Testing the Random Walk Hypothesis and Capital Market Efficiency in Bombay Stock Exchange Sectoral Indices

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Abstract

Capital Market deals with medium and long term funds. It is an institutional arrangement for borrowing medium and long term funds. The movements of the market value of stocks encourage traders to trade in a competitive manner, with the objective of maximising the profit. Capital Market Efficiency is judged by its success in incorporating information, generally about the basic value of securities, into the price of securities. The sectoral index indicates the performance of same kind of businesses (industry) in the country. The sectoral analysis is typically employed by investors who plan to select better stocks to invest. Investors normally identify most promising sectors and review the final performance of companies within the sector to determine which individual stock would provide better returns and purchase such stocks ultimately. Hence the study of Sectoral Efficiency could provide useful input to the Government, Policymakers and Investors to identify the efficient sectors and to channel the available resources into the profitable sectors. This study tested the Market Efficiency of BSE (Nine) Sectoral Indices by using daily share price returns during the study period from 01st January 2012 to 31st December 2017. This study evaluated the random distribution and weak form of efficiency in BSE Sectoral Indices. The analysis consisted of Descriptive Statistics, Augmented Dickey Fuller Test, Runs Test and Autocorrelation Test during the study period. The Runs Test indicated that market did not follow random distribution during the study period. The study advices investors to invest their money in BSE Bankex as it performed well during the study period.

Keywords*: Sectoral Analysis, BSE Indices, Random Walk and Market Efficiency.*

1. Introduction

A stock market index is one which indicates the pattern of movements of the prices of a group of securities which are considered to be the representative sample of the entire stock market. The stock market index is an invaluable guide to study the trend of growth patterns in the economy to analyse as well as forecast business cycles and also to correlate stock market indices to various economic activities.

The term, Market Efficiency, in capital market theory is used to explain the degree to which the stock prices reflect all available and relevant information. The concept of Efficiency Market Hypothesis (EMH) explains how the anticipated price of an asset fluctuates randomly **(Samuelson** - 1965**)**. It presented a formal theory and evidence for market efficiency and subsequently revised it further on the basis of development in research **(Fama** - 1991**)**.

The Capital Market Efficiency suggests that stock prices incorporate all relevant and readily available information, which implies that there is no systematic way to exploit trading opportunities and achieve superior results. **Grossman S.J** and **Stiglitz J.E** (1980) assert that if markets were fully efficient, there could be no return earned by information gathering and hence no one would trade **(Mishra P.K,)**.

Fama (1970) classifies the market efficiency into three levels on the basis of the information: a) Weak Form Efficiency, b) Semi-Strong Form Efficiency and c) Strong Form Efficiency. Prices under the weak form efficiency reflect all the information found in the record of past prices and volumes. This means that there is no relationship between the past and future price movements. The earlier test of weak form efficient market hypothesis looked at randomness in the short run. The semi strong efficient market hypothesis holds that the stock prices adjust rapidly to all publicly available information. This implies that using publicly available information, investors will not be able to earn superior risk adjusted returns **(Prasanna Chandra 7th Edition 2008).** If stock market is efficient in semi strong form, then investors cannot achieve a consistently above-normal returns. On the other hand, if investors can consistently obtain above-normal return on trading at the time of the public announcement of specific information, then the stock market is inefficient with respect to this information. Since excess return represents the difference between the actual return and the expected return, implicit in a test of market efficiency is some model of the expected return. The expected return may be based on the Capital Asset Pricing Model or Arbitrage Pricing Model **(Mahdi M.Hadi, 2006).**

The strong form efficient market hypothesis holds that all available information, public or private, is reflected in the stock prices. To test the strong form efficient market hypothesis, Researchers analyzed the returns earned by certain groups (like corporate insiders, specialists on stock exchanges and mutual fund managers) who have access to information which is not publicly available and ostensibly possess greater resources and abilities to intensively analyze information which is in the public domain (**Prasanna Chnadra 7th Edition 2008**).

2. Review of Literature

An attempt has been made in this section to review the earlier research works undertaken in the area of capital market efficiency to understand the research gap and methodology adopted by researchers in the earlier studies.

