Random Walk Investigation in Indian Market with special reference to S&P Nifty – Fifty Stocks

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Abstract

The competence of a financial system is entirely depending upon the stock market efficiency. The gradual growth of equity investor’s participation is inevitable to enrich the overall growth of emerging economies. Hence the necessity is felt to provide an empirical support to the investing community. For the purpose, this study attempts to examine the weak-form efficiency of Indian stock market – National Stock Exchange (NSE). The study has used the daily closing price of the Nifty fifty stocks from 3rd January 2011 to 24th April 2015. To test the weak form efficiency both parametric and non-parametric tests called Autocorrelation, Augmented Dicky Fuller test, and Runs Test were performed. The study reveals that 39 stocks of NSE-Nifty Fifty are found to be weak form inefficient, so that the investors can formulate trading strategies to gain abnormal returns. The Index and 10 stocks are found to be weak form efficient during the study period since the price series found to be autocorrelation existence.

Key Words: Time Series - Auto Correlation – Unit Root Test – Random Walk– Stationary – National Stock Exchange

JEL classification: F 15, F 53

Introduction

There are internal and external factors affecting and determining the economic growth of a nation. They are persistent slow growth, high inflation, exchange rate instability on account of capital outflows, fiscal and current account imbalances and lower investment. The 1991 economic reform made a robust structural reformation in banking system and capital market. As a result a paradigm shift has occurred in financial sector and market transited to a system with market determined interest and exchange rate, current account convertibility, auction based trading
system. The reform also initiated the financial stability, decrease excessive fluctuation and interest rate volatility, efficient allocation of resources in the needy sectors in the country.

Even after the financial crisis, the Indian economy witnessed a vigorous growth for two successive years. Since then it has decelerated, in 2013 the GDP growth was 4.5%. In 2014 it has marginally picked up to 4.7% due to increase in agriculture sector growth, net exports due to rupee depreciation, curbing gold imports. The overall growth was sluggish due to reduction of investment and private consumption expenditure. The GDP achieved a higher growth in the last 10 quarters with 5.7% in the first quarter of 2015. The growth was driven by improvement investment demand and exports. As well as rise in manufacturing and mining sector output. The reduction of uncertainty on the legal and regulatory frame work boosted the investors’ confidence in the economy. The GDP in second quarter of 2015 recorded a mild slow down with 5.3%. It was driven by the community, social and personal services. The industrial sector underperformed in the second quarter.

Stock market efficiency with transparency and unfair trade practices is the significant objective of capital market reform. The entire process of establishing market efficiency is centered on the main objectives of investors’ protection. In India, the Securities Exchange Board of India (SEBI) is progressively performing the regulating activities. Having been implemented a considerable reform; the Indian stock market has achieved a phenomenal growth at rapid pace in the post liberalization era. The market capitalization and turnover ratio are the key determinants influencing the economic growth in India. The positive correlation between capital mobilization and risk diversification is the economic significance of the stock market. According to WEF, Bombay Stock Exchange and National Stock exchange are ranked 10th and 11th position respectively with 1.58 and 1.55 trillion USD in terms of market capitalization at the end of October, 2014. Indian stock exchanges have risen by more than 40% in the last year.

The market capitalization is more significantly related to the GDP growth of the nation. The incremental growth of market capitalization ratio is the good sign of economic growth. The ratio is defined as the market capitalizations divided by the GDP. The trading volume of Indian stock market has witnessed a predominant growth of 67.3% between 2003-2004. The upsurge continued for the next few years. The turnover was increased by 21.4% and 76.8% during 2007 and 2008 and it came down to 24.9% in 2009. Again it peaked in 2010. Since last three years the turnover in cash market had plunged continuously witnessing the fall of 15%, 25.6% and 6.5% from 2011-2013. The trend reversed in 2014, the market recovered and recorded an increased growth of 2.6%. Investors think that Indian companies will benefit from a host of reforms expected from the new government. The efficient capital market system facilitates faster economic growth through pooling fund, encouraging and mobilizing domestic savings, risk diversification and liquidity management. According to Crisil research report, November 2014unless the economy witnesses significant pick up in consumption and investment demand in the rest of the fiscal, growth numbers are unlikely to bring much optimism.

