"Estimating Sensex Volatility using GARCH Model at the Bombay Stock Exchange (BSE) Brokers Forum, Dalal Street Fort, Mumbai"

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1. Abstract

The two principal stock exchanges in India are the National Stock Exchange and the Bombay Stock Exchange. The Bombay Stock Exchange is the first stock exchange in Asia and ranks 10th in terms of market capitalization worldwide. Indian stock markets have a big impact on the country's economic growth. The stock markets' erratic behavior, which makes returns unclear, is brought on by the fluctuation of speculative market values and the erratic nature of corporate performance. The ability of volatility to assess risk exposures in investments and the uncertainty of stock return influences the financial actions of investors, managers, policy makers, and academics. Investors who are afraid of taking risks steer clear of volatile markets. This paper has made an attempt to analyse the Estimating Sensex Volatility using GARCH Model at the Bombay Stock Exchange (BSE) Brokers Forum, Dalal Street Fort, Mumbai.

2. INTRODUCTION

Finance is the study and understands the features, behavior, creation, administration and regulation of money. Financial service sector is one of the growing sectors in the economy. Financial service system consists of financial market, financial product, financial services, financial instrument, and financial intermediation. Financial service is one of the major parts of financial system. Financial service includes financial institutions, financial products, financial services etc. financial institutions provide the various financial services to the individual and the institutional investors. It provides service through the various financial instruments related to capital market and money market. Financial service refers to financial products and services offered by the financial institutions like banks, insurance company, mutual fund companies, stock broking companies etc. The financial product and services includes loans, debit card, credit card, life insurance, general insurance, mutual fund schemes, investment opportunities, wealth management, portfolio management, etc.

3. LITERATURE REVIEW

Kaur (2004), investigated the nature and characteristics of Indian stock market volatility between the time period January 1993 and March 2003. The paper exhibited the time varying volatility considering both BSE and NSE stock exchanges. The author mentions that various volatility estimators' diagnostic tests indicate volatility clustering and leverage effect meaning that the impact of good and bad news is not the same on market volatility. It has also been found that for both the indices, BSE Sensex and NSE Nifty, February month exhibits highest volatility and return among all other months. The March month too exhibited higher volatility but it is lesser than February month. This implies during these two months the conditional volatility increases because various events occur in that period like presentation of union budget, major policy announcements etc. The author also found that December month have given higher positive returns with lesser volatility and higher volatility with lesser returns observed during September month mainly on account of quarterly result announcement.

Bhowmik (2013), evaluated the multidimensional framework for stock market volatility in India. In the study, author mentions that the depression and recession cause market volatility severely which can't be alleviated in short-run. The study reports that the stock market volatility exhibited negative relationship with country's growth rate. Besides, it documents that there is negative correlation between stock market volatility and international trade. The author concludes that the political instability and depression cause market volatility which diminished the growth rate in the country. The nexus between selected variables explained with the help of econometric models showed the asymmetric relation in the study.

Mall, Pradhan, & Mishra (2011), studied the time varying characteristics of volatility in Indian Future Market using indices. By applying GARCH class models, authors found that there is time varying volatility and its asymmetric effect exists. They also found that stock market volatility is substantially increased due to bad news. The authors also reported the volatile behavior during study period in Indian capital market happened mainly because of global financial crisis.

Mallikarjunappa&Afsal (2007), reported the volatility implication on the introduction of derivatives in Indian stock market using CNX IT index. The author found in their study that there exists a clustering effect and its persistence in various degrees during pre and post introduction of derivatives in Indian capital market. They also mention that listing in futures has increased the stock market volatility.

Thenmozhi (2002), documented that the inception of future trading has drastically reduced the volatility of spot prices index futures and increased flow of information across the market. However, Shenbagaraman (2003) gives contradictory results that the introduction of derivatives has not reduced the volatility significantly in India. The study of Raju and Karande (2003) supports the Thenmozhi (2002) work claiming that there is reduction in the volatility after introduction of index futures in India.

4. RESEARCH GAP

From the above literature review, it can be noticed majority of studies have been carried out by researchers taking data from official sources and adopting GARCH model using R package. This study tries to calculate the market volatility from the data obtained from BSEHead office & GARCH model is adopted by official software of BSE-BBF.

5. STATEMENT OF PROBLEM

In this section, various situations are given that indicate the importance of measuring, modeling and predicting stock market volatility and its impact on investor behavior and their investment decisions are highlighted.

