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Testing of Efficient Market Hypothesis in the Emerging Capital Markets: Evidence from India

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Abstract: *With the wave of globalization across the countries, the capital markets got integrated, this integration led to new developments in the securities market of both developed and developing countries. The emerging economies specially witnessed a metamorphosis in their markets probably due to new initiatives of liberalisation,privatization,globalization,de-materilisation,transparency and so on. All this helped the flow of information from companies to market and vice-versa, faster and efficient, which determine the investor's decision making in the capital market. The present study is an attempt to investigate the efficiency of Efficient Market Hypothesis in the context of Indian securities market. The aim of this study is to analyses whether prices in stocks in capital market follow a random walk process or not. The study is based on the six most significant indices of Indian stock market viz. Sensex 30,BSE 100,BSE 200,BSE 500,BSE Midcap and BSE Small cap.The behavior of these indices has been observed during the period (Jan 1991-August 2013).*
Key Words: *Efficient Market hypothesis, Random Walk Theory, Indian Capital Market, Bombay Stock Exchange.*

I. Introduction

In Financial literature the term stock market efficiency is used to explain the relationship between information and share prices in the capital market of any economy. Fama (1970 and 1991) provides the formal definition of "Market Efficiency". He classifies market efficiency into three categories namely, weak-form, semi strong-form and strong-form. In its weak form, Efficient Market Hypothesis (EMH) states that the stock returns are serially un-correlated and have a constant mean. In other words, a market is considered weak form efficient if current prices fully reflect all information contained in historical prices, which implies that no investor can devise a trading rule based solely on past price patterns to earn abnormal returns. A market is semi strong efficient if stock prices instantaneously reflect any new publicly available information and Strong form efficient if prices reflect all types of information whether available publicly or privately. Thus in an efficient capital market, past information is of no use in predicting future prices and the market should react only to new information.

Market Efficiency has an influence on the investment strategy of an investor because Since in an efficient market, the prices of securities will reflect the market's best estimate of their expected return and risk, taking into account all that is known about them. Therefore, there will be no undervalued securities offering higher than deserved expected returns, given their risk. So, in an efficient market, an investment strategy concentrating simply on the overall risk and return characteristics of the portfolio will be more sensible. If however, markets are not efficient, and excess returns can be made by correctly picking winners, then it will pay investors to spend time finding these undervalued securities,Rutterford(1983).

II. Review of literature

Fama (1970) argued that in an active market of large numbers of well-informed and intelligent investors,stocks will be appropriately priced and reflect all available information. In these circumstances, no information or analysis can be expected to result in out-performance of an appropriate benchmark. Because of the wide availability of public information, it is nearly impossible to beat the market consistently.

Sunil (1996) provides empirical evidence on weak form efficiency and the day of the week effect in Bombay Stock Exchange over a period of1987-1994. The results provide evidence of day of the week effect and that the stock market is not weak form efficient.

Mitra (2000) developed ANN model based on past stock market prices as parameters and showed that network performs very well I forecasting developments in BSE sensitive index, thus rejecting the criteria of unforcastibility of stock prices in BSE.Ming et al.(2000) also tries to disprove random walk by establishing the predictive capability of technical rules like Variable Moving Average (VMA) and Fixed Length Moving Average (FMA),this study shows that variance ratio and multiple variance ratio tests reject random walk for Kuala Lumpur stock exchange.Researchers further show that trading rules like variable lag moving average (VMA) and fixed length moving average (FMA) have predictive ability of earning profits over and above the transaction costs.

Meredith Beechey et al.(2000) in this paper, authors discuss the main ideas behind the efficient market hypothesis, and provide a guide as to which of its predictions seem to be borne out by empirical evidence, and which do not. In examining the empirical evidence, they concentrate on the stock and foreign exchange markets. The evidence suggests, however, that it cannot explain some important and worrying features of asset market behaviour.Most importantly for the wider goal of efficient resource allocation, financial market prices appear at times to be subject to substantial misalignments, which can persist for extended periods of time.

Ramasastri (2001) conducted a study on stock market efficiency spectral analysis. This research studies efficiency of Indian stock market since the beginning of 1996 to 1998 using a powerful technique-spectral analysis. Correlogram, based on Sensex, establishes that Indian stock market has been efficient, Spectral analysis finds that there is a presence of periodic cycles in the movements of share prices. Thus, confirms market efficacy as power function flatten at higher frequencies. In the post reforms era (after 1991) in a period where stock market has become mature (after 2001), the efficiency of capital market in India assume greater importance as the trend of investment is growing as a result of regulatory reforms and removal of other barriers for the entry of foreign high networth and institution investors. It is against this back drop the present study has been undertaken to test the efficiency of the Indian capital market.

Pant et al.(2002) conducted a research on Testing Random Walk hypothesis for Indian stock market Indices. While analyzing the behavior of daily and weekly returns of 5 Indian market indices for random walk during April 1996-June 2001, it shows that the Indian stock market indices do not follow random walk.

Lucio Sarno, L.Daniel (2003) this study extends this literature by showing that if the SVAR includes one or more variables that are efficient in the strong form of the efficient market hypothesis, the identifying restrictions frequently imposed in SVARs cannot be satisfied. The paper argue that the analysis will likely apply to VARs that include variables that are consistent with the weaker form of the efficient market hypothesis, especially when the data are measured at the monthly or quarterly frequencies.

Allan Timmermann, Clive W.J (2004) examine that forecasters constantly search for predictable patterns and affect prices when they attempt to exploit such trading opportunities. Thence stable forecasting patterns are therefore unlikely to persist for long periods of time and will self-destruct when discovered by a large number of investors. This gives rise to non-stationarities in the time series of financial returns and complicates both formal tests of market efficiency and the search for successful forecasting approaches.

Abdulnasser (2009) this paper tests for informational efficiency in the Australian stock market. Using daily data for the period 1994-2006, test were carried out using robust methods that are not sensitive to either non-normality in the data or the presence of ARCH effects. Authors found that the share price index has one unit root, which implies that the changes in the share price index are totally random. This finding is consistent with the weak form of market efficiency and earlier studies (Henry and Olekalns, 2002; Chaudhuri and Smiles, 2004; Hatemi-J, 2004a, b).

Hashem Pesaran (2010) the paper is focuses on the theoretical foundation of the EMH, and show that market efficiency could co-exit with heterogeneous beliefs and individual irrationality so long as individual errors are cross sectionally weakly dependent in the sense defined by Chudik, Pesaran, and Tosetti (2010). But at times of market euphoria or gloom these individual errors are likely to become cross sectionaly strongly dependent and the collective outcome could display significant departures from market efficiency but, it is likely to be punctuated with episodes of bubbles and crashes.

