in the wake of global financial crisis and the limitations of existing literature, this study is intended to test weak form efficiency of Indian stock market so as to assess the efficiency of Indian stock market and suggest necessary measures to improve it. For the purpose of study, National Stock Exchange, the biggest player and a model stock exchange of Indian stock market has been selected. To test weak form efficiency, the most commonly used parametric as well as non-parametric tests have been applied. Runs test is used to check randomness, auto correlation test is used to examine independence and Ljung-Box (LB) statistics is used to test significance of independence in return series. The results of study offer supportive evidence for partial rejection of weak form efficiency in Indian stock market by endorsing absence of randomness and independence in noticeable number of return series. It reveals drifts in market efficiency which offers avenues to market participants for devising profitable trading strategies. The study also stresses on improving efficiency of Indian stock market by taking necessary measures to further strengthen economic development.

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

## 1. Introduction

Against the backdrop of global economic downturn, stock market efficiency is definitely crucial for economic development and Indian economy is no exception. The

empirical evidences affirm that stock market development is strongly correlated with growth rates of real GDP per capita (Levine and Zervos, 1993; Atje and Jovanovic, 1993; Levine and Zervos, 1998 and Rousseau and Wachtel, 2000). Levine and Zervos (1995) also appreciated the role of stock markets in furthering economic development. Stock market facilitates economic development by increasing liquidity and improving allocation of investment resources. An efficient market enhances liquidity by attracting more investors and improves allocation of resources by sending accurate signals to investors through efficient pricing of securities. Informational efficiency of stock market is at the base of resource allocation. If asset prices do not reflect fundamentals well, then the confidence of economists in the efficiency of market allocations of investment resources is, to say the least weakened (Stiglitz, 1990).

The importance of an efficient stock market also increases due to inability of traders to devote time and resources for gathering information. Instead, investors prefer to depend on the market itself to properly reflect all available information in prices (Fama, 1970). For such uninformed traders, an inefficient market would become unattractive being many trades at unfavorable prices. Therefore, realizing the significance of stock market efficiency in the wake of global financial crisis and the limitations of existing literature, this study is intended to test weak form efficiency of Indian stock market so as to assess the efficiency of Indian stock market and suggest necessary measures to improve it. The study would also augment the existing literature by testing the area neglected so far and would also extend the existing literature being length of time series data and sample size large.

## 2. Concept of Stock Market Efficiency

In capital market literature, markets are said to be efficient if they quickly and correctly incorporate information

\* Amit Kumar Mishra, Assistant Professor, Galgotias University, Greater Noida, Uttar Pradesh, India.

\*\* Assistant Professor, SRMS-IBS, Unnao. U.P., India.

\*\*\* Associate Professor, Indian Institute of Foreign Trade (IIFT), New Delhi, India. (Corresponding Author).

into prices. It implies that in an efficient market, new information is processed rapidly and the price of security is adjusted to its new investment value instantaneously which makes passive buy and hold strategy as the best investment strategy.

Fama (1970) described an efficient market as a market condition in which prices always 'fully reflect' all available information. Based on the type of information that is fully reflected in the security prices, Fama (1965) explored the weak, the semi-strong and the strong form of market efficiency.

In weak form of efficiency, current security prices fully reflect all information contained in historical prices, which implies that no investor can devise a trading rule, based solely on past price patterns to earn abnormal returns. In semi-strong form of efficiency, prices reflect not only all information found in the record of past prices and volumes but also all other publicly available information. Under the strong form of efficiency, the security prices fully reflect all available information, whether available publicly or privately. Generally, first two forms of market efficiency exist in actual practice and not the strong form. The notion of an efficient capital market is based on the following set of assumptions (Chander, et.al, 2008):

- A. A large number of independent competing profit maximizing participants to analyze and value securities;
- B. New information regarding securities comes to market in a random fashion;
- C. The market mechanism tends to adjust security prices rapidly to reflect the effect of new information.

The chief corollary of the efficient market hypothesis is random walk theory. The random walk theory for share prices reflects a securities market where price movements do not follow any patterns or trends, rather, prices follow a 'random walk', an intrinsically unpredictable pattern. The term random, here, does not mean that price movements are erratic or chaotic, it just implies that prices respond only to new information. This information may be randomly good or bad and prices will therefore move in an unpredictable manner. The movements themselves are a perfectly rational response to the available information (Keane, 1983). Since price movement is unpredictable, the possibility for analysts and investors to spot over and undervalued stocks and devise different investment strategies to earn excess return becomes remote.

Fama (1970) found absence of transactions costs in trading of securities, costless availability of information to all market participants and agreement among all market participants on the implications of current information for the current price and distributions of future prices of each security as sufficient and not necessary conditions for market efficiency, as in practice a frictionless market rarely prevails. He explained that even in a market wherein large transaction costs are present, the ability of traders to take account of all available information does not harm efficiency of a market. Similarly, market would be efficient, if it has sufficient number of investors with ready accessibility to available information. Disagreement among investors about the implications of given information does not imply inefficiency unless there are investors who can consistently make better evaluations of available information that are implicit in market prices (Fama, 1970).

### 3. Review of Literature

The most explicit and intuitively appealing explanation of stock market efficiency came from efficient market hypothesis. The efficient market hypothesis, developed from empirical studies, gained its ground first time when Louis Bachelier (1900) discovered commodity speculation in a competitive market as a fair game and current price of a commodity as the best unbiased estimate of its future price. After three decades of Bachelier's contribution, Working (1934), Kendall (1953), Roberts (1959) and Osborne (1959) also reported independence of successive price changes whereas during 1960's Samuelson (1965) and Mandelbrot (1966) presented economic justification for random walk through the argument of 'fair game'. Thus, the impetus for the development of a theory came from empirical evidences offered by researches of 1950's and 1960's.

But the most debated study of efficient market hypothesis was presented by Fama (1965) which gave an impetus to the studies of market efficiency and flooded the capital market literature with empirical as well as theoretical evidences of efficient market hypothesis. Fama (1965) agreed with the proposition that price changes are random and past price changes are not useful to predict future price changes particularly after considering transaction costs. Granger & Morgenstern (1970) found various cues of randomness in short term stock prices with some deviations in high and low frequency regions of the spectrum under differing sampling intervals. But, there

are some studies which found either predictability of stock returns too low (Groenewold, 1997) or insufficient to devise profitable trading rules (Fama & French, 1988 a and b) in developed market.

The efficient market hypothesis has been studied most extensively in developed economies, but studies focusing on emerging economies are comparatively few. It is a general belief that emerging markets are less efficient. This proposition have been endorsed in different studies e.g. Claessens, Dasgupta and Glen (1995), Jarrett & Sun (2009), Chong et. al. (2010), Liu (2011), Bashir et. al. (2011), Chaity N. S. & Sharmin S. (2012). Chaity N. S. & Sharmin S. (2012) and Fernando, (2012) with few exceptions ( Kung & Wong, 2009 and Rehman et. al., 2012). Though, it has also been observed that stock markets are getting more efficient over time (Lee et al., 2001)

The review of literature reveals that weak form efficiency in Indian stock market have been tested by many, semi-strong form of efficiency has been tested by a few whereas strong form of efficiency has rarely been tested. 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 et. al (2004), Chander et. al (2008), Gupta (2010), Khan et. Al. (2011), Kaur & Dhillon (2011) and Kumar & Kumar (2012) have supported weak form efficiency of Indian stock market whereas evidences produced by Ray (1976), Barua (1981), Yalawar (1988), Chaudhari (1991), Sarma (2004), Poshakwale (2003), Ahmad et. Al. (2006), Gupta, Basu (2007), Srinivasan (2010), Thomas & Kumar (2010) and Gupta & Yung (2011) have traced interdependence in index/stock price series. The results of Mahapatra and Biswasroy (2007) and Patel et.al. (2011) are entirely different. Mahapatra and Biswasroy (2007) found Indian stock market more efficient with increase in length of time interval used for performance observation. Whereas, Patel et.al. (2011) examined weak for efficiency for the period August 1998 to July 2010 and found Indian stock market weak form efficient in the period August 2001 to July 2004 which leaves the scope for further research.

