Volume 3, Issue 11, November 2013 ISSN: 2277 128X

International Journal of Advanced Research in Computer Science and Software Engineering

Research Paper

Available online at: www.ijarcsse.com

Fractal Market Hypothesis in Indian Stock Market

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Abstract - ***In current market scenario, capital market largely relies upon Efficient Market Hypothesis (EMH) but other existing hypothesis like Heterogeneous Market Hypothesis (HMH), Arbitrage pricing Theory (APT), Capital Asset Pricing Model (CAPM), Fractal Market Hypothesis (FMH), etc. are equally good and if numerical values and formulae are developed then prediction of the market will become much easier. Financial markets of the third and fourth world countries are relatively untouched with these methods because of various reasons. In this paper, considering the prices of State Bank of India (SBI) from Indian capital market is being analyzed using Fractal Market Hypothesis which is non-linear, complex, modern and alternative to the other financial methods.***

Keywords- Fractal Market Hypothesis (FMH), Heterogeneous Market Hypothesis (HMH), Arbitrage pricing Theory (APT), Efficient Market Hypothesis (EMH), Capital Asset Pricing Model (CAPM), Forecasting.

I. INTRODUCTION

History of first trade and transaction of human being is not recorded but it is believed that the first transaction happened sometime around 10000 BC. First stock market trading took place in the year 1602; the Dutch East India Company was formed as a joint-stock company based in six locations with shares that were readily tradable. First Indian stock market trading struck in 1875 at Bombay Stock Exchange Ltd. The Trading took place in the hope of better tomorrow**.** In general there are two types of traders in the market one is called Technical and the other is called Fundamental also known a Technical School and Fundamental School. Both schools have their own advocacy about prediction of the market. A major difference between these schools is the period of forecast. Fundamental school forecasts for the long period of time where as Technical school forecasts for shorter period of time. But exact time horizon or length of the time is not been described anywhere in the literature. Technical traders are generally follow charts. Technical analysis is the study of market action, primarily through the use of charts, for the purpose of forecasting future price trends." [20]. According to the principles of Technical Analysis, there are three properties on which technical approach is based:

- Market action discounts everything.
- Prices move in trends.
- History repeats itself

Every school has its own mindset about length of time horizon. In developed countries, traders in financial markets are using developed scientific tools to predict the market but behavior but on the contrary, the third and the fourth world countries have their own micro and macro-economic factors which require customized forecasting tools[9]. Socio-economic factors like education level, poverty, population and others deeply affect the investment behavior in the market. Adoptability of new and relatively advanced non-linear tools in these markets is extremely low. According to the available secondary data, it has been observed that trading and investment behavior in India is very conservative and middle class population has less or no faith in the market because of its chaotic behavior, although people are relatively comfortable in the market through intermediaries like banks, mutual funds, brokerage houses etc. Motivation of this study comes from third property of the technical analysis which says that "History repeats itself" i.e. similar incidents are observed to happen in the history after some span of time which is termed by B Mandelbrot as self similar which is characteristic of Fractals[16][18]. This theory was first introduced by Benoit Mandelbrot in 1963 by studying the prices of cotton [11]. He found that patterns of self-similarity were present during the entire period 1900-1960. Mandelbrot used his fractal theory to explain the presence of extreme events in Wall Street[17]. In 2004 he published his book on the "misbehavior" of financial markets–"The (Mis) behavior of Markets: A Fractal View of Risk, Ruin, and Reward". These finding were done only on the developed market but the fractal behavior of Indian market is yet to be explored and studied thoroughly [1][2].In view of all the above mentioned challenges, this paper tries to bring out the suitability of the non-linear chaotic behavior of the Indian market and its relevance in comparison to the other existing hypothesis like EMH.