Bhanu Panit and Bishnoi T.R (2001) analysed the behavior of daily and weekly returns of five Indian Stock Market indices for random walk during the study period. The results revealed that Indian Stock Market indices did not follow random walk. **Robert T. Kleiman,** et.al (2002), studied the weak form efficiency for international commercial real estate markets, utilizing stock market indices of real estate for three geographical regions like Europe, Asia and North America. **Mufeed Rawashdeh and Jay Squalli** (2004) examined the Market Efficiency across four sectors, namely, banking, industrial, insurances and services in the Amman Stock Exchange (ASE). It was found from the analysis that the random walk and weak form efficiency hypotheses did not apply to all sample sectors. **Hareesh Kumar. V and Malabeika Deo** (2007) tested the information efficiency of Indian Securities Market with respect to a widely reported market anomaly. They found out the prevalence of Day-of-the-Week Effect in the Indian Stock Market, which was attached both to the stock return and volatility and thus proved the Indian Stock Market to be efficient. **Francesco Guidi,** et.al (2010) explored the weak form of the efficient market hypothesis for Central and Eastern Europe (CEE) equity markets. **Natarajan . P and Dharani. M** (2010) investigated the efficiency of Nifty Benchmark Schemes by using Alpha and Beta Co efficient. The study found that the Nifty BeEs over performed in relation to the Nifty Index. **Selvam.M,** et.al (2010) studied the market efficiency of the sample companies listed on the BSE PSU Index. The study found that the PSU Index performed well during the study period and the investors of PSU companies earned maximum return through stock market operations. **Asha E Thomas and Dileep Kumar M.C** (2010) tested the Weak Form Efficiency of Indian Stock Market. The results of Runs Test and Autocorrelation Test provided evidence

that the share prices did not follow random walk. **Uttam Sapate and Valeed Ansari** (2011) analysed the weak form of Market Efficiency Hypothesis (EMH). It was found that stock market returns followed random walk and they supported the weak form of market efficiency. **Khan.A.Q**, et.al (2011) studied the market efficiency of Indian Capital Market in its weak form based on the indices of two major stock exchanges of India viz National Stock Exchange (NSE) and Bombay Stock Exchange (BSE). **Rajesh Ramkumar. R**, et.al (2012) tested 13 sectoral indices of BSE and examined the market efficiency. The study found that the returns of 8 indices out of 12 indices, namely, BSE Automobile index, BSE Bankex, BSE capital Goods Index, BSE Consumer Durables Index, BSE Health Care Index, BSE Metal Index, BSE PSU Index and BSE Realty Index followed normal distribution and earned better return.

The earlier studies concentrated on estimating the indices in global stock exchanges. None of the researchers studied different indices from BSE Sectoral Indices. Besides, there was no comprehensive study carried out in Indian Stock Markets with respect to Bombay Stock Exchange. In order to fill this gap, the present study was undertaken to analyse the market efficiency in BSE Sectoral Indices in the Indian context.

3. Statement of the Problem

Capital Market is a vital institution that facilitates economic development of the country. It is true that so many parties are interested in understanding the efficiency of the Capital Market. Retail investors could be motivated to save and invest their hard earned money in the capital market only if their securities in the market are appropriately priced. But many investors suffer due to lack of awareness on how to invest their money in appropriate indices in the Indian Stock Market. Besides, majority of investors do not have an idea about which index is the best in India for investment. The information about the economy development and performance of different indices are to be provided to the investors and other stakeholders on a periodical basis. The performance of each segment (industry) of economy gets reflected through the analysis of sectoral indices. There are a few earlier studies which tested the efficiency of global stock markets in general and the random walk for various popular indices in particular. But in India, very few studies have examined the daily returns, weekly returns and monthly returns of stock indices like S&P CNX Nifty, BSE 100 Index, Nifty Junior etc. It is to be noted that no researcher in India has compared the index returns among different sectoral indices in previous studies.

Besides, there has been no comprehensive study carried out to test the efficiency of sectoral indices of a stock exchange in the Indian context. Hence the present study to investigate the efficiency of Sectoral Indices of Bombay Stock Exchange (BSE) by using the daily returns.

4. Objectives of the Study

The main objectives of this study are to examine the stationarity of price returns of BSE Sectoral Indices and to evaluate the randomness and efficiency in BSE Sectoral Indices.

5. Hypotheses of the Study

In the light of the objectives, the following Null Hypotheses were developed and tested.

NH_1: There is no normal distribution in the returns of BSE Sectoral Indices

NH_2: There is no stationarity in the returns of BSE Sectoral Indices

NH_3: There is no random distribution in the returns of BSE Sectoral Indices

NH_4: There is no weak form efficiency in the returns of BSE Sectoral Indices

6. Methodology of the Study

6.1 Sample Selection

The present study tested the performance of sectoral indices listed in BSE. Turnover Values of Indices were used to decide the sample size for this study. The sample indices were selected by taking into account the following criteria.

