Testing Market Efficiency of Indian Capital Market

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Abstract

The paper is an empirical study on Indian capital market for the period 1st January, 2010 to 31st December, 2015. The random walk hypothesis is tested to see the behavior of stock prices. While there are three forms of Market efficiency namely weak, semi strong and the strong, market efficiency of weak form is tested here by applying the Runs test and Auto-correlation test. The random walk hypothesis proves the market efficiency of the Indian market. The Runs test shows the daily return on nifty index does not move in a random manner. The results of the test raise the question mark on the efficiency of the market. Auto-correlation test suggest that there is no serial correlation in the nifty index data which supports the market efficiency in the Indian capital market.

Keywords: *market efficiency, Runs Test, Auto-correlation, Random Walk hypothesis, unit root, Augmented Dickey Fuller test*

Introduction

The market efficiency concept was introduced by Bacheilier in 1900 and in the empirical research work by Cowles in 1933 (Campbell et al., 1997). The concept of random walk hypothesis which states that the stock prices behave in a random order was empirically proved by Samuelson in 1965 and thus can be regarded as the beginning of modern literature on market efficiency. Fama (1970) talks about information assimilation in the market prices and three forms of market efficiency namely weak form of market efficiency, semi-strong form of market efficiency and strong form of market efficiency.

The weak form of market efficiency assumes that the stock price incorporates all the previous information or the history of a company. The future change in the stock price depends upon future information and as the future information is uncertain changes in the stock prices are random and cannot be predicted from the historical prices. Weak form of hypothesis says that any investor cannot gain higher returns by conducting technical analysis on the stock price of a firm.

Semi-strong form of market efficiency talks about the quick incorporation of any public information in the stock prices. The public information could be like a company announces dividend payout, stock splits, bonus shares, merger etc. In an efficient market, the public information would be captured in the stock prices in a very short interval and no investors would be able to make any abnormal returns by applying any trading strategies on the basis of public information.

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Strong form of market efficiency says that the stock price incorporates all the three types of information – historical, the public and the private. The meaning of the term private information means the information which is available with the few individuals who may or may not be associated with the company and the information is still not in public domain. The implication of the strong market efficiency is that it is not possible to make any abnormal returns by adapting any investment strategies.

Many modern financial researchers have criticized the existence of market efficiency in the capital market due to various anomalies. The market crash of 1987, financial crisis in 2008, the January effect, the Monday effect, internet bubble burst, size effect etc. are few such phenomena which are against the efficient market hypothesis. All these cases depict the irrational behavior of the investors and put a question on the incorporation of all information in the stock prices of a company.

The objective of the current research is to see the behavior of the Indian capital market from the perspective of market efficiency.

Review of Literature

As suggested by Fama and French (1988), stock prices support efficient market hypothesis and some time there could be an anomaly in short run but in longer run they tend to behave in a random manner or they have a tendency to revert to its mean.

Performance of professional investors was analyzed (Jensen 1968) for a long period and it was found that on average, all the funds underperformed the market on the basis of its expense ratio. Similar results were reconfirmed by Malkiel (1995) when the mutual fund data were further extended to the future period.

Short-term movement of the stock prices were found to have serial correlation and therefore, the stock prices could be predicted on the basis of technical analysis (Lo and McKinlay, 1999). The market behavior was not efficient and investors exhibited bandwagon effect (Shiller, 2000).

Seasonal, Day of the week, January effect pattern are also seen in the stock returns (Haugen and Lakonishok, 1988). Further research suggests that such anomaly does not last for a long period as such information becomes public, the abnormal returns seems to disappear.

Efficient market hypothesis model was tested by Gupta (1985). He examined the share price behaviour in India during 1971 to 1976 and concluded that the results uphold market efficiency. Similar studies done by Barua (1981), Singh et al (2010) taking daily, weekly, monthly price data, and have concluded that the stocks in India support Random Walk hypothesis and the market support the weak form of efficient market hypothesis model. Ahmad et al (2006) rejected the random walk hypothesis using daily data for stock indices of NSE, Nifty and BSE, Sensex, for period 1999-2004. They concluded that both the stock markets had become relatively more inefficient in recent periods and have high and increasing volatility.

The movement of a stock can be forecasted with the fair amount of certainty on the basis of its price to earnings ratio and price to book value ratio. This imply that the markets are not efficient (Campbell and shiller, 1998)

Many contrary views have been discuss in this paper on efficient market hypothesis in terms quantity of dynamics and international reach. Also the paper finds that writing of behavioral finance lag behind efficient market (Wójcik and Mcgill, 2013). Hence here, research is attempted fill the gap.