II. Literature Review

Many theories have been developed for technical analysis like Fibonacci Numbers theory in 1202, Dow Theory in 1884, Elliott Wave Theory in 1920, The Golden Ratio and others. The most famous work done in technical analysis was initiated by Charles H. Dow. Over 125 years ago he founded a newspaper called, "The Wall Street Journal." Back in

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1884, he made up an average of the daily closing prices of eleven important stocks and began to record the fluctuations of this average. Today's markets, especially Indian Stock Market, is a complex social organism, embracing a great number of interacting components, incorporating not only demand and supply, but almost all human actions, reactions, fashion trends, moods, intentions, traditions, happenings, information and its interpretation, micro and macro economic factors etc. Indian market players largely rely upon Efficient Markets Hypothesis (EMH) which advocates that there are three sets of assumptions imply an efficient capital market: (a) an efficient market requires that a large number of competing profit- maximizing participants analyze and value securities, each independently of the others, (b) new information regarding securities come to the market in a random fashion, and the timing of one announcement is generally independent of others, and (c) the competing investors attempt to adjust security prices rapidly to reflect the effect of new information. In spite of, all benefits and usability of EMH there are few critics also. George Soros, a famous investor, who made a fortune on market speculations, criticized the theory of "efficient markets", the cornerstone of technical analysis. In his book "Le döfidel'argent" he writes, that economy attempts to follow physics [6][7][8]. Classical economists tried to follow Isaak Newton; however, they forgot that Newton lost his own capital in a speculative "South Sea bubble" that took place at his time in England. Soros compares social-economical studies with alchemy that flourished in the middle Ages. Technical Analysis is an empirically developed system of methods, which don't have any theoretical background to support their successful application. The application criteria are not defined. Strictly speaking, chart analysis as a method doesn't fulfill the criteria of scientific approach. That doesn't mean however, that its application must be unsuccessful. The application of fractals and Fibonacci numbers though marked the point when Technical Analysis of Financial Markets (TA), founded by N. Dow, gave birth to a new branch within itself, named later Chaos-Theoretical Analysis (CA). The FMH derives its name from the theory of fractals (Mandelbrot, 1982)[3][4]. Mandelbrot introduced fractal model to describe a certain class of objects exhibiting a complex behavior [5]. The fractal view starts from a basic principle: analyzing an object on different scales, with different degrees of resolution, and comparing and inter-relating the results. For financial time series, this means using different time yardsticks from hourly through daily to monthly and yearly, within the same study. This is contradiction of the from the conventional time series analysis, which focuses on regularly spaced observations with fixed time intervals. When the fractal dimension of a time series is non-integer, or equivalently when the co-dimension is non-zero, this is associated with two characteristic features. First, fractal processes exhibit non homogenous-a high probability of extreme or outlying fluctuations, generally at irregular intervals. Second, fractal processes also exhibit scaling symmetries - proportionality relationships between fluctuations at different separation distances. Evidence of fractal in financial markets does not imply chaotic behavior reminiscent of randomness produced by a small number of deterministic equations. Nowadays, Financial Chaos Theory and the Science of Fractals is an emerging thrust area of study [12][13][14][15][23].In spite of its rich history of fractals in finance, Indian market is till far away from these developments. Recently, Banerjee and F.Mulligan studied five alternative methods for estimating Hurst exponent (1951)[21], fractal dimension, and Mandelbrot-Lévy characteristic exponent (Lévy 1925)[22] to examine the fractal character of three information technology equities, Satyam, Tata Consultancy Services, and Infosys[2]. Similarly there is an abundance of scientific research available which is enough to support the statement that "stock markets exhibit fractal and chaotic nature" [19][20].

III. Fractal Behavior of the Indian Stock Market: A case study of the State Bank of India (SBI).

According to the five basic assumptions proposed by Peters[10] for his FMH:

FMH1. The market is made up of many individuals with a large umber of different investment horizons.

FMH2. Information has a different impact on different investment horizons.

FMH3. The stability of the market is largely a matter of liquidity (balancing of supply and demand). Liquidity is available when the market is composed of many investors with many different investment horizons.

FMH4. Prices reflect a combination of short-term technical trading and long-term fundamental valuation.

