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Evidence of Weak Form Hypothesis on The Indian Stock Market Through The Use of Unit Root Test

Management

KEYWORDS : Efficient Market Hypothesis, Weak Form Hypothesis, National Stock Market.

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ABSTRACT

This study is directed at studying the efficiency of the market by using a period of fifteen years data from the NIFTY and try to understand whether the EMH in its weak form hold good for the market or not. In the study unit root test confirms the random walk whereas the other two methods reject it. Since the variance ratio test is more powerful than the usual Dickey Fuller test we can safely conclude that random walk does not hold good for the Indian Market at this period of time. The results are consistent for all the three split periods.

1 Introduction

The capital market is based on information flows and the market is said to be efficient on how it reacts to these information which is largely depended on the degree to which the participants of the market can use the information available to them. The more reactive the stock price is to the available information the more is the efficiency of the market. Fama (1970) noted that Efficiency of the market depends on the extent of absorption of information, the time taken for absorption and type of information absorbed.

2. Literature Review

Pioneering works of Fama (1965) developed the theory of efficient market hypothesis. Later Fama (1970), introduced the concept of three form of EMHs. The first order auto correlations were positive for 23 of the 30 companies and they were significant for 11 of the 30 companies.

Cooper (1982) analyzed the world stock markets by taking 36 countries and observes that the markets in USA and UK as efficient based on random walk hypothesis. Sharma and Kennedy (1977) used run test and spectral analysis and concluded that all these markets analysis were strong form efficiency of EMH for BSE, NYSE and LSE. Barua (1981) and Gupta (1985) and Bhaumik (1977) found that the Indian market were weak form efficient. Ramasastri (1999) tested Indian Stock Markets for random walk using Dickey –fuller unit root test and study supports the null hypotheses that stock prices are random walk.

Mitra (2000)developed a neural network model and disapproved the random walk hypothesis for BSE Index. Chaudhuri and Yangru (2003) investigated whether stock prices indices of seventeen emerging markets can be characterized as random walk. Dutta (2010) tested for volatility using asymmetric GARCH and concluded that the volatility in Indian market is spurious and does not support the random walk. Several other studies over the period including Ahmad et al (2007), Worthington and Higgs (2003) suggested that Asian markets show weak form hypothesis using the unit root process.

3. Gap in Research

The literature shows mixed results about the efficiency of the Indian and to be more into establishing the EMH then to suggest a specific method to understand this. Therefore a study to understand the EMH weak form in the period of study is in place.

4. Objective of the paper

The main objectives of this chapter is given below

To test the random walk hypothesis for the Indian stock market.

To establish a new tool to measure the EMH, especially the random walk hypothesis.

5. Scope of the Paper

The scope of this paper is limited to Indian stock market (NSE) and for the period of the study i.e; March 31 1998 to 1st April 2013.

6. Data Source and Method of Study

6.1 Data Source:

Data has been procured from the official website of NSE for the period of the study March 31 1998 to 1st April 2013. Return for the NIFTY series was found using one period lag and subjected the methods described below.

6.2 Method of Study:

In the present study several econometric models were used to check the random walk hypothesis for the Indian stock market with reference to BSE.

6.2 Unit root test

A data set is said to be stationary if its mean and variance are constant over time and the value of covariance between two time periods depends only on the distance or lag between the two periods and on the actual time at which the covariance is computed. A series observing these properties is called a stationery time series. The unit root test checks whether a series is stationery or not using Augmented Dickey-Fuller (ADF). For this the following types of ADF regression has been applied.

$$\Delta Y_t = \alpha_1 Y_{t-1} + \sum_{m=1}^{n} \beta_m \Delta Y_{t-m} + \mu_t \quad \text{.....}$$

Equation 1.

$$\Delta Y_t = \alpha_o + \alpha_1 Y_{t-1} + \sum_{m=1}^{n} \beta_m \Delta Y_{t-m} + \mu_t \quad \text{.....}$$

Equation 2.

Where μtis white noise. The additional lagged terms have been included to ensure that the errors are uncorrelated. The following hypotheses have been tested by applying unit root test as given below.

$H_o = Y_t$ is not I (0) and H = Yt is I (0)

This means that Y_t is not integrated of order zero in null hypothesis and Y_t is integrated of order zero in alternate hypothesis.

If the calculated value of ADF statistics are higher than their critical values from fullers table, then the series are non- stationery or not integrated of order zero and vice versa.