1. Turnover of 50 crores and above (per day)
2. Availability of required data during the study period

There were totally 13 sectoral indices in BSE as on 21st June 2018. In the first stage, nine indices (70%), out of 13 indices, were selected as the sample size, based on its turnover values in the market. The required data for BSE FMCG, BSE Oil and Gas and BSE Realty Indices were not available. Therefore, only nine indices became eligible for selection. The details of sample indices listed in those sample six indices are given in **Table-1.**

6.2 Sources of Data

The study was mainly based on secondary data i.e, daily returns of BSE sectoral indices. The details regarding sample indices were collected from BSE official website www.bseindia.com while daily returns of sample indices were collected from PROWESS Corporate Database published by CMIE. Other required data were collected from various websites, books and journals.

6.3 Period of the Study

The study is an attempt to test the efficiency of the Indian Capital Market by analyzing the share price returns of sample indices from Bombay Stock Exchange Ltd during the study period from 01st January 2012 to 31st December 2017. For the purpose of this study, totally 1737 observations were made to collect the required data.

6.4 Tools Used for Analysis

For the purpose of analysis of sectoral indices in the Bombay Stock Exchange Ltd, the following tools were used.

(a) Descriptive Statistics

Descriptive Statistics was used to identify the measure of average return and risk. Measures of central tendency include the mean while measures of variability include standard deviation, skewness and kurtosis. Descriptive Statistics provided a useful summary of security returns and the historical account of return behavior. Although past information is useful in any analysis, one should always consider the expectations of future events.

$$\text{Mean } (\bar{x}) = \frac{\sum xi}{n}$$

Where, $\bar{x}$ = represents the mean,
$\sum$ = Symbol of Summation
Xi =Value of the i^{th} item x, i= 1, 2, 3 ….n,
n=total number of items

ii) Standard Deviation

Standard Deviation is the square root of the mean of the squared deviation from the arithmetic mean. It measures the absolute dispersion greater the standard deviation, greater will be the magnitude of the deviation of the values from their mean. A small standard deviation means a high degree of uniformity of the observation as well as homogeneity of a series. A large standard deviation means just the opposite. The standard deviation of a random variable X is defined as:

$$\sigma = \sqrt{E((X - E(X))^2)} = \sqrt{E(X^2)} - (E(X))^2$$

$$= \sqrt{Var(X)}$$

Where,
$E(X)$ is the expected variable of X
$Var(X)$ is the variance of X.

iii) Skewness

Measures of skewness indicated us the direction and the extent of skewness. Skewness is a measure of symmetry, or more precisely, the lack of symmetry. A distribution of data set is symmetric if it looks the same to the left and right of the centre point. The skewness for a normal distribution is zero and any symmetric data should have skewness near zero. Negative values for the skewness indicate that data are skewed left and positive values for the skewness indicate that data are skewed right. The skewness is calculated as follows.

$$\gamma_1 = \frac{\mu_3}{\sigma^3}$$

Where,
μ_3 is the third movement about the mean
σ is the standard deviation

iv) Kurtosis

Kurtosis measures the amount of peakedness of distribution. A flatter distribution than normal distribution is called Platykurtic. A more peaked distribution than the normal distribution is referred to as Leptokurtic. Between these two types of distribution, there is a distribution which is normal in shape, referred to as a Mesokurtic Distribution. A negative kurtosis value implies a Platykurtic Distribution and a positive kurtosis value implies a Leptokurtic Distribution. The kurtosis is defined as.

$$\gamma_1 = \frac{\mu_4}{\sigma^4}$$

Where,
μ_4 is the fourth movement about the mean
σ is the standard deviation

(b) Augmented Dickey Fuller (ADF) Test

In statistics and econometrics, an Augmented Dickey Fuller (ADF) Test is a test for a Unit Root in a time series sample. It is an augmented version of the Dickey Fuller Test for a larger and more complicated set of time series models. In the Augmented Dickey Fuller Test Statistic, more negative the number, stronger the reason for the rejection of the hypotheses and there is a Unit Root at some level of confidence. The ADF Test is calculated as follows.

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + \cdots + \delta_p \Delta y_{t-p} + \varepsilon_t,$$

Where,

α is a constant, β the coefficient on a time trend and p the lag order of the autoregressive process.

Imposing the constraints α=0 and β=0 corresponds to modeling a random walk and using the constraint β=0 corresponds to modeling a random walk with a drift.