Literature Review

Concept of Market Efficiency

In investment decision, the investors are using two prominent approaches such as fundamental and technical analysis. The first approach is finding all the mispriced stocks in the market where as the second approach is seeming the price movements. The actual stock price of a particular stock in a given time is away from the intrinsic value determined by the fundamental analysis due to systematic error made by the investors. The error is likely to happen in order to earn more return appropriate to risk level. Eventually, the investment decisions are made out of intertemporal choices of the investors. So, a separate field of finance called ‘behavioral finance’ has evolved to analyze and explain the unexpected distress in the stock market using efficient market hypothesis (EMH).

Market efficiency signifies how ‘quickly and accurately’ does relevant information have its effect on the stock prices. Depending upon the degree of efficiency of the market or a sector thereof, the return earned by an investor will vary from the normal return. Weak Form efficiency is also known as random walk model. It refers that the
current prices fully reflect all historical information. So, it is ineffective attempt to predict the prices based on historical information. According to Semi-strong form, the current stock prices reflect all publicly available information such as earnings, stock and cash dividends, splits, mergers and takeovers, interest rate changes etc. It emphasizes that prices adjust to such information ‘quickly’ and ‘accurately’. So, superior return cannot be earned consistently. In strong form efficiency the securities prices fully reflect all available information both public and private. There two versions of the strong form such as near strong form and super strong form. In near strong form the analysts use the publicly available information which is reflected in the prices to draw the conclusions. The super strong form is based on confidential information which is available for selected groups. But, it is not useful to make abnormal return as the prices have already been adjusted.

Scottish thinker Adam Smith in his wealth of nation, advanced the now famous representation of the ‘invisible hand’ to capture the seemingly unbelievable process by which the selfish and divergent interest of individual economic actors somehow merges into a self-regulating economic system. The nineteenth century economics accepted that the markets are fundamentally self-regulating always moving towards some magical equilibrium. David Ricardo and Alfred Marshall refined Smith’s insights and started to build a mathematical structure to prove this point.

French mathematician Louis Bachelier demonstrated in his work “Theorie de la speculation” that an asset’s price accurately reflects all known information about it. There is no such thing, in his view, as an undervalued or overvalued asset, the market is perfect reflection of the underlying fundamentals. Often the asset prices are changing dramatically towards a rational and automatic response to the arrival of new information.

University of Chicago economics professor Eugene Fama constructed a mathematical model and proved that the markets are rational and efficient. He believed that the price of any asset at any time is completely correct. The asset cannot be overvalued or undervalued. The current price is the right price. This theory hypothesized that all public information is immediately and accurately incorporated in the asset’s price, and any further price change must depend on things not yet known. Therefore predicting the future price movement and beating the market is impossible. Eventually, in 1970s the Efficient Market Hypothesis had become a conventional wisdom.

Yale university economics professor Robert Shiller(1980) conducted a research and evidently proved with rigorous statistical analysis that the stock prices are more volatile. He had combined a remarkable body of evidence and elaborated that asset prices rarely rest in a state of equilibrium. It fluctuates violently. On any one day, investors may over react optimistically about an asset and bidding up its price to new heights and the next day they may panic at fire-sale prices. These movements are not rational; they are irrational desires of the crowd.

M.A. Moustafa(2004) examined the behavior of stock prices in United Arab Emirates (UAE) stock market using the daily prices of the 43 stocks included in the Emirates market index covering the period commencing October 2, 2001 - September 1, 2003. The results reveal that the returns of 40 stocks out of the 43 are random at a 5% level of significance. Hence, the empirical study supports the weak-form EMH of UAE stock market.