Though, weak form efficiency of Indian stock market has been extensively researched, a few studies have conducted scrip based decadal analysis. Besides this, use of indices is another obvious weakness of earlier studies. Kendall

(1953) has also admitted that aggregative index numbers behave more systematically than their components. He further explained that this might be due to the reduction of random elements by averaging and the consequent emergence of systematic constituents; but it could well be due to chance. Evidences in support of existence as well as absence of interdependence in return series have left the scope for further research open.

#### 4. Objectives of Study

Realizing the significance of stock market efficiency in the wake of recent global financial crisis and the limitations of existing literature, this study is intended to test weak form efficiency of Indian stock market by studying National Stock Exchange (hereafter NSE), the biggest player and a model stock exchange of Indian stock market so as to assess the efficiency of Indian stock market and suggest necessary measures to improve it. The study would also augment the existing literature by testing the area neglected so far and would also extend the existing literature being length of time series data and sample size large. To test weak form efficiency of Indian stock market, empirical testing of following objectives has been conceptualised:

- A. To study whether the returns of index and selected stocks traded on NSE follow a random walk?
- B. To study whether returns generated by index and selected stocks of NSE depict any trend or are interdependence?
- C. To empirically test whether the weak form of efficient market hypothesis holds well in NSE encompassing observable interdependence and non-randomness.

#### 5. Hypotheses

To document evidence on its weak form of efficiency, the study intends to examine the validity of the following null hypotheses:

H01: Returns of selected stocks and index are random on NSE.

H02: The successive returns of selected stocks and index on NSE are not interdependent.

H03: That successive interdependence in returns of selected stocks and index is not statistically significant and approximately follows a Chi-square distribution.

## 6. Data & Methodology

A close review of literature has found use of indices as the most obvious weakness of studies conducted for longer duration (for ten or more years). Kendall (1953) has also admitted that aggregative index numbers behave more systematically than their components. He further explained that this might be due to the reduction of random elements by averaging and the consequent emergence of systematic constituents; but it could well be due to chance. Therefore, for the purpose of study return series of scrips as well as Nifty has been selected. As the underlying process of the time series under study is stock trading and generation of index based on such trading, use of scrip and index value at the end of each business day is appropriate for the purpose of this study.

Thus, keeping in view the limitation of existing literature and the nature of study, daily closing price data of ten years for a sample of 100 most actively traded stocks of NSE has been taken. Nifty was considered as a market proxy for comprehension and comparability of consequential trend/ randomness in stock returns. The study being based on closing price of each trading day, scrips with frequent trading records have been selected. The data was compiled from Prowess database maintained by the CMIE since April 1999 till March 2012. It comprises of both bearish phase and bull phase.

To examine the validity of stated hypotheses, the most commonly used parametric as well as non-parametric tests have been applied in this study. Runs test is used to check randomness, auto correlation test is used to examine independence and Ljung-Box (LB) statistics is used to test significance of independence in return series. 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).

Before applying the selected statistical tools, the Log Random Walk (LRW) Model is used to make the original series stationary. It is a suitable data transformation procedure. Following is the mathematically testable form of LRW model:

$$\ln \left( \frac{P_t}{P_{t-1}} \right) = e_t \tag{1}$$

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, runs test which ignores the absolute values in a time series and deals only with the signs is applied 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 stock returns are random and concludes that the price series has trends and future share prices may be predicted using historical information. A lower expected number of runs indicates market's overreaction to information, subsequently reversed, while higher number of runs reflects a lagged response to information (Poshokwale, 1996). Either situation would suggest the existence of an opportunity to make excess returns and absence of weak form efficiency in stock market. The runs test variables are converged into Z statistics to test significance of randomness in stock prices. The expected number of runs to test the null hypothesis of randomness are computed in the framework given below:

$$E(R) = [2n_1n_2/n_1+n_2] + 1 \tag{2}$$

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

$$SE(R) = [2n_1n_2(2n_1n_2-n)/n^2(n-1)]^{1/2} \tag{3}$$

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

$$Z = [R - E(R) / SE(R)] \sim N(0,1) \tag{4}$$

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. Runs test applied to examine randomness

in return series, has its own merits over parametric test.

The auto correlation test which is also known as serial correlation test, is used to test whether price changes in the day are influenced by price changes occurring k-days earlier, where  $k=1,2,3 \dots, 16$  days and thus tests interdependencies of a random variable ( $X_t$ ) in time  $t$  and its value k-periods earlier. The autocorrelation matrix is estimated as following:

$$R_k = C_k/C_0 \quad (5)$$

Wherein,

$C_0$  = Variance of  $X_t$ , and

$$C_k = 1/n \sum_{t=1}^{n-k} (X_t - \mu)(X_{t+k} - \mu)$$

Wherein

$$k = 0, 1, 2, \dots, n \text{ and } \mu = 1/n \sum_{t=1}^n (X_t)$$

$N$  = number of observation.

The statistical testing of auto correlation matrices requires computation of standard error of estimated matrices S.E.(k), which is obtained as:

$$S.E. (k) = 1/(n-k)^{1/2} \quad (6)$$

When  $n$  is sufficiently large ( $n > 50$ ), approximate value of the standard error of estimated S.E. (k) matrices is computed with the help of following formula:

$$S.E. (k) = 1/(n)^{1/2} \quad (7)$$

A positive (negative) and statistically significant auto correlation is an evidence of price momentum in markets and suggests that returns in a period are more likely to be positive (negative), if the prior period returns were positive (negative), For testing the joint hypothesis that

all the auto-correlation co-efficients are simultaneously equal to zero, Ljung-Box (LB) statistics is defined as follows:

$$LB = n(n-2) \sum_{k=1}^m (\rho^2/n - k) \sim \chi^2_{2m} \quad (8)$$

Ljung-Box statistic follows chi-square distribution with  $m$  degree of freedom for large sample size. If computed value of LB statistic exceeds its critical value on the chi-square distribution at a given significance level (0.05), null hypothesis is rejected, that is all (true)  $R_k$  are zero, at least some of them must be nonzero.

## 7. Results & Analysis

The results of runs test applied to various sample companies & S&P CNX Nifty as presented in table 1, shows that the standardized value of z statistics, computed to test the significance of the difference between the number of actual runs and the expected runs, is significant for return series of 43 percent stocks at five percent level of significance and thereby it rejects the null hypothesis of randomness for 43 percent return series and affirms the possibility of devising profitable trading strategies. To determine whether day-to-day price changes follow a random walk, runs test has also been applied to S&P Nifty Index for the period of study and test results reject the null hypothesis of randomness in return series of Nifty, being standardised value z significant at five percent level of significance. Thus, above results partially affirms the absence of randomness by rejecting the null hypothesis related to presence of randomness in return series.

