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Testing Random walk Hypothesis in Indian Stock Market: A Study of CNX Nifty

ABSTRACT

Efficient market hypothesis has plethora of literature. In the beginning the researchers believed that the market is efficient and it is almost impossible to predict the prices or to pick superior stock to beat the market. Afterward, the researchers began to prop survival of inefficient stock markets particularly, in emerging markets. The present study makes an earnest attempt to discover the weak form of market efficiency in case of India. In order to test the efficiency in said form, Run test, Variance Ratio test and ARIMA Model have been employed. Further, the results have been examined in context of behavioral biases. For the purpose daily data of NSE CNX Nifty is considered (from 2003 to 2012). The results of the present study substantiate the inefficiency of Indian stock market in its weak form. The study has been conducted dividing the referred period in to bullish market and bearish market. In both the cases, various behavioral prejudices are found to be vital. Some of the behaviors may be overreaction, under confidence, overconfidence, return chasing and disposition effect etc.

Key Words: Weak form of market efficiency, Random Walk Model, behavioral finance
JEL Codes: G02, G14

INTRODUCTION

The notion of stock market efficiency depicts the connection between the news or information and prices in the stock market. Fama (1970) classifies MARKET EFFICIENCY into three forms i.e. Weak form, semi strong form and strong form. In Weak Form efficient market, present stock prices reflect all historical information. Therefore, in the market it becomes impossible for the investors to beat market by making use of past data. So, superior returns can not be earned. Semi-Strong Form efficient market reveals that the existing stock price reflects both, past news or information and present publicly available information. Thus, any new information is immediately absorbed by the market, Hence, can not be used to pick superior stocks to earn abnormal returns. A market is considered in its Strong form, if prices reflect all the available information, such as, past information, publicly available present information and private or insiders information.

Fama (1970) illustrates that it is almost impossible for both, technical or fundamental analysts to select undervalued shares and earn abnormal returns. The model of efficient market hypothesis, particularly weak form, is primarily linked with "random walk theory". The theory is popularly employed to reveal that succeeding prices do not correspond to prior prices. Hence, the prices imitate all available information. An unaware investors, carrying diversified portfolio also get returns like arbitragers.

REVIEW OF LITERATURE

Lo and Mackinglay (1988) revealed the failure of Random Walk in case of weekly stock returns, by evaluating the variances of the data sampled at diverse frequencies. The study found that in case of portfolio there was positive serial correlation while negative serial correlation was observed in case of individual stocks.

Butler and Malaikah (1992) did comparison of Kuwaiti and Saudi Arabian stock market. The study found that there are signs of inefficiency in the Saudi Arabian stock market but Kuwaiti market is efficient.

Groenewold and Kang (1993) assessed Australian stock market for weak and semi-strong form of efficiency. It was found that the market is efficient in its weak form. Claessens, Dasgupta and Glen (1995), conducted weak form tests on 19 emerging markets. They concluded that the markets are inefficient in weak form as,significant serial correlation in the stock returns was found.

Dharamasena and David A. Bessler (2004), conducted study on seven international black tea markets. The foremost rationale of conducting the study was to know the efficiency of price discovery process. The prices were considered in both US Dollar and the local currency of that country. It was revealed that Indian stock Market was not weak form efficient and all the markets were semi strong form efficient.

Samanta (2004) conducted efficiency test in Indian stock market using daily price data of BSE for eight years (from January 1993 to December 2001). The study demonstrated that there were signs of inefficiency till June 1996 but the market depicted high level of efficiency from July 1996 to December 1999. Subsequently, lower level of efficiency was observed.

Mishra, P.K., Das, K. B. and Pradhan, B. B. (2009), in their study conducted some empirical tests and found evidences as regards efficiency of Indian market in the context of global financial crisis of 2008. The study confirms weak form of market inefficiency in India. The paper also scrutinizes the mean reversion in the market and finds the existence of mean reversion illusion. Pichardo, Christine and Bacon, Frank (2009), reviewed the impact of Lehman Brother's Bankruptcy. It was proved that the bankruptcy had a negative impact on stock prices in the US.

