Empirical Evidence From Unit Root Test For Weak Form Market Efficiency: Special Reference To Broad Based Indian Stock Market Indices

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Abstract *Examination of market efficiency especially in the context of developing markets plays a paramount role in order to structure informed investment decision and facilitates the existing and prospective investors to construct a well-diversified portfolio. This paper examines the presence of weak-form of market efficiency attributing to the random walk model in Indian Stock Market by considering the broad based market indices such as National Stock Exchanges' NIFTY, NIFTY 500 and Bombay Stock Exchanges' SENSEX, BSE 100, BSE 200 and BSE 500 for the period between 2000 and 2016 (17 years). During the study period, selected indices' daily returns have shown non-normality, homogeneity of mean and variance. Runs test for randomness, Auto-Correlation Function (ACF) and Augmented Dickey-Fuller (ADF) Unit root test have indicated statistically significant results and accentuates that the selected broad based market indices remained weak-form inefficient during the study period.*

Keywords *Indian Stock Market, Investment Decisions, Efficient Market, Randomness, Unit Root*

JEL Classification *IG10, G11, G14, C14, C58*

INTRODUCTION

Organizations' business cycle facilitate the prospective investors to perceive several economic indicators which impact the performance of stock prices in market and apparently these distinct variables help to predict the possible future price during the up market and recessionary periods. By virtue, on all parlances, the stock price of an organization shall possibly indicate better prospects; the successive financial performance of organizations comprises of peak positions and down positions that might reflect in the stock prices. Astonishingly, empirically, many researchers (Kendall & Hill, 1953; Ramasastri, 2000; Tripathi & Kumar, 2014) found no clear predictable patterns in stock prices and many found contradicting results (Gupta & Basu, 2007; Thomas & Kumar, 2010) that the stock prices followed predictable patterns. If the latter research studies proven pertinently tenacious, stock markets would have certainly become treasure hunt for all and this would have helped the investors buy stocks which are expected to increase in the short-run and sell the stocks which are expected to fall in the short-run. One might advocate that any prospective information pertaining to the organization which is arriving to the market newly would have already reflected in the stock price. However, if the price of the stock stabilizes at fair levels after adjusting to the new information, the new information said to be unpredictable and opportunity to generate abnormal profits over long-run would certainly become impossible. Thus, consecutive stock prices occurrence would have become purely random. The new information pertaining to the organization or exogenous shall cause variation in the stock prices, eventually, in an efficient market, profit opportunity may not exist. The stock prices would rapidly adjust to normalcy upon arrival of new information and current prices would expected to be reflecting all available information (Samuelson, 1965; Fama, 1970). Hence, the stock prices and the passive portfolios such as market indices are expected to follow pure stochastic process i.e. the successive price changes follow random process and remain unpredictable. Indeed, from other school of thought, if stock prices remain predictable, it inherently conveys that the availability of new information has not reflected in the stock prices which contradict the efficient market hypothesis. Therefore, in nutshell, in an efficient market, the stock prices and passive portfolios reflect all the available information and the distinct three categories of efficient market hypothesis can be classified as weak-form, semi-strong form and strong form hypothesis (Fama, 1970). Weak-form hypothesis portrays that the stock prices reflect all historical information from the trading track records.

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Semi-strong form of hypothesis iterate that all publicly available information such as financial performance, earnings forecast and technical know-how in addition to the past prices. Strong form of hypothesis states that all the available information would reflect in the stock prices and this state has been considered as extreme. This version of hypothesis enumerates that even strategic level corporate executives who have access to insider information would not be able to use the information to generate abnormal profits. Hence this study is attempted to examine the existence of weak-form of random walk model in Indian stock market by considering the major indices such as S&P BSE SENSEX, S&P BSE 100, S&P BSE 200, S&P BSE 500, NIFTY and NIFTY 500. Brief profile of the aforementioned indices is as follows.