A.C. Worthington and H. Higgs (2006) examined weak form efficiency of ten emerging Asian markets and five developed markets using serial correlation, runs tests, Augmented Dickey-Fuller, Phillips-Perron and Kwiatkowski, Phillips, Schmidt and Shin unit root tests and multiple variance ratio tests. The serial correlation and runs tests conclude that all of the markets are weak-form inefficient. The unit root tests suggest weak-form efficiency in all markets, with the exception of Australia and Taiwan. The results from variance ratio tests indicate that none of the emerging markets are characterised by random walks and hence are not weak-form efficient, while only the developed markets in Hong Kong, New Zealand and Japan are consistent with the random walk criteria.
Scott J. Niblock (2007) evaluated whether or not Chinese stock markets are weak-form efficient, based on an 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.

Victor K. Gimba (2009) tested the Weak-form Efficient Market Hypothesis of the Nigerian stock market using the return series. Daily and weekly return series of all Share Index and five most traded and oldest bank stocks of the NSE were examined from January 2007 to December 2009 for the daily data and from June 2005 to December, 2009 for the weekly data. The empirical findings rejected the null hypothesis. In general, it was concluded that the NSE stock market is inefficient in the weak form.

Kevin Keasey, Asma (2010) studied about the weak form efficiency of Bangladesh stock market and the results of both non-parametric (Kolmogrov –Smirnov normality test and run test) test and parametric test (Auto-correlation test, Auto-regression, ARIMA model) provide evidence that the share return series do not follow random walk model and the significant autocorrelation co-efficient at different lags reject the null hypothesis of weak-form efficiency.

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 mixed results were found. 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.

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.

Abdul Haque and Hung-Chun Liu (2011) tests out the weak form efficiency of Pakistani stock market by examining the weekly KSE -100 index over the period 2000-2010. The test revealed that the Pakistani stock prices are not Weak Form Efficient.

Abushammala (2011) investigated the weak form efficiency of Palestine stock market through Augment Dickey fuller (ADF), the Phillips Peron (PP), and the Kwiatkoowski-Phillips-Schmidt-Shin (KPSS) and proved the inefficiency of the Palestine exchange in the weak level, which means the possibility of taking advantage of technical analysis to be able to predict future prices by extrapolating the past prices.

Saqip Nisar and Muhammad Hanif (2012) performed an empirical research applying tests including runs test, serial correlation, unit root and variance ratio test. The findings suggested 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 during 1997-2011.

Abu Towhid Muhammad Shaker (2013) the weak form efficiency of the Finnish and Swedish stock markets has been investigated by employing a serial correlation test, an Augmented Dickey-Fuller test and a variance ratio test. Overall, the results 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 stockmarkets are not weak form efficient.

Vladimir Khrapko (2013) empirical research was made to test a weak-form market efficiency of Ukraine stock market using the index as compared with other countries’ stock indexes. The daily data were investigated for the period from August 2008 to October 2011. Different statistical tests such as autocorrelation and variance ratio were used and found support to the random walk hypothesis.
Ilona Shiller and Ishmael Radikoko (2014) studied the validity of the weakform EMH on the Canadian TSX equity market using seven TSX daily index returns employing autocorrelation, unit root test. The Overall, results uniformly reject the RWM governing TSX equity index returns, implying that the Canadian equity market is weak-form inefficient.

**Research and Method**

**Statement of Problem**

The foremost important assumption of EMH is that the investors are rational who select the assets based on their risk return profile. In contrast, various empirical studies exposed that the assumption is under vague impression. The weak form efficiency is clearly emphasizing that the price prediction based on historical price is complete disappointment since the future price change is independent of past price changes. The change in securities prices is completely random as long as new information is incorporated. Niamh Brodie Merrion evidently demonstrated, in the article “Speculative Bubble” that there was a persistent deviation from a share’s ‘correct’ value and cannot be deemed random. Hence, it is figured out that the share price movement is not always random due to various reasons. With this theoretical and empirical background initiated to frame certain research questions whether the Indian market is weak form efficient to facilitate a healthy investment climate. Therefore this paper it is attempted to test the weak form efficiency.