RESEARCH GAP AND SCOPE

After exploring the literature, it is exposed that several studies have been conducted on market efficiency. In case of India also a number of studies are available. But, to the best of author's knowledge, the studies have not explained reasons for weak form inefficiency of the markets, particularly Indian stock market. The present study makes solemn attempt to explicate efficiency through behavioral prejudices.

RESEARCH METHODOLOGY

With the purpose of probing randomness in stock returns prevalent in Indian Stock market, daily returns of S&P CNX Nifti, have been used. The time span for the study is from 1 January 2003 to 31 December 2012. The data has been divided into two lags of five years each. The first lag (from 2003 to 2007) and the second lag (from 2008 to 2012) were periods of bullish trend and bearish trend respectively. Both the periods have been analyzed separately. The data is collected from the official website of NSE. Taylor (1986) believes that large sample enhances the probability of random walk Hypothesis.

The daily market returns are calculated using daily closing prices. For the purpose, the following equation is employed:

$$Rt = \ln(Pt/Pt-1)$$

The stationarity of time series data is examined using unit root test. the data is found to be stationary at first difference.

The tests, which are conducted for assessing weak form efficiency in the study include run test, Variance Ratio test and Autoregressive Integrated Moving Average Model (ARIMA).

Hypothesis of the Study

H0 : The Indian Stock Market follows Random Walk Model.

H1 : The Indian Stock Market does not follow Random Walk Model.

EMPIRICAL RESULTS

Descriptive Statistics

Table 1 illustrates the descriptive statistics for both the lags. Skewness is 0.73 and -0.89 for the first lag and the second lag respectively. Kurtosis for the lags is 2.4 and 3.3. Both the results discard normal distribution of the series. Jarque-Bera statistic which is significant at 0 % level of significance, also verifies that the series are not normally distributed. As the statistic is employed to test normal distribution. The hypothesis of normal distribution is rejected in both the cases.

Table- 1 Descriptive Statistics

	Lag 1	Lag 2
Observations	1259	1488
Mean	1931.79	4866.147
Median	1790.05	5062.425
Maximum	4015.95	6312.45
Minimum	922.7	2524.2
Std. Dev.	860.27	838.44
Skewness	0.73	-0.89
Kurtosis	2.45	3.36
Jarque-Bera	129.48	206.61
Probability	0	0

Unit Root Test

The unit root test is conducted to know existence of unit root. Null hypothesis of the test states about existence of unit root in the series. If there exists unit root, it implies that the series is non stationary. Table 2 and table 3 show in case of both the lags the series are non stationary at level form, so, null hypothesis can not be rejected at 5 % level of significance. Conversely, at first difference, the hypothesis is rejected. The results also point towards non randomness of the series.

Augmented Dickey-Fuller (ADF) test

Table- 2 ADF Unit Root Test (Lag 1)

	Coefficient	Std. Error	t-Statistic	Prob.
Level	0.0012	0.001	1.22	0.22
First difference	0.0956	0.0281	3.39	0.00

Table- 3 ADF Unit Root Test (Lag 2)

	Coefficient	Std. Error	t-Statistic	Prob
Level	-0.004	0.0023	-1.714	0.086
First difference	-0.946	0.025	-36.518	0

Auto-regressive Integrated Moving Average (ARIMA)

ARIMA is extremely imperative test to test weak form efficiency of a market. AR term illustrates predictability of current returns on the basis of past returns, whereas, MA term signifies impact of past error terms or disturbances on present returns.

Expert modeler of SPSS package has been used to know best fitted ARIMA model for the lags. Table 4 portrays results of expert modeler for ARIMA model. The best model for first and second lags are (004) and (008) respectively. The results suggest that in both the lags, there is no impact of AR term or past returns on current returns. But in both the cases MA is significant. During first lag fourth lag is significant, while in case of second lag eighth lag is vital.

The first lag is typically period of bullish trend, ARIMA model for the period, suggests that even four days old good news or good experience of an investor is crucial. This shows over confidence and return chasing behavior of the investors.

The results of ARIMA model for the second lag imply that in bearish market, eight days old information or bad news is also critical. This depicts under confidence and risk avert nature of the investors.