6.3 Auto correlation function (ACF)

The auto correlation function is another alternative for testing random walk hypotheses for stock index series. It was defined by Barlett (1946) as:

$\hat{P}k = \hat{Y}k / Yo$ .....Equation 3.

Where $\hat{Y}k$ is the covariance at lag k and $\hat{Y}o$ is variance at lag k which are expressed as follows.

$\hat{Y}k = \Sigma (Yt - \bar{Y}) (Yt+k - \bar{Y})/n$ .....Equation 4

$\hat{Y}o = \Sigma (Yo - \bar{Y})2 /n$ .....Equation 5

Thus ϱ can be finally rewritten as follows;

$$p = \frac{\sum_{t=1}^{n-k} (Yt - \bar{Y}) (Yt+k - \bar{Y})}{\sum_{t=1}^{n} (Yo - \bar{Y})2} \quad \text{.....Equation 4}$$

If the prices changes of the stocks are random then, ϱ_k for the first differences of stock index series will be zero for all time lags. Standard error of ϱ_k [SE (ϱ)] can be estimated as below:

$SE = 1/\sqrt{n}$

Here, SE standard error and n stands for number of observations.

6.4 Hypothesis

The hypothesis of the autocorrelation test is are given below;

H_o = Auto correlation coefficient are equal to zero

H_a = Auto correlation coefficient are not equal to zero

Ljung and Box test is applicable to test the joint hypotheses that all ϱ_k autocorrelation coefficients are simultaneously equal to zero.

7 Analysis and Interpretation of the results

7.1 Unit root test.

Unit root test is conducted for the period March 31 1998 to 1st April 2013. Since the basic assumption of the random walk hypothesis is that if stock index (here NIFTY) series follow random walk then these series will be non-stationery at levels and their first difference will be random variable. The period has been broken into three period of 31st March 1998 to 1st April 2002 (hence forth called as period 1), 2nd April 2002 to 1st of April 2008 (henceforth called as period 2) and 2nd of April 2009 to 31st March 2013 (henceforth called as period 3). There after ADF has been taken into consideration for these periods as well as for the entire period. Table 2 shows the result of the ADF tests.

Table 2 Augmented Dickey-Fuller Test for Unit Root

Series or periods	ADF Test Statistics	At 5% confidence level	P-value
NIFTY (period 1)	- 1.46	-1.68	0.13
NIFTY (1st difference of SENSEX series at period 1)	-13.66	-1.68	0.00
NIFTY (period 2)	-2.05	-1.86	0.16
NIFTY (1st difference of NIFTY series at period 2)	-23.42	-1.86	0.00
NIFTY (period 3)	-2.88	-1.86	0.00
NIFTY (1st difference of NIFTY at level 3)	-28.75	-1.86	0.00
NIFTY (overall period)	-2. 21	-1.86	0.00
NIFTY (1st difference for the overall period)	-45.66*	-1.86	0.00

Source: Computed

Table 2 shows that for all the three periods separately and the overall period the series of NIFTY is non-stationery but stationery when the first difference of theses series are been considered. It is concluded on the basis of the unit root test, that NIFTY follow a random walk hypothesis and Indian stock markets are efficient.

7.2 Autocorrelation and Ljung-Box Test

The autocorrelation coefficients for the first order differences are presented in the table 3 below.

Table 3 Autocorrelation coefficients statistics of first difference of the NIFTY series.

Lag	Autocorrelation 1st period	Autocorrelation2nd period	Autocorrelation3rd period	Autocorrelation entire period
1	0.11*	0.01	0.02*	0.09*
2	-0.06	-0.04	0.06	-0.06
3	-0.11*	-0.10*	-0.12	-0.10*
4	-0.09	-0.08	0.08*	0.11
5	0.02	0.03*	0.02	0.02
6	0.02*	0.01	0.03	0.02*
7	-0.11*	-0.10*	-0.10	-0.12*
8	0.03	0.02	0.02*	0.06
9	0.04	0.04*	0.22	0.05*
10	-0.06*	-0.04	0.12	-0.06*
11	-0.01	-0.01*	-0.11*	-0.11*
12	0.11	0.01	0.11	0.11
13	-0.04*	-0.06	-0.06*	-0.04*
14	-0.13	-0.12*	-0.12*	-0.11
15	-0.06*	-0.07	-0.06*	-0.11*
16	-0.06	-0.09*	-0.06	-0.12
17	0.04	0.03	0.04*	0.11
18	0.02	0.01	0.01	0.12*
19	0.03*	0.01*	0.02	0.13*
20	0.05	0.05	0.03*	0.07*
21	0.06	0.05*	0.02*	0.09
22	0.07*	0.06	0.07	0.08*
23	0.01	0.06	0.01	0.02
24	0.02*	0.02*	0.02*	0.03*
25	0.03	0.03	0.01	0.03
26	-0.01	0		
27	0.11	0		
28	0.13	0		
29	-0.12	-1		
30	-0.14	-1		
31	-0.14	-1		
32	-0.16	-1		
33	-0.17	-1		
34	-0.12	-1		
35	0.01	0		
36	0.07	0		
37	0.05	0		