Also, the author after consulting literature on market efficiency analyses, finds that research on market efficiency hypothesis have been undertaken more internationally to explain the dynamics of the stock market. Very less research work has been done on Indian stock market. This way the paper an attempt to contribute to this field.

Data and Methodology

Data for research were taken from the NSE website. The nifty index was selected as it can be used as an indicator for the overall market. The time period of 6 years was selected from 1st January, 2010 to 31st December 2015. The total number of observation found in the period is 1492. Three different tests will be used to test the market efficiency of the Indian

capital market. The first is the random walk hypothesis. The second is the runs test and the third is the auto-correlation test.

Test -1

The concept of random walk states that a series behaves in a random order and is not possible to predict the future data on the basis of previous data. The series is said to have a unit root and is non-stationary. The presence of unit root in the series is tested by Augmented Dickey Fuller test. The first difference of the series called displacement stationary process is tested for the condition of stationary. A series is said to be stationary if it has a property to revert back to its mean value. The Random walk hypothesis is tested using the following model.

$$Y_t = Y_{t-1} + U_t;$$

Displacement stationary Process (DSP)

$$\triangle Y_t = U_t$$

Where:

Y_t = Price of stock on day "t"

Y_{t-1} = Price of stock on day "t-1"

$$\triangle Y_t = Y_t - Y_{t-1}$$

U_t = iid (0,1): strongly stationary process

Test -2

The Runs test is a non-parametric test and is used to test that the weak form of market efficiency. The runs test detects the randomness behavior of a series. The null hypothesis of the runs test is that the sequence of data is random. It is based on the observed and the expected sequence of data. The market is said to be efficient if the difference between the expected and observed frequency is less.

R = Total number of Runs observed in the data sequence

$$E(R) = 1 + 2*N_0N_1/N;$$

$$V(R) = 2*N_0N_1(2*N_0N_1 - Ne)/N^2/(N-1);$$

Where:

N_0: Number of days the when return is lower than the mean return,

N_1: Number of days the when return is more than the mean return,

N: $N_0 + N_1$;

E(R) = Expected Runs in the data sequence

V(R) = Variance of Runs between the expected and the observed

Test -3

Auto-correlation tests, whether the current data are related to previous data. In an efficient market, the future stock price cannot be predicted on the basis of past stock prices. Which means the there is no correlation of the current stock prices to the previous stock prices in an efficient market. Auto-correlation or serial correlation will be tested by Q-statistics and LM test using E-Views software.

Data Analysis and Empirical Results

Test 1

The nifty index data expressed in log is shown in exhibit -1(a). The series has a ascending long term trend. The series is tested for the stationary properties. Exhibit -1(b) shows the log of first difference of nifty index. The series suggests that it is mean reverting series and have a tendency to come to its mean position after fluctuation in random order.