Phil Simmons (2010) the author studies n Differential Evolutionary Algorithm (DEA) that is can supposedly violate the weak form of the Efficient Markets Hypothesis is tested using daily data from the Australian share market from 2000 until 2008. The paper concludes speculators may make supernormal profits from new methodologies however that such profits are unlikely to be sustained.

Saqib and Mohammad (2012) examined the weak form of efficient market hypothesis on the four major stock exchanges of South Asia including, India, Pakistan, Bangladesh and Sri Lanka. Historical index values on a monthly, weekly and daily basis for a period of 14 Years (1997-2011) were used for analysis. They applied four statistical tests including runs test, serial correlation, unit root and variance ratio test. The findings suggest that none of the four major stock markets of south-Asia follows Random-walk and hence all these markets are not the weak form of efficient market.

C.Nguyen et al (2012) this empirical study investigates whether the Taiwan Stock market is weakly efficient by modifying and estimating Dockery and Kavussanos' multivariate model using a set of panel data. The Taiwan equity market is characterized as high-tech, one of the most liquid markets on the globe, well and strictly regulated, and in an advanced emerging economy. However, the empirical findings suggest that the Taiwan stock market is not informationally efficient, which may be attributable to the lack of broadness and depth of the market.

Objective of the Study

To investigate whether prices of stocks in BSE follow a Random Walk process as required by the market efficiency theory.

Research Methodology & Data

This Study is based on a case study of BSE where the Closing value of indices, viz., SENSEX30,BSE100,BSE 200,BSE 500,BSE small cap and BSE midcap have been taken as variables for the purpose of analysis and the data taken for the study range from January 1991 – August 2013. Secondary data is used for the study and the data on monthly prices is collected form bseindia.com for all indices.

To analyze the data, statistical tools like Kolmogorov-Smirnov test, Runs test, Serial correlation, Autocorrelation Function and Augmented-Dickey Fuller test are applied.

Hypotheses

Same hypothesis applies to all tests and data series.

H_{01}: The price movements in the share prices of Sensex are not affected by past prices.

H_{02}: The price movements in the share prices of BSE 100 are not affected by past prices.

H_{03}: The price movements in the share prices of BSE 200 are not affected by past prices.

H_{04}: The price movements in the share prices of BSE 500 are not affected by past prices.

H_{05}: The price movements in the share prices of Mid cap are not affected by past prices.

H_{06}: The price movements in the share prices of Small cap are not affected by past prices.

III. Results and Discussion

One of the basic assumptions underlying the random walk theory and, therefore, EMH is that if the stock prices are random then its distribution should be normal.

To understand this concept, the study has been discussed under the following heads:

i. Descriptive statistics;
ii. Frequency distributions;
iii. Kolmogorov – Smirnov Goodness of fit test;
iv. Runs test;
v. Serial test;
vi. Auto correlation function:
vii. Unit root test.

Descriptive statistics

Any normal distribution is an advantage because we need only two summary measures, mean and variance, to describe the entire distribution. Then is Jarque-Bera (JB) test of normality which is asymptotic, i.e applied to large samples where it first computes skewness and kurtosis measures and then calculates JB statistic with the joint null hypothesis that the data are normally distributed. If the computed JB statistic is low then probability value the null hypothesis is accepted i.e skewness and kurtosis is zero or vice versa.

Table: 1 Descriptive statistics

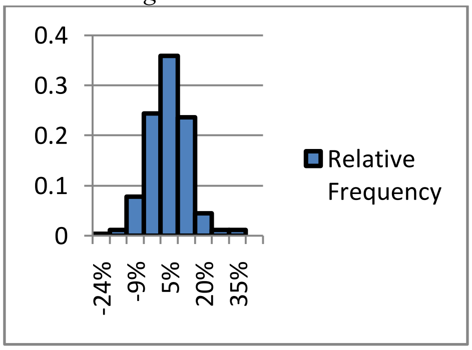
	Sensex	BSE 100	BSE 200	BSE 500	Mid cap	Small cap
Mean	7709.52	2283.39	929.37	3961.82	5124.79	6051.13
S.D	5984.08	1863.24	758.33	2448.38	2005.80	2573.57
Kurtosis	-0.86	-0.84	-0.84	-1.55	-0.86	-0.44
Skewness	0.88	0.88	0.88	0.20	-0.37	-0.21
JB	200.33	198.76	198.32	147.69	77.26	60.12
Prob.	0.00	0.00	0.00	0.00	0.00	0.00
Range	19526.77	6178.49	2526.20	7741.87	8837.22	12455.10
Minimum	982.32	290.99	130.32	850.56	952.27	893.27
Maximum	20509.09	6469.48	2656.52	8592.43	9789.49	13348.37

Frequency Distribution

The Histograms of the indices is computed to ascertain whether the distribution of index values fits the normal distribution. A distribution that is not symmetric but has a tail toward on one end of the distribution than the other is called skewed. If the tail is toward larger values, the distribution is positively skewed or skewed to the right. If the tail is toward smaller values, the distribution is negatively skewed or skewed to the left. Kurtosis indicates the extent to which, for a given standard deviation, observations cluster around a central point. If, observations within a distribution cluster more than those in the normal distribution (that is the distribution is more peaked), the distribution is called leptokurtic. If, observations cluster less than in the normal distribution (that is, it is flatter), the distribution is termed platokurtic. Values for skewness and Kurtosis are 0 if the observed distribution is exactly normal.

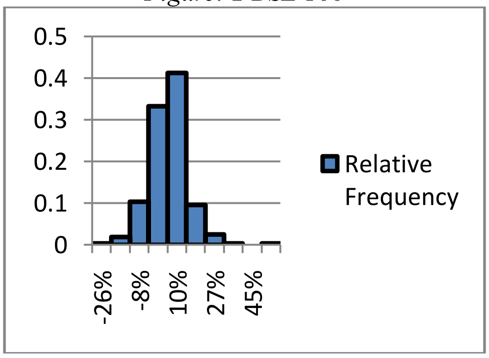
As can be seen from Figures, that the frequency distributions is not normal in the indices under study. Skewness & Kurtosis were observed to varying degrees & that none of the index is said to have normal distribution as can be seen form below depicted diagrams. As is further confirmed by Jarque-Bera (JB) test where joint hypothesis of normality is rejected in all the cases.Thence by descriptive statistics given in Table 1. The results indicate that the distribution is not normal and, therefore, the prices on BSE do not follow random walk.