Table-4 Results of ARIMA

Variables	ARIMA Model
Lag 1 (1259Observations)	(0,0,4)
Lag 2(1488 Observations)	(0,0,8)

Run Test

The run test is applied to assess random walk model in a series. The null hypothesis of Run Test assumes that the given series follows random walk. If expected and actual numbers of runs differ significantly from each other then the null hypothesis is rejected. In words of Poshakwale (1996) lower than expected number of runs indicates market's overreaction to information, subsequently reversed, while higher number of runs reflects a lagged response to information. Either situation would suggest an opportunity to make excess returns.

According to Sharma and Kennedy (1977) The Z statistic exhibits the total number of runs in a series. In case of large samples, Z statistic illustrates the disparity between actual and estimated number of runs. The value greater than or equal to + 1.96 reject the null hypothesis at 5% level of significance.

Table 5 depicts results of run test for the first lag. Z statistic for mean, median and mode is -3.24, -2.77 and -2.36 respectively. In all the three cases Z statistic is less than -0.196, so, null hypothesis of randomness at 5 % level of significance, can be rejected. Further, negative Z statistic in all the cases exemplifies actual runs are lower than expected runs. The results point towards over reaction of the investors.

Table- 5 Results of Run Test (Lag 1)

	Mean	Median	Mode
Test value	00	0.104	0.20
Cases < Test Value	536	585	629
Cases >= Test Value	722	673	629
Total Cases	1,258	1,258	1,258
Number of Runs	560	578	588
Z	-3.244	-2.773	-2.369
Asymp. Sig. (2-tailed)	0.001	0.006	0.018

As per Table 6, Z statistic for mean (0.03), median (-0.33) and mode (-0.46) falls between +1.96 and -1.96. But number of runs for mean, median and mode are 3, 738 and 736 respectively. Therefore, null hypothesis can be rejected. "If in an application it is found that the number of runs is equal to or less than 9 or equal to greater than 20, one can reject (At 5% level of significance)the hypothesis that the observed sequence is random" (Gujrati, 1988).

Table- 6 Results of Run Test (Lag 2)

	Mean	Median	Mode
Test Value	16.334	0.026	0.062
Cases < Test Value	1,487	724	744
Cases >= Test Value	1	764	744
Total Cases	1,488	1,488	1,488
Number of Runs	3	738	736
Z	0.037	-0.335	-0.467
Asymp. Sig. (2-tailed)	0.971	0.737	0.641

The results of run test demonstrate over reaction of the investors. In the first lag the behavior is more visible which confirms that chances of over reaction are more in bullish market.

Variance Ratio Test

Variance Ratio test is based on the postulation that if a time series is random, the variance of the data would increase linearly with intervals of the observation. The Test was proposed by Lo and Mackinlay (1988). If the time series follow a random walk then the variance of P period should be P times the variance of one different period.

Variance Ratio should be equal to one for the selected intervals, so as to, verify Hypothesis of randomness. If it is less than one, it indicates mean reversion, while, variance ratio more than one recommends persistence in the series. In both the cases market is found inefficient in its weak form. Mean Reversion is often attributed by over reaction of the investors. Alternatively, persistence signifies slow reaction on part of the investors.

Table 7 displays results of variance ratio. For all the 16 periods Z statistic is less than one except fifth period. As per the table in all the cases hypothesis of randomness is rejected at almost 0 % level of significance.

Table- 7 Results of Variance Ratio Test (Lag 1)

Period	Var. Ratio	Std. Error	z-Statistic	Probability
2	0.602	0.051	-7.73168	0
3	0.356	0.078	-8.16233	0
4	0.244	0.098	-7.65185	0
5	2.161	0.114	-6.86199	0
6	0.187	0.127	-6.39435	0
7	0.163	0.138	-6.05766	0
8	0.137	0.147	-5.84448	0
9	0.117	0.155	-5.65997	0
10	0.103	0.163	-5.47998	0
11	0.100	0.170	-5.26696	0
12	0.095	0.177	-5.10407	0
13	0.079	0.183	-5.02282	0
14	0.075	0.189	-4.88778	0
15	0.075	0.194	-4.7424	0
16	0.073	0.200	-4.62401	0

Table 8 portrays results of variance ratio test for the second lag. Like first lag, in all the 16 periods, Z statistic is less than 1 and probability is 0 %. The results of both the lags, support mean reversion. In other words it can be said that the market is cursed by over reaction of the investors. The results confirm results of the run test.