The results of auto correlation test, conducted to test independence in successive stock returns, elucidates that out of 1616 auto correlation matrices 838 auto correlation matrices are significant at five percent level of confidence (significance), thus rejecting the null hypothesis of independence in successive stock and index returns for

**Table 1: Results of Runs Test**

Name of Company	Test Value <sup>a</sup>	Cases < Test Value	Cases >= Test Value	Total Cases	Number Z of Runs	Asymp. Sig. (2-tailed)	
A B B Ltd.	0.0002	1625	1625	3250	1567	-2.07	0.038
A C C Ltd.	0.0005	1625	1625	3250	1590	-1.263	0.207
Aban Offshore Ltd.	-0.0005	1625	1625	3250	1488	-4.842	0

Name of Company	Test Value <sup>a</sup>	Cases < Test Value	Cases >= Test Value	Total Cases	Number of Runs	Z	Asymp. Sig. (2-tailed)
Adani Enterprises Ltd.	-0.0006	1625	1625	3250	1558	-2.386	0.017
Aditya Birla Nuvo Ltd.	-0.0002	1625	1625	3250	1584	-1.474	0.141
Alok Industries Ltd.	0	1588	1662	3250	1575	-1.761	0.078
Ambuja Cements Ltd.	0.0003	1625	1625	3250	1618	-0.281	0.779
Ashok Leyland Ltd.	-0.0006	1625	1625	3250	1522	-3.649	0
Axis Bank Ltd.	0	1600	1650	3250	1604	-0.759	0.448
B E M L Ltd.	-0.0014	1625	1625	3250	1552	-2.596	0.009
Bajaj Hindusthan Ltd.	0	1447	1803	3250	1539	-2.397	0.017
Balrampur Chini Mills Ltd.	-0.0006	1625	1625	3250	1656	1.053	0.293
Bank Of Baroda	0	1619	1631	3250	1572	-1.894	0.058
Bank Of India	0	1559	1691	3250	1548	-2.647	0.008
Bharat Electronics Ltd.	0	1625	1625	3250	1560	-2.316	0.021
Bharat Forge Ltd.	-0.0002	1625	1625	3250	1564	-2.175	0.03
Bharat Heavy Electricals Ltd.	0.0002	1625	1625	3250	1582	-1.544	0.123
Bharat Petroleum Corpn. Ltd.	-0.0002	1625	1625	3250	1598	-0.982	0.326
Bhushan Steel Ltd.	0	1473	1777	3250	1488	-4.382	0
Birla Corporation Ltd.	-0.0003	1625	1625	3250	1631	0.175	0.861
Blue Star Ltd.	0.0003	1625	1625	3250	1565	-2.14	0.032
Bombay Dyeing & Mfg. Co. Ltd.	0	1624	1626	3250	1616	-0.351	0.726
Century Textiles & Inds. Ltd.	-0.001	1625	1625	3250	1546	-2.807	0.005
Chambal Fertilisers & Chemicals Ltd.	0	1463	1787	3250	1610	0.005	0.996
Cipla Ltd.	0	1616	1634	3250	1628	0.072	0.943
Colgate-Palmolive (India) Ltd.	-0.0006	1625	1625	3250	1626	0	1
Crompton Greaves Ltd.	0	1614	1636	3250	1602	-0.84	0.401
Cummins India Ltd.	-0.0001	1625	1625	3250	1664	1.333	0.182
Dr. Reddy'S Laboratories Ltd.	0.0003	1625	1625	3250	1624	-0.07	0.944
Essar Oil Ltd.	0	1617	1633	3250	1642	0.563	0.574
Exide Industries Ltd.	0	1600	1650	3250	1634	0.294	0.769
Federal Bank Ltd.	-0.0003	1625	1625	3250	1540	-3.018	0.003
G A I L (India) Ltd.	0.0004	1625	1625	3250	1650	0.842	0.4
Glaxosmithkline Consumer Healthcare Ltd.	0.0002	1625	1625	3250	1676	1.754	0.079
Grasim Industries Ltd.	0.0003	1625	1625	3250	1562	-2.246	0.025
Great Eastern Shipping Co. Ltd.	0	1593	1657	3250	1570	-1.944	0.052
H D F C Bank Ltd.	0.0002	1625	1625	3250	1580	-1.614	0.107
Hero Honda Motors Ltd.	0.0003	1625	1625	3250	1624	-0.07	0.944
Hindalco Industries Ltd.	0.0003	1625	1625	3250	1558	-2.386	0.017
Hindustan Construction Co. Ltd.	0	1610	1640	3250	1538	-3.083	0.002

Name of Company	Test Value <sup>a</sup>	Cases < Test Value	Cases >= Test Value	Total Cases	Number of Runs	Z	Asymp. Sig. (2-tailed)
Hindustan Oil Exploration Co. Ltd.	-0.003	1625	1625	3250	1636	0.351	0.726
Hindustan Petroleum Corpn. Ltd.	-0.0004	1625	1625	3250	1600	-0.912	0.362
Hindustan Unilever Ltd.	0	1625	1625	3250	1638	0.421	0.674
Hindustan Zinc Ltd.	0	1169	2081	3250	1108	-14.86	0
Housing Development Finance Corpn. Ltd.	0.0003	1625	1625	3250	1568	-2.035	0.042
I D B I Bank Ltd.	0	1615	1635	3250	1554	-2.524	0.012
I F C I Ltd.	0	1620	1630	3250	1595	-1.087	0.277
I T C Ltd.	0.0001	1625	1625	3250	1652	0.912	0.362
I V R C L Infrastructures & Projects Ltd.	0	1489	1761	3250	1419	-6.912	0
India Cements Ltd.	-0.0007	1625	1625	3250	1591	-1.228	0.219
Indian Hotels Co. Ltd.	-0.0003	1625	1625	3250	1596	-1.053	0.293
Indian Oil Corpn. Ltd.	0.0001	1625	1625	3250	1548	-2.737	0.006
Indusind Bank Ltd.	0	1588	1662	3250	1600	-0.883	0.377
Infosys Technologies Ltd.	0.0004	1625	1625	3250	1608	-0.632	0.528
JSW ISPAT Steel Ltd.	0	1537	1713	3250	1578	-1.521	0.128
J S W Steel Ltd.	0	1374	1876	3250	1370	-7.808	0
Jindal Saw Ltd.	0	1601	1649	3250	1556	-2.444	0.015
Kotak Mahindra Bank Ltd.	0.0003	1624	1626	3250	1540	-3.018	0.003
L I C Housing Finance Ltd.	0	1612	1638	3250	1570	-1.961	0.05
Larsen & Toubro Ltd.	0.0005	1625	1625	3250	1544	-2.877	0.004
J S W Steel Ltd.	0	1374	1876	3250	1370	-7.808	0
Jindal Saw Ltd.	0	1601	1649	3250	1556	-2.444	0.015
Kotak Mahindra Bank Ltd.	0.0003	1624	1626	3250	1540	-3.018	0.003
L I C Housing Finance Ltd.	0	1612	1638	3250	1570	-1.961	0.05
Larsen & Toubro Ltd.	0.0005	1625	1625	3250	1544	-2.877	0.004
Lupin Ltd.	0	1603	1647	3250	1576	-1.744	0.081
Mahanagar Telephone Nigam Ltd.	-0.0012	1625	1625	3250	1608	-0.632	0.528
Mahindra & Mahindra Ltd.	0.0005	1625	1625	3250	1526	-3.509	0
Moser Baer India Ltd.	-0.0007	1625	1625	3250	1572	-1.895	0.058
Mphasis Ltd.	-0.0004	1625	1625	3250	1608	-0.632	0.528
N I I T Ltd.	-0.0007	1625	1625	3250	1608	-0.632	0.528
Nagarjuna Construction Co. Ltd.	0	1507	1743	3250	1474	-5.059	0
National Aluminium Co. Ltd.	0	1593	1657	3250	1625	-0.013	0.99
Oil & Natural Gas Corpn. Ltd.	0	1625	1625	3250	1634	0.281	0.779
Orchid Chemicals & Pharmaceuticals Ltd.	-0.0009	1625	1625	3250	1572	-1.895	0.058
Oriental Bank Of Commerce	0	1591	1659	3250	1590	-1.239	0.215