**Hypotheses**

\[ H_0^\text{a} = \text{The changes in stock prices are dependent. It cannot be deemed random} \]

\[ H_0^\text{a} = \text{The changes in stock prices are independent. It is completely random} \]

\[ H_0^\text{a} = \text{The time series data is not serially correlated.} \]

\[ H_0^\text{a} = \text{The time series data is serially correlated.} \]

\[ H_0^\text{a} = \text{The time series data has unit root} \]

\[ H_0^\text{a} = \text{The time series data is not having unit root} \]

**Objectives of the Study**

- To understand the concept of efficient market hypothesis
- To review the empirical evidences of weak form efficiency in different global capital markets.
- To understand various parametric and nonparametric tests used to detect the random walk model.
- To empirically investigate the randomness of stock price movement of NSE-Nifty fifty using different quantitative models.

**Data Set**

In this study one of the non-probability sampling techniques, judgement sampling technique was used. The sample stocks for the study have been taken from National Stock Exchange. The data relating to daily adjusted closing price of 15 automobile stocks, out of 1635 listed stocks as on July 2013, and the value of S&P Automobile Index were obtained from National Stock Exchange Website for the period of two years between May 2013 – April 2015. The data has been analyzed using non-parametric test like runs test.
Unit Root Test

In econometric analysis, the statistical properties like mean and variance of a time series data should be constant for long time. If the data is not stationary, it is difficult to use the econometric models in analysis and forecasting. Hence, the stationarity is verified using appropriate quantitative models. There are few tests used to diagnose the existence of unit root in the time series data. Such as Dicky Fuller test, Augmented Dicky Fuller test and Philip Peron test. In popular parlance, the Augmented Dicky Fuller test is performed. The ADF test has three models as mentioned below. After performing the models the decisions can be made using the test statistic and critical values.

\[
\Delta Y_t = \beta_1 + \beta_2 t + Z Y_t - 1 + ai + et
\]

Runs Test

The runs test is a non-parametric test used widely in discovering the randomness of the stock price movement and testing the weak form efficiency of the market. It is comparatively superior model than other parametric test like auto correlation, because it does not requires the observations to be normally distributed. It is understood that the market is suffering from over or under reaction to information when the significant difference is between expected and observed number of runs. Hence the traders have an opportunity to excess return (Poshakwale, 1996).

Mean

\[
\mu_r = \frac{2n_0n_1}{N} + 1
\]

Standard Error

\[
\sigma_r^2 = \frac{2n_0n_1(2n_0n_1-N)}{N^2(N-1)}
\]

Test Statistic

\[
\hat{z} = \frac{r - \mu_r}{\sigma_r}
\]

Auto Correlation Test

Serial dependence is most common test of Random Walk Model in a form of estimates of serial correlation for stock prices. The correlation between the error terms and its own lagged values is called auto correlation. The problem is arisen due to the omission of significant independent variables. If there is any correlation in the residual series it is most likely the first order serial correlation between \( E_t \) and \( E_{t-1} \) (Granger,1969).