(c) Runs Test

Runs Test is used for measuring the market performance. It does not require specification of the probability distribution. It depends only on the share price. It is essentially concerned with direction of changes in price. The randomness of the sample can be tested by using the Runs Test. A run is defined as the sequences of identical occurrence of the elements (numbers or symbols), preceded or followed by different occurrence of the elements or by no elements at all. The following formula is used for the Runs Test.

$$M = \frac{N(N+1) - \Sigma_{i=1}^{3} n_i^2}{N}$$

Where,

M = Expected number of runs

ni = Number of price changes of each sign (i=1,2,3)

N = Total number of price changes.

(d) Autocorrelation

Autocorrelation is the statistical tool used for measuring the indices successive terms in a given time series and dependence of the successive share price changes. One way to test for randomness in stock price changes is serial correlations (also called as Autocorrelation). If such auto correlations are negligible, the price changes are considered to be serially independent. Numerous serial correlation studies, different stocks, different time lags, and different time period, have been conducted to detect serial correlations. The following formula is used for autocorrelation.

$$\rho_k = \frac{\sum_{t=1}^{n-k}(R_t - \bar{R})(R_{t+k} - \bar{R})}{\sum_{t=1}^{n}(R_t - \bar{R})^2}$$

Where,
K is the number of lags
Rt represents the real rate of return
n is the total number of observations
Pk is the sample autocorrelation function for the lag K

7. Limitations of the Study

The proposed study suffers from the following limitations.

1. The study was purely based on secondary data and hence it could be riddled with certain limitations which are bound to be connected with secondary data.
2. The study was restricted to only BSE in India.
3. This study focused only on select BSE Sectoral Indices i.e, nine indices out of 13 indices.
4. The study period covered only seven years from 2012 to 2017.
5. All the limitations associated with various tools like Descriptive Statistics, Augmented Dickey Fuller (ADF) Test, Runs Test and Autocorrelation Function (ACF) Test are applicable to this study also.

8. Analysis of Random Walk and Market Efficiency in Sectoral Indices

The main aim of this study is to find out the existence of the random walk in the stock market and analyse the market efficiency in India. For the purpose of this study, analysis was made as follows.

8.1 Analysis of Normality of Returns Data for BSE Sample Sectoral Indices

8.2 Anlaysis of Stationarity for BSE Sample Sectoral Indices

8.3 Analysis of Randomness for BSE Sample Sectoral Indices

8.4 Analysis of Market Efficiency for BSE Sample Sectoral Indices

8.1 Analysis of Normality of Returns Data for BSE Sample Sectoral Indices

The normal distribution is a probability distribution that associates the normal random variable with a cumulative probability. The analysis of normal distribution for BSE Sample Sectoral Indices was made with the measures of central tendency (using mean) while the variability of return was measured by using Standard Deviation, Skewness and Kurtosis.

Table-2 depicts the Descriptive Statistics for daily share price returns of the nine sample BSE Indices taken for this study. As stated earlier, Mean, Standard Deviation, Skewness and Kurtosis were used for the analysis of normality for return data. It is to be noted that the mean average returns were positive for all sample indices, namely, BSE Automobile, BSE Bankex, BSE Consumer Durables, BSE Health Care, BSE Information Technology, BSE Metal, BSE Power, BSE PSU and BSE TECk Indices. However, the mean return was high for BSE Bankex, compared to the other sample indices considered for this study. It is significant to note that BSE Bankex earned high return (0.0841) while BSE Power Index accounted for the lowest return (0.0353) during the study period. The standard deviation of returns (risk) ranged from 1.25741 (BSE Health Care Index) to 2.51288 (BSE Metal Index). The BSE Metal Index earned the highest standard deviation (2.51288), which indicates the highest risk, followed by BSE Bankex (2.23450), BSE Consumer Durables Index (1.99640), BSE Power Index (1.97526), BSE IT Index (1.92238), BSE TECk Index (1.75342), BSE PSU Index (1.70934), BSE Automobile Index (1.67512) and BSE Health Care Index (1.25741). It is clearly understood from the analysis of skewness that out of 9 sample indices, 5 indices registered positive values, i.e BSE Bankex (0.317), BSE Information Technology Index (0.138), BSE Power Index (0.247), BSE PSU Index (0.146) and BSE TECk Index (0.175). The remaining four indices (BSE Automobile Index, BSE Consumer Durables Index, BSE Health Care Index, BSE Metal Index) earned negatively skewed values (-0.211, -0.185, -0.518 and -0.145 respectively). According to the analysis of Kurtosis, the obtained values were positive for all nine sample indices during the period of study. It is seen that out of 9 sample indices, all indices earned a value over the level of 3. The values of 9 indices [BSE Automobile Index (3.703), BSE Bankex (5.310), BSE Consumer Durables Index (4.742), BSE Health Care Index (5.438), BSE Information Technology Index (3.244), BSE Metal Index (3.434), BSE Power Index (7.481), BSE PSU Index (8.108) and BSE TECk Index (4.470)], as shown in the Table, being more than 3, make them leptokurtic. It is clearly understood from the anlaysis of kurtosis that all the nine indices used in this study were not normally distributed during the study period. Hence the Null Hypothesis (NH1) **"There is no normal distribution in the returns of BSE Sample Sectoral Indices",** was accepted.