Table 1.1: Shows the Profile of the Selected Market Indices

S. No.	Index	Launch Year	1 Year Annualized Return (%)
1	S&P BSE SENSEX	1986	9.26
2	S&P BSE 100	1989	12.57
3	S&P BSE 200	1994	13.44
4	S&P BSE 500	1999	14.89
5	NIFTY	1996	12.88
6	NIFTY 500	1996	16.08

Source: Fact sheets from Bombay Stock Exchange and National Stock Exchange as on 31st August, 2017

LITERATURE REVIEW

Ramasastri (2000) studies the weak form of efficiency of the Indian stock market between 1991 and 1998 by considering the daily data of SENSEX. The ADF's unit root test was employed and the study suggested that the Indian stock market was weak form efficient during the study period.

Jarrett & Kyper (2005) examined the weak form of the efficient market hypothesis by randomly selecting 49 firms listed in NYSE and NASDAQ for the sample between April 1992 and September 2002. They found that the time series of closing prices of selected firms were not following stochastic trend and they contain daily effects. They also found that there was substantial existence of the time series components in closing prices of selected organizations.

Gupta & Basu (2007) examined the weak form of efficiency in the framework of random walk hypothesis for the two major equity markets in India for the period between 1991 and 2006. In order to test the weak form of market efficiency, daily returns using daily index values were considered. They had used Runs test, Augmented-Dicky Fuller (ADF) Unit root test, Philips-Perron test and KPSS test to validate whether the successive occurrences are independent or does the series contain a pattern. They found that the daily returns of both stock exchanges did not follow random walk model and the series contain significant auto correlation.

Nayak (2008) studied forty five listed stocks in National Stock Exchange representing various industries vertical such as Automobile, Power, FMCG, Infrastructure and Banking for its price predictability through Runs test. Among the selected sector stocks fourteen organisations were weak form inefficient and thirty one organisations were weak form efficient.

Thomas & Kumar (2010) analysed the weak form of efficiency by considering 29 listed organisations in Indian stock market. Their study reveals that during the study period all the selected stocks did not follow random walk hypothesis and all the stocks exhibited statistically significant auto correlation at different lags. Thus, they concluded that Indian stock market was weak form inefficient during the study period.

Singh (2010) explored the market efficiency of Indian stock market attributed to globalization and capital market reforms under the assumption that domestic and international reforms would improve the market efficiency. The period of study was between 1991 and 2002 which addresses the period after liberalization, globalization and initiation of capital market reforms. The sample stocks comprised 158 listed organisations in BSE 200 and the measures adopted to study the market efficiency had shown that the market was moving towards efficiency. Their study also revealed that daily returns had exhibited maximum departure from randomness and efficiency as compared to monthly returns.

Kumar (2011) studied the weak form of market efficiency in Indian foreign exchange market for the period between April 1993 and June 2010 by administering various variance ratio tests and found that the Indian Foreign exchange market was weak form inefficient during the study period.

Khan *et al.* (2011) analyzed Indian capital market for its weak form by considering two major exchanges such as National Stock Exchange (NSE) and Bombay Stock exchange (BSE) for the period between April 2000 and March 2010 by

administering Runs test. The results of this article exhibited that both markets were weak form inefficient during the study period.

Prasanna (2011) argued that effective corporate governance should facilitate to create efficient capital markets, specifically attributing to Clause 49 of the listing agreement during the year 2000. The study had shown that this reform has significantly caused high bandwidth volatility and subsided post-governance period there was no substantial evidence found for improved informational efficiency accounted to corporate governance regulation.

Srinivasan (2011) studied the integration and causality between National Stock Exchange and Bombay Stock Exchange from July 1997 to August 2010, consisted of 3244 daily indices return. They found the existence of market integration between the two selected broad based Indian indices. Both exchanges had exhibited strong bidirectional relationship and they significantly influence each other. He suggested that market inefficiency in the short-run ensures market efficiency in the long-run.