Results and Implications

The unit root investigation has been performed for the time series data using the second model of Augmented Dickey Fuller Test. The model contains both trend and intercepts. The result of unit root was derived with first difference and 21 lags. The test results evidently prove with test statistics and probability values. It is found that the test statistic is higher than the critical value for all the 50 stocks. The p-values of the test are less than 5% in all cases. Since the p-values are less than 5% level, the null hypothesis is rejected and the alternative hypothesis is
accepted. So, it indicates that the unit root is not found in the time series data and the stock prices are not moving in random fashion. The runs test results show that the calculated P-Values of NSE – Nifty Fifty stocks are 0.000 which is too small than alpha (i.e.0.05). If the P-value is smaller than alpha it means that value of z-statistic does not fall between ≠ 1.96 hence the null hypothesis is rejected. It means that the stock prices on daily basis are not occurring on random fashion during the study period. In this study, the correlogram “Q” statistics was performed to investigate the autocorrelation with 10 lags on full sample. The test result shows that the Q statistics are significant at lag with p-values of 0.000 except for INDEX, TCS, LUPIN, ITC.ULTRACEMEN, Dr REDDY, IDEA, HDFC, ZEEL,YESBANK and CIPLA. Thus, the null hypothesis is rejected for 39 stocks and concluded that the NSE – Nifty fifty index and stocks movement is not following random walk model and it is considered to be weak form inefficient during the study period.

Conclusion
At the outset the paper deals about an overview on three levels of EMH, weak form, semi strong form, and the strong form. Besides, the contemporary empirical studies on testing weak form efficiency conducted in emerging markets were reviewed. The mixed evidences have been witnessed in the recent studies. Inspite, the present study reveals that the NSE – Nifty Fifty Index and 39 stocks are found to be weak form inefficient, so that trading strategies can be formulated by investors to gain abnormal returns. The p-values of Q statistics prove that the movement of 11 stocks is non stationary. Hence, it is understood that those stock’s movement follows the random fashion. Therefore the overall results illustrates that there is possibility of earning extra income on the account of market inefficiency.