Name of Company	Test Value <sup>a</sup>	Cases < Test Value	Cases >= Test Value	Total Cases	Number of Runs	Z	Asymp. Sig. (2-tailed)
Piramal Healthcare Ltd.	-0.0005	1625	1625	3250	1618	-0.281	0.779
Praj Industries Ltd.	0	1511	1739	3250	1570	-1.693	0.091
Ranbaxy Laboratories Ltd.	0.0002	1625	1625	3250	1604	-0.772	0.44
Reliance Capital Ltd.	0.0009	1625	1625	3250	1538	-3.088	0.002
Reliance Industries Ltd.	0.0006	1625	1625	3250	1618	-0.281	0.779
Reliance Infrastructure Ltd.	-0.0003	1625	1625	3250	1590	-1.263	0.207
Rolta India Ltd.	-0.0008	1625	1625	3250	1566	-2.105	0.035
S Kumars Nationwide Ltd.	0	1616	1634	3250	1682	1.967	0.049
S R E I Infrastructure Finance Ltd.	0	1518	1732	3250	1606	-0.457	0.648
Satyam Computer Services Ltd.	-0.0013	1625	1625	3250	1606	-0.702	0.483
Sesa Goa Ltd.	-0.0006	1625	1625	3250	1552	-2.596	0.009
Siemens Ltd.	0	1625	1625	3250	1596	-1.053	0.293
Sintex Industries Ltd.	0	1450	1800	3250	1547	-2.135	0.033
Steel Authority Of India Ltd.	0	1551	1699	3250	1596	-0.936	0.349
Sterling Biotech Ltd.	0	1588	1662	3250	1596	-1.024	0.306
Sun Pharmaceutical Inds. Ltd.	0.0001	1625	1625	3250	1621	-0.175	0.861
Tata Chemicals Ltd.	0	1622	1628	3250	1578	-1.684	0.092
Tata Communications Ltd.	-0.0007	1625	1625	3250	1552	-2.596	0.009
Tata Motors Ltd.	0.0008	1625	1625	3250	1600	-0.912	0.362
Tata Power Co. Ltd.	0.0004	1625	1625	3250	1544	-2.877	0.004
Tata Steel Ltd.	0.0005	1625	1625	3250	1590	-1.263	0.207
Tata Tea Ltd.	-0.0004	1625	1625	3250	1564	-2.175	0.03
Titan Industries Ltd.	0	1625	1625	3250	1562	-2.246	0.025
Unitech Ltd.	0	1574	1676	3250	1610	-0.506	0.613
United Phosphorus Ltd.	0	1427	1823	3250	1532	-2.489	0.013
Videocon Industries Ltd.	0	1617	1633	3250	1618	-0.279	0.78
Voltas Ltd.	-0.0007	1625	1625	3250	1619	-0.246	0.806
Wipro Ltd.	0.0004	1625	1625	3250	1630	0.14	0.888
Zee Entertainment Enterprises Ltd.	0	1616	1634	3250	1637	0.388	0.698
Nifty	0	1625	1625	3250	1538	-3.088	.002

Note: a. Median

51.86% auto correlation matrices ( See Table No. 2). A close look at auto correlation matrices reveals that lag-wise frequency of significant auto correlation matrices is hovering approximately around 50 percent to 56 percent (See Table No. 3). It shows consistency in results and

supports the presence of interdependence in noticeable number of auto correlation matrices. Thus, by rejecting the null hypothesis of independence in successive returns of selected series, this study partially accepts the presence

of interdependence in return series.

**Table 2: Auto Correlation Matrices of Hundred Selected Stocks and Nifty**

Name of Company	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	LB
A B B Ltd.	.694	.629	.801	.903	.959	.798	.819	.830	.812	.861	.844	.872	.912	.932	.956	.969	7.191
A C C Ltd.	-.011	.028	-.009	-.018	-.017	.018	-.014	-.031	-.004	-.011	-.027	.009	.010	-.024	.004	.021	17.118
Aban Offshore Ltd.	.043*	.022*	-.002	.010	.030	-.001	-.014	.001	.018	.009	.012	.020	.028	-.017	.025	-.009	20.409
Adani Enterprises Ltd.	.086*	.042*	.017*	-.010*	-.014*	.006*	.014*	.011*	.001*	.007*	.018*	.003*	-.006*	.005*	.013*	.002*	34.529*
Aditya Birla Nuvo Ltd.	.112*	.049*	.004*	.002*	-.018*	-.016*	.033*	.046*	.009*	-.002*	-.005*	.000*	-.013*	.025*	-.030*	-.002*	67.102*
Alok Industries Ltd.	.076*	.018*	.044*	.031*	.039*	.015*	.001*	.030*	.028*	.007*	-.042*	.006*	-.033*	.034*	-.002*	.011*	53.999*
Ambuja Cements Ltd.	-.025	-.022	.003	.013	-.006	.000	.010	.013	-.012	-.005	.005	-.007	.012	.005	-.017	-.006	7.573
Ashok Leyland Ltd.	.013	-.026	-.002	.022	.005	-.008	.026	.005	.008	.004	-.003	.000	.002	.011	.000	.004	7.681
Axis Bank Ltd.	-.030	-.032*	-.021	-.002	-.015	-.034	-.003	.006	.042*	.048*	-.005*	-.039*	-.001*	.021*	-.016*	-.003*	32.899*
B E M L Ltd.	-.105*	-.009*	.006*	.010*	.020*	-.019*	.005*	-.013*	-.001*	.022*	.014*	.035*	.038*	.007*	.017*	.004*	51.924*
Bajaj Hindusthan Ltd.	.007	-.006	.017	.011	.008	.013	.041	.009	-.015	-.004	.021	-.007	.006	.017	-.001	-.004	11.759
Balrampur Chini Mills Ltd.	-.111*	-.007*	.005*	-.003*	.006*	.002*	.012*	.018*	-.002*	.016*	-.014*	.005*	-.005*	-.004*	.006*	.028*	46.458*
Bank Of Baroda	-.198*	-.009*	-.014*	-.006*	-.021*	-.023*	-.002*	-.005*	.026*	.016*	.003*	-.012*	-.001*	.007*	.011*	-.009*	135.990*
Bank Of India	-.192*	-.010*	.007*	-.002*	-.026*	-.032*	-.003*	-.005*	.018*	.021*	.004*	-.035*	-.016*	.025*	-.004*	.001*	135.951*
Bharat Electronics Ltd.	.000	.010	.008	-.009	.011	-.045	-.023	.022	.032	-.007	.000	-.033	.031	.021	.023	.018	25.583
Bharat Forge Ltd.	.024	-.017	-.006	.024	-.004	.009	-.003	.009	.013	.014	-.002	.006	.012	.030	.008	.016	11.322
Bharat Heavy Electricals Ltd.	.029	-.031	-.008	-.011	.004	-.028	.020	.002	-.001	.011	-.015	.011	-.006	.006	.008	-.005	12.340
Bharat Petroleum Corpn. Ltd.	-.431*	.003*	.008*	.002*	-.004*	.001*	-.002*	-.001*	-.008*	-.002*	.006*	-.007*	.004*	-.008*	.006*	-.005*	605.925*
Bhushan Steel Ltd.	.015	-.013	-.009	.007	.009	.002	.018	-.005	-.010	.023	-.021	-.009	.016	.018	.014	-.022	11.023
Birla Corporation Ltd.	-.135*	.025*	-.021*	.007*	.003*	-.032*	.010*	.027*	-.025*	.029*	-.019*	-.018*	-.014*	.004*	.001*	.010*	76.919*