8.2 Analysis of Stationarity for BSE Sample Sectoral Indices

Stationarity is defined as the quality of a process in which the statistical parameters (mean and standard deviation) of the process do not change with time. The study of data was done with the help of Augmented Dickey Fuller Test and Durbin Watson Test.

The results of the Augmented Dickey Fuller Test and Durbin Watson Test for daily share price returns for sample BSE Sectoral Indices listed during the period from 01st January 2012 to 31st December 2017, are presented in **Table-3**. It is to be noted that the different BSE Indices taken for this study included BSE Automobile Index, BSE Bankex, BSE Consumer Durables Index, BSE Health Care Index, BSE Information Technology Index, BSE Metal Index, BSE Power Index, BSE PSU Index and BSE TECk Index. It is to be noted that the values of test critical for all sample indices were analysed at significant level of 1%, 5% and 10%. The probability value for all the nine sample indices was zero. According to the Table, the statistical values for all sample indices were -36.02145 for BSE Automobile Index, -36.33807 for BSE Bankex, -38.15922 for BSE Consumer Durables Index, -38.88648 for BSE Health Care Index, -31.59647 for BSE Information Technology Index, -36.99202 for BSE Metal Index, -37.81981 for BSE Power Index, -36.58648 for BSE PSU Index and -31.20954 for BSE TECk Index during the study period. It is significant that the statistical values for all sample indices were less than that of test critical values at 1%, 5% and 10% level of significance. This indicates the fact that the returns data of all sample indices attained stationarity during the study period. According to the analysis of Durbin Watson Test, the values for all sample indices were below the value of two, i.e 1.00556 (BSE Automobile Index), 1.99347 (BSE Bankex), 1.00328 (BSE Consumer Durables Index), 1.00393 (BSE Health Care Index), 1.008376 (BSE Information Technology Index), 1.00200 (BSE Metal Index), 1.99690 (BSE Power Index), 1.00470 (BSE PSU Index) and 1.00347 (BSE TECk Index). This further confirms the fact that the return data for all sample indices were found to have attained stationarity during the study period. Hence the Null Hypothesis (NH2), namely, **"There is no stationarity in the returns of BSE Sectoral Indices",** was rejected

8.3 Analysis of Randomness for BSE Sample Sectoral Indices

Randomness means different things in various fields. This test in data evaluation is used to analyse the distribution pattern of a set of data. The expected random input data can be verified

to show that events were performed by using randomized data. The randomness of the sample can be tested by using the Runs Test.

The results of Runs Test for daily share price returns of the BSE sample indices (BSE Automobile Index, BSE Bankex, BSE Consumer Durables Index, BSE Health Care Index, BSE Information Technology Index, BSE Metal Index, BSE Power Index, BSE PSU Index and BSE TECk Index) are displayed in **Table-4**. It is clear that a total of 1737 observations for each index were used in this study. The number of runs registered by each sample index were 821 for BSE Automobile Index, 769 for BSE Bankex, 823 for BSE Consumer Durables Index, 830 for BSE Health Care Index, 840 for BSE Information Technology Index, 795 for BSE Metal Index, 791 for BSE Power Index, 781 for BSE PSU Index and 848 for BSE TECk Index during the study period from 01st January 2012 to 31st December 2017. Sample indices, which earned negative Z values, were BSE Automobile Index (-2.299), BSE Bankex (-4.823), BSE Consumer Durables Index (-2.150), BSE Health Care Index (-1.893), BSE Information Technology Index (-1.387), BSE Metal Index (-3.555), BSE Power Index (-3.721), BSE PSU Index (-4.171) and BSE TECk Index (-1.002). It is to be noted that only three sample indices, out of nine, namely, BSE Health Care Index, BSE Information Technology Index and BSE TECk Index earned values in between ± 1.96. Thus the remaining sample indices, namely, BSE Bankex, BSE Consumer Durables Index, BSE Metal Index, BSE Power Index and BSE PSU Index were not randomly distributed sat the 5% level of significance. Hence the Null Hypothesis (NH3) "**There is no random distribution in the returns of BSE Sample Sectoral Indices**", was partially accepted.