Kumar & Dhankar (2011) examined the normality of daily, weekly, monthly and annual returns of Bombay Stock Exchange indices such as SENSEX, BSE-100 and BSE500 for the period between 1996 and 2006 by applying various parametric and non-parametric tests. The entire study period were split into three distinctive time horizon for examining the normality. They found that 1) the returns were negatively skewed for all the selected indices 2) daily and weekly returns were not normally distributed 3) monthly and annual returns were normally distributed.

Patel & Dhawan (2012) investigated weak form of market efficiency of Bombay Stock Exchange, Hong Kong Stock Exchange, Shanghai Stock Exchange and Tokyo Stock Exchange from the year 2000 to 2011. The daily returns were examined by administering various tests such as Serial correlation, Runs test, Unit root tests and Variance ratio. The study iterated mixed findings that 1) Unit root examination showed all markets exhibited no unit root during the study period, 2) Runs test revealed Bombay Stock Exchange and Hong Kong Stock exchange remained inefficient; Shanghai Stock Exchange and Tokyo Stock Exchange remained efficient during the study period 3) Serial correlation examination revealed that the returns were weak form efficient at certain lagged returns and inefficient at certain lagged returns.

Mishra *et al.* (2012) examined 100 most actively traded stocks at National Stock exchange for its informational efficiency by taking the closing prices for the period from April 1999 to March 2012. They found that there was informational asymmetry and absence of weak form of efficiency in Indian Stock Market.

Jain *et al.* (2013) studied the weak form of Indian capital market during the global financial crisis i.e. from April 2005 to March 2010 by considering the daily closing prices of BSE, Nifty, CNX100 and CNX500. They employed tests such as ADF Unit root test, Philips-Perron (PP) and Runs Test to evaluate the Indian capital market's random walk. Their study had shown that the Indian capital market was informational efficient and no investor could have earned any abnormal profits by accessing to insider information.

Siddiqui & Narula (2013) explored the randomness in stock return of Indian stock market by considering the daily return of S&P CNX Nifty for the period between 1992 and 2012 (20 years). The total number of daily returns included 5113 observations. They employed both parametric and non-parametric tests to determine the randomness of stock prices. They concluded that all the measures employed to test weak form of efficiency supported inefficiency of Indian stock market.

Totala *et al.* (2013) attempted to provide empirical evidences of weak form of efficiency in Indian stock market by considering several indices of National Stock Exchange for the period between 2006 and 2012. Their study showed that the selected NSE indices were not fully weak form efficient during the study period.

Jayakumar & Sulthan (2013) examined weak form of efficiency from 2007 to 2011 by validating the returns of National Stock Exchange indices such as NIFTY, Bank NIFTY, NSE Infra index, NSE IT index and NSE FMCG Index through Runs test, Auto Correlation and ADF test. The study exhibited that the selected indices did not show the characteristics of random walk model and concluded that the stock prices had remained predictable during the study period.

Tripathi & Kumar (2014) analysed the sectorial efficiency of Indian stock market by studying 11 industry indices such as FMCG, Media, PSU Banks, Auto, Banks, Finance, Energy, IT, Metal, Realty and Pharma. Their study covered 10 years of daily returns for the period between 2004 and 2014 which included global financial crisis. They had applied various methodologies such as ADF Unit root tests, KPSS, Philips-Perron test and variance test ratios. They concluded that market index had shown weak form efficient but no substantial evidence was witnessed for sectorial indices during the study period.

OBJECTIVE OF THE RESEARCH

The primary objective of the research is to examine whether the selected broad based Indian stock exchanges follow random walk model and exhibit weak-form of efficiency.