Figure: 1 BSE Sensex



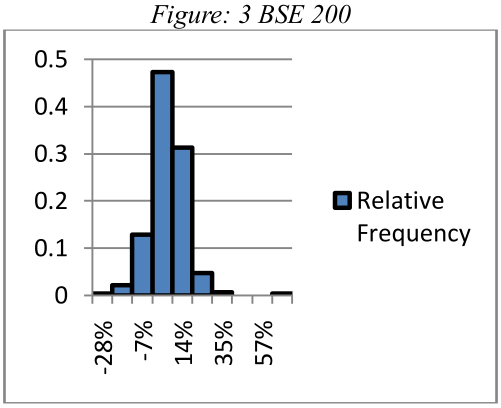
The distribution is slightly more peaked than normal

Figure: 2 BSE 100



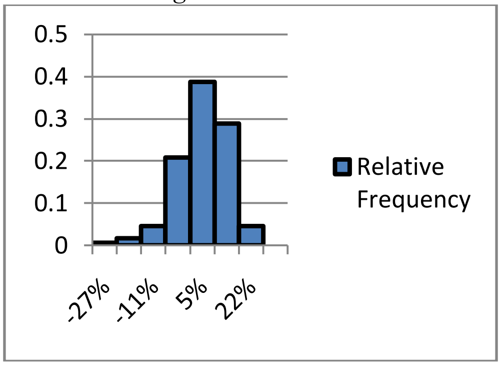
Distribution is positively skewed and leptokurtic

Figure: 3 BSE 200



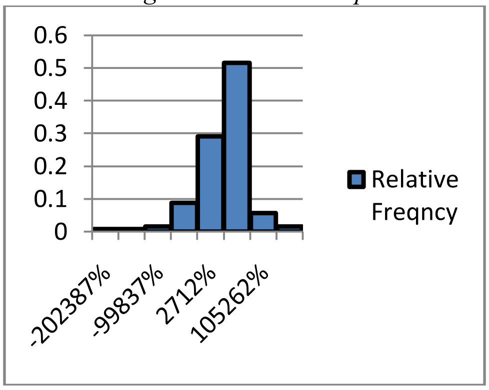
Distribution is positively skewed and leptokurtic

Figure: 4 BSE 500



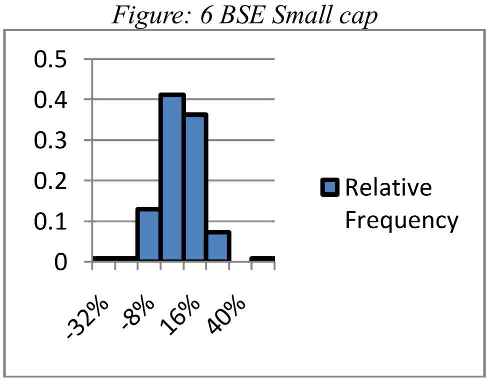
Distribution is negatively skewed and leptokurtic

Figure: 5 BSE Mid cap



Distribution is negatively skewed and leptokurtic

Figure: 6 BSE Small cap



Distribution is negatively skewed and leptokurtic with some outiers

Kolmogorov-Smirnov Goodness of fit Test

The Kolmogorov-Smirnov one sample goodness of fit test compares the cumulative distribution function of a variable with a uniform or normal distributions and tests whether the distributions are homogeneous. In other words it is used to determine how well a random sample of data fit a particular distribution (uniform,normal).It is based on compares of the samples cumulative distribution against the standard cumulative function of each distribution .The Kolmogorov-Smirnov one sample goodness of fit test compares the cumulative distribution function for a variable with a uniform or normal distribution and tests whether the distribution are homogenous with the null hypothesis as, Distribution is normal. The table 2 below clearly indicate, that the frequency distribution of the monthly values of all the indices does not fit either normal or uniform distribution as null hypothesis is rejected in all the indices.As an be seen D-values are more than critical values.

Table:2

Variable	Dmax
Sensex	1
BSE 100	1.250422
BSE 200	1.281326
BSE 500	1.601351
BSE Mid cap	2.088492
BSE Small cap	2.012428

Critical value @5%=.084
Critical value@ 20%=.066

As the results clearly indicate that the frequency distribution of Indian stock market viz, BSE does not fit either normal or uniform distribution and hence it can't be said to exhibit efficiency in weak form, in other words prices are no said to follow random walk.

Runs Test

Second method used to test the market efficiency,
The test examines whether the value of one observation influences the values taken by later observations. If there is no influence the sequence is considered random. The table 3 shows the results of Run test,for monthly returns, the p- value for all variable indices is .000 which is clearly too small than alpha-(.05).Hence, we reject the null hypothesis, that observation are randomly generated i.e. for monthly succession returns are not randomly generated.

Table:3

Variable	Z-value	p-value
Sensex	-16.2417471	0.00
BSE 100	-13.1117584	0.00
BSE 200	-16.2420911	0.00
BSE 500	-12.6147477	0.00
BSE Mid cap	-10.0551197	0.00
BSE Small cap	-9.47623233	0.00

Serial Test

Serial correlation between current and previous series was analyzed through auto correlation. If the correlation between current return and previous return is significantly positive then we infer that there exists certain trend in return series. Hence there is non-randomness in data. If it is significantly negative then, we still infer that there is certain reverse relationship in return series, implying non-randomness in data, if correlation between current and previous return is zero, only then we can infer that there is randomness in return series. It is analyzed whether the average monthly return on any month (t) correlates with the average monthly return on month (t+1,t+2,t+3……t+n).if the markets are efficient then there would be an insignificant relation between return on month (t) with the returns on month (t+1,t+2,t+3….t+n).For testing significance of autocorrelation D-W test was selected .the value of D-W test static "d" always lies between 0-4.If d is substantially less than 2,then there is evidence that series has positive autocorrelation,& if the "d" is substantially greater than 2,then there is evidence that series has negative auto-correlation, As a rule of thumb ,if d is less than 1 signify strong positive correlation, greater than 3 signify strong negative correlation. The table 4 below represents the results of D-W test for monthly return series of the indices viz; Sensex, BSE 100,BSE200,BSE 500,BSE Mid cap,BSE Small cap. All the calculated D-W statics are approximately higher or lower than 2,hence positive or negative autocorrelation is present. In that case there is no randomness in data and market can't be said weak form efficient.

