

# AN EMPIRICAL ANALYSIS OF WEAK FORM EFFICIENCY: EVIDENCES FROM SELECTED SECTORAL INDICES OF BSE, INDIA

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## Abstract

The present analysis was conducted to examine weak form of efficient market hypothesis in sectoral indices of Bombay Stock Exchange (BSE), India. For the purpose of study daily statistical data for five listed sectoral indices (BSE Auto, BSE Bankex, BSE FMCG, BSE Healthcare and BSE Oil & Gas) was used for five years covering the period from April 2012 to March 2017. Unit root test, Serial correlation test, Variance ratio test and Runs test was conducted in order to test the weak form efficiency. With the exception of two sectors BSE FMCG and BSE Oil & Gas under Runs test, the random walk hypothesis framed under the respective tests were rejected during the study period which indicates that Indian stock is a weak form efficient.

**KEYWORDS:** *Efficient market hypothesis, Random walk, sectoral indices, Autocorrelation, Runs test.*

## I. Introduction

Stock market is an indicator of economy's overall strength, weakness and financial stability. Significant role is played by the stock market for investors as well as for industries as it provides opportunities to investors for channelizing their surplus funds in different sectors of the economy and after collecting these funds, it makes available these funds to the listed companies for their expansion requirements. By evaluating the market index, an investor can have idea about the performance of stock market and also predict the future trends of the market. Stock index movements are highly sensitive to macroeconomic factors irrespective of the fact that they are of global or of domestic level. Indian economy is affected by changes in political and legal environment of the world after adoption of liberalisation, privatisation and globalization reforms in the year 1990.

The early evidence of relationship between stock market movements and macroeconomic variables was opined by Fama and Schwert (1977) with the help of Efficient Market Hypothesis (EMH). Efficient Market Hypothesis explains that stock prices represent all information readily available, so that prices are similar to underlying values. According to the random walk theory of stock market prices, price shifts cannot be forecast in any significant way from previous changes. Consecutive price movements in individual stocks over time are distinct, and fluctuations in prices take place without noticeable variations. In an efficient market, security prices adjust itself to the new information within a short span of time so, current price of security reflects corporate profits, corporate performance and economic activities in general. Fama proceeded to establish an efficient market hypothesis, and eventually identified three possible categories of market efficiency-weak form efficiency, semi-strong form efficiency and strong form efficiency. This paper strives to recognize weak form of market efficiency of sectoral indices of BSE, India

Bombay Stock Exchange (BSE), and National Stock Exchange (NSE), are the two largest and most influential stock exchanges in India. Since its formation in 1992 NSE has risen rapidly to prominence While BSE was founded in 1875, it distinguishes itself from being the oldest Indian stock exchange. Within the scope of the current study; BSE is chosen over NSE being India and Asia's oldest stock exchange.

Rest of the paper is structured as follows: Similar research work is discussed in Section 2, objective of study has been formulated under section 3, the methodology was addressed in section 4, the findings and analysis presented section 5 and finally work concluded in section 6.

## II. Review of Literature

**Vidya A (2018)** conducted market efficiency test such as runs test and autocorrelation test on 10 companies of NSE and found that market is efficient in weak form as price changes were unpredictable and there was very meagre relationship exists between past prices of sample stocks with their future price. **Kalsie et al. (2015)** has analyzed six indices of NSE and concluded that Indian market is not weak form efficient. **Samithamby senthinatan (2015)** shows that the share markets in Singapore, Thailand, New Zealand and Japan sensibly represents efficiency. **Evgenia Yavrumyan (2015)** tested weak form market efficiency of Oslo Stock Exchange (OBX) and Oslo Børs Small Cap Index (OSEAX) and concluded that market is inefficient in case of OBX and OSEAX indices and said certain segments of the market are effective in weak form. **Ankita Mishra et al. (2014)** noticed Indian market indexes are mean reverting. The researcher indicates that accommodating structural breaks is not only necessary, but also point out the need to consider heteroscedasticity when testing for a random walk with high frequency financial data. **R.Jayaraman and M.S.Ramaratnam (2011)** examined index value of stock exchanges of USA, China, Japan and South Korea from January 2010 to December 2010 on weekly basis. The study results in virtually all stock indexes rising independently without being affected by the indices of the past. **Gagan Deep Sharma and Mandeep Mahendru (2009)** derived that the impact of sample companies' stock prices on future prices is very low and the investor is unable to earn gains by using share price data as current share prices represent the impact of past share prices.

**George Filis (2006)** identifies no institutional changes between the two years of inquiry but also inferred that Athens stock market is weak form efficient. **Christos Alexakis (1992)** found that, in the case of Athens stock market, the analysis did not support the Efficient Market Hypothesis as the shift in the regular stock prices of some individual securities was not random but found to be linked positively and highly correlated. **Kinandu Muragu (1990)** states the findings do not say with absolute certainty that the market is effective in weak form but instead that the findings do not contradict the weak form of market efficiency. He also inferred that OSEAX index showing increase in efficiency in the post-crisis period.