DATA AND METHODOLOGICAL FRAMEWORK

The daily closing index values have been obtained from Bombay Stock Exchange (BSE) and National Stock Exchange (NSE) for the period of 17 years between 2000 and 2016 (January to December), comprising a total of 4255 observations. This long study period is taken to minimize any impact that would arise due to short-term economic fluctuations. The research considers the broad based major market indices such as S&P BSE SENSEX, S&P BSE 100, S&P BSE 200, S&P BSE 500, NIFTY 50 and NIFTY 500 for analysis. In this study, attempt is made to analyze only the stock market returns generate from respective market indices during the sample period and there have been no specific attribution made with respect to rights issue, bonus issue etc.

The daily return of selected broad based indices is ascertained as the logarithmic difference between two consecutive index values during the study period, which results in continuously compounded return at period *t* and the index return *RM* is calculated as follows.

$$R_M = \ln (I_t - I_{(t-1)}) \times 100 \quad \ldots \text{(Eq. 4.1)}$$

Where 'It' is the current period's index value and 'It-1' is the previous period's index value. 'RM' is the daily market return.

Phase 1: Normal distribution of daily market returns

In order to analyse whether the daily market returns are normally distributed or not normally distributed, Jarque-Bera test statistic is used. JB statistic has proven as a precise measure when the sample size is relatively very large. The testable hypothesis is as follows.

H0: The daily returns of selected broad based market indices follow normal distribution during the study period.

H1: The daily returns of selected broad based market indices do not follow normal distribution during the study period.

Phase 2: Examination of homogeneity of mean and variance of daily returns for block periods

The block periods have been considered as the calendar years i.e. January, 2000 to December, 2000 is taken as block period 1 and accordingly. This block period arrangement has been done to examine the mean and variance difference across the block periods during the study period. In order to validate the following hypotheses, one way analysis of variance (ANOVA) and Levene's statistic are used.

H0: There is no significant difference in mean daily return across the selected broad based market indices during the entire study period and block periods (17 blocks).

$$\mu_{(R(NIFTY))} = \mu_{R(NIFTY\ 500)} = \mu_{R(SENSEX)} = \mu_{R(BSE100)} = \mu_{(R(BSE200))} = \mu_{(R(BSE500))}$$

H1: The selected broad based market indices exhibit significantly different daily mean return during the entire study period and block periods (17 blocks).

$$\mu_{(R(NIFTY))} \neq \mu_{R(NIFTY\ 500)} \neq \mu_{R(SENSEX)} \neq \mu_{R(BSE100)} \neq \mu_{(R(BSE200))} \neq \mu_{(R(BSE500))}$$

H0: There is no significant difference in variance of mean daily return across the selected broad based market indices during the entire study period and the block periods (17 blocks).

$$\sigma^2_{R(R(NIFTY))} = \sigma^2_{R(R(NIFTY\ 500))} = \sigma^2_{R(R(SENSEX))} = \sigma^2_{R(R(BSE100))} = \sigma^2_{R(R(BSE200))} = \sigma^2_{R(R(BSE500))}$$

H1: The selected broad based market indices exhibit significantly different variance of daily mean return during the entire study period and the block periods (17 blocks).

$$\sigma^2_{R(R(NIFTY))} \neq \sigma^2_{R(R(NIFTY\ 500))} \neq \sigma^2_{R(R(SENSEX))} \neq \sigma^2_{R(R(BSE100))} \neq \sigma^2_{R(R(BSE200))} \neq \sigma^2_{R(R(BSE500))}$$

Phase 3: Test for randomness

In order to examine the random walk model at its weak-form of efficiency among the selected broad based market indices, runs test has been used. It helps to find whether the successive departures of price level changes in the passive portfolio is a pure stochastic process (non-stationary) or price level changes follows a significant pattern due to informational asymmetry in the market. The testable hypothesis is as follows.

H0: The successive daily return of selected indices occurs randomly and no anomaly to earn substantial profits.

H1: The occurrence of successive daily return of selected indices is non-random and it follows significant pattern.