FMH5.If a security has no tie to the economic cycle, and then there will be no long-term trend. Trading, liquidity, and short-term information will dominate.

Behavior of SBI's Stock prices at National Stock Exchange from Jan/2000 to Dec/2012 on its closing prices is shown in Fig01. Sign 0 indicates self-similar peaks and indicates self-similar downwards movements. Distance (calculated in terms of time period) between two peaks and two downwards are asymptotically equal. By calculating self-similar behavior of price changes we can easily formulate a fractal formula like Hurst exponent which needs to be redesigned and reconstructed for the Indian market. The behavior of such mathematics will represents the nature of the peaks as well as distance between two self-similar behaviors, so that we can know the probable pattern of the price change behavior of the stock in normal market conditions.

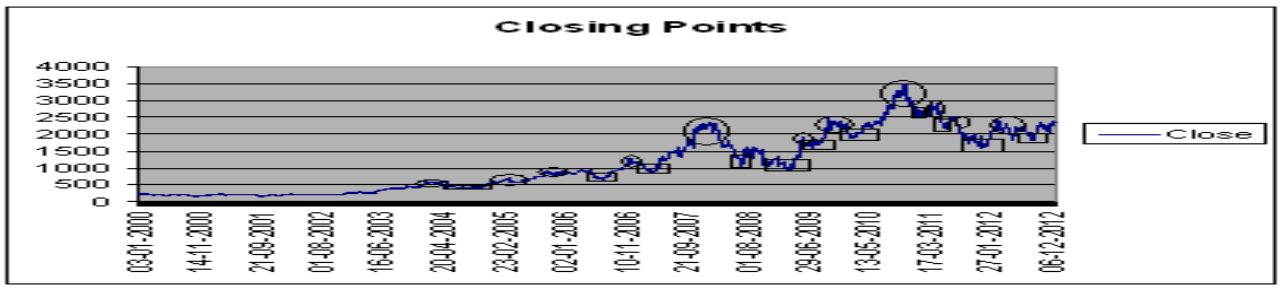

Fig. 01

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Fig 02, shows the relationship between stock price changes by applying the formulae value = current value – previous value. This shows that prices of stock vary differently with time period in both directions (positive and well as negative). By plotting the difference value on number line we got a graph like Brownian motion. Behavior of the price differences is similar to the Brownian motion and its value reacts depending upon α = 0.5, α = 1.0 etc.

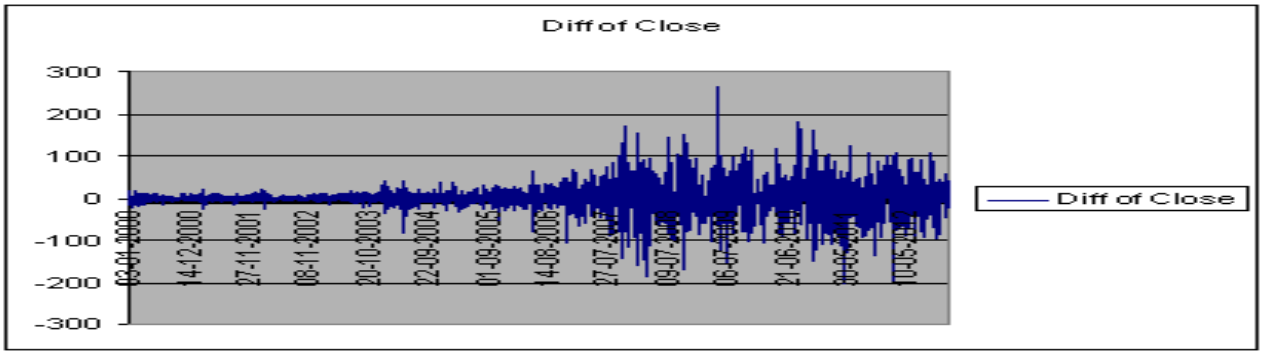

Fig.02

Fig 03, shows the relationship between volume and prices. In some conditions the prices reacts similar to the volume increase or decrease but in some conditions they contradicts to each other.