Name of Company	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	LB
Blue Star Ltd.	.018	.031	.024	.007	-.001	-.025	-.009	.006	.037	.006	.012	.015	-.015	.005	.007	-.023	16.969
Bombay Dyeing & Mfg. Co. Ltd.	.083*	.013*	-.019*	-.001*	.035*	-.024*	.011*	.024*	.031*	.032*	-.017*	.001*	.022*	.020*	-.018*	-.007*	43.469*
Century Textiles & Inds. Ltd.	-.130*	-.010*	.013*	.007*	.025*	-.007*	.007*	.006*	.012*	.000*	-.015*	.007*	-.009*	.008*	.008*	.008*	60.369*
Chambal Fertilisers & Chemicals Ltd.	-.393*	.007*	-.006*	-.003*	-.002*	-.003*	-.001*	.006*	-.003*	.001*	-.005*	.000*	-.003*	.006*	.000*	.000*	502.212*
Cipla Ltd.	-.124*	.007*	.006*	.000*	-.006*	-.007*	.001*	-.010*	-.008*	-.005*	.007*	.002*	.000*	-.007*	.002*	-.001*	51.559*
Colgate-Palmolive (India) Ltd.	-.396*	.010*	-.042*	.022*	.002*	-.003*	.000*	-.008*	.008*	-.001*	-.005*	-.001*	.004*	.001*	-.008*	.000*	518.865*
Crompton Greaves Ltd.	.010	-.024	.013	-.001	.004	-.014	-.008	-.007	.000	-.005	-.011	-.009	.013	.023	-.003	-.004	6.871
Cummins India Ltd.	-.350*	-.005*	-.003*	.006*	-.003*	.002*	-.002*	.002*	.000*	-.002*	-.009*	-.001*	-.001*	.008*	-.008*	.009*	400.805
Dr. Reddy'S Laboratories Ltd.	-.425*	.000*	-.001*	.000*	.001*	-.001*	-.003*	.000*	-.004*	-.004*	.002*	.003*	-.002*	-.003*	.001*	.006*	587.673*
Essar Oil Ltd.	-.111*	-.001*	-.006*	.002*	.001*	.000*	-.005*	.005*	.011*	.002*	.005*	-.009*	.007*	.001*	.008*	-.019*	42.945*
Exide Industries Ltd.	-.013	-.007	-.016	.000	.006	.003	-.029	-.001	-.008	.005	.014	.002	.007	-.003	.012	-.013	6.612
Federal Bank Ltd.	-.008	-.053*	.014*	.001*	.010	-.046*	.008*	.007*	.005*	.023*	.014*	.001	-.010	.020	.019	-.056*	33.185*
GAIL (India) Ltd.	-.285*	-.003*	-.007*	-.007*	-.023*	.005*	-.012*	-.003*	.006*	.016*	-.016*	-.006*	-.004*	.009*	-.004*	-.027*	271.845*
Glaxosmith-Kline Consumer Healthcare Ltd.	-.092*	.003*	-.013*	-.018*	.033*	-.006*	.007*	-.038*	-.033*	.000*	.024*	.017*	.003*	-.017*	-.001*	.005*	44.830*
Grasim Industries Ltd.	-.406*	-.009*	.014*	.004*	.006*	.004*	.001*	.000*	-.010*	-.011*	.000*	.001*	-.008*	.000*	.002*	-.001*	538.884*
Great Eastern Shipping Co. Ltd.	-.325*	.000*	-.011*	-.002*	.003*	-.019*	.009*	-.004*	.008*	-.004*	-.007*	.008*	.001*	.005*	.003*	-.005*	345.816*
HDFC Bank Ltd.	-.004	-.021	.007	.000	-.011	-.011	-.009	.006	-.009	.016	.000	.010	-.005	-.007	-.002	.004	4.526
Hero Honda Motors Ltd.	-.005	-.021	-.019	.003	.020	.001	.020	-.019	-.050	-.005	-.010	.026	.026	-.003	.007	-.027	22.205
Hindalco Industries Ltd.	.015	.010	-.016	-.012	.007	-.009	.014	.007	-.005	-.009	-.026	.000	-.018	.001	.011	.021	9.015

Name of Company	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	LB
Hindustan Construction Co. Ltd.	.017	-.019	-.029	-.005	-.008	.004	-.001	.002	.005	.018	.023	-.011	-.001	.012	.007	-.002	9.143
Hindustan Oil Exploration Co. Ltd.	-.030	-.003	-.003	.005	-.023	-.011	.020	-.002	.021	-.014	-.024	.015	.020	.047	-.011	-.037	24.556
Hindustan Petroleum Corpn. Ltd.	-.100*	.002*	.005*	-.014*	-.024*	-.005*	-.008*	-.011*	-.012*	.015*	.006*	-.006*	-.004*	.014*	.002*	.008*	38.026*
Hindustan Unilever Ltd.	.005	.015	-.003	.000	-.024	-.027	-.005	-.003	-.006	.000	.008	-.002	.026	.013	.004	.004	8.375
Hindustan Zinc Ltd.	-.005	.004	-.007	.009	-.007	.003	.000	.005	.007	.001	-.005	-.005	-.002	-.009	-.013	.002	1.951
Housing Development Finance Corpn. Ltd.	.006	-.011	-.010	-.017	-.018	-.004	-.007	.006	.008	.007	.003	-.008	.014	.019	-.005	-.017	6.553
I D B I Bank Ltd.	.097*	-.020*	.014*	-.020*	-.016*	-.046*	.012*	.036*	.029*	.029*	-.015*	-.006*	-.005*	.015*	.001*	.014*	54.366*
I F C I Ltd.	.025	.011	-.012	-.014	.015	-.007	-.005	-.012	.013	.011	.017	.000	-.003	.046	.004	-.007	13.971
I T C Ltd.	.005	-.017	-.017	.001	.009	.001	-.007	-.010	-.003	.006	-.005	.002	-.008	-.001	-.005	.003	3.317
I V R C L Infrastructures & Projects Ltd.	.062*	-.031*	-.017*	-.021*	-.002*	-.004*	-.018*	.024*	.009*	.011*	-.008*	-.030*	.015*	.017*	-.008*	-.016*	27.362*
India Cements Ltd.	.015	-.042*	.002	.035*	-.008	-.034*	.020*	-.009*	.000	.028*	-.003	.000	.033	.011	.003	-.008	22.593
Indian Hotels Co. Ltd.	.030	.002	.003	-.007	-.007	-.023	-.016	.010	.004	-.008	.006	-.012	.002	.010	.011	.012	8.287
Indian Oil Corpn. Ltd.	.035*	-.007	-.006	-.022	-.025	-.028	-.003	-.012	.012	-.009	-.012	-.011	.009	.022	.005	-.025	16.279
Indusind Bank Ltd.	.015	-.054*	-.022*	-.013*	.001*	-.001	.000	.040*	.022*	.025*	-.038*	-.002*	.014*	.029*	-.002*	-.013*	30.130*
Infosys Technologies Ltd.	.031	-.014	-.030	-.001	-.027	-.032	-.024*	-.011	.003	-.014	.020	-.012	.044*	.029*	-.003*	-.017*	27.180*
JSW ISPAT Steel Ltd.	-.021	-.037	.000	.020	.031	-.031*	.020*	-.008	.059*	-.009*	-.028*	-.012*	.016*	.028*	.021*	.019*	35.419*
J S W Steel Ltd.	.015	.012	-.001	.001	.005	.005	-.008	-.004	.014	-.005	-.008	.004	.006	.002	-.002	-.006	2.847
Jindal Saw Ltd.	.118*	.032*	.043*	.021*	.020*	-.001*	.008*	-.012*	.020*	.025*	.012*	.025*	.016*	.024*	.034*	.002*	70.629*
Kotak Mahindra Bank Ltd.	-.068*	.026*	.024*	-.012*	.003*	-.025*	-.011*	.018*	.022*	-.020*	.013*	-.018*	.028*	.011*	.021*	-.010*	32.104*
L I C Housing Finance Ltd.	-.012	-.008	-.019	.003	.006	-.024	.024	.006	-.019	.047	-.006	-.003	-.021	.012	.020	-.019	18.922