The successive change in index value is measured as a run, which is attributed to the following test statistic.

$$Z = \frac{V - \mu_V}{\sigma_V} \approx N(0,1) \quad \ldots \text{(Eq. 4.2)}$$

$$\mu_V = \frac{2n_1n_2}{n_1 + n_2} \quad \ldots \text{(Eq. 4.3)}$$

$$\sigma_V^2 = \frac{2n_1n_2 \times (2n_1n_2 - n_1 - n_2)}{(n_1 + n_2)^2 \times (n_1 + n_2 - 1)} \quad \ldots \text{(Eq. 4.4)}$$

Where, n_1 and n_2 represents the number of observations above and below the median daily return respectively. μV is the mean of V statistic and σV is the standard deviation of V statistic. The sampling distribution of V statistic is approximated to standard normal distribution with mean '0' and variance '1'.

Phase 4: Unit Root analysis (Augmented Dickey-Fuller Test)

The Augmented Dickey-Fuller test for Unit root examination is used in order to determine whether the broad based indices return time series is stationary or non-stationary and it is ascertained by the following regression.

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-1} + \varepsilon_t \quad \ldots \text{(Eq. 4.5)}$$

Where is a pure white noise error term and $\Delta Y_{t-1} = Y_{t-1} - Y_{t-2}$ and $\Delta Y_{t-2} = Y_{t-2} - Y_{t-3}$

The testable hypothesis is as follows.

Ho: δ i.e. Broad based indices' return time series have Unit root and non-stationary. If the null hypothesis is not rejected then it can be concluded that the selected broad based market indices are weak-form efficient.

H1: δ i.e. Broad based indices' returns do not have Unit root and stationary. If the null hypothesis is rejected then it can be concluded that the selected broad based market indices follow a significant pattern and they are weak-form inefficient.

ANALYSIS & DISCUSSIONS

Table 5.1: Shows the Descriptive Statistics of Selected Broad based Market Indices and Results of Normality Tests

Index	Average Daily Return (%)	SD (%)	Skewness	Jarque-Bera	Probability
	No. of daily observations (n) = 4255				
NIFTY	0.040	1.508	-0.2964	12667.07***	0.0000
NIFTY 500	0.041	1.518	-0.5572	10337.22***	0.0000
SENSEX	0.039	1.517	-0.1965	9318.49***	0.0000
BSE100	0.040	1.557	-0.3806	8373.48***	0.0000
BSE200	0.041	1.533	-0.4816	9351.71***	0.0000
BSE500	0.042	1.513	-0.5515	9201.61***	0.0000

*** 0.01, ** 0.05, * 0.1 Level of Significance

Table 5.1 exhibits the descriptive statistics of selected broad based indices with their normality distribution. The average daily return of the selected indices during the study period showed uniform level ranging between 3.9% and 4.2%. The daily return's risk measurement through standard deviation ranges between 1.508 and 1.557. Comparatively, the S&P BSE 500 yield highest daily return during the study period and NIFTY resulted in lowest standard deviation. All indices have shown that the daily returns are negatively skewed i.e. asymmetrical distribution of return data series, hence, there is a high probability that the daily return series of the indices, statistically, may not follow normal distribution due to the very fact that the Skewness value significantly departed from zero. Although for very large sample size, normality investigation is insignificant, in order to lay foundation for successive price occurrences are serially independent to justify weak-form market efficiency, normality of daily return data series has been tested by administering Jarque-Bera normality test. The test has been carried out at three distinctive levels of significance such as 1%, 5% and 10%. The test has showed that the calculated probability pertaining to all indices are less than the assumed level of significance, hence, the null hypothesis is rejected *(PCal< Pα: 0.0000 < 0.01, 0.05, 0.1)* and conclude that the broad based market indices' daily return do not follow normal distribution i.e. Skewness ≠ 0. This empirical result lays a platform to further examinewhether the selected broad based indices weak-form efficient or weak-form inefficient.