The capital market volatility is persistent in emerging markets including India. Indian capital market is the favorite investment hub for various kinds of investors from all walks of life around the world. However, too much of volatility is causing investors psychologically to make bad investment decisions, especially the retail investors. The volatility causes investors to make erratic decisions and thereby it leads to huge financial losses. Therefore, one should be in a position to determine the level of volatility and predict it's persistence with accuracy using sophisticated models for making better investment decisions.

The investors do fail in analyzing the realistic and practical aspects that influence capital market volatility while making investment decisions. The stock market performance is affected by various factors at domestic level and global level thereby, influencing the investors' expected returns over a period of time.

Many studies tried to understand and analyze investors behavior. But, however they failed to clearly draw the conclusion on why and how investors behave in a certain way during market volatility in Indian capital market. The methodology of studying investor behaviour can be direct method or indirect. The direct method of studying and understanding investor behavior will give rise to many questions as these studies cannot generalize the results across the markets. Therefore, both direct and indirect methods, when clubbed can provide a more accurate picture about the investor behavior during various states of capital market volatility.

6. OBJECTIVES OF THE STUDY

To attain the broad objective mentioned above, the following research objectives are set:

1. To analyze the performance of top rated stocks using BSE MOJO analysis techniqueduring this study period.
2. To measure, model and forecast the Indian Stock Market Volatility using advanced

econometric techniques.

3. To identify and prioritize the economic factors at domestic level and global level that influence volatility in the Indian Capital Market.
4. To develop the investor sentiment index using the market related implicit variables in Indian capital market.
5. To propose a model to understand and analyze the investor decision making process and their behavior during market volatility in Indian Capital Market.

7. SCOPE OF THE STUDY

The scope of the study is confined to following time frame selected for the analysis.

Table 1.1

Data Set with Time Frame

Sl. No	Data Type	Time Frame	Duration
1	S&P CNX NSE Nifty and BSE Sensex closing prices for modeling and forecasting volatility	1st Jan 1995 to 31st Dec 2018	26 Years
2	Economic Indicators	Jan 2014 to Jan 2019	05 Years
3	Trading days during the study period	3rd Jan 2019 to 15th Feb 2019	38 Days

8. Nature and Source of Data

I. Primary data

Primary data provides very significant inputs for the study. The data which is collected as first hand information is known as primary data. In the report the primary data has been collected by direct interaction with various levels of employees which is very much required for analysis of the project.

II. Secondary data

The data which has been previously gathered and can be accessed by researchers is called as secondary data. The secondary data is collected from various books of accounts, financial statements, audit reports and management reports.

This analysis and interpretation of estimation of sensex volatility is mainly based on the secondary financial data which is published in various financial reports.

9. Techniques and Tools of Data Analysis Proposed Model

This model is devised to look up and examine the investor behaviour and their investment decisions under various market volatility states. For this purpose required constructs have been identified through the exploratory factor analysis and the investor investment decisions under positive and negative market volatility.

10. ANALYSIS AND INTERPRETATION

FLOW OF ANALYSIS

- In the first section, the VOLATILITY OF INDIAN CAPITAL MARKET has been measured and exhibited for the time period starting from 1990 to 2019.
- In the next stage, an extensive study has been conducted to figure out the Factors That Cause Market Volatility in both NSE and BSE.
- Further, the study reports the CONSTRUCTION OF INVESTOR SENTIMENT INDEX and measures its relationship with the market volatility for the time period of 5 years starting from 2014 to 2019 on a monthly basis.
- In the Last section, the Indian stock market volatility is modelled and FORECASTED USING ADVANCED ECONOMETRIC MODELS LIKE GARCH, EGARCH AND TGARCH.

11.TESTING OF HYPOTHESIS FOR VARIOUS VARIABLES USED IN STUDY

Ho: There is no significance volatility exist among the selected variables during the study period H1: There is a significance volatility exist among the selected variables during the study period

Table 1.2: Statement Showing Testing Of Hypothesis

Investment Decisions and Biases	**t-value**	**p-value**
Overall Volatility	-3.97	0.00*
Positive Volatility	-2.12	0.03*
Negative Volatility	-3.79	0.00*
Market Related Implicit Variables	4.34	0.00*
OLS model	3.30	0.00*
Annual Volatility	2.22	0.03*

Interpretation:

Overall Volatility : An analysis of the above table brings out the t-value and the probability value at -3.97 and 0.00 respectively. Hence, the null hypothesis is rejected.

Positive Volatility: The mean score estimated by Positive Volatility for unmarried respondents it is 9.55 while that for married respondents it is 10.12. The t-value is -2.12 and p-value is 0.03. Hence, the null hypothesis is rejected.

