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TESTING RANDOM WALK HYPOTHESIS FOR BOMBAY STOCK EXCHANGE LISTED STOCKS

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Abstract

For many years researchers have been testing the existence of random walk in stock prices in developing countries. Present paper has investigated whether prices in Indian stock markets follow a random-walk process as required by market efficiency. The current paper has studied the stock returns of the Bombay Stock Exchange and tested the randomness using Run Test.Auto Correlation test and also tested the stationarity of the monthly stock returns using Dickey-Fuller test. In time series econometrics, a time series that has a unit root is known as a random walk. A random walk is an example of a non-stationary time series. The Dickey-Fuller test of stationarity is applied to the stock returns of selected 20 companies. The Dickey-Fuller test rejects the unit root hypothesis whereas Run test and Serial Correlation Tests which are very popular tests, support randomness of Bombay Stock Exchange listed stocks.

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Keywords:

Runs test;

Dickey-Fuller test;

Random Walk Hypothesis;

Market Efficiency;

Unit Root;

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1. Introduction

The weak form of market efficiency believes that all the available information about the economy, the market and the specific security has already been reflected in the price of a security, and whenever new information releases, the prices adjust immediately. Therefore in an efficient market nobody can make abnormal profits on the basis of past information. Hence future prices cannot be predicted on the basis of past prices. Random Walk theory hypothesis (RWH) states that the present market price is the best indicator of the future market prices with an error term that is stochastic in nature. The price in any period will be equal to the price in the period before, plus or minus some random variable. If a market moves randomly, the predictions about market returns would become difficult. If the market is most efficient then the future prices will move randomly and the prices formation process woould become a stochastic process.

2. Literature Survey

2.1. Studies Supporting Weak Form Market Efficiency

Fama (1965)	They found that the serial correlation coefficients for a sample of 30 Dow Jones Industrial stocks, even though statistically significant, were too small to cover transaction costs of trading.
Vaidyanathan and Gali(1994)	The study tested for the weak form efficiency checking for randomness using the runs test, serial correlation and filter rule tests based on the daily closing prices of ten shares actively traded on the Bombay Stock Exchange and found evidence from all the three tests supporting the weak form of Efficient Market Hypothesis.
Pant and Bishnoi (2002)	They also used autocorrelation function, unit root test and variance ratio to examine the random walk hypothesis for Indian stock market. On the basis of the test results, they concluded that Indian stock market follows random walk and thus is efficient in weak form.
Rao and Shankaraiah (2003), Sharma	They ran various econometric tests, found that the returns follow random walk and concluded that the Bahrain Stock Exchange is weak form efficient.

and Mahendru (2009),	
Mahmood et al. (2010)	They tried to examine the impact of recent financial crisis on the efficiency of Chinese stock market by dividing the stock price data from Shanghai and Shenzhen stock market for the period of six years, starting from January 2004 to December 2009, into two sub-periods, i.e. before crisis and during crisis period. The sample data was analyzed by applying Runs test, Variance Ratio test, Durbin-Watson test and Unit Root (ADF) test and it was concluded that the Chinese stock market was weak form efficient and global financial crisis has no significant impact on the efficiency of Chinese stock market.
Prof. Davinder Suri (2015)	In this research, they tested the weak form efficiency in the framework of random walk hypothesis for the National Stock exchange in India for the period March 2003 to February 2015. The tests conducted include tests for stationarity and normality. The test results of the data series of NSE S & P 500 Index series and daily returns from the index show that the NSE mostly follows a random walk.

2.2. Studies Not Supporting Weak Form Market Efficiency

Madhusudan (1998)	The study found that BSE sensitivity and national indices did not follow random walk.
Bhanu Pant and Dr. T.R.Bishnoy (2001)	They analyzed the behaviour of the daily and weekly returns of five Indian stock market indices for random walk during April 1996 to June 2001.They found that Indian Stock Market Indices did not follow random walk.
Gupta and Basu(2007)	They also found evidence suggesting the Indian Stock market does not follow random walk model and that there is an evidence of autocorrelation in both BSE and NSE markets rejecting the weak form efficiency hypothesis.