Name of Company	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	LB
Larsen & Toubro Ltd.	.049*	.002*	.060*	.023*	.006*	-.032*	.015*	.028*	.013*	.007*	-.026*	.007*	.017*	.025*	.034*	.013*	38.929*
Lupin Ltd.	.003	-.010	-.007	-.023	-.010	-.011	.000	-.012	.003	.017	.001	.002	.016	-.026	.007	.010	7.965
Mahanaagar Telephone Nigam Ltd.	.056*	-.037*	-.025*	.024*	-.001*	-.012*	.031*	.025*	-.031*	.011*	-.046*	-.019*	.001*	.008*	-.048*	.014*	44.004*
Mahindra & Mahindra Ltd.	.076*	-.007*	-.011*	-.015*	-.051*	-.018*	.021*	-.011*	.015*	.007*	.005*	-.005*	.023*	.013*	.004*	.013*	35.192*
Moser Baer India Ltd.	.069*	-.028*	.011*	-.011*	-.023*	.014*	.015*	-.014*	-.018*	.036*	-.001*	.015*	.028*	.069*	.013*	.005*	47.329*
Mphasis Ltd.	-.002	.027	.029	-.051*	.026*	-.017*	.005*	.014*	.000*	.008	.034*	.024*	.034*	.001*	-.018*	-.002*	28.064*
N I I T Ltd.	.045*	-.015*	.003	.014	.017	.007	-.009	.001	-.016	-.015	-.011	.031	.026	.019	.001	-.010	18.384
Nagarjuna Construction Co. Ltd.	.031	-.006	-.010	.016	-.018	-.008	-.017	.010	.030	.010	-.002	-.029	-.003	.016	.004	.017	14.771
National Aluminium Co. Ltd.	-.012	.001	-.003	.004	.009	-.016	-.005	.007	.001	.010	-.012	-.012	.015	-.012	-.011	.007	4.935
Oil & Natural Gas Corp. Ltd.	-.060*	-.013*	-.007*	.013*	.006*	-.020*	-.005*	.021*	-.012	.009	.008	.017	.008	-.017	.002	-.001	18.843
Orchid Chemicals & Pharmaceuticals Ltd.	.116*	.002*	.025*	.019*	.034*	-.015*	-.013*	-.022*	.008*	.013*	-.015*	-.029*	-.006*	.010*	.023*	-.002*	60.273*
Oriental Bank Of Commerce	.081*	-.039*	.021*	-.010*	-.022*	-.042*	.009*	.008*	.039*	.021*	-.009*	-.017*	-.008*	.008*	-.013*	-.023*	46.146*
Piramal Healthcare Ltd.	-.027	-.034*	.009	.002	.012	-.026	.008	.007	-.035	.026	.026	.010	-.006	.014	-.004	-.012	19.671
Praj Industries Ltd.	-.030	-.015	-.002	-.024	-.018	-.007	.034	-.005	.009	-.043	-.016	.020	.005	.033	.014	.020	24.677
Ranbaxy Laboratories Ltd.	.029	-.002	.026	-.020	-.003	-.010	.004	.027	.019	-.007	-.009	-.001	-.007	-.022	-.025	.001	14.456
Reliance Capital Ltd.	.118*	.003*	.025*	.018*	.004*	-.010*	-.002*	.009*	.022*	.029*	-.021*	-.016*	.007*	.031*	.006*	.026*	61.473*
Reliance Industries Ltd.	.047*	-.014*	-.043*	-.010*	.000*	-.018*	.020*	.017*	.014*	-.005	-.014	-.018	.023	.030*	-.018*	-.009	25.983
Reliance Infrastructure Ltd.	.039*	-.050*	.009*	-.022*	-.013*	-.001*	.011*	.026*	.025*	.023*	-.022*	-.019*	.029*	.026*	-.006*	.034*	33.433*
Rolta India Ltd.	.085*	.018*	.049*	.047*	.005*	-.048*	-.049*	.036*	.051*	.040*	.017*	.034*	.038*	.028*	-.023*	-.004*	87.007*
S Kumars Nationwide Ltd.	-.041*	-.007	.007	-.017	.029	-.020	-.010	.025	.013	.018	.002	-.031	.023	.022	-.021	.010	22.743