Table 5.2: Shows the Results of Homogeneity of Daily Mean Return and Variance of Selected Broad based Market Indices in Respective Years from 2000 To 2016

Description	Entire Period		Block Periods (17 Blocks)	
	F-Statistic	Probability	F-Statistic	Probability
Homogeneity of mean daily return	0.004 *df(5,25523)*	0.9999	0.00 *df (5,96)*	0.9999
Homogeneity of variance of mean daily return	0.370 *df (5,25523)*	0.8690	0.11 *df (5,96)*	0.9896

*** 0.01, ** 0.05, * 0.1 Level of Significance*

In order to examine the homogeneity of average daily return and variance, one way analysis of variance and Levene's statistic respectively have been used. This examination has been carried out by considering 1) entire period i.e. from January, 2000 to December, 2016; number of observations for each selected index = 4,255 2) Each calendar year has been considered as one block, thus, resulting in 17 block periods. The summary of inference is as follows,

- *Homogeneity of mean return (Entire period): P_{Cal} > Pα: 0.9999 > 0.01, 0.05, 0.1*
- *Homogeneity of mean return (Block period): P_{Cal} > Pα: 0.9999 > 0.01, 0.05, 0.1*
- *Homogeneity of variance (mean-Entire period): P_{Cal} > Pα: 0.8690 > 0.01, 0.05, 0.1*
- *Homogeneity of variance (mean-Block period): P_{Cal} > Pα: 0.9896 > 0.01, 0.05, 0.1*

The results reveal that none of the hypotheses have been rejected at the assumed level of significance and conclude that there is no significant difference in average daily return and variance among all the selected broad based indices during the study period.

Table 5.3: Shows the Results of Runs Test of Selected Broad based Market Indices

Index	No. of Runs	Z	Probability
NIFTY	1994	-4.123***	0.0000
NIFTY 500	1900	-7.005***	0.0000
SENSEX	1986	-4.370***	0.0000
BSE100	1954	-5.351***	0.0000
BSE200	1924	-6.270***	0.0000
BSE500	1890	-7.311***	0.0000

*** 0.01, ** 0.05, * 0.1 Level of Significance

The runs test has been performed to determine that the successive occurrence of price is independent. This iterates the fact that the historical prices do not contain any valuable information that can be used to yield abnormal profits. In order to ascertain the test statistics the median value has been used because in an asymmetrical distribution as evident from Table no. 5.1 the median value would exist between mean and mode. It has been observed that the test value (median) is ranging between 0.09 and 0.15. Table 5.3 indicates that all the selected broad based indices' null hypothesis has been rejected at all level of significance (P_{Cal} < *Pα: 0.000 < 0.01, 0.05, 0.1)* and conclude that the successive occurrence of prices is not independent and not following random order during the study period. This statistically significant evidence iterates that there is a significant pattern which can be possibly exploitable. Hence, the runs test reveals that the selected broad based market indices are weak-form inefficient.

Table 5.4: Shows the results of Unit root analysis of selected broad based market indices

Index	ACF/Box-Ljung Statistic	Random walk with intercept and deterministic trend			
		Intercept	Det. trend	Lag return (R_{t-1})	Lag First difference (ΔR_{t-1})
NIFTY	Ho: ρ = 0 H_1: ρ ≠ 0 (Up to 36 lags: P_{Cal} = *0.0000*)	0.03 t=0.59,0.56	0.00 t=0.26,0.80	-0.97*** t=-46.44,0.00	0.05*** t=3.20, 0.00
NIFTY 500		0.02 t=0.33,0.74	0.00 t=0.49,0.62	-0.88*** t=-57.68,0.00	--
SENSEX		0.02 t=0.44,0.66	0.00 t=0.37,0.71	-0.93*** t=-60.70,0.00	--
BSE100		0.02 t=0.32,0.75	0.00 t=0.47,0.64	-0.90*** t=-59.06,0.00	--
BSE200		0.02 t=0.39,0.70	0.00 t=0.45,0.65	-0.89*** t=-58.52,0.00	--
BSE500		0.02 t=0.42,0.67	0.00 t=0.43,0.67	-0.88*** t=-57.83,0.00	--