Table: 4

Variable	D-value
Sensex	1.96542746
BSE 100	1.924704
BSE 200	1.89699
BSE 500	1.889404
BSE Mid cap	1.782168
BSE Small cap	1.8881804

d is approx = 2 implying that there is no autocorrelation of first order

Autcorrelation function

The autocorrelation function (ACF) test is examined to identify the degree of autocorrelation in a time series. It measures the correlation between the current and lagged observations of the time series of stock returns. If time series has unit root, than the autocorrelation function slowly decrease starting from the value of one and the partial correlation function has only first value which differs from zero. By examining the correlogram in all the figures below we see that the autocorrelation coefficients start form very high values and their values decrease very slowly towards zero as k increases Thus by autocorrelation function we can make a conclusion that the indices of BSE series under study non stationary time series.

Figure: BSE Sensex

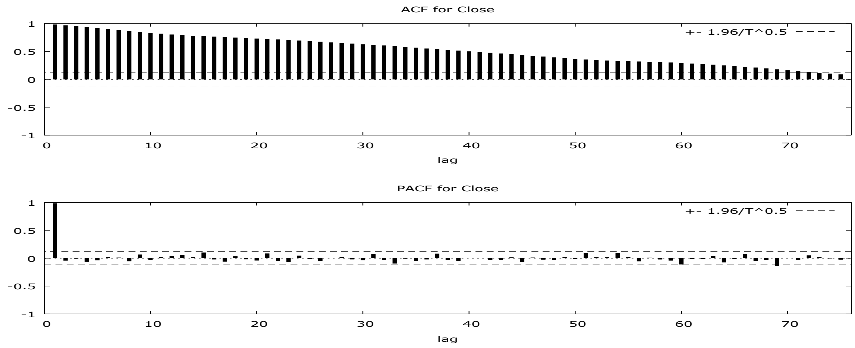


Figure: BSE 100

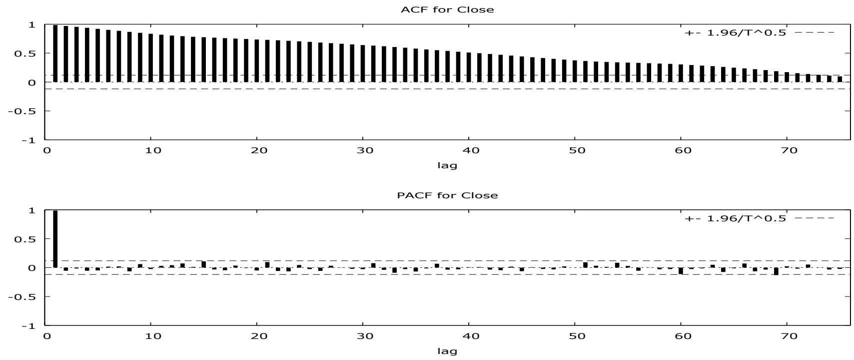


Figure: BSE 200

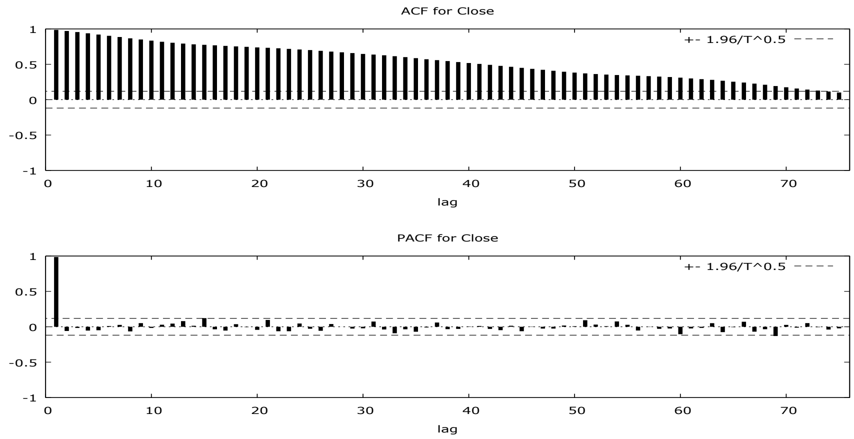


Figure: BSE 500

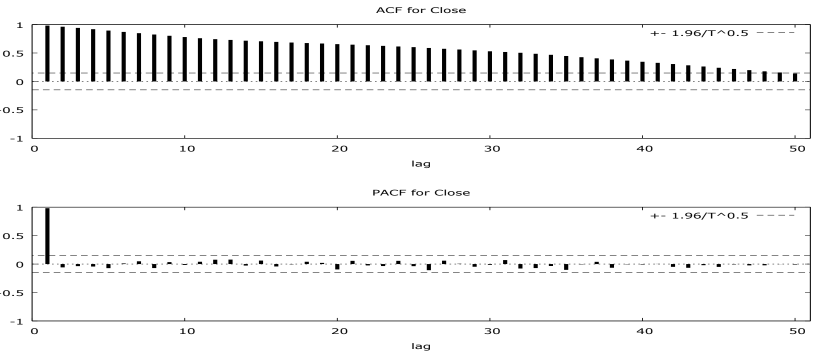


Figure: BSE Mid cap

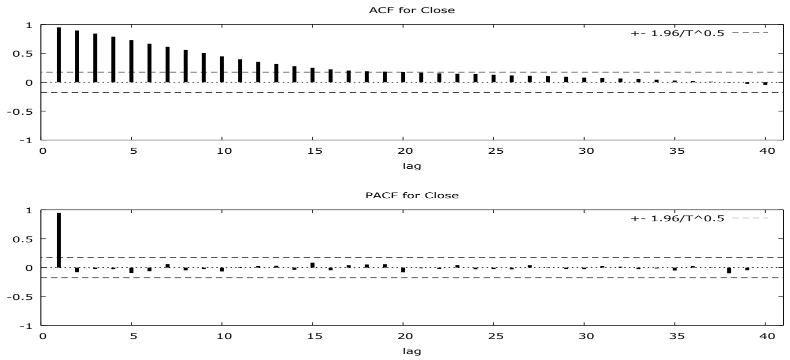
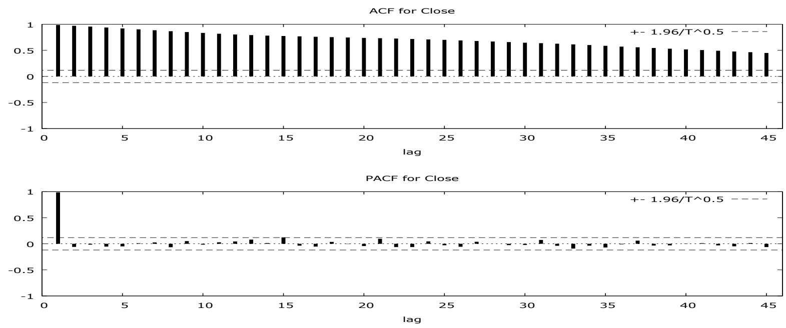


Figure: BSE Small cap



Unit root test

In this paper Augmented Dickey Fuller (ADF) was selected to test the unit root .This test can be used for testing efficiency of markets because market efficiency demands randomness (non-stationarity) in the prices of securities and unit root test investigates whether the financial time series is non-stationary or not. Unit root test has been conducted on monthly returns series of Sensex 30,BSE 100,BSE 200,BSE 500, BSE Mid cap and BSE Small cap. In table 5 results have shown that there is unit root in monthly return series of all indices at level (without differencing) but all the return series are stationary at Ist difference i.e don't contain unit root. The null hypothesis is accepted in all cases. Thereby being the second test that supports weak form of efficiency in Indian stock market.