Anil K. Sharma and Neha Seth (2011)	They studied the impact of recent financial crisis on stock market efficiency in India. The data for last 10 years were collected from both Bombay Stock Exchange (BSE) and National Stock Exchange (NSE) in India. The data was divided into two sub-periods, i.e. before financial crisis period (period-I) and during financial crisis period (period-II) and it was concluded that Indian stock markets do not exhibit weak form of market efficiency and thus do not follow random walk in both period-I and period-II. It was found that the recent financial crisis did not impact the behavior of Indian stock markets to a great extent.
Harper, Alan; ZhenhuJin(2012) .	This study tries to determine whether the Indian stock market is efficient by examining if the stock returns follow a random walk. Following previous studies, they used autocorrelation, the Box-Ljung test statistics and the run test and found that the Indian stock market was not efficient in the weak form during the testing period. The results suggest that the stock prices in India do not reflect all the information in the past stock prices and abnormal returns can be achieved by investors exploiting the market inefficiency.
Janet Jyothi Dsouza, T. Mallikarjunappa(2012)	This study intends to contribute to the existing literature by investigating the weak-form market efficiency. The efficiency of the Indian stock market is tested by using the daily data of Bombay Stock Exchange (BSE)-200 index-based companies over the period of 1 January 1991 to 31 December 2012 by employing runs test, augmented Dickey–Fuller test (ADF) Test, Phillips–Perron test (PP) test, autocorrelation test and generalized autoregressive conditional heteroscedasticity (GARCH) (1, 1) model. The empirical results of these tests do not support the weak-form efficiency for the Indian stock market. Therefore, they concluded that the Indian stock market is not weak-form efficient. This result suggests that there is a systematic way to exploit the

	trading opportunities in the Indian stock market and the investors can earn abnormal profits by exploiting this opportunity. Since the results indicate that the market is not efficient in the weak form, the study of historical prices is beneficial for the investors. This also means that there is a scope for technical analysis as a trading strategy. The findings also open up scope for the market regulators to initiate measures to ensure market efficiency. There is an overwhelming literature supporting the weak-form market efficiency. They employed multiple tests to investigate the dependence structure of the historical prices to unravel the myth of market efficiency in the weak form.

3. Research Method

3.1. Objectives of the study

The objective of the study is to test the randomness of the Stock returns of the Bombay Stock Exchange listed companies.

3.2. Sample Selection

The study covers the period from Jan,2015 to Nov,2017. Twenty stocks which have been in top hundred stocks of BSE on the basis of market capitalization as on 31st Nov, 2017 were selected randomly.

3.3. Data Selection

The study uses monthly stock returns for the sampled 20 companies listed on the Bombay Stock Exchange for the period of Nov, 2012 to Nov, 2017. The nature of data collected for this study is secondary. The data was obtained from Yahoo Finance. The reason the monthly returns were chosen is that returns calculated using a shorter time period (e.g. daily) might result in the use of very noisy data and thus incur inefficient estimation.

3.4. Methodology

3.4.1. Run Test

The runs test (Bradley, 1968) has been used to decide if a data set is random.

Hypothesis

H0: the sequence was produced in a random manner

Ha: the sequence was not produced in a random manner

The test statistic is

$$Z = \frac{R - E(R)}{S_R}$$

Where *R* is the observed number of runs,

E(R), is the expected number of runs,

S_R is the standard deviation of the number of runs. The values of E(R) and S_R are computed as follows:

$$E(R) = \frac{2n_1n_2}{n_1+n_2}+1$$

$$s_R^2 = \frac{2n_1n_2(2n_1n_2 - n_1 - n_2)}{(n_1 + n_2)^2(n_1 + n_2 - 1)}$$

With n_1 and n_2 denoting the number of positive and negative values in the series.

At the 5 % significance level, a test statistic with an absolute value greater than 1.96 indicates non-randomness.

3.4.2. **Serial Correlation or Auto Correlation test**

Serial Correlation or Auto Correlation test is one of the parametric tests. Auto Correlation has been used for testing the randomness in a series. Serial correlation measures the correlation co – efficient in a series of numbers with the lagging values of the same series. Serial correlation test is generally used in order to test the weak form of Efficient Market Hypothesis. Serial correlation co – efficient shows the relationship between the value of a random variable in time (t) and its value (k) periods earlier. These co-efficient indicate whether price changes at time (t) is influenced by the price changes occurring (k) periods earlier. (Mathivannan & Selvakumar, 2015)

The following formula is used to calculate the serial correlation test:

$$r_k = \frac{C_k}{C_0}$$

$$C_k = \frac{1}{N}\sum_{t=1}^{N-K}(X_1 - \bar{X})(X_{t+k} - \overline{X})$$

K=1, 2……..