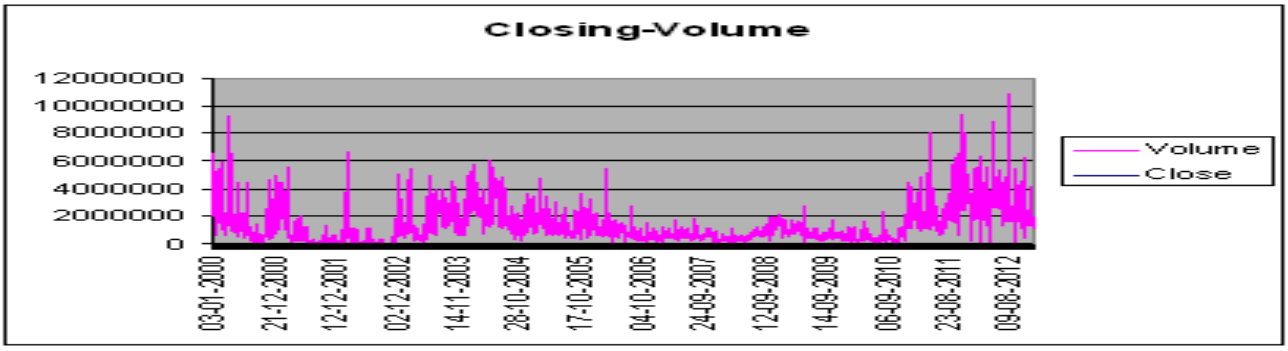

Fig.03

Fig 04 shows that the Yearly price value of SBI has been drawn individually and it shows the self – similarity of the price reaction. Almost every year, ups and downs of prices in the market are self – similar under the same period of time.

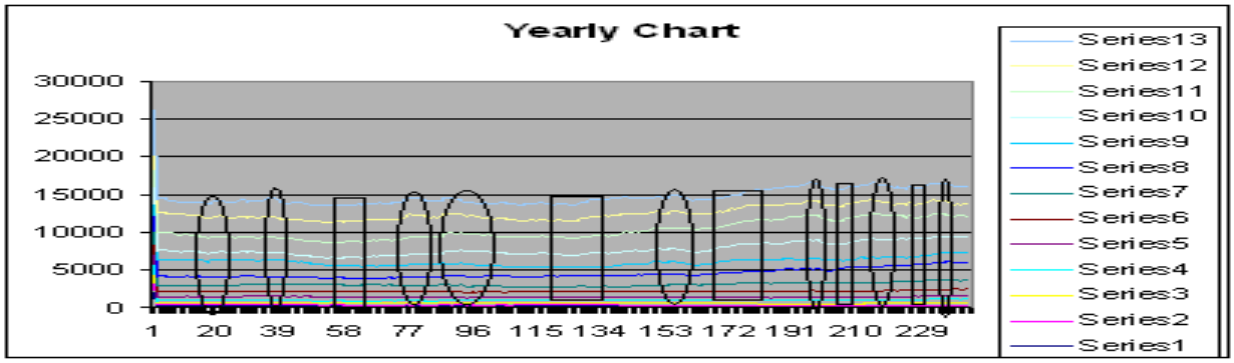

Fig.04

Fig. 05. Shows that the monthly price value of year 2012 of SBI is drawn and it is again self – similar.