Results of Augmented Dickey-Fuller Test **(Constant and Trend)**

Variables	Level	p-value	First difference	p-value
BSE Sensex Index	-1.92042	0.6437	-6.38125	1.262e-007
BSE 100 Index	-1.96789	0.6183	-6.46448	7.618e-008
BSE 200 Index	-2.02499	0.587	-6.52884	5.129e-008
BSE 500 Index	-3.06258	0.1154	-4.40278	0.002111
BSE Mid cap Index	-2.44472	0.3562	-4.47024	0.001634
BSE Small cap Index	-2.25573	0.4578	-10.6636	1.391e-014

IV. Conclusions

Results from all the seven tests conducted so far in this research work to test the weak form of market efficiency reveal that there is no normal distribution in any of the time series for the given period under study and that trends can be observed in past prices of all the six indices which, clearly point towards the informational inefficiency of Indian capital market. Hence it can be said, investors may get benefits due to market inefficiency or by seeking advice from fund managers as none of the time series follow Random Walk and Technical analysis of stocks and Indices can be put to use.

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Annexure:
Table : Sensex
Autocorrelation function for Close

LAG	ACF		PACF		Q-stat. [p-value]	
1	0.9855	***	0.9855	***	267.0973	[0.000]
2	0.9700	***	-0.0428		526.8101	[0.000]
3	0.9545	***	-0.0077		779.2014	[0.000]
4	0.9373	***	-0.0629		1023.5275	[0.000]
5	0.9193	***	-0.0374		1259.4173	[0.000]
6	0.9022	***	0.0244		1487.4500	[0.000]
7	0.8856	***	0.0122		1708.0227	[0.000]
8	0.8677	***	-0.0552		1920.5563	[0.000]
9	0.8519	***	0.0668		2126.2127	[0.000]
10	0.8357	***	-0.0342		2324.8648	[0.000]
11	0.8201	***	0.0192		2516.8972	[0.000]
12	0.8059	***	0.0355		2703.0494	[0.000]
13	0.7938	***	0.0606		2884.3866	[0.000]
14	0.7829	***	0.0259		3061.4247	[0.000]
15	0.7751	***	0.1025	*	3235.6275	[0.000]
16	0.7675	***	-0.0215		3407.1122	[0.000]
17	0.7582	***	-0.0612		3575.1293	[0.000]
18	0.7503	***	0.0351		3740.3085	[0.000]
19	0.7421	***	-0.0194		3902.5564	[0.000]
20	0.7326	***	-0.0410		4061.3024	[0.000]
21	0.7253	***	0.0862		4217.5056	[0.000]
22	0.7173	***	-0.0500		4370.8830	[0.000]
23	0.7067	***	-0.0713		4520.3712	[0.000]
24	0.6972	***	0.0465		4666.4656	[0.000]
25	0.6877	***	-0.0179		4809.1832	[0.000]

26	0.6761	***	-0.0489		4947.6864 [0.000]
27	0.6641	***	0.0076		5081.8644 [0.000]
28	0.6536	***	0.0247		5212.3397 [0.000]
29	0.6421	***	-0.0208		5338.7753 [0.000]
30	0.6294	***	-0.0369		5460.7789 [0.000]
31	0.6198	***	0.0731		5579.5613 [0.000]
32	0.6094	***	-0.0307		5694.8649 [0.000]
33	0.5961	***	-0.0949		5805.6542 [0.000]
34	0.5833	***	-0.0075		5912.1828 [0.000]
35	0.5692	***	-0.0529		6014.0831 [0.000]
36	0.5544	***	-0.0217		6111.1598 [0.000]
37	0.5425	***	0.0824		6204.5036 [0.000]
38	0.5303	***	-0.0325		6294.0559 [0.000]
39	0.5166	***	-0.0451		6379.4154 [0.000]
40	0.5038	***	0.0010		6460.9429 [0.000]
41	0.4916	***	0.0085		6538.9237 [0.000]
42	0.4783	***	-0.0306		6613.0451 [0.000]
43	0.4645	***	-0.0313		6683.2715 [0.000]
44	0.4518	***	0.0170		6750.0091 [0.000]
45	0.4369	***	-0.0720		6812.6896 [0.000]
46	0.4231	***	0.0127		6871.7212 [0.000]
47	0.4098	***	-0.0257		6927.3562 [0.000]
48	0.3954	***	-0.0312		6979.3711 [0.000]
49	0.3816	***	0.0247		7028.0301 [0.000]
50	0.3684	***	-0.0172		7073.5921 [0.000]
51	0.3569	***	0.0913		7116.5402 [0.000]
52	0.3461	***	0.0247		7157.1296 [0.000]
53	0.3381	***	0.0190		7196.0278 [0.000]
54	0.3318	***	0.0936		7233.6703 [0.000]
55	0.3265	***	0.0263		7270.2858 [0.000]
56	0.3213	***	-0.0559		7305.9065 [0.000]
57	0.3159	***	0.0097		7340.5018 [0.000]
58	0.3099	***	-0.0222		7373.9457 [0.000]
59	0.3037	***	-0.0421		7406.2104 [0.000]
60	0.2944	***	-0.1115	*	7436.6843 [0.000]
61	0.2837	***	-0.0114		7465.1155 [0.000]
62	0.2734	***	-0.0153		7491.6487 [0.000]
63	0.2641	***	0.0421		7516.5218 [0.000]
64	0.2514	***	-0.0747		7539.1636 [0.000]
65	0.2382	***	-0.0116		7559.5895 [0.000]
66	0.2269	***	0.0738		7578.2134 [0.000]
67	0.2128	***	-0.0504		7594.6771 [0.000]
68	0.1979	***	-0.0337		7608.9896 [0.000]
69	0.1804	***	-0.1350	**	7620.9404 [0.000]
70	0.1636	***	0.0032		7630.8176 [0.000]
71	0.1457	**	-0.0359		7638.6872 [0.000]
72	0.1305	**	0.0520		7645.0326 [0.000]
73	0.1168	*	0.0183		7650.1419 [0.000]
74	0.1032	*	-0.0047		7654.1522 [0.000]
75	0.0906		-0.0258		7657.2588 [0.000]