8.4 Analysis of Market Efficiency for BSE Sample Sectoral Indices

Market Efficiency refers to the degree to which market prices reflect available information. It also reflects the accuracy of predicted return. The Market Efficiency in respect of the sample indices was tested by using the Autocorrelation Test.

The results of autocorrelation for daily returns of the BSE Sectoral Indices (namely, BSE Automobile Index, BSE Bankex, BSE Consumer Durbales Index, BSE Health Care Index, BSE Information Technology Index, BSE Metal Index, BSE Power Index, BSE PSU Index and BSE TECk Index) during the study period from 01.01.2012 to 31.12.2017 are reported in **Table-5**. It is noted that totally 28 lags were used for the analysis during the study period. The analysis of autocorrelation coefficients shows the fact that BSE Automobile Index were significant at 5%

level of significant, with positive value (0.144) for 1st lag. The autocorrelation results of BSE Bankex shows that out of 28 lags, three lags (1st, 8th and 26th lag) were significant at 95% level of confidence. It is noted that the highest magnitude of coefficient was 0.135 at lag one during the study period. It is clearly understood that the autocorrelation coefficient value of BSE Health Care Index was significant at 5% level and there were positive values for 1st, 13th 14th, 17th and 28th lags during the study period. The analysis of BSE IT Index clearly shows the fact that out of 28 lags, only one lag (17th lag) was significant while the remaining lags were insignificant at 5% level of significance. The autocorrelation analysis was performed for 28 lags of daily returns for BSE Metal Index during the study period. It was found that the autocorrelation coefficients for 1st lag, 8th lag and 17th lag were significant at 5% level of significance for BSE Metal Index. The results of autocorrelation coefficient for BSE Power Index during the study period indicate the fact that the autocorrelation coefficients were significant at 95% of confidence level, with positive values at 1st, 8th, 14th and 17th lags during the study period. The analysis of PSU Index indicates that the autocorrelation coefficients were significant at 95% of confidence level, with positive values at 1st, 7th, 8th, 14th and 26th lags during the study period. It is noted that the positive value sign of the autocorrelation coefficient clearly shows that the daily returns of PSU Index tended to be the same sign on consecutive days. From the analysis of BSE TECk Index, it is seen that out of 28 lags, only one lag (17th lag) was significant during the study period. The remaining lags were insignificant at the 95% of confidence level. Thus the Null Hypothesis (NH4) "**There is no weak form efficient in the returns of BSE Sample Sectoral Indices**", was accepted.

9. Findings and Suggestions of the Study

The following are the important findings and suggestions of the study.

i. Among the sample Sectoral Indices selected for this study, the average Returns for Bankex (0.0841) was the highest compared to all other sample indices. The remaining eight Sample Indices (BSE Automobile Index, BSE Consumer Durables Index, BSE Health Care Index, BSE Information Technology Index, BSE Metal Index, BSE Power Index, BSE PSU Index and BSE TECk Index) did not yield high returns to the investors. In future, necessary steps could be taken to improve the market returns by improving the

performance of indices. Otherwise those investors who invested their money in the above eight sample indices will be affected.

ii. The value of Standard Deviation for BSE Health Care Index was less than that of all other Sample Indices. The highest value of Standard Deviation was registered for BSE Metal Index (2.51288). The Standard Deviation of returns for Metal Index indicated more risk as its mean value was high. Hence the Investors are advised to use this information before investing their hard earned money in the stock market.

iii. The analysis of ADF Test indicates that the daily returns for all companies showed stationarity at 1%, 5% and 10% significant levels. Besides, the statistical value was less than the critical value for all sample indices. In other words, the daily returns of share prices were stationary in the Indian Stock Market.

iv. The results of Runs Test indicate that the majority of Sample Indices (like BSE Automobile Index, BSE Bankex, BSE Consumer Durables Index, BSE Metal Index, BSE Power Index, BSE PSU Index) did not follow random distribution during the study period. Besides, the above indices earned negative Z values beyond the value of ± 1.96, which indicates that there was no random distribution.

v. The anlaysis of Autocorrelation indicates that out of nine sample indices, two indices (BSE Health Care Index and BSE PSU Index) showed positive and significant autocorrelation value only at five lags out of 28 lags while the remaining seven indices received positive and significant autocorrelation value at 1 lag for BSE Automobile Index, 3 lags for BSE Bankex, 4 lags for BSE Consumer Durables Index, 1 lag BSE information Technology Index, 3 lags for Metal Index, 4 lags for BSE Power Index and 1 lag for BSE TECk Index.

vi. From the analysis, it is suggested that retail investors may invest their hard earned money in BSE Bankex as it performed well during the study period.

vii. Retail investors are advised to observe the periodic assessment of stock markets trend because it would help them to identify appropriate trading strategies for better investment.