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| Stock Ticker | UNIT ROOT TEST | AUTO CORRELATION | RUNS TEST |
|-------------|----------------|------------------|-----------|
|              | ADF-Stat        | P-Value          | Q-Stat    | P-Value | Z-Stat | P-Value |
| INDEX       | -29.02645       | 0.0000           | 22.716    | 0.012   | -30.843 | .000    |
| ONGC        | -32.48780       | 0.0000           | 4.9516    | 0.894   | -29.372 | .000    |
| NMDC        | -32.30951       | 0.0000           | 7.3529    | 0.692   | -30.904 | .000    |
| CAIRN       | -25.93716       | 0.0000           | 17.948    | 0.056   | -27.841 | .000    |
| TCS         | -32.40085       | 0.0000           | 21.497    | 0.018   | -32.129 | .000    |
| LUPIN       | -30.34466       | 0.0000           | 21.878    | 0.016   | -31.884 | .000    |
| MARUTI      | -31.26912       | 0.0000           | 13.679    | 0.188   | -31.578 | .000    |
| GRASIM      | -32.20436       | 0.0000           | 9.0167    | 0.531   | -30.526 | .000    |
| HCLTECH     | -31.39114       | 0.0000           | 4.8098    | 0.904   | -32.252 | .000    |
| ITC         | -33.08254       | 0.0000           | 24.373    | 0.007   | -32.129 | .000    |
| TATAM       | -31.41194       | 0.0000           | 6.853     | 0.429   | -30.904 | .000    |
| NTPC        | -33.71208       | 0.0000           | 9.8450    | 0.454   | -29.882 | .000    |
| RELIANCE    | -31.02865       | 0.0000           | 15.331    | 0.120   | -28.882 | .000    |
| BHEL        | -29.01839       | 0.0000           | 6.3015    | 0.789   | -30.414 | .000    |
| ACC         | -31.32988       | 0.0000           | 11.859    | 0.295   | -30.267 | .000    |
| BAJAJ       | -30.41297       | 0.0000           | 14.919    | 0.135   | -30.904 | .000    |
| POWERG      | -34.36592       | 0.0000           | 12.532    | 0.251   | -29.801 | .000    |
| SUNPHAR     | -33.27775       | 0.0000           | 19.409    | 0.035   | -31.394 | .000    |
| AIRTEL      | -34.09093       | 0.0000           | 5.657     | 0.850   | -28.760 | .000    |
| KOTAK       | -31.67034       | 0.0000           | 13.746    | 0.185   | -30.781 | .000    |
| TATASTEEL   | -31.16222       | 0.0000           | 10.044    | 0.437   | -30.046 | .000    |
| HDFC BANK   | -33.34206       | 0.0000           | 1.6053    | 0.999   | -29.863 | .000    |
| SBIN        | -31.32958       | 0.0000           | 5.8903    | 0.824   | -30.904 | .000    |
| WIPRO       | -32.57880       | 0.0000           | 7.0804    | 0.718   | -30.230 | .000    |
| ULTRACEM    | -29.79630       | 0.0000           | 21.097    | 0.020   | -31.639 | .000    |
| DRREDDY     | -29.40748       | 0.0000           | 31.256    | 0.001   | -32.129 | .000    |
| ICICI       | -32.60662       | 0.0000           | 3.0631    | 0.980   | -29.556 | .000    |
| PNB         | -32.05855       | 0.0000           | 2.3241    | 0.993   | -31.149 | .000    |
| TATAPOW     | -33.08980       | 0.0000           | 2.0760    | 0.996   | -30.291 | .000    |
| IDEA        | -31.27398       | 0.0000           | 19.845    | 0.031   | -32.006 | .000    |
| IDFC        | -31.55663       | 0.0000           | 7.9362    | 0.635   | -29.617 | .000    |
| GAIL        | -32.07425       | 0.0000           | 11.144    | 0.346   | -30.617 | .000    |
| UNILIVER    | -31.65760       | 0.0000           | 18.325    | 0.050   | -31.516 | .000    |
| COALIND     | -32.47960       | 0.0000           | 16.155    | 0.095   | -29.924 | .000    |
| HEROMOT     | -30.72315       | 0.0000           | 6.4262    | 0.778   | -30.353 | .000    |
| ASIANPAI    | -32.65990       | 0.0000           | 5.4848    | 0.857   | -32.006 | .000    |
| AMBUJA      | -32.29798       | 0.0000           | 6.9758    | 0.728   | -31.026 | .000    |
| HDFC        | -25.47718       | 0.0000           | 33.453    | 0.000   | -30.781 | .000    |
| M&M         | -32.62646       | 0.0000           | 9.7598    | 0.462   | -31.149 | .000    |
| Company  | Value 1  | Value 2  | Value 3  | Value 4  | Value 5  |
|----------|---------|---------|---------|---------|---------|
| L&T      | -30.17197 | 0.0000 | 16.018  | 0.099   | -31.088 | .000    |
| HINDALC  | -32.55675 | 0.0000 | 10.277  | 0.417   | -30.720 | .000    |
| AXIS     | -31.69733 | 0.0000 | 3.3901  | 0.971   | -30.659 | .000    |
| SSLT     | -32.59845 | 0.0000 | 11.994  | 0.285   | -29.495 | .000    |
| ZEEL     | -25.76148 | 0.0000 | 22.574  | 0.012   | -31.271 | .000    |
| TECHM    | -31.33176 | 0.0000 | 5.4562  | 0.859   | -31.578 | .000    |
| INDUSIND | -30.33911 | 0.0000 | 17.501  | 0.064   | -31.761 | .000    |
| YESBANK  | -29.61284 | 0.0000 | 23.675  | 0.009   | -30.414 | .000    |
| BPCL     | -32.56761 | 0.0000 | 2.5260  | 0.990   | -31.578 | .000    |
| BARODA   | -33.42349 | 0.0000 | 3.5366  | 0.966   | -30.781 | .000    |
| CIPLA    | -31.30260 | 0.0000 | 24.767  | 0.006   | -30.169 | .000    |
| INFY     | -32.25958 | 0.0000 | 4.7982  | 0.904   | -30.904 | .000    |