Name of Company	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	LB
S R E I Infrastructure Finance Ltd.	-.087*	-.048*	-.017*	-.017*	-.009*	-.006*	-.015*	.018*	-.001*	.025*	-.057*	.008*	.002*	.043*	.007*	-.021*	56.527*
Satyam Computer Services Ltd.	.063*	-.041*	.016*	.021*	.032*	-.067*	-.042*	-.019*	-.003*	.009*	-.038*	-.012*	-.022*	.066*	.003*	-.032*	70.246*
Sesa Goa Ltd.	.022	-.001	.011	-.007	.006	.010	-.007	.013	.013	.007	.008	-.032	-.020	.002	.011	-.004	9.133
Siemens Ltd.	.085*	.018*	.049*	.047*	.005*	-.048*	-.049*	.036*	.051*	.040*	.017*	.034*	.038*	.028*	-.023*	-.004*	87.007*
Sintex Industries Ltd.	.018	-.005	.006	.002	-.007	-.002	.001	.011	-.010	-.027	-.019	.020	.030	.005	.000	-.013	10.378
Steel Authority Of India Ltd.	.043*	-.054*	-.013*	-.026*	-.001*	-.014*	.028*	.038*	.037*	.022*	-.017*	-.006*	.020*	.013*	.003*	-.040*	40.476*
Sterling Biotech Ltd.	-.076*	-.009*	-.030*	-.006*	.004*	-.006*	-.029*	.024*	.009*	.012*	.014*	-.003*	.008*	.011*	.012*	.007*	29.269*
Sun Pharmaceutical Inds. Ltd.	.022	-.001	.003	-.017	-.004	-.006	-.030	.028	-.004	.020	.007	-.008	-.004	-.004	-.011	.017	11.386
Tata Chemicals Ltd.	.082*	-.017*	-.016*	-.009*	.028*	.000*	-.026*	.008*	.001*	.052*	-.026*	-.043*	-.002*	-.007*	.007*	-.018*	47.277*
Tata Communications Ltd.	.058*	-.020*	-.031*	-.019*	-.025*	-.003*	.007*	.020*	.013*	-.011*	-.029*	-.015*	.033*	.002*	-.012*	.006*	28.274*
Tata Motors Ltd.	.058*	-.019*	-.024*	-.038*	.002*	-.032*	.013*	.010v	.052*	.014*	-.011*	.014*	-.023*	.034*	.032*	.030*	45.424*
Tata Power Co. Ltd.	.007	-.015	-.013	.014	.013	-.010	-.005	.001	-.008	.011	-.003	.012	-.007	.014	.015	.010	5.983
Tata Steel Ltd.	.050*	.002*	.009*	-.016	.008	-.019	.010	.067*	.029*	.021*	.005*	-.015*	-.001*	-.008*	-.004*	-.005*	30.566*
Tata Tea Ltd.	.028	-.020	-.007	.009	.001	-.002	-.017	.009	-.004	.011	-.003	-.019	-.019	-.001	.001	.002	8.152
Titan Industries Ltd.	.027	.002	-.005	-.009	.004	-.002	.004	-.006	-.007	-.005	-.004	-.015	.010	.003	.000	.009	4.487
Unitech Ltd.	-.009	-.011	-.018	-.016	.001	-.004	.008	.007	.005	.007	-.004	.024	.018	.023	.017	-.005	8.750
United Phosphorus Ltd.	-.026	-.046*	-.019*	-.013*	-.024*	.033*	.006*	-.007*	-.035*	.003*	-.002*	.032*	-.008*	-.033*	-.019*	.037*	33.091*
Videocon Industries Ltd.	-.452*	-.047*	.052*	-.018*	-.035*	.005*	.140*	-.178*	.105*	-.011*	-.044*	-.015*	.099*	-.103*	.031*	.043*	972.347*
Voltas Ltd.	.023	-.011	.009	-.020	.003	.009	.016	.001	.002	.011	.017	.002	-.001	-.018	.005	-.009	7.640
Wipro Ltd.	-.006	-.011	-.007	-.003	.005	.006	.015	.021	.008	.041	.011	.003	.016	.008	-.016	-.004	11.110
Zee Entertainment Enterprises Ltd.	-.001	-.016	-.030	-.032	.001	-.019	-.030	.000	.004	.012	-.018	-.009	-.003	-.005	.010	-.010	13.764
Nifty	.064*	-.040*	-.004*	.019*	-.019*	-.045*	.011*	.036*	.025*	.030*	-.018*	-.013*	.018*	.046*	-.002*	-.001*	46.632*

Note: \* indicates significant auto correl

Moreover, a close look at the auto correlation matrices reveals that of significant matrices 45.34 percent matrices have negative autocorrelation, implying that the probability of a price increase on a day being followed by a price decline on the next day comes to 0.45. Lag-wise description of significant negative autocorrelation matrices as shown in Table 3 reveals that at second,

sixth, eleventh and twelfth lag more than 50 percent of significant auto correlation matrices are negative whereas at first, third, fifth, thirteenth, fifteenth and sixteenth lag, the stake of significant negative autocorrelation matrices is more than 40 percent which further endorses presence of price reversal trend and opportunity to devise profitable investment strategies.

**Table 3: Lagwise Description of Significant Auto Correlation Matrices of Hundred Selected Stocks and Nifty**

Lag	No. of Significant Auto Correlation Matrices	No. of Negative Significant Auto Correlation Matrices	Negative Significant Auto Correlation Matrices (in percentage)
1	52	24	46.15
2	56	34	60.71
3	51	25	49.02
4	52	28	53.85
5	50	23	46.00
6	52	43	82.69
7	53	21	39.62
8	53	16	30.19
9	53	15	28.30
10	52	11	21.15
11	52	32	61.54
12	51	29	56.86
13	52	23	44.23
14	53	9	16.98
15	53	22	41.51
16	53	25	47.17
<b>LB</b>	<b>53</b>	-	-

The results of auto correlation tests are further endorsed by LB statistics which re-examines the independence of stock returns as documented through autocorrelation matrices to conclusively comment on the status of market efficiency in its weak form by testing the joint hypothesis that all the auto correlation matrices are simultaneously equal to a given lag. Table No.3 clearly shows that 54 LB statistics (comprising of stocks as well as Nifty return series) out of total are significant at five percent level of significance, resulting in rejection of joint hypothesis that all the auto correlation matrices are simultaneously equal

to zero at zero at a given lag and suggesting that successive daily returns are interdependent of previous day returns in case of approximately 53 percent return series. It shows drifts in market efficiency and offers avenues for devising profitable trading strategies to market participants.

## 8. Conclusion

Thus, all three tests provide supportive evidence for the absence of weak form of efficiency in Indian stock market by endorsing absence of randomness and independence

in noticeable number of return series. Such absence of randomness and independence in stock returns 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 increasing the liquidity of market and improving the allocation of investment resources, necessary measures must be taken to root out inefficiencies from stock market in the wake of recent global financial crisis so as to promote sustainable development of Indian economy. For this purpose, 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 address the market inefficiency.

## References

- Alimov, A. A., Chakraborty, D., Raymond A. K. C. & Jain, A. K. (2004). The Random Walk Hypothesis on the Bombay Stock Exchange: Finance India, September, 18, 3, pp. 1251 - 1258.
- Ahmad, K. M., Ashraf, S. & Ahmed, S. (2006). Testing Weak Form Efficiency for Indian Stock Markets. Economic and Political Weekly, 41(1), pp. 49 - 56.
- Atje, R. & Jovanovic, B. (1993). Stock Markets and Development. European Economic Review, 37, pp. 632 - 40.
- Bachelier, L. (1900). Th'éorie De La Sp'eculation. Annales Scientifiques De l' 'Ecole Normale Sup'erieure s'er., 3<sup>rd</sup> Series, Tome (17, pp. 21 - 86). English Translation: In Cootner (ed.). Random Character of Stock Market Prices, Massachusetts Institute of Technology, pp. 17 - 78.
- Barua, S. K. (1981). The Short-Run Price Behavior of Securities-Some Evidence of Efficiency on Indian Capital Market. Vikapla, 6(2), pp. 93 - 100.
- Bashir T., Ilyas M. & Furrurkh A. (2011). Testing the Weak-Form Efficiency of Pakistani Stock Markets - An Empirical Study in Banking Sector. European Journal of Economics, Finance and Administrative Sciences. 31, pp. 160 - 175.
- Chaity N. S. & Sharmin S. (2012). Efficiency Measures of Capital Market: A Case of Dhaka Stock Exchange. International Journal of Business and Management. 7(1), pp. 102 - 108.
- Chander., Mehta. & Sharma. (2008). Empirical Evidences on Weak form Stock Market Efficiency: The Indian Experience. Decision, January- June, 35(1), pp. 75 - 109.
- Chaudhari, S. K. (1991). Short - Run share Price Behaviour: New Evidence on Weak Form of Market Efficiency. Vikalpa, Oct-Dec, 16(4), pp. 17 - 21.
- Chong, T. T., Cheng, S. H. & Wong, E. N. (2010). A Comparison of Stock Market Efficiency of the BRIC Countries. Technology and Investment, 1, pp. 235 - 238.
- Claessens, S., Dasgupta, S., & Glen, J. (1995). Return Behavior in Emerging Stock Market. The World Bank Economic Review, 9(1), pp. 131 - 151.
- Fama, E. F. (1965). The Behavior of Stock Market Prices. Journal of Business, Jan, 38(1), pp. 34 - 105.
- Fama, E. F. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. Journal of Finance, 25(2), pp. 283 - 306.
- Fama, E. F. (1998). Market Efficiency, Long-Term Returns and Behavioural Finance. Journal of Financial Economics, 49(3), pp. 283 - 306.
- Fama, E. F. & French, K. R. (1988). Dividend Yields and Expected Stock Returns. Journal of Financial Economics. 22, pp. 3 - 25.
- Fama, E. F. & French, K. R. (1988). Permanent and Temporary Components of Stock Prices. Journal of Political Economy. 96(2), pp. 246 - 273.
- Fernando, P. A. N. D. (2012). Testing the Weak Form Efficiency of Emerging Colombo Stock Exchange (CSE) with Statistical Independence Tests and Technical Trading Strategies. International Journal of Business Economics & Management Research, 2(4), pp. 1 - 13.
- Granger, C. W. J. & Morgenstern, O. (1963). Spectral Analysis of New York Stock Market Prices. Kyklos, 16, pp. 1- 27.
- Groenewold, N. (1997). Share Market Efficiency: Tests Using Daily Data for Australia and New Zealand. Applied Financial Economics, 7, pp. 645 - 657.
- Gupta, A. (2010). A Critical Analysis of Weak Form Efficiency in Indian Stock Market. Asian Journal of Management Research, ISSM 2229-3795, pp. 657 - 665.
- Gupta, R. & Basu, P. K. (2007). Weak Form Efficiency in Indian Stock Markets. International Business & Economics Research Journal, March, 6(3), pp. 57 - 64.