Table: BSE 100

Autocorrelation function for Close

LAG	ACF		PACF		Q-stat. [p-value]
1	0.9860	***	0.9860	***	267.3393 [0.000]
2	0.9706	***	-0.0538		527.3778 [0.000]
3	0.9550	***	-0.0151		780.0532 [0.000]
4	0.9381	***	-0.0539		1024.7684 [0.000]
5	0.9199	***	-0.0486		1260.9957 [0.000]
6	0.9024	***	0.0172		1489.1683 [0.000]
7	0.8858	***	0.0214		1709.8143 [0.000]
8	0.8675	***	-0.0639		1922.2770 [0.000]
9	0.8511	***	0.0607		2127.5638 [0.000]
10	0.8346	***	-0.0248		2325.6993 [0.000]
11	0.8190	***	0.0300		2517.2477 [0.000]
12	0.8049	***	0.0419		2702.9755 [0.000]
13	0.7934	***	0.0721		2884.0985 [0.000]
14	0.7826	***	0.0130		3061.0408 [0.000]
15	0.7751	***	0.1079	*	3235.2728 [0.000]
16	0.7677	***	-0.0322		3406.8301 [0.000]
17	0.7590	***	-0.0456		3575.2076 [0.000]
18	0.7517	***	0.0354		3740.9908 [0.000]
19	0.7444	***	-0.0079		3904.2410 [0.000]

20	0.7359	***	-0.0493	4064.3869	[0.000]
21	0.7294	***	0.0954	4222.3746	[0.000]
22	0.7223	***	-0.0580	4377.8972	[0.000]
23	0.7128	***	-0.0643	4529.9561	[0.000]
24	0.7040	***	0.0449	4678.9167	[0.000]
25	0.6950	***	-0.0255	4824.6425	[0.000]
26	0.6838	***	-0.0558	4966.3010	[0.000]
27	0.6725	***	0.0322	5103.8930	[0.000]
28	0.6623	***	0.0035	5237.8656	[0.000]
29	0.6510	***	-0.0209	5367.8627	[0.000]
30	0.6388	***	-0.0267	5493.5428	[0.000]
31	0.6294	***	0.0766	5616.0613	[0.000]
32	0.6192	***	-0.0380	5735.1390	[0.000]
33	0.6063	***	-0.0884	5849.7600	[0.000]
34	0.5934	***	-0.0259	5960.0156	[0.000]
35	0.5789	***	-0.0676	6065.3834	[0.000]
36	0.5639	***	-0.0140	6165.7877	[0.000]
37	0.5511	***	0.0671	6262.1169	[0.000]
38	0.5381	***	-0.0353	6354.3304	[0.000]
39	0.5241	***	-0.0291	6442.1814	[0.000]
40	0.5111	***	0.0070	6526.0822	[0.000]
41	0.4987	***	0.0098	6606.3078	[0.000]
42	0.4851	***	-0.0349	6682.5702	[0.000]
43	0.4710	***	-0.0442	6754.7545	[0.000]
44	0.4578	***	0.0174	6823.2756	[0.000]
45	0.4430	***	-0.0618	6887.7208	[0.000]
46	0.4292	***	0.0074	6948.4736	[0.000]
47	0.4159	***	-0.0230	7005.7655	[0.000]
48	0.4016	***	-0.0303	7059.4396	[0.000]
49	0.3881	***	0.0222	7109.7772	[0.000]
50	0.3754	***	-0.0009	7157.0844	[0.000]
51	0.3645	***	0.0915	7201.8780	[0.000]
52	0.3546	***	0.0324	7244.4843	[0.000]
53	0.3470	***	0.0123	7285.4629	[0.000]
54	0.3409	***	0.0837	7325.2033	[0.000]
55	0.3361	***	0.0287	7363.9948	[0.000]
56	0.3312	***	-0.0534	7401.8525	[0.000]
57	0.3260	***	0.0027	7438.6835	[0.000]
58	0.3199	***	-0.0280	7474.3292	[0.000]
59	0.3141	***	-0.0253	7508.8492	[0.000]
60	0.3052	***	-0.1126 *	7541.5889	[0.000]
61	0.2945	***	-0.0247	7572.2329	[0.000]
62	0.2842	***	-0.0131	7600.8929	[0.000]
63	0.2747	***	0.0491	7627.8036	[0.000]
64	0.2620	***	-0.0754	7652.3914	[0.000]
65	0.2486	***	-0.0119	7674.6344	[0.000]
66	0.2368	***	0.0710	7694.9215	[0.000]
67	0.2221	***	-0.0633	7712.8485	[0.000]
68	0.2065	***	-0.0343	7728.4337	[0.000]
69	0.1882	***	-0.1300 **	7741.4411	[0.000]
70	0.1713	***	0.0228	7752.2636	[0.000]
71	0.1538	**	-0.0173	7761.0400	[0.000]
72	0.1390	**	0.0530	7768.2383	[0.000]
73	0.1254	**	0.0035	7774.1313	[0.000]
74	0.1117	*	-0.0324	7778.8235	[0.000]
75	0.0987		-0.0224	7782.5054	[0.000]

Table : BSE 200
Autocorrelation function for Close

LAG	ACF		PACF	Q-stat.	[p-value]
1	0.9861	***	0.9861 ***	267.4267	[0.000]
2	0.9708	***	-0.0592	527.5649	[0.000]
3	0.9552	***	-0.0162	780.3298	[0.000]
4	0.9382	***	-0.0536	1025.1343	[0.000]
5	0.9201	***	-0.0487	1261.4494	[0.000]
6	0.9024	***	0.0104	1489.6028	[0.000]
7	0.8856	***	0.0266	1710.1864	[0.000]
8	0.8673	***	-0.0648	1922.5518	[0.000]
9	0.8506	***	0.0515	2127.5621	[0.000]
10	0.8339	***	-0.0163	2325.3522	[0.000]
11	0.8182	***	0.0293	2516.4939	[0.000]
12	0.8040	***	0.0450	2701.7857	[0.000]