Exhibit -1(a): Nifty index from 2010 to 2015 expresses in log of nifty index

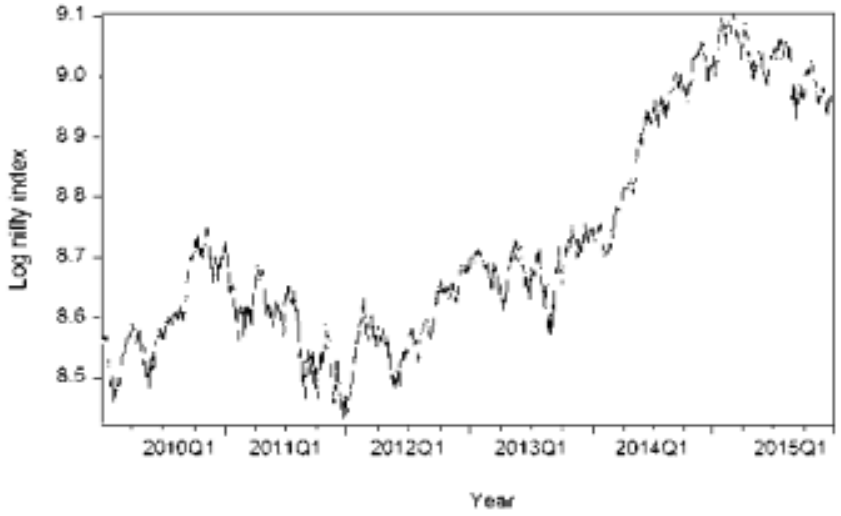
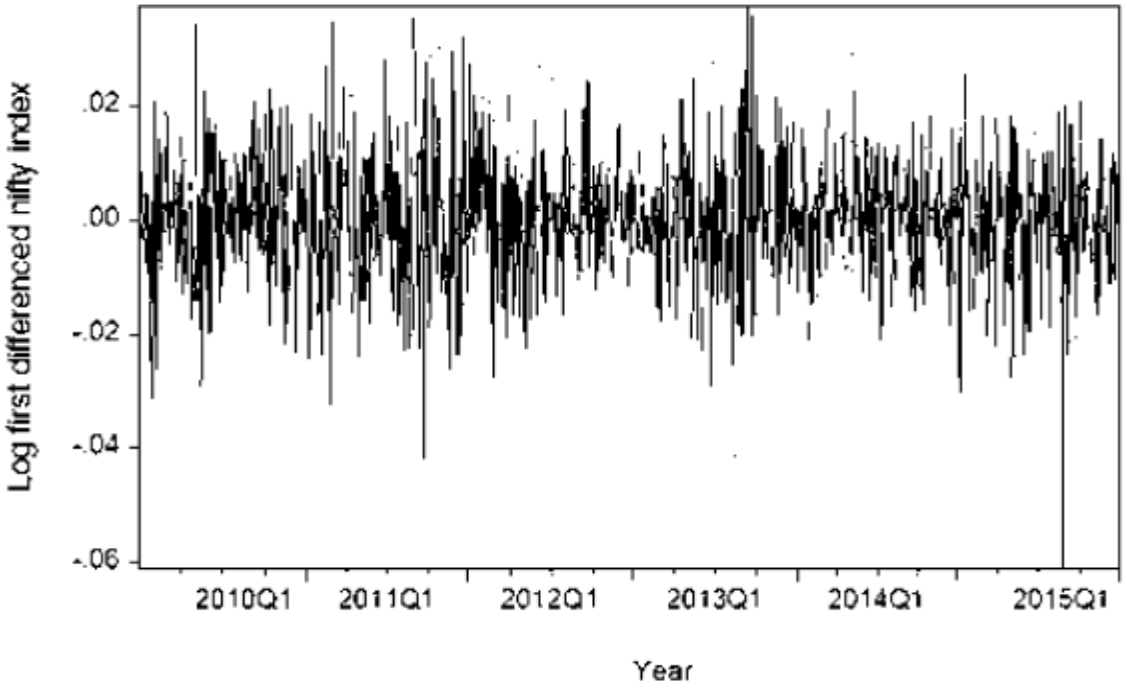


Exhibit – 1(b): Nifty index from 2010 t0 2015 expresses in log of first differenced nifty index



Augmented Dickey Fuller (ADF) was applied to test whether the nifty series has a unit root. Table – 1(a) shows that the *P*-value is 0.4955 which suggest that we accept the null hypothesis and can say that the nifty series in non-stationary. The ADF was applied to the series when log of first difference of nifty index was taken. Table- 1(b) shows that *P*-value is 0.000 which suggest that we reject the null hypothesis. Which means that the series does not have a unit root, and the series is stationary.

Table – 1(a): ADF test for unit root for the log nifty index

Null Hypothesis: NIFTYINDEX has a unit root Exogenous: Constant, Linear Trend Lag Length: 1 (Automatic - based on SIC, maxlag=23)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.187863	0.4955
Test critical values:	1% level	-3.964215	
	5% level	-3.412829	
	10% level	-3.128398	

Table – 1(b): ADF test for unit root for the log first differenced nifty index

Null Hypothesis: D(NIFTYINDEX) has a unit root Exogenous: Constant, Linear Trend Lag Length: 0 (Automatic - based on SIC, maxlag=23)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-35.77321	0.0000
Test critical values:	1% level	-3.964215	
	5% level	-3.412829	
	10% level	-3.128398	

*MacKinnon (1996) one-sided p-values.

Test 2

Runs test was conducted on the nifty data. The descriptive statistics of the test are given in Table-2. The data shows that we reject the null hypothesis as the P-value is 0.021. Therefore we can say that the sequence was not produced in the random manner. The null hypothesis (H_0) of the test is that the data sequence or the number of runs is produced in a random manner.

Table -2: Results of Runs test

Mean of daily returns	0.033615211
Runs	703
n0	744
n1	747
n	1491
E(R)	746.4969819
V(R)	372.4968141
Standard deviation (R)	19.30017653
Z	-2.25370902
P-value	0.01210724

The Q-statistics values when 36 lags were taken, are shown in Table-3. The null hypothesis of the test is that there is no serial correlation or auto-correlation. As run values of the Table 3 suggest we accept the null hypothesis.

