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Test of Random Walk Hypothesis at the Indian Banking Industry

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ABSTRACT

While capital markets play a pivotal role in promoting economic development, investors can be motivated to invest in the capital market only if securities in the market are appropriately priced, which, in turn, is governed by the market efficiency. Market Efficiency is closely related to the random walk hypothesis which states that a share price will follow a random walk. While there has been ample research to test the Random Walk Hypothesis at the capital markets in developed economies, very few studies have been conducted for capital markets in India. Further, even fewer studies have been conducted for the Indian Banking sector, represented by the Bank NIFTY Index. The current study examines Random Walk Hypothesis at the Bank NIFTY Index for the period from 1st April 2014 to 31st March 2017. Normality tests indicate that the day-wise returns are normally distributed. In order to provide a better understanding of the data utilized in this study, the descriptive statistics are examined. Further, results from the Runs test indicate that the Bank NIFTY Index does not follow a random walk for the period examined.

1. Introduction

Market efficiency is used to explain the relationship that exists between information and share price in capital markets, following whether or not returns in a market follow the Random Walk Hypothesis (RWH). In order to understand the RWH, it is vital to understand the theories that describe how one may be able to predict the stock prices. There are basically two approaches to predicting stock prices which are technical analysis and the theory of fundamental or intrinsic value analysis (Fama, 1965). Technical analysis hinges on the basic assumption that history repeats itself and thus the way to predict stock prices and increase one's potential gains is to become familiar with past patterns of price behaviour and recognise situations of likely repetition. This means that successive price changes in individual securities are dependent.

The fundamental or intrinsic analysis, on the other hand, is based on the assumption that at any point in time individual security has an intrinsic value or an equilibrium price which depends on the earnings potential of that security. Earnings potential in turn depends on fundamental factors such as quality of management, outlook of the industry and the economy, to name but a few. What this then means is that through a careful study of these fundamental factors, an investor would be able to determine whether actual price is above or below its intrinsic value.

In contrast, the RWH starts from the grounds that the market for securities is a good example of an efficient market and in an efficient market, rational profit-maximisers actively compete with each other and try to predict future prices. This competition leads to a situation where actual prices reflect all information and will be good estimates of the intrinsic value of the security.

The main concern of this research is to test the random walk hypothesis at the Bank NIFTY Index. In other words the research aims at testing the hypothesis that successive price changes are independent. The importance of Bank NIFTY Index is due to the fact that it shows the pulse of the Indian economy and captures the performance of Indian banking system as compared to the capital market for investors and traders. Given its importance, the government, industry and even central or reserve banks of countries keep a close watch on the happenings of the Bank NIFTY Index. It is against this background that this research looks at the behaviour of Bank NIFTY Index.

2. Literature Review

Researches has been carried out on random walk hypothesis across developed countries and in developing economies with those on developed countries being prevalent. This section briefly presents various researches that have been conducted on properties of stock market prices in different countries with their various findings. Although there have been numerous studies on whether or not stock market prices follow a random walk process, it has been shown that there still exists some inconclusiveness on the matter, which makes this research not only relevant but also vital.

Ilona Shiller and Ishmael Radikoko (2014) studied the validity of the weak form efficiency on the Canadian TSX equity market using seven TSX daily index returns. The results uniformly reject the Random Walk Hypothesis governing TSX equity index returns, implying that the Canadian equity market is weak-form inefficient. Similarly,

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Abu Towhid Muhammad Shaker (2013) investigated the weak form efficiency of the Finnish and Swedish stock markets. Results of the study conclude that daily prices and returns do not follow random walks in any of the two countries. This implies that both the Finnish and Swedish stock markets are not weak form efficient. However, "Thin Trading and Stock Market Efficiency: the Case of the Kuala Lumpur Stock Exchange" by Paul Barnes (1986) provided support for the weak form of the EMH.

A research on the Asian stock markets by Worthington and Higgs (2006) concluded that none of the emerging markets are characterised by random walks and hence are not weak-form efficient, only the developed markets in Hong Kong, New Zealand and Japan were consistent with random walk criteria.

Evidence of random walk process in stock prices is weak in developing economies. Scott J. Niblock (2007) evaluated whether or not Chinese stock markets are weak-form efficient, based on analysis of daily data of the Shanghai "A", Shanghai "B", Shenzhen "A", Shenzhen "B", Hang Seng, and Dow Jones Industrial Average indices from 2002 to 2005. The results of this study support the assertion that despite continual financial liberalization and unparalleled growth, China's stock markets are still not weak-form efficient.