$\bar{X}=\frac{1}{N}\sum_{t=1}^{N} X_t$

$C_0 = Variance\ of\ X_t$

To analyze the result, three limits of correlation co –efficient have been taken. These limits are

– 0.25 to 0.25 (low correlation),

– 0.25 to – 0.75 or 0.25 to 0.75 (moderate correlation) and

– 0.75 to – 1 or 0.75 to 1 (high correlation).

The Serial Correlation is calculated for monthly returns of twenty companies from January 2015 to November, 2017. In serial correlation test, lag t is compared with lag t +1, lag t +2, lag t +3 and so on.

3.4.3. Dickey-Fuller Unit Root test

In order to test stationarity of the stock prices **Dickey-Fuller** Unit Root test has been used.This test is used to identify whether a given time series is non-stationary or not.

Hypothesis:

H0=There is a unit root for the series.

Ha=There is no unit root for the series. The series is stationary.

Here are the following three versions of the Dickey-Fuller Test:

Version	**Details**	**Model**
Type 0	No constant, no trend	$\Delta y_i = \beta_1 y_{i-1} + \varepsilon_i$ where Δy_i is the variable of interest, t is the time index,

		β_1 is a coefficient, and ε_i is the error term.
Type 1	Constant, no trend	$\Delta y_i = \beta_0 + \beta_1 y_{i-1} + \varepsilon_i$
Type 2	Constant and trend	$\Delta y_i = \beta_0 + \beta_1 y_{i-1} + \beta_2 i + \varepsilon_i$

Each version of the test uses a different set of critical values, as shown in the Dickey-Fuller Table. The coefficient follows a tau distribution, and so this test consists of determining whether the tau statistic τ (which is equivalent to the usual t statistic) is less than τ_{crit} based on a table of critical tau statistics values shown in Dickey-Fuller Table. If the calculated tau value is less than the critical value in the table of critical values, then we have a significant result; otherwise we accept the null hypothesis that there is a unit root and the time series is not stationary. (www.real-statistics.com)

4. Analysis and Intepretation

4.1. Run Test

Table I reveals that, according to the analysis of Runs test, the Z value of 18 out of the 20 sampled companies are less than the critical value at 5 per cent level of significance. Hence, the null hypothesis is accepted, that is the price movements in the BSE do not follow any pattern. It also states that the price movements of 18 sampled companies follow Random Walk Model.

Table 1: Results of Runs Test

Stock	Z Value	Table Value	Significant/Not Significant	Results
Ambuja Cements	1.393261	1.96	Not Significant	Randomness
Bank of Baroda	1.768376	1.96	Not Significant	Randomness
BHEL	0.370125	1.96	Not Significant	Randomness
DLF	0.347677	1.96	Not Significant	Randomness
Hindalco	0.083143	1.96	Not Significant	Randomness
Idea Cellular	-0.329	1.96	Not Significant	Randomness
NMDC	0.179969	1.96	Not Significant	Randomness
PNB	-0.329	1.96	Not Significant	Randomness
Power Finance	-0.97693	1.96	Not Significant	Randomness
SAIL	0.550394	1.96	Not Significant	Randomness

Tech Mahindra	-2.68846	1.96	Significant	Non-Randomness
ACC	0.020563	1.96	Not Significant	Randomness
Ashok Leyland	1.455896	1.96	Not Significant	Randomness
Aurobindo Pharm	0.370125	1.96	Not Significant	Randomness
Bajaj Holdings	0.348315	1.96	Not Significant	Randomness
Bosch	0.696631	1.96	Not Significant	Randomness
Cadila Health	0.477918	1.96	Not Significant	Randomness
Cipla	0.436502	1.96	Not Significant	Randomness
Container Corp	-2.07681	1.96	Significant	Non-Randomness
JSW Steel	0.826738	1.96	Not Significant	Randomness

4.2. Serial Correlation or Auto Correlation test

It is observed from Table II that, large number of companies show low correlation. It shows that the price changes are independent of past prices and the past prices are of no use in predicting future prices. Hence, the serial correlation result confirms that the BSE is efficient in the weak form.