*** 0.01, ** 0.05, * 0.1 Level of Significance

Table 5.4 describes the autocorrelation function of selected broad based indices and statistical significance for stochastic process through Augmented Dickey-Fuller test. The autocorrelation function signifies whether the lagged return contains any useful information which will explain the current period's return. If there is no statistically significant

autocorrelation, it can be interpreted that the daily return follows random walk. It has been observed that albeit there is statistically significant autocorrelation (*PCal< Pα: 0.000 < 0.01, 0.05, 0.1)* observed till 36 lags, the autocorrelation coefficient of selected broad based indices' lagged return are either very low degree of positive correlation or very low degree of negative correlation, hence, unable to draw conclusion deterministically. Traditionally, for initiating the unit root process, it is assumed that where the coefficient of *Rt-1* is expected to be between -1 and +1 i.e. $-1 < \rho < +1$. It is known that if the $\rho = 1$, then the selected broad based indices would exhibit random walk model without intercept term and shall be treated as nonstationary stochastic process. This aforementioned notion can be expressed as random walk without intercept term and this is the foundation for Dickey-Fuller Unit root examination. This notion can also be rewritten as where is the first order difference operator of return pertaining to the selected broad based market indices and the results are summarized as follows.

In order to test existence of unit root in the selected indices, the null hypothesis has been set as against the alternate hypothesis. If the null hypothesis is not rejected, then the return time series of selected broad based indices have unit root and non-stationary. If null hypothesis is rejected, then the time series is considered to be stationary. It is seen from the analysis that all the selected broad based indices' return time series exhibited stationary and remains predictable during the study period as per the basic notion of random walk without intercept and trend terms. In the aforementioned analysis, it is presumed that white noise error term is not correlated. Augmented Dickey-Fuller test (ADF) is a restructured version if the white noise error term is correlated and the results of ADF statistic is summarized in the table 5.4. The ADF test includes an intercept term with deterministic trend. Analysis has revealed that the calculated 't' value in absolute terms is far greater than the critical values at 0.01, 0.05, 0.1 level of significance i.e. -3.9602,-3.4109, -3.1272 respectively as well as the calculated probability is less than the assumed level of significance (*PCal< Pα: 0.000 < 0.01, 0.05, 0.1),* hence, reject the null hypothesis and conclude that the selected broad based indices do not have unit root during the study period and the daily return is considered to be stationary. Thus, it can be interpreted that the selected broad based market indices is weak-form inefficient.

CONCLUSION

In an information ally efficient markets possibility of generating abnormal profits do not exist. This paper examines the presence of weak-form of efficiency among the major Indian stock market indices such as NIFTY, NIFTY 500, SENSEX, BSE 100, BSE 200 and BSE 500. Initial examination with respect to normality of daily returns by using Jarque-Bera test has shown that the selected broad based market indices follow asymmetrical distribution during the study period. Homogeneity of mean daily return and homogeneity of variance of daily return examination has yielded statistically insignificant results portraying that the selected broad based market indices have exhibited equal return with equal variance during the study period. Preliminary examination for efficient market hypothesis at weak form of efficiency through runs test has shown statistically significant results as the selected indices' daily returns are not successively independent and it follows significant pattern, hence, they exhibit weak-form inefficiency during the study period (khan *et al.*, 2011; Jayakumar & Sulthan, 2013). The results of Augmented Dickey-Fuller test show statistically significant outcomes as the selected broad based indices do not have unit root and the daily return time series are stationary during the study period (Gupta & Basu, 2007). Thus, this study enumerates the fact that the selected broad based market indices remain predictable and investors can generate abnormal returns by holding a well-diversified portfolio through rational use of information existed in the past prices.

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