A.Q.Khan & Mariyam Mehtab (2011) studied the weak form market efficiency of Indian Capital Market using the daily closing values of the indices of two major stock exchanges of India National Stock Exchange (NSE) and Bombay Stock Exchange (BSE) for the period of 1st April 2000 to 31st March 2010. The results of Runs test proved that Indian Capital market neither follow random walk model nor is a weak form efficient.

Rakesh Gupta and Junhao Yang (2011) tested the random walk hypothesis for the two major equity markets (BSE and NSE) in India for the period 1997 to 2011. The results were found were mixed. The results of ADF, PP and KPSS tests using quarterly data for the later period 2007-2011 support the weak form efficiency. But for later sample period 2007 to 2011, only PP test showed weak form inefficiency.

Poshakwale (1996) presented evidence concentrating on the weak form efficiency and on the day of week effect in the Bombay Stock Exchange. The results of Runs test and serial correlation coefficients tests indicated non-random nature of the series and, therefore, violation of weak form efficiency in the BSE. The other null hypothesis that there is no difference between the returns achieved on different days of the week was also rejected, as there was clear evidence of varying average returns on each day of the week. The weekend effect was evident as the returns achieved on Fridays were seen to be significantly higher compared to rest of the days of the week.

Khan, Ikram & Mehtab (2011) in their paper analysed the market efficiency of Indian capital market in its weak form based on the indices of BSE & NSE by using daily closing prices of indices of NSE & BSE over a period of 1st April 2000 to 31st March 2010. It was found that Indian capital market neither follows random walk model nor is weak form efficient.

Kumarasamy, Umanath & Chellasamy (2013) analysed the weak form efficiency of Indian IT stocks from 1st August 2006 to 31st July 2012 for 1491 days. It was found that Indian IT stock market was efficient and but did not follow random walk hypothesis.

3. Research Hypothesis

The current study examines Random Walk Hypothesis at the Bank NIFTY Index for the period from 1st April 2014 to 31st March 2017. In other words the research aims at testing the hypothesis that successive price changes are independent.

H_1: The changes in prices of the Bank NIFTY Index are not dependent and follow the Random Walk Theory

H_2: Bank NIFTY Index is consistent with the weak form efficient market

H_3: There is no scope for investors to earn more than normal profits

4. Research Methodology

This section elaborates on the methodology employed in investigating whether price changes at the Bank NIFTY Index follow a random walk for the period from 1st April 2014 to 31st March 2017. The sample for the present study is the Bank NIFTY Index which represents the 12 most liquid and large capitalised stocks from the banking sector which trade on the National Stock Exchange (NSE). It provides investors and market intermediaries a benchmark that captures the capital market performance of Indian banking sector. The data relating to daily adjusted closing price of Bank NIFTY Index were obtained from National Stock Exchange Website for the period of one year, from 1st April 2014 to 31st March 2017.

4.1 Index Returns

The Bank NIFTY Index returns are measured as the continuously compounded daily percentage change in the index value in order to avoid the influences of extreme index values.

$$R_t = \frac{P_t - P_{t-1}}{P_{t-1}}$$

Where R_t is the return in the period 't', P_t is the daily closing price of the Bank NIFTY Index at a particular time 't'; P_{t-1} is the closing price index for the preceding period.

4.2 Investigation Model

4.2.1 Descriptive Statistics

In order to provide a better understanding of the data utilized in this study, the descriptive statistics are examined. Descriptive statistics for the observations includes the Arithmetic Mean, Median, Range, Variance, Skewness, and Kurtosis.

4.2.2 Test of Normality for the Returns

The key assumption for investigating the random walk model is normality. Here, the return series of Bank NIFTY Index should be normal. Normality of data can be examined by two ways: Graphical method and Numerical methods. Graphical methods envisage the Distributions of random variables or the differences between the given empirical distribution and a theoretical distribution. On the other hand, Numerical methods gives summary of statistics such as skewness and kurtosis, or by conducting statistical tests for normality. In this study, we use the following tools to test the normality of the returns:

i. One-Sample Kolmogorov-Smirnov Test

One-Sample Kolmogorov-Smirnov Test investigates whether the returns are normally distributed by looking at the maximum difference between the empirical and theoretical distribution functions.

ii. Quantile-Quantile Plot:

In order to determine normality graphically, we can use the output of a normal Q-Q Plot. If the data are normally distributed, the data points will be close to the diagonal line.

If the data points stray from the line in an obvious non-linear fashion, the data are not normally distributed.

4.2.3 Runs Test

The Runs test is a non-parametric test which investigates whether or not successive price changes are independent and autonomous as contemplated by random walk hypothesis. The null hypothesis of randomness is examined by observing the number of runs which derive it essence from sequence of successive price changes. The runs test tests for a statistically significant difference between the actual numbers of runs versus expected number of runs. A run is defined as change in series of prices having identical signs. In this paper a positive return is implied as 1, otherwise 0.