Table- 8 Results of Variance Ratio Test (Lag 2)

Period	Var. Ratio	Std. Error	z-Statistic	Probability
2	0.529	0.050	-9.26035	0
3	0.355	0.072	-8.86554	0
4	0.273	0.087	-8.27335	0
5	0.220	0.099	-7.80333	0
6	0.187	0.110	-7.37873	0
7	0.144	0.119	-7.17991	0
8	0.122	0.1	-6.89066	0
9	0.117	0.134	-6.5427	0
10	0.105	0.142	-6.299	0
11	0.098	0.148	-6.06443	0
12	0.087	0.155	-5.88632	0
13	0.080	0.161	-5.70967	0
14	0.072	0.166	-5.56191	0
15	0.070	0.172	-5.39208	0
16	0.064	0.177	-5.26617	0

CONCLUSION

In the study four tests have been employed to test weak form efficiency of Indian stock market. For the purpose, daily data of NSE CNX Nifty has been used for ten years (2003 to 2012), in two lags of five years each. It has been found that there exists unit root in both the cases, at level form but not at first differenced form. ARIMA model suggests impact of past disturbances but past returns are not significant for prediction. The results of ARIMA model suggest existence of over confidence and panic behavior of the investors during bullish trend and bearish trend respectively. Run test and variance ratio test reject hypothesis of random walk in all the cases and depict tendency of over reaction in the market. Therefore, all tests confirm that the stock market is weak form inefficient. The inefficiency of a market can be exploited if, some useful strategy is formulated keeping in view aforementioned reasons for the inefficiency.

REFERENCES

Claessens Stijin, dasgupta Susmita and glen Jack (1995). "Return Behavior in Emerging Stock Market". *The World Bank Economic Review.* Vol. 9 (1). Pp.131-191.

Dharamsen. K.A.S.D.B & Bessler. A. D. (2004). "Weak Form Efficiency Vs. Semi Strong Efficiency in price Discovery : An Application To International Black Tea Markets". *Sri Lankan Journal Journal Of Agricultural Economics.* Vol 6. No. 1.

Fama E. (1970). "Efficient Capital Markets: A Review of Theory and Empirical Work" *The Journal of Finance.* Vol. 25 (2). Pp. 383-417.

Groenewold N., and Kang K.C.(1993). "The Semi-strong Efficiency of the Australian Share Market". *Economic Record.* Vol. 69(207). Pp. 405-410.

Gujrati Damodar.N. (1988). "Basic Econometrics". Second Edition. *Mc-Graw Book Company.* P. 691.

Lo.A.W and Mackinlay.C.A. (1988). "Stock Market Prices do not Follow random walks: Evidnce from a Simple Specification Test" *Review of Financial Studies.* Vol.1 . Pp. 41-66.

Mishra. P.K. and Das K. B. and Pradhan B. B. (2009). "Efficiency in Context of the Global Financial Crisis". *Global Journal of Finance and Management.* Volume 1 (2). Pp. 149-157.

Pichardo. Christine and Bacon. Frank. (2009). "The Lehman Brother's Bankruptsy: A test of Market Efficiency". *Academy of Accounting and Financial Studies.* Vol.14 (1). New Orleans.

Poshokwale.S. (1996). "Evidence on the Weak Form Efficiency and the Day of the Week Effect in the Indian Stock Market". *Finance India.* Vol. 10(3). September. Pp. 605-616.

Samanta G. P. (2004). "Evolving Weak: Form Informational Efficiency of Indian Stock Market". *Journal of Quantitative Economics.* New Series. 2.

Sharma J.L. & Kennedy. R.E. (1977). "A Comparative Analysis of Stock Price Behavior on the Bombay, London and New York Stock Exchanges". *Journal of Financial and Quantitative.*