10. Conclusion

An attempt has been made in this study to investigate the weak form efficiency in the Indian Stock Market by examining the returns of nine sample indices using Descriptive Statistics, Augmented Dickey Fuller Test, Runs Test and Autocorrelation Test. The Runs Test and Autocorrelation Test indicate that out of nine sample indices, only three indices (BSE Health Care Index, BSE IT Index and BSE TECk Index) were randomly distributed at 5% significant level while the remaining six indices did not follow random walk method. The Autocorrelation revealed that out of nine indices, 2 indices (BSE Health Care Index and BSE PSU Index) earned positive values and were significant at 5% level at more number of lags. As mentioned earlier, this research mainly looked for the evidence of weak form efficiency by hypothesizing the normality of the distribution series and random walk assumption. The absorption of good and bad news or any other price-forming information may be reflected on share price thanks to available advance technology, control system and publication of business journals. The development of financial markets has significant benefits for the economic growth. The Regulators and Policy Markers should pay attention to the performance of indices in the market.

According to the results of earlier studies undertaken by **Bhanu Panit and Bishoni T.R** (2001), **Mufeed Rawashdeh and Jay Squalli** (2004), **Asha E Thomas and Dileep Kumar M.C** (2010) and **Rajesh Ramkumar et.al** (2012), there was no random distribution and no weak form efficient in stock market indices. In the same way, the present study also confirmed the findings of these studies. However, there are few other studies undertaken by **Francesco Guidi et.al** (2010), **Uttam Sapate and Valeed Ansari** (2011) and **Khan A.Q et.al** (2011) which found that there was random walk and weak form of market efficiency in stock market indices. The present study did not confirm the findings of these studies.

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Table-1
Name of BSE Sectoral Sample Indices Listed

Sl.No	Name of the Indices
1	BSE Automobile Index
2	BSE Bankex
3	BSE Consumer Durables Index
4	BSE Health Care Index
5	BSE Information Technology Index
6	BSE Metal Index
7	BSE Power Index
8	BSE PSU Index
9	BSE TECK Index

Source: www.bseindia.com

Table-2
The Results of Normality of Data (Descriptive Statistics) for BSE Sample Sectoral Indices during the Study Period from 01.01.2012 to 31.12.2017

Descriptive Statistics / Name of the Company & Index	Mean	Standard Deviation	Skewness	Kurtosis
BSE Automobile Index	0.0712	1.67512	-0.211	3.707
BSE Bankex	0.0841	2.23450	0.317	5.310
BSE Consumer Durables Index	0.0690	1.99640	-0.185	4.747
BSE Health Care Index	0.0632	1.25741	-0.518	5.438
BSE Information Technology Index	0.0428	1.92238	0.138	3.244
BSE Metal Index	0.0620	2.51288	-0.145	3.434
BSE Power Index	0.0374	1.97526	0.247	7.841
BSE PSU Index	0.0321	1.70934	0.146	8.108
BSE TECk Index	0.0352	1.75342	0.175	4.470

Source: Collected from PROWESS Corporate Database & Computed using SPSS (Version 19)

Table-3
Analysis of Stationarity (ADF and Durbin Watson Test) for BSE Sample Sectoral Indices during the Study Period from 01.01.2012 to 31.12.2017

Company Name	Statistical Value	Test Critical Value			Probability	Durbin Watson Test
		1%	5%	10%		
BSE Automobile Index	-36.02145	-3.433914	-2.863001	-2.567595	0.000000	2.005565
BSE Bankex	-36.33807	-3.433914	-2.863001	-2.567595	0.000000	1.99347
BSE Consumer Durables Index	-38.15922	-3.433914	-2.863001	-2.567595	0.000000	2.003286
BSE Health Care Index	-38.88648	-3.433914	-2.863001	-2.5667595	0.000000	2.003933

BSE Information Technology Index	-31.59647	-3.433916	-2.863002	-2.567595	0.000000	2.008376
BSE Metal Index	-36.99202	-3.433914	-2.863001	-2.567595	0.000000	2.002002
BSE Power Index	-37.81981	-3.433914	-2.863001	-2.567595	0.000000	1.996909
BSE PSU Index	-36.58645	-3.433914	-2.863001	-2.567595	0.000000	2.004700
BSE TECk Index	-31.20954	-3.433916	-2.863002	-2.567595	0.000000	2.00347