For instance, the sequence of 0001110000 has three runs so same signs make one run. Positive return (+) which imply that return >0 and negative return (-) imply <0 with respect to mean return. The foundation on which this test is built is that if price changes or returns appear random then actual number of runs must be close to the projected number of runs. The Z statistic is observed level of significance.

$$Z = \frac{R - \mu}{\sigma}$$

Mean,

$$\mu = \frac{2*n1*n2+1}{n1+n2}$$

Standard error,

$$\sigma^2 = \frac{2*n1*n2\,(2*n1*n2-n1-n2)}{(n1+n2)^2*(n1+n2-1)}$$

If the Z value is less than the critical value of 5 per cent level of significance, it accepts the null hypothesis i.e. the price movements are not affected by past prices. If the Z value is greater than the 5 per cent level of significance, it rejects the null hypothesis i.e. the price movements are affected by past prices.

5. Results and Discussions

In order to provide a better understanding of the data utilized in this study, the descriptive statistics are examined. Table 5.1 enumerates the Descriptive Statistics for Bank NIFTY Index from 1st April 2014 to 31st March 2017.

Table 1. Descriptive Statistics for Bank NIFTY.

N		738
Minimum		12506.45
Maximum		21620.70
Mean		17496.07
Std. Deviation		1874.32
Skewness	Statistic	-0.41
	Std. Error	0.09
Kurtosis	Statistic	-0.301
	Std. Error	0.18

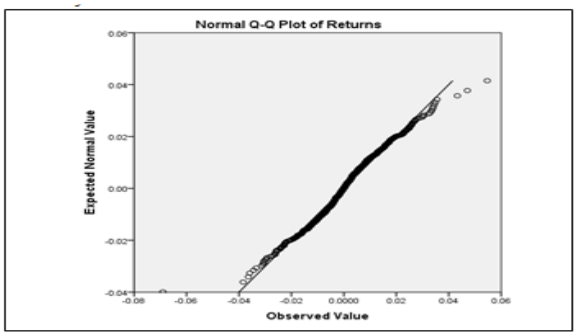

Figure 1. Normal Q-Q Plot of the Bank NIFTY Index returns.

Test of Normality

Normal Quartile-Quartile plot of the data also indicates that the data is normally distributed. From the tests, we can firmly conclude that the day-wise returns at the Bank NIFTY Index are normally distributed

The return series was analysed with One-Sample Kolmogorov-Smirnov Test to check the assumption of normality. Results of the test are presented in Table 2. Results indicate that the data is normally distributed.

Table 2. One-Sample Kolmogorov-Smirnov Test Result.

N		738
Normal Parameters[a,b]	Mean	.000807
	Std. Deviation	.0129676
Most Extreme Differences	Absolute	.053
	Positive	.053
	Negative	-.053
Test Statistic		.053
Asymp. Sig. (2-tailed)		.000[c]

a. Test distribution is Normal.
b. Calculated from data.
c. Lilliefors Significance Correction.

Runs Test

The runs test has been used to test whether changes in Bank NIFTY Index prices are independent. Results of the test are tabulated in Table 3.

Table 3. Results of the Runs Test.

Test Value[a]	17496.0679
Cases < Test Value	323
Cases >= Test Value	415
Total Cases	738
Number of Runs	24
Z	-25.464
Asymp. Sig. (2-tailed)	.000

a. Mean

Results show the Z value of Bank NIFTY Index is greater than the critical value at 5% level of significance. Hence, the null hypothesis is rejected, that is the price movements in the Bank NIFTY Index does not follow the random walk hypothesis.

6. Conclusion

This study conducted tests of the random walk hypothesis for the Bank NIFTY Index. The traditionally used method for testing random walk hypothesis in stock prices, the Runs test used in this study. In the present study, the z-statistic is -25.55, which falls outside the critical value of ±1.96 which implies that the closing prices of the Bank NIFTY are statistically significant at the 5% level. Thus, the null hypothesis that changes in prices are not dependent and follow the Random Walk Theory cannot be accepted at 5% significant level. However, rejection of the random walk hypothesis in a particular market does not necessarily mean the market is inefficient. In other words, it should be noted that rejecting the random walk hypothesis does not necessary contradict market efficiency.

Thus, the overall results indicates there exists utility for technical analysis, availability of arbitrage profit and opportunities for investment management by diversification of portfolios across the markets.

7. Areas of further research

This research made use of a weighted average index, the Bank NIFTY Index. Thus further research could be done on the prices of individual stocks that comprise the Bank NIFTY Index which might be able to give different insights on the size or liquidity angle since individual stocks as well as shed more light on specific areas of concern and policy measures.

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