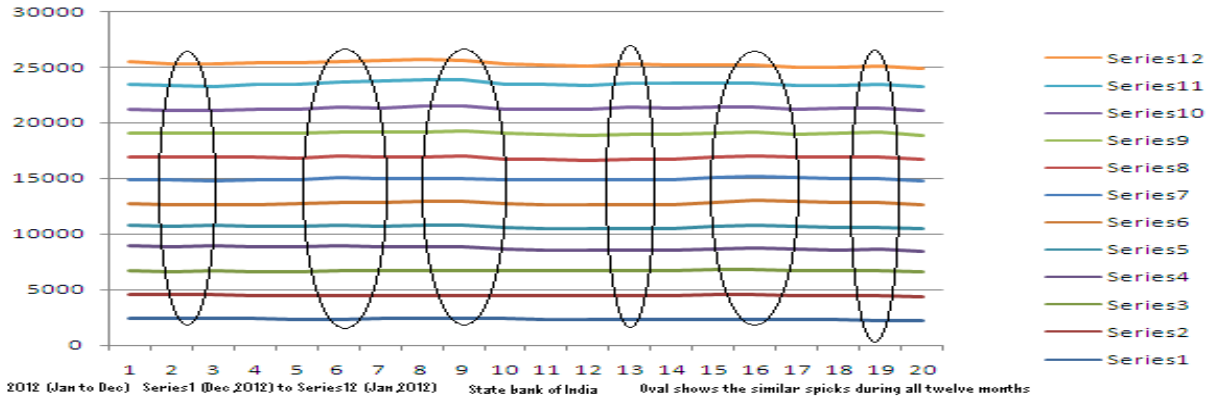

Fig. 05

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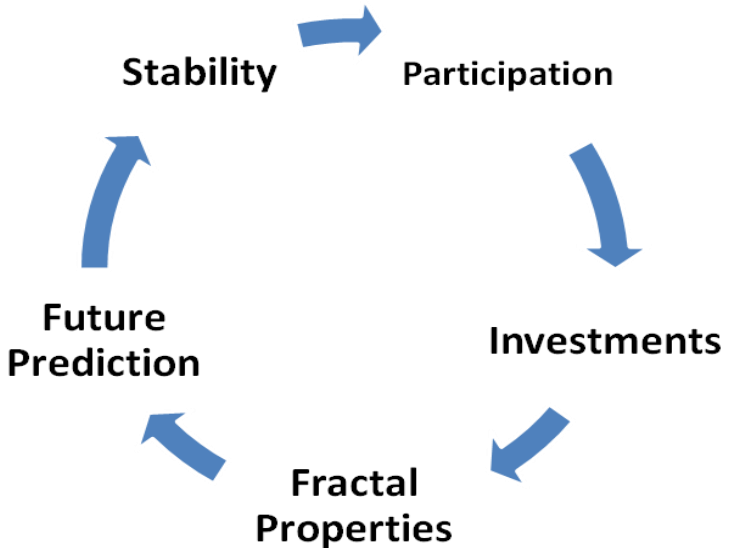
After above analysis from Fig.01 to Fig. 05, we conclude that SBI prices at NSE have self – similar properties and it proves the Mandelbrot theory for cotton prices and it also signifies the above literature of fractal theory hypothesis in the financial markets.

IV. CONCLUSION AND FUTURE WORK

After the above study we come to conclusion that

- Indian stock markets have self – similar properties and it need to be addressed properly.
- Future prediction of stock prices is possible with the fractal theories developed for the relatively mature market.
- Fractal mathematical formulation of the stock prices is possible by applying the Brownian motion theory.
- Future prediction of the market with the help of mathematical formulae is much more accurate.
- Self – Similar property will occurred after a certain interval of time, so non – linear formulae will possible to formulate by considering time gap of the graph.
- Volume will play crucial role in fractility.

Fractal behavior of Indian Stock market is explored and it is found that FMH will become next generation tool for financial market forecasting. Volume will play a crucial role in the forecasting methodology. It has been seen that the middle class population of the third world countries like India do not participate in the trading as they are afraid of losing money. By implementing FMH, people will able to predict more accurately and that directly creates faith and belief in the market. , With this faith and belief more and more middle class (population) will participate which in turn will create huge volume in the market that will directly lead to the stability of the market which in turn will lead to more stable fractal behavior. For example, one rupee day in Indian Market will add approximately more than 8 Billion buy and 8 Billion sell. It means total of 16 Billion trades per day will increase. Relationship between participation, Investment, Fractal property, Future prediction, and Stability is shown in the cyclic diagram given below:



Maturity of the stability cycle will create a new paradigm in the Indian market.

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