Source: Collected from PROWESS Corporate Database & Computed using E Views (Version 7)

Note: Critical Value at 1%, 5% and 10% level of significance

Table-4

The Results of Randomness (Runs Test) for BSE Sample Sectoral Indices during the Study Period from 01.01.2012 to 31.12.2017

Name of the Inidces	Number of Runs	Z Value *	Significant Value
BSE Automobile Index	821	-2.299	0.021
BSE Bankex	769	-4.823	0.000
BSE Consumer Durables Index	823	-2.150	0.032
BSE Health Care Index	830	-1.893	0.058
BSE Information Technology Index	840	-1.387	0.166
BSE Metal Index	795	-3.555	0.000
BSE Power Index	791	-3.721	0.000
BSE PSU Index	781	-4.171	0.000
BSE TECk Index	848	-1.002	0.316

Source: Collected from PROWESS Corporate Database and Computed using SPSS (Version 19)

Note: * Z value calculated at 5% level of Significance

Table-5
The Results of Market Efficiency (Autocorrelation Test) for BSE Sample Sectoral Indices during the Study Period from 01.01.2012 to 31.12.2017

Lags	BSE Automobile Index	BSE Bankex	BSE CD Index	BSE HC Index	BSE IT Index	BSE Metal Index	BSE Power Index	BSE PSU Index	BSE TECk Index
1	0.144*	0.135*	0.087*	0.068*	0.016	0.117*	0.096*	0.128*	0.016
2	0.038	-0.005	0.027	0.028	-0.078	0.022	-0.007	0.034	-0.066
3	-0.027	-0.011	0.062*	0.008	-0.057	0.006	0.005	-0.004	-0.030
4	-0.014	-0.036	-0.029	-0.002	-0.012	-0.035	-0.013	-0.006	-0.014
5	-0.029	-0.059	0.018	-0.003	0.019	-0.001	-0.007	-0.041	-0.002
6	-0.013	-0.073	0.002	-0.036	-0.001	-0.004	-0.050	-0.056	-0.025
7	0.043	0.002	0.038	0.045	0.000	0.036	0.031	0.060*	-0.001
8	0.021	0.062*	0.036	0.031	0.032	0.085*	0.084*	0.071*	0.043
9	0.009	0.023	-0.016	-0.007	0.013	0.043	0.029	0.026	0.019
10	0.030	0.009	-0.000	0.043	0.020	-0.019	0.011	-0.001	0.027
11	0.013	0.023	0.009	0.009	-0.002	-0.033	-0.045	-0.045	-0.012
12	0.043	0.005	0.035	0.032	-0.006	0.003	-0.022	-0.015	-0.002
13	0.047	0.002	0.042	0.071*	-0.023	0.026	0.027	0.017	0.004
14	0.016	0.035	0.063*	0.064*	0.008	0.041	0.065*	0.069*	0.032
15	0.016	0.012	-0.003	-0.001	-0.005	0.038	0.027	0.024	-0.015
16	0.015	0.031	0.009	0.009	0.008	0.023	0.039	0.034	0.009
17	0.045	0.037	0.051*	0.065*	0.080*	0.054*	0.069*	0.046	0.089*
18	0.018	-0.023	-0.002	-0.017	0.021	-0.006	-0.004	-0.058	0.021
19	0.014	-0.028	0.024	-0.001	0.036	0.024	-0.002	-0.031	0.021
20	-0.043	-0.038	-0.025	-0.002	-0.051	-0.034	-0.043	-0.070	-0.070
21	-0.005	0.009	-0.026	-0.003	-0.016	-0.003	0.026	-0.001	-0.031
22	-0.021	0.023	-0.002	-0.024	0.007	0.019	0.000	0.000	0.011
23	-0.026	-0.003	-0.043	-0.060	-0.039	-0.016	-0.000	-0.007	-0.044
24	0.011	-0.013	-0.002	0.016	-0.011	0.003	0.028	0.032	0.006
25	0.047	0.032	0.046	-0.004	0.042	0.014	0.009	0.015	0.040
26	0.036	0.060*	0.004	0.025	0.027	0.041	0.027	0.050*	0.011
27	0.016	-0.019	0.003	-0.040	0.011	-0.013	-0.024	-0.047	0.007
28	-0.015	0.018	0.008	0.053*	-0.008	-0.002	0.012	-0.000	0.001

Source: Collected from PROWESS Corporate Database and Computed using SPSS (Version 19)
Note: * positive value at 5% level of significance