Table II: **Values Of Auto Correlation Co-Efficient For Sample Companies**

Lag / Stock	1	2	3	4	5	6	7	8	9	10	11	12
Ambuja Cements	-0.051	-0.014	0.121	-0.188	0.003	-0.141	-0.083	-0.163	-0.121	0.159	-0.252	0.052
Bank of Baroda	-0.125	-0.263	0.049	-0.003	-0.233	-0.181	0.231	0.049	0.055	-0.038	0.115	-0.081
BHEL	-0.459	0.310	-0.266	0.050	-0.094	-0.042	-0.028	-0.148	0.152	0.059	0.037	-0.009
DLF	0.008	-0.160	0.172	-0.195	-0.323	0.129	0.007	-0.047	0.253	0.205	-0.112	-0.050
Hindalco	-0.086	0.176	0.169	-0.131	0.376	-0.034	-0.201	0.155	-0.195	-0.050	-0.052	-0.370
Idea Cellular	-0.022	-0.253	-0.003	-0.160	-0.021	0.144	-0.125	-0.044	0.298	-0.058	0.026	-0.196
NMDC	-0.036	-0.210	0.128	0.049	0.069	0.103	0.066	-0.313	-0.039	0.181	-0.090	-0.046
PNB	-0.121	-0.161	0.270	-0.062	-0.250	-0.011	0.084	-0.026	0.065	0.000	0.050	-0.008
Power Finance	-0.170	-0.375	-0.103	-0.052	0.480	-0.112	-0.250	0.008	0.055	0.080	-0.031	-0.078

SAIL	-0.199	-0.176	0.296	-0.053	-0.051	0.178	0.024	-0.237	0.310	0.051	-0.171	0.108
Tech Mahindra	0.038	-0.016	-0.106	-0.213	-0.275	0.004	0.083	0.306	0.087	0.008	0.016	-0.339
ACC	-0.016	-0.072	0.213	-0.145	-0.235	-0.157	-0.087	-0.199	0.034	0.247	-0.185	0.031
Ashok Leyland	-0.200	0.107	-0.096	0.000	-0.151	-0.036	0.107	0.071	0.087	-0.115	-0.163	-0.033
Aurobindo Pharm	-0.170	-0.083	-0.087	0.091	-0.015	0.034	-0.133	-0.220	0.165	-0.002	-0.030	0.177
Bajaj Holdings	0.077	-0.078	-0.187	-0.037	-0.101	-0.133	-0.043	-0.335	0.056	0.278	0.193	0.049
Bosch	-0.241	0.134	0.020	-0.207	0.234	-0.437	-0.056	0.010	-0.092	0.261	-0.240	0.243
Cadila Health	-0.203	-0.031	0.035	-0.048	0.000	-0.050	-0.028	0.002	-0.012	0.005	0.002	-0.020
Cipla	-0.240	0.081	-0.036	0.006	-0.040	-0.159	-0.135	-0.035	0.074	-0.102	0.096	0.046
Container Corp	0.113	-0.212	-0.118	0.136	-0.155	0.001	-0.096	-0.227	-0.080	0.038	0.098	0.148
JSW Steel	-0.271	0.512	-0.203	0.128	-0.120	-0.094	-0.067	-0.066	-0.042	-0.050	-0.059	-0.034

4.2. The Dickey Fuller Unit Root

The Dickey Fuller Unit Root was applied to the various leading stocks of BSE and tested for stationarity. The results of the Unit root tests of the various indices are put in a consolidated table format and interpreted. The Dickey Fuller Unit Root test is applied to the 20 stock returns and results are tabulated. The output from the Dickey-Fuller Unit Root regression analysis is shown in Table III. The study finds that the tau critical value for type 0 test is -1.950 when n = 34 and α = .05. Since Tau (Observed value) in all the stocks is greater than Tau (Critical value), we reject the null hypothesis that the time series is not stationary. The study further finds that the tau critical value for type I test is -2.958when n = 34 and α = .05. Again Tau (Observed value) in all the stocks is greater than Tau (Critical value); we reject the null hypothesis that the time series is not stationary. In type II test ,the critical value is -3.554 and again the test does not support presence of unit root.Thus the Null Hypothesis that the share return series are non-stationary can be rejected. Hence it can be concluded that share returns values are stationary and are not moving at random.