Negative Volatility: The mean score attained by Negative Volatility for single respondents at 31.12 while that from married respondents at 33.68. The t-value is -3.79 and p-value is

0.0. Hence, the null hypothesis is rejected.

12. FINDINGS, SUGGESTIONS, CONCLUSION OF THE STUDY

12.1 FINDINGS

Measuring, Modeling and Forecasting Indian Stock Market Volatility

1. The volatility in Indian capital market was persistent and very high during global financial crisis, during the period of integration of Indian economy with the world economy and the Harshad Mehta financial crisis.
2. The mean daily volatility of S&P CNX NSE Nifty and BSE Sensex are same at 0.80 and the annual volatility for BSE Sensex is higher than that of S&P CNX NSE Nifty.

3. The modelling of the volatility is a very difficult task, however in this study it is found that the preferred model for modelling both selected markets is TGARCH (1, 1). For choosing the best method to model the volatility was based on AIC, SIC and LL criteria.
4. The best model to forecast the Indian stock market volatility among the symmetric and asymmetric models is found to be TGARCH (1, 1). This task of choosing the best model for volatility prediction with an out-of-sample has been done based on error content that would occur while forecasting. The forecasting accuracy is more for TGARCH (1, 1) model that accounts the leverage effects.

Factors Influencing Stock Market Volatility

5. Except four of the selected seventeen economic indicators, all other variables were found to be stationary at first difference order. Call money rate, net foreign institutional investments, inflation and FDI economic variables were found to be stationary at level order. For testing the unit root, ADF, PP and KPSS tests were used.
6. The stock market volatility is the resultant of many factors at micro level and macro level. As per the OLS regression analysis, the macro level economic factors explained thevariance to the extent of 59.89% and 58.27% for S&P CNX NSE Nifty returns and BSE Sensex returns respectively during the study period of sixteen years. This clearly indicates that the stock market performance is dependent on the economic performance at large. The OLS regression model for both the markets is found to be fit as all the diagnostic tests were passed through.
7. Out of seventeen economic variables that were regressed on the stock market volatility in both the markets, as many as four factors namely crude oil price, net foreign institutional investments, Inflation rate and S&P 500 index, have significantly influenced the market.
8. The unrestricted VAR model also was tested as most of the economic variables were non-stationary at level. The VAR model is found to be best for explaining the Indian capital market volatility. The VAR model passed through all the diagnostic checking. The total variance explained by the selected economic indicators in the returns of S&P CNX NSE Nifty was found at 65% and that of for BSE Sensex it was at 63.98%. This indicates that investors cannot ignore the economic indicators while making investment decisions as these factors play a key role in the market volatility.

Sentiment Index as Investor Behavior and Stock Market Volatility

9. The sentiment index is constructed using thirteen surrogate market variables to study the investor behavior and the effect of market volatility on it. The results of this study were similar with Dash & Mahakud (2013) in terms of factors loading for all the selected MRIVs.
10. The correlation between stock market volatility and investor sentiment index is found to be

positive and the common variance among the orthogonal MRIVs found at 38.13% for the first component as per principal component analysis.

11. For estimating long-term relationship between the stock market volatility and investor sentiment index, the Johansen Cointegration test and VECM are used and also Wald test is used for estimating short-term association between them. The Cointegration test confirmed the relationship between the sentiment and volatility. One of the main guideline for conducting Cointegration test is that the variables in the study should be non-stationary at level and stationary at the same order. Both the sentiment index and markets were stationary at first order difference as per ADF, PP and KPSS unit root tests. The analysis showed that there is at least one integrating variable as per the results of Trace and Max-Eigen statistics.
12. Since there was at least one integrating variable, VEC model was applied to test the long term relationship with 2 lags and found that there is a long term association between the investor sentiment and stock market volatility in both the markets as Error correction term (ECT) was negative and was statistically significant.
13. The short-term relationship is tested using Wald test and the results have shown that there is also short term relations between the investor sentiment and stock market volatility.
14. The granger causality test was conducted to test whether market volatility granger cause the investor sentiment in both BSE and NSE stock markets. The results found that the BSE Sensex and NSE Nifty granger cause the investor sentiment and vice-versa.

12.2 SUGGESTIONS

1. The present study with the evidence of its empirical findings will be highly useful to the investors as it provides a strong evidence of stock market volatility in Indian market. Any investor has to study and analyze market volatility as one of the important factors before making investment decisions.
2. From the major episodes of stock market history, it is clear that major announcements by the government have put stock market in stake many times. Therefore, investors should be cautious while