Table -3: Q-statistics test for Auto-correlation

Date: 05/08/16 Time: 18:27
Sample: 1/06/2010 2/03/2014
Included observations: 1490

Autocorrelation AC	Partial Correlation PAC		AC	PAC	Q-Stat	Prob
| |	| |	1	0.000	0.000	0.0004	0.985
| |	| |	2	-0.005	-0.005	0.0328	0.984
| |	| |	3	-0.040	-0.040	2.4689	0.481

| |	| |	4	-0.002	-0.002	2.4725	0.650
| |	| |	5	-0.001	-0.001	2.4744	0.780
| |	| |	6	0.008	0.006	2.5635	0.861
| |	| |	7	0.011	0.010	2.7311	0.909
| |	| |	8	-0.027	-0.027	3.8454	0.871
| |	| |	9	0.033	0.034	5.5057	0.788
| |	| |	10	0.003	0.004	5.5224	0.854
| |	| |	11	-0.051	-0.053	9.3967	0.585
| |	| |	12	0.007	0.010	9.4637	0.663
| |	| |	13	-0.008	-0.008	9.5577	0.730
| |	| |	14	0.032	0.028	11.060	0.681
| |	| |	15	-0.018	-0.018	11.575	0.711
| |	| |	16	-0.035	-0.038	13.448	0.640
| |	| |	17	0.014	0.020	13.761	0.684
| |	| |	18	0.006	0.004	13.809	0.741
| |	| |	19	0.023	0.017	14.612	0.747
| |	| |	20	-0.000	0.004	14.612	0.798
| |	| |	21	-0.039	-0.040	16.948	0.714
| |	| |	22	-0.020	-0.018	17.562	0.732
| |	| |	23	-0.036	-0.038	19.509	0.671
| |	| |	24	-0.033	-0.039	21.119	0.632
| |	| |	25	0.003	0.007	21.130	0.685
| |	| |	26	-0.006	-0.013	21.181	0.733

| |	| |	27	-0.055	-0.061	25.847	0.527
| |	| |	28	-0.025	-0.024	26.766	0.531
| |	| |	29	0.005	0.003	26.810	0.582
| |	| |	30	0.002	0.005	26.819	0.633
| |	| |	31	0.026	0.021	27.815	0.631
| |	| |	32	-0.024	-0.029	28.690	0.635
| |	| |	33	0.027	0.031	29.799	0.627
| |	| |	34	0.020	0.019	30.384	0.646
| |	| |	35	-0.011	-0.016	30.580	0.681
*| |	| |	36	-0.068	-0.064	37.602	0.396

Test 3

Breusch-Godfrey serial correlation LM test was applied on the daily returns data series of nifty index. The chi-square at a lag 4 is 0.6507 as shown in the Table-4. The LM test suggests that we accept the null hypothesis that there is no serial correlation in the data series on the basis of the 'F' and chi-square values.

Table 4

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic Obs*R-squared	0.615040 2.466017	Prob. F(4,1484) Prob. Chi-Square(4)	0.6519 0.6507
Test Equation:			
Dependent Variable: RESID			
Method: Least Squares Date: 05/08/16 Time: 18:36 Sample: 1/06/2010 2/03/2014 Included observations: 1490 Presample missing value lagged residuals set to zero.			

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.64E-05	0.000503	0.032666	0.9739
RETURNS(-1)	-0.048970	1.253740	-0.039059	0.9688
RESID(-1)	0.049222	1.254007	0.039252	0.9687
RESID(-2)	-0.001432	0.086142	-0.016623	0.9867
RESID(-3)	-0.040166	0.026495	-1.516001	0.1297
RESID(-4)	-0.001538	0.025971	-0.059212	0.9528

R-squared	0.001655	Mean dependent var	-5.74E-19
Adjusted R-squared	-0.001709	S.D. dependent var	0.010546
S.E. of regression	0.010555	Akaike info criterion	-6.260407
Sum squared resid	0.165331	Schwarz criterion	-6.239039
Log likelihood	4670.003	Hannan-Quinn criter.	-6.252444
F-statistic	0.492032	Durbin-Watson stat	1.999759
Prob(F-statistic)	0.782416		

Conclusion

The Indian capital market follows random walk hypothesis. It signifies that the future movement of nifty index cannot be predicted from the past data. Runs test result suggests that the sequence of daily returns is not purely in random nature, which means that the future return can be predicted on the basis of past returns. Auto-correlation test shows that there is no serial correlation in the returns data. Overall three tests were applied on the data set and out of three, two tests support the view point that the market efficiency exist in Indian capital market. The research findings are similar to results concluded by samuelson (1965) and Fama (1970).

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