- Gupta, R. & Yang, J. (2011). Testing Weak Form Efficiency in the Indian Capital Market. *International Journal of Finance & Economics*, (75), pp. 108 - 119.
- Jarrett, J. E. & Sun, Z. (2009). Daily Variation, Capital Market Efficiency and Predicting Stock Returns for the Hong Kong and Tokyo Exchanges. *Applied Economics*, 41, pp. 3477 - 3482.
- Kaur, M. & Dhillon, S. S. (2011). Testing Weak Form of Efficiency Hypothesis for Indian Stock Market. *Finance India*, 15(3), pp. 851 - 862.
- Keane, S. M. (1983). *Stock Market Efficiency: Theory, Evidence and Implications*. Delhi: Heritage Publishers.
- Kendall, M. G. (1953). The Analysis of Economic Time Series, Part-I: Prices. *Journal of the Royal Statistical Society, Series A, (General)*, 116(1), pp. 11 - 25.
- Khan, Q., Ikram, S. & Mehtab, M. (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* 3(6), pp. 115 - 127.
- Kumar, A. & Kumar, S. (2012). Weak Form Efficiency of Indian Stock Market: A Case of National Stock Exchange (NSE). *International Journal of Management Sciences*, 1(1), pp. 27 - 31.
- Kung, J. J. & Wong, W. (2009). Efficiency of the Taiwan Stock Market. *The Japanese Economic Review*. 60(3), pp. 389 - 394.
- Lee, C. I., Gleason, J. C. & Mathur, I. (2001). Trading Rule Profits in Latin American Currency Spot Rates. *International Review of Financial Analysis*, 10, pp. 135 - 156.
- Levine, R. & Zervos, S. J. (1993). What We Have Learned about Policy and Growth from Cross-Country Regressions? *American Economic Review*, 83, pp. 426 - 430.
- Levine, R. & Zervos, S. J. (1995). Stock Market Development and Long-Run Growth. *World Bank Economic Review*, 82(4), pp. 942 - 963.
- Levine, R. & Zervos, S. (1998). Stock Markets, Banks and Economic Growth. *American Economic Review*, 88(3), pp. 537 - 57.
- Liu, T. (2011). Market Efficiency in China Stock Market and Hong Kong Stock Market. *International Research Journal of Finance and Economics*. 76, pp. 128 - 137.
- Mahapatra, R. P. & Biswasroy, P. K. (2007). How Efficient is Our Stock Market in Its Weak Form? A Study on BSE 30 (Sensex) Scrips. *Finance India*, March, 21(1), pp. 211 - 221.
- Mandelbrot, B. (1966). Forecasts of Future Prices, Unbiased Markets and Martingale Models. *Journal of Business*, January, 39, pp. 242 - 255.
- Mittal, R. K. (1995). Weak Form Market Efficiency. *Prajnan*, 23(3), pp. 297 - 312.
- Osborne, M. F. M. (1959). Brownian Motion in the Stock Market. *Operations Research*, March-April, 7, pp. 145-73.
- Poshakwale, S. (1996). Evidence on Weak Form Efficiency and Day of the Week Effect in the Indian Stock Market: *Finance India*, September, 10(3), pp. 605 - 616.
- Patel, N. R., Patel, B. K. & Ranpura, D. (2011). Testing Weak Form Market Efficiency of Indian Stock Markets. *S. S. International Journal of Business and Management Research*, 1(3), pp. 1 - 28.
- Poshakwale, S. (2003). The Random Walk Hypothesis in the Emerging Indian Stock Market. *Journal of Business Finance & Accounting*, 29(9-10), pp. 1275 - 1299.
- Ramashastri, A. S. (1999-2000). Market Efficiency in Nineties: Testing Through Unit Roots. *Prajnan*, 28(2), pp. 155 - 161.
- Rao, N. K. & Mukherjee, K. (1971). Random Walk Hypothesis: An Empirical Study. *Arthaniti*, 14(1 & 2), pp. 53 - 49.
- Ray, D. (1976). Analysis of Security Prices in India. *Sankhya, Series C*, 38(4), pp. 149 - 164.
- Rehman, A. U., Masood, M., Arshed, S. & Shah, S. Z. A. (2012). Evaluation of Weak Form of Efficiency: An Empirical Study of Emerging South Asian Stock Markets. *International Research Journal of Finance and Economics*, 88, pp. 124 - 131.
- Roberts, H. V. (1959). Stock Market Patterns & Financial Analysis: Methodological Suggestions. *Journal of Finance*, March, 14, pp. 1 - 10.
- Srinivasan, P. (2010). Testing Weak-Form Efficiency of Indian Stock Markets. *APJRB*, 1(2), pp. 1-7.
- Sarma, S. N. (2004). Stock Market Seasonality in an Emerging Market. *Vikalpa*, 29(3), pp. 35 - 41.
- Samuelson, P. A. (1965). Proof that Properly Anticipated Prices Fluctuate Randomly. *Industrial Management Review*, spring, 6, pp. 41- 49.
- Sharma, J. L. & Kennedy, R. E. (1977). Comparative Analysis of Stock Price Behavior on the Bombay, London and New York Stock Exchanges. *Journal of Financial and Quantitative Analysis*, Sept, 12, pp. 319 - 414.

- Sharma, J. L. (1983). Efficient Capital Markets and Random Character of Stock Price Behavior in A Developing Economy. *Indian Journal of Economics*, Oct-Dec, 63, (251), p. 53 - 70.
- Stiglitz, J. E. (1990). Symposium on Bubbles. *The Journal of Economic Perspectives*, Spring, 4(2), pp. 13 - 18.
- Thomas, A. E. & Kumar, M. C .D. (2010). Empirical Evidence on Weak Form Efficiency of Indian Stock Market, *Journal of Management*, 3(1&2), pp. 89 - 100.
- Vidyanathan, R. & Gali, K. K. (1994). Efficiency of Indian Capital Market. *Indian Journal of Finance and Research*, July, 5, (2), pp. 27 - 40.
- Working, H. (1934). Random Difference Series for Use in the Analysis of Time Series. *Journal of American Statistical Association*, March, 29, pp. 11 - 24.
- Yalawar, Y. B. (1988). Bombay Stock Exchange: Rates of Return and Efficiency. *Indian Economic Journal*, Apr-Jun, 35(4), pp. 68 - 121.