### III. Objective of the Study

- i) To test the weak form of market efficiency of selected five sectoral indices of BSE, India (BSE Auto, BSE Bankex, BSE FMCG, BSE Healthcare and BSE Oil & Gas).

### IV. Research Methodology

This section explains research design, population and sample size, reference period, data base and sources, analytical models and statistical tools used in analyzing to achieve the above objective of current study.

The present study has exploratory and descriptive research design as it has attempted to analyze the presence of random walk hypothesis in BSE sectoral Indices of India. There are total twenty sectoral indices at BSE. In this study, population was consisting of only eleven sectoral indices out of twenty sectoral indices which are listed on BSE, India. The final sample includes five sectoral indices- BSE Auto, BSE Bankex, BSE FMCG, BSE Healthcare and BSE Oil & Gas. The study period was extended from April 1, 2012 to March 31, 2017, a total time span of five years. Daily observations of stock market were considered during this period. The data related to current study was collected from secondary sources such as websites of SEBI (www.sebi.gov.in) and BSE (www.bseindia.com).

#### 4.1 Data inputs:

Adjusted daily closing prices of selected sectoral indices for the reference period were extracted from official website of BSE. Returns of selected sectoral indices have been calculated from their respective adjusted closing prices by using the following formula:

$$R_{i,t} = \frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}}$$

Where,

$R_{i,t}$  = Return on Security  $i$  on day  $t$

$P_{i,t}$  = Closing Price of the security on day  $t$  of company  $i$

$P_{i,t-1}$  = Opening Price of the security on day  $t$  of company

#### 4.2 Data analysis techniques:

Weak form of market efficiency for the study period has been analyzed with help of following analytical tools:

- a) **Unit Root Test:** Stationary of data is the basic requirement for drawing logical conclusions in a time series study and for increasing the effectiveness and reliability of constructed models. A data series is usually called a stationary series if its mean and variance are static over a specified time period. Before proceeding with further tests, Augmented Dickey-Fuller test (ADF) on the daily returns of each selected sectoral indices was applied to test if the series considered was stationary or not-stationary.

$$\Delta p_{it} = a_0 + a_1 t + \rho_0 p_{it-1} + \sum_{i=1}^p \rho_i p_{it-1} + \epsilon_{it}$$

Where,  $p_{it}$  signifies the cost for the  $I$ -the market at time  $t$ ,  $\Delta p_{it} = p_{it} - p_{it-1}$  are coefficients to be assessed,  $t$  is the trend term,  $a_1$  is the estimated coefficient for the trend,  $a_0$  is the constant and  $\epsilon$  is white noise and  $\rho_0$  is utilized to ascertain the significance of the test with MacKinnon critical values

- b) **Serial correlation test:** Durbin-Watson test was used to analyze the serial correlation between the current and previous return sequences. The Statistical estimation of Durbin-Watson typically falls somewhere between the range from 0 and 4. When value of the Durbin-Watson statistics is equal to 2 it means that the study does not consider any autocorrelation. The Durbin Watson value below 2 shows positive autocorrelation and the value greater than 2 shows negative autocorrelation. Data is referred to as non-random when the association between current and previous returns is found to be strongly positive, meaning that certain trends exist in the return series. The existence of substantial negative correlation between current and past returns guarantees inverse relationship in data series returns. Randomness can be inferred in data series if the association between current return and past return is zero.

- c) **Variance ratio test:** In order to assess if returns or stock prices are volatile or not, the variance ratio test was introduced (Lo and MacKinlay, 1988). Using asymptotic distributional, variance-ratio test statistics are used to evaluate the random walk under two separate hypotheses of homoskedastic and heteroskedastic. All individual time series observations would be random values with an equal amount of variance under the assumption of homoscedasticity [  $z(q)$  ], while individual time series observations would be random values with an unequal variance under heteroscedasticity assumption [  $z^*(q)$  ]. In order to accept the null hypothesis, the joint probability must exceed 0.05, which implies that defined Z-test statistics fall between  $\pm 1.96$  and that the joint variance ratio of all periods is equal to one.

- d) **Runs test:** As a statistical tool, the run test applied to verify whether the return series of various strategies is running randomly or not. Run test is a non-parametric in nature which takes into account variations in a return sequence with regard to signs as positive and negative and values are ignored in the absolute form. The method is distinct from the data's continuous variance and normality. Runs test is a powerful randomness test for examining serial dependency in movements of stock prices.

## V. Data analysis and Interpretation

Following hypothesis has been framed in order to test the weak form of market efficiency in returns of selected five sectoral indices of BSE;

**H<sub>0</sub>:** Series is autonomous and distributed identically (randomly).

**H<sub>a</sub>:** Series is not autonomous and distributed identically (non-randomly).

In order to achieve the hypothesis set out above, the following techniques were used:

**5.1 Stationary analysis of data:** Augmented Dickey-Fuller (ADF) method has been applied on data series with a view to check the stationary of data. Table 1 presented the results of stationary analysis. It can be depicted from Table 1 that there is no presence of unit root in the data series of selected sectors of BSE as probability values in each sector is less than alpha (0.05). To endorse this, t-statistics is also smaller than tabularized value of MacKinnon i.e. t-critical values at 5% significance level which ultimately rejects the null hypothesis that Data has unit root. Randomness implies non-stationary sequence. Randomness in return series is unavoidable in weak form of efficient market. Table 1 proves that Indian market is weak form efficient as data is stationary during the sample period.