13	0.7925 ***	0.0797	2882.5197 [0.000]
14	0.7820 ***	0.0144	3059.1812 [0.000]
15	0.7751 ***	0.1224 **	3233.4001 [0.000]
16	0.7682 ***	-0.0353	3405.1927 [0.000]
17	0.7600 ***	-0.0536	3573.9965 [0.000]
18	0.7531 ***	0.0363	3740.3907 [0.000]
19	0.7463 ***	-0.0051	3904.4813 [0.000]
20	0.7385 ***	-0.0432	4065.7909 [0.000]
21	0.7328 ***	0.0965	4225.2327 [0.000]
22	0.7262 ***	-0.0626	4382.4641 [0.000]
23	0.7174 ***	-0.0624	4536.5237 [0.000]
24	0.7093 ***	0.0463	4687.7287 [0.000]
25	0.7007 ***	-0.0276	4835.8782 [0.000]
26	0.6900 ***	-0.0564	4980.1282 [0.000]
27	0.6792 ***	0.0386	5120.4678 [0.000]
28	0.6693 ***	0.0006	5257.2945 [0.000]
29	0.6583 ***	-0.0253	5390.2086 [0.000]
30	0.6464 ***	-0.0211	5518.8877 [0.000]
31	0.6372 ***	0.0737	5644.4617 [0.000]
32	0.6273 ***	-0.0378	5766.6459 [0.000]
33	0.6144 ***	-0.0911	5884.3543 [0.000]
34	0.6013 ***	-0.0350	5997.5890 [0.000]
35	0.5866 ***	-0.0696	6105.7963 [0.000]
36	0.5716 ***	-0.0097	6208.9661 [0.000]
37	0.5586 ***	0.0601	6307.9341 [0.000]
38	0.5453 ***	-0.0331	6402.6527 [0.000]
39	0.5312 ***	-0.0299	6492.9107 [0.000]
40	0.5180 ***	0.0051	6579.0985 [0.000]
41	0.5054 ***	0.0113	6661.4963 [0.000]
42	0.4918 ***	-0.0301	6739.8751 [0.000]
43	0.4776 ***	-0.0479	6814.0970 [0.000]
44	0.4643 ***	0.0146	6884.5632 [0.000]
45	0.4495 ***	-0.0624	6950.8850 [0.000]
46	0.4356 ***	0.0042	7013.4441 [0.000]
47	0.4222 ***	-0.0254	7072.4882 [0.000]
48	0.4081 ***	-0.0253	7127.9022 [0.000]
49	0.3947 ***	0.0176	7179.9602 [0.000]
50	0.3821 ***	0.0079	7228.9763 [0.000]
51	0.3714 ***	0.0926	7275.4828 [0.000]
52	0.3618 ***	0.0311	7319.8296 [0.000]
53	0.3542 ***	0.0083	7362.5352 [0.000]
54	0.3481 ***	0.0755	7403.9519 [0.000]
55	0.3430 ***	0.0281	7444.3642 [0.000]
56	0.3380 ***	-0.0527	7483.7717 [0.000]
57	0.3324 ***	-0.0035	7522.0690 [0.000]
58	0.3260 ***	-0.0284	7559.0840 [0.000]
59	0.3199 ***	-0.0239	7594.8939 [0.000]
60	0.3109 ***	-0.1047 *	7628.8732 [0.000]
61	0.3003 ***	-0.0231	7660.7186 [0.000]
62	0.2898 ***	-0.0158	7690.5143 [0.000]
63	0.2801 ***	0.0507	7718.4871 [0.000]
64	0.2672 ***	-0.0753	7744.0718 [0.000]
65	0.2537 ***	-0.0057	7767.2464 [0.000]
66	0.2417 ***	0.0711	7788.3865 [0.000]
67	0.2268 ***	-0.0691	7807.0800 [0.000]
68	0.2109 ***	-0.0346	7823.3323 [0.000]
69	0.1923 ***	-0.1306 **	7836.9045 [0.000]
70	0.1752 ***	0.0268	7848.2247 [0.000]
71	0.1578 ***	-0.0127	7857.4547 [0.000]
72	0.1427 **	0.0519	7865.0478 [0.000]
73	0.1289 **	-0.0058	7871.2698 [0.000]
74	0.1148 *	-0.0389	7876.2287 [0.000]
75	0.1014 *	-0.0214	7880.1193 [0.000]

Table: BSE 500
Autocorrelation function for Close

LAG	ACF	PACF	Q-stat. [p-value]
1	0.9818 ***	0.9818 ***	171.6019 [0.000]
2	0.9619 ***	-0.0580	337.2545 [0.000]
3	0.9409 ***	-0.0363	496.6851 [0.000]
4	0.9187 ***	-0.0435	649.5593 [0.000]
5	0.8942 ***	-0.0716	795.2348 [0.000]

6	0.8703	***	0.0113	934.0426 [0.000]
7	0.8485	***	0.0487	1066.7711 [0.000]
8	0.8247	***	-0.0703	1192.9113 [0.000]
9	0.8024	***	0.0343	1313.0482 [0.000]
10	0.7802	***	-0.0161	1427.3332 [0.000]
11	0.7602	***	0.0405	1536.4775 [0.000]
12	0.7432	***	0.0764	1641.4294 [0.000]
13	0.7298	***	0.0781	1743.2564 [0.000]
14	0.7165	***	-0.0264	1842.0189 [0.000]
15	0.7059	***	0.0614	1938.4789 [0.000]
16	0.6950	***	-0.0421	2032.5675 [0.000]
17	0.6842	***	-0.0053	2124.3285 [0.000]
18	0.6748	***	0.0405	2214.1755 [0.000]
19	0.6667	***	0.0207	2302.4327 [0.000]
20	0.6557	***	-0.0946	2388.3589 [0.000]
21	0.6461	***	0.0567	2472.3346 [0.000]
22	0.6365	***	-0.0237	2554.3559 [0.000]
23	0.6250	***	-0.0348	2633.9604 [0.000]
24	0.6146	***	0.0566	2711.4453 [0.000]
25	0.6031	***	-0.0371	2786.5652 [0.000]
26	0.5883	***	-0.1076	2858.5135 [0.000]
27	0.5741	***	0.0594	2927.4984 [0.000]
28	0.5613	***	0.0056	2993.8738 [0.000]
29	0.5465	***	-0.0474	3057.2264 [0.000]
30	0.5304	***	-0.0138	3117.3236 [0.000]
31	0.5178	***	0.0701	3174.9918 [0.000]
32	0.5037	***	-0.0783	3229.9402 [0.000]
33	0.4861	***	-0.0705	3281.4846 [0.000]
34	0.4683	***	-0.0339	3329.6522 [0.000]
35	0.4476	***	-0.1019	3373.9768 [0.000]
36	0.4263	***	-0.0059	3414.4816 [0.000]
37	0.4067	***	0.0389	3451.6095 [0.000]
38	0.3865	***	-0.0651	3485.3900 [0.000]
39	0.3656	***	-0.0050	3515.8363 [0.000]
40	0.3455	***	-0.0085	3543.2314 [0.000]
41	0.3267	***	0.0026	3567.9066 [0.000]
42	0.3059	***	-0.0487	3589.6927 [0.000]
43	0.2838	***	-0.0656	3608.5945 [0.000]
44	0.2629	***	-0.0197	3624.9328 [0.000]
45	0.2404	***	-0.0498	3638.7039 [0.000]
46	0.2194	***	-0.0072	3650.2574 [0.000]
47	0.1988	***	-0.0230	3659.8221 [0.000]
48	0.1777	**	-0.0215	3667.5276 [0.000]
49	0.1574	**	-0.0020	3673.6197 [0.000]
50	0.1384	*	-0.0094	3678.3689 [0.000]