Table III: Dickey Fuller Unit Root Test Co-efficient under all three versions

	Without Intercept and Trend		With Intercept		With Intercept and Trend		Results
Variable	Tau (Observed value)	Tau (Critical value)	Tau (Observed value)	Tau (Critical value)	Tau (Observed value)	Tau (Critical value)	
Ambuja Cements	-5.963	-1.950	-5.869	-2.958	-5.992	-3.554	Stationarity
Bank of Baroda	-6.445	-1.950	-6.353	-2.958	-6.294	-3.554	Stationarity
BHEL	-9.307	-1.950	-9.162	-2.958	-9.020	-3.554	Stationarity
DLF	-5.417	-1.950	-5.475	-2.958	-5.698	-3.554	Stationarity
Hindalco	-5.935	-1.950	-6.032	-2.958	-6.550	-3.554	Stationarity
Idea Cellular	-5.769	-1.950	-5.692	-2.958	-5.642	-3.554	Stationarity
NMDC	-5.832	-1.950	-5.782	-2.958	-5.850	-3.554	Stationarity
PNB	-6.366	-1.950	-6.322	-2.958	-6.541	-3.554	Stationarity
Power Finance	-6.635	-1.950	-6.598	-2.958	-6.505	-3.554	Stationarity
SAIL	-6.936	-1.950	-6.880	-2.958	-7.608	-3.554	Stationarity
Tech Mahindra	-5.403	-1.950	-5.351	-2.958	-5.619	-3.554	Stationarity
ACC	-5.696	-1.950	-5.608	-2.958	-5.719	-3.554	Stationarity
Ashok Leyland	-6.294	-1.950	-6.690	-2.958	-6.567	-3.554	Stationarity
Aurobindo Pharm	-6.948	-1.950	-7.015	-2.958	-7.230	-3.554	Stationarity
Bajaj Holdings	-4.692	-1.950	-5.087	-2.958	-5.100	-3.554	Stationarity
Bosch	-7.435	-1.950	-7.331	-2.958	-7.237	-3.554	Stationarity
Cadila Health	-6.736	-1.950	-6.837	-2.958	-7.066	-3.554	Stationarity
Cipla	-7.243	-1.950	-7.130	-2.958	-7.143	-3.554	Stationarity
Container Corp	-5.073	-1.950	-5.008	-2.958	-4.971	-3.554	Stationarity
JSW Steel	-6.529	-1.950	-7.361	-2.958	-7.932	-3.554	Stationarity

5. Conclusion

Conclusion

The paper studied the weak form of efficiency of twenty Bombay Stock Market listed stocks using monthly stock returns during the period Jan, 2015 –Nov, 2017. The Dickey Fuller Test does not support random walk theory and accepts the absence of unit root. Whereas Run test and Serial Correlation tests confirm the random walk. The Run Test concluded that majority of Stock returns values are non-stationary and are moving at random. It is observed from Serial

Correlation tests that, large number of companies show low correlation. Hence, the serial correlation result confirms that the BSE is efficient in the weak form.

References

[1] Dsouza, J. J., & Mallikarjunappa, T. (2015). Does the Indian Stock Market Exhibit Random Walk? *Paradigm* .

[2] Dutta, A. (2016). Evidence of Weak Form Hypothesis on the Indian Stock Market Through The Use of Unit Root Test. *International Journal of Scientific Research* .

[3] Fama, E. (1965). The Behaviour of Stock Market Prices. *Journal of Business* .

[4] Gupta, R. a. (2007). Weak form efficiency in Indian Stock Markets. *International Business & Economics Research Journal* .

[5] Harper, A., & Jin, Z. (2012). Examining market efficiency in India: An Empirical Analysis of Random Walk Hypothesis. *Journal of Finance and Accountancy* .

[6] Madhusoodan, T. (1998). Persistence in Indian Stock Market Returns. *Vikalpa* .

[7] Mahmood, F. X. (2010). Global Financial Crisis:Chinese Stock Market Efficiency. *Asian Journal of Management Research* .

[8] Pant, B., & Bishnoi, T. *Testing Random Walk Hypothesis for Indian Stock Market Indices.*

[9] Rao, D. a. (2003). Stock Market Efficiency and Strategies for Developiping GCC Financial Markets:A case study of Bahrain Stock Market. *The Arab Bank Review* .

[10] Sarkar, S. (2014-15). Revisiting Random Walk Hypothesis in Indian Stock Market-An Empirical Study on Bombay Stock Exchange. *Business Studies* .

[11] Sharma, A., & Seth, N. (2012). Literature review of stock market integration: a global perspective. *Qualitative Research in Financial Markets* .

[12] Suri, D. (2015). The Indian Stock Market – is it a Random Walk? *International Journal of Economic and Business Management* .

[13] Vaidyanathan, R. a. (1994). Efficiency of the Indian Capital Market. *Indian Journal of Finance and Research* .