Table 1: Unit root test (Augmented Dickey-Fuller test)

Sector Name	Probability	T-Statistics	T-test critical values 5% level
Auto	0	-32.02425	-3.413448
Bankex	0	-31.91206	-3.413448
FMCG	0	-33.47858	-3.413448
Healthcare	0	-31.76982	-3.413448
Oil & Gas	0	-34.06297	-3.413448

Source: Author's own work

H<sub>0</sub>: Data has unit root

**5.2 Serial correlation analysis:** For checking correlation among data series, serial correlation test has been applied by using Durbin Watson test. Table 2 depicted the outcome of serial correlation analysis. From the table it can be inferred that all the values of Durbin Watson statistics during the study period are less than 2 in all selected BSE sectors which means that there is a positive correlation between the data series. Therefore, the null hypothesis was rejected meaning data had autocorrelation showing Indian stock market to be efficient market in weak form.

Table 2: Serial correlation Test

Sector Name	Durbin Watson Calculated Values
Auto	1.989921
Bankex	1.987292
FMCG	1.998446
Healthcare	1.99985
Oil & Gas	1.993776

Source: Author's own work

H<sub>0</sub>: Data had autocorrelation

**5.3 Variance ratio test:** Randomness of the return series under the assumption of homoscedasticity and heteroscedasticity by making interims of 2, 4,8,16 has been evaluated with the help of variance ratio test. Table 3 presented the results of variance ratio test. From the table it can be observed that in all selected sectoral indices of BSE the joint probability value is less than alpha (0.05) under both homoskedastic and heteroscedastic assumptions. Whereas Z-statistical values in all selected sectoral BSE indices, under both homoskedastic and heteroscedastic assumptions, do not fall between  $\pm 1.96$  leading to a rejection of the null hypothesis of data randomness.

Table 3: Variance Ratio Test

Sector Name		under the assumption of homoskedastic	under the assumption of heteroscedastic
		z-statistics value	14.91555
Auto	Joint probability value	0	0
Bankex	z-statistics value	14.62538	9.929697

	Joint pobability value	0	0
FMCG	z-statistics value	16.4698	11.72299
	Joint pobability value	0	0
Healthcare	z-statistics value	15.81486	9.486016
	Joint pobability value	0	0
Oil & gas	z-statistics value	16.18048	9.319994
	Joint pobability value	0	0

Source: Author's own work

$H_0$ : Indian stock market follows random walk

**5.4 Runs test:** Runs Test is used to analyze the randomness over a period of time of continuous positive or negative change in stock prices. The results of the Runs test were reported in Table 4. Table 4 shows that Z-statistic value is negative in all the selected sectoral indices which indicate existence of positive autocorrelation in the return series. In three sectors namely BSE Auto, BSE Bankex and BSE healthcare, the Z-statistics is more than  $\pm 1.96$  while their p-value is less than alpha (0.05) leading to the rejection of null hypothesis. On the other hand, Z-statistic value is less than  $\pm 1.96$  in two sectors of BSE i.e. BSE FMCG and BSE Oil & gas but p-value of these two sectors were also more than alpha (0.05) resulting in the acceptance of null hypothesis of weak form of market efficiency. It can be inferred that market is said to be inefficient for BSE Auto, BSE Bankex and BSE healthcare sectors.

Table 4: Runs test

Sector Name	No. of Runs	Z- statistics	P value(2-tailed)
Auto	574	-2.571	.010
Bankex	586	-1.980	.054
FMCG	610	-0.487	.626
Healthcare	562	-3.233	.001
Oil & Gas	610	-0.565	.572

Source: Author's own work

$H_0$ : Indian stock market is weak form efficient

## VI. Conclusion

This research focuses on evaluating the weak form of efficiency in returns of selected sectoral indices (BSE Auto, BSE Bankex, BSE FMCG, BSE Healthcare and BSE Oil & Gas) of BSE. Unit root test, Serial correlation test, Variance ratio test and Runs test was conducted in order to test the weak form efficiency. With the exception of two sectors BSE FMCG and BSE Oil & Gas under Runs test, the random walk hypothesis framed under the respective tests were rejected during the study period which indicates that Indian stock is a weak form inefficient. The results of this study suggest that if an investor is using the information found in past stock prices, he would not be able to consistently outperform the market. The investor can choose stocks from different sectors such as BSE Auto, BSE Bankex and BSE Healthcare in order to earn abnormal gain during very short period of time. However, extreme gains can earned from BSE FMCG and BSE Oil & Gas sector during long period of time also.

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