*Significance +- 1.96

Source: Computed

The autocorrelation stock return is depi lation coefficients fo here for all the three sults shows that au for the 1st period at Similarly for the 2nd cant for the lags 3, 34, 36. For the 3rd pe at the lags 1, 3, 8, 31, 35 and 37 and f 14, 15, 17, 20,21,24, esis that p=0 is not indicates that the In during all the period its efficiency.

Table 4 Ljung-Box SENSEX series

Lag	1st perio
37	145.14*

Significant at 1% le

Source: Computed

The table 4 shows nificance of the aut statistics is found three levels as wel thus rejects the ran

Hence both autoc rejects the random

8. Conclusion

This study is direc ket by using a pe and try to underst hold good for the confirms the rand reject it. Since the the usual Dickey random walk doe at this period of t three split periods not be predicted o

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26	-0.01	0.01	0.02	-0.01
27	0.11	0.10*	0.03	0.11*
28	0.13	0.11	0.13*	0.13
29	-0.12	-0.11*	0.01	-0.12
30	-0.14	-0.12	-0.11*	-0.12
31	-0.14	-0.12	-0.11*	-0.14
32	-0.16	-0.15*	-0.12	-0.13
33	-0.17	-0.11	-0.13	-0.12
34	-0.12	-0.01*	-0.11	-0.12
35	0.01	0.01	0.02*	0.02*
36	0.07	0.07*	0.07	0.07
37	0.05	0.04	0.06*	0.04

*Significance +- 1.96 SE
Source: Computed

The autocorrelation coefficient for the first difference of the stock return is depicted in the table above. The autocorrelation coefficients for a lag up to 37 periods are reported here for all the three periods and the overall period. The results shows that autocorrelation coefficients are significant for the 1st period at lags 1, 3 ,6 ,7 ,10, 13, 15 ,19, 22 and 24. Similarly for the 2nd period the autocorrelations are significant for the lags 3, 5, 7, 9, 11, 14,16, 19, 21, 24, 27, 29, 32, 34, 36. For the 3rd period the autocorrelations are significant at the lags 1, 3, 8, 11, 12, 14, 15, 17, 20, 21, 24, 25, 28, 30, 31, 35 and 37 and for the overall period at 1, 4, 8, 11, 13, 14, 15, 17, 20,21,24,28, 30, 31, 35 and 37. The null hypothesis that p=0 is not rejected. Hence, the autocorrelation test indicates that the Indian stock market remained inefficient during all the period despite several steps taken to increase its efficiency.

Table 4 Ljung-Box Q statistics of first difference of the SENSEX series

Lag	1st period	2nd period	3rd period	Overall period
37	145.14*	60.63*	98.67*	110.98*

Significant at 1% level of significance
Source: Computed

The table 4 shows the Ljung-Box statistics for the joint significance of the autocorrelations at a selected lag of 37. L-J statistics is found to be significant at 1% level for all the three levels as well at the overall level. The L-B statistics thus rejects the random walk hypothesis.

Hence both autocorrelation coefficients and L-B statistics rejects the random walk hypotheses.

8. Conclusion

This study is directed at studying the efficiency of the market by using a period of fifteen years data from the NIFTY and try to understand whether the EMH in its weak form hold good for the market or not. In the study unit root test confirms the random walk whereas the other two methods reject it. Since the variance ratio test is more powerful than the usual Dickey Fuller test we can safely conclude that random walk does not hold good for the Indian Market at this period of time. The results are consistent for all the three split periods. This means that future stock prices cannot be predicted on the basis of the historical prices.

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