Table: BSE Mid cap

Autocorrelation function for Close

LAG	ACF		PACF		Q-stat. [p-value]
1	0.9509	***	0.9509	***	115.7660 [0.000]
2	0.8967	***	-0.0789		219.5426 [0.000]
3	0.8427	***	-0.0233		311.9533 [0.000]
4	0.7891	***	-0.0260		393.6483 [0.000]
5	0.7296	***	-0.0918		464.0771 [0.000]
6	0.6670	***	-0.0624		523.4211 [0.000]
7	0.6134	***	0.0613		574.0369 [0.000]
8	0.5594	***	-0.0482		616.4922 [0.000]
9	0.5059	***	-0.0241		651.5231 [0.000]
10	0.4492	***	-0.0669		679.3734 [0.000]
11	0.3979	***	0.0130		701.4181 [0.000]
12	0.3539	***	0.0307		719.0114 [0.000]
13	0.3159	***	0.0325		733.1575 [0.000]
14	0.2778	***	-0.0368		744.1943 [0.000]
15	0.2507	***	0.0862		753.2629 [0.000]
16	0.2244	**	-0.0469		760.5940 [0.000]
17	0.2042	**	0.0407		766.7206 [0.000]
18	0.1909	**	0.0537		772.1287 [0.000]
19	0.1855	**	0.0582		777.2808 [0.000]
20	0.1757	**	-0.0825		781.9492 [0.000]
21	0.1644	*	-0.0124		786.0752 [0.000]
22	0.1543	*	-0.0208		789.7468 [0.000]
23	0.1489	*	0.0444		793.1965 [0.000]

24	0.1418	-0.0301	796.3580 [0.000]
25	0.1307	-0.0255	799.0689 [0.000]
26	0.1186	-0.0315	801.3248 [0.000]
27	0.1110	0.0418	803.3202 [0.000]
28	0.1057	0.0050	805.1500 [0.000]
29	0.0947	-0.0227	806.6319 [0.000]
30	0.0816	-0.0265	807.7453 [0.000]
31	0.0722	0.0304	808.6255 [0.000]
32	0.0668	0.0161	809.3863 [0.000]
33	0.0567	-0.0266	809.9408 [0.000]
34	0.0455	-0.0146	810.3013 [0.000]
35	0.0303	-0.0503	810.4632 [0.000]
36	0.0203	0.0289	810.5366 [0.000]
37	0.0111	0.0048	810.5587 [0.000]
38	-0.0062	-0.0996	810.5658 [0.000]
39	-0.0274	-0.0460	810.7049 [0.000]
40	-0.0467	-0.0000	811.1128 [0.000]

Table : BSE Small cap

Autocorrelation function for Close

LAG	ACF	PACF	Q-stat. [p-value]
1	0.9861 ***	0.9861 ***	267.4267 [0.000]
2	0.9708 ***	-0.0592	527.5649 [0.000]
3	0.9552 ***	-0.0162	780.3298 [0.000]
4	0.9382 ***	-0.0536	1025.1343 [0.000]
5	0.9201 ***	-0.0487	1261.4494 [0.000]
6	0.9024 ***	0.0104	1489.6028 [0.000]
7	0.8856 ***	0.0266	1710.1864 [0.000]
8	0.8673 ***	-0.0648	1922.5518 [0.000]
9	0.8506 ***	0.0515	2127.5621 [0.000]
10	0.8339 ***	-0.0163	2325.3522 [0.000]
11	0.8182 ***	0.0293	2516.4939 [0.000]
12	0.8040 ***	0.0450	2701.7857 [0.000]
13	0.7925 ***	0.0797	2882.5197 [0.000]
14	0.7820 ***	0.0144	3059.1812 [0.000]
15	0.7751 ***	0.1224 **	3233.4001 [0.000]
16	0.7682 ***	-0.0353	3405.1927 [0.000]
17	0.7600 ***	-0.0536	3573.9965 [0.000]
18	0.7531 ***	0.0363	3740.3907 [0.000]
19	0.7463 ***	-0.0051	3904.4813 [0.000]
20	0.7385 ***	-0.0432	4065.7909 [0.000]
21	0.7328 ***	0.0965	4225.2327 [0.000]
22	0.7262 ***	-0.0626	4382.4641 [0.000]
23	0.7174 ***	-0.0624	4536.5237 [0.000]
24	0.7093 ***	0.0463	4687.7287 [0.000]
25	0.7007 ***	-0.0276	4835.8782 [0.000]
26	0.6900 ***	-0.0564	4980.1282 [0.000]
27	0.6792 ***	0.0386	5120.4678 [0.000]
28	0.6693 ***	0.0006	5257.2945 [0.000]
29	0.6583 ***	-0.0253	5390.2086 [0.000]
30	0.6464 ***	-0.0211	5518.8877 [0.000]
31	0.6372 ***	0.0737	5644.4617 [0.000]
32	0.6273 ***	-0.0378	5766.6459 [0.000]
33	0.6144 ***	-0.0911	5884.3543 [0.000]
34	0.6013 ***	-0.0350	5997.5890 [0.000]
35	0.5866 ***	-0.0696	6105.7963 [0.000]
36	0.5716 ***	-0.0097	6208.9661 [0.000]
37	0.5586 ***	0.0601	6307.9341 [0.000]
38	0.5453 ***	-0.0331	6402.6527 [0.000]
39	0.5312 ***	-0.0299	6492.9107 [0.000]
40	0.5180 ***	0.0051	6579.0985 [0.000]
41	0.5054 ***	0.0113	6661.4963 [0.000]
42	0.4918 ***	-0.0301	6739.8751 [0.000]
43	0.4776 ***	-0.0479	6814.0970 [0.000]
44	0.4643 ***	0.0146	6884.5632 [0.000]
45	0.4495 ***	-0.0624	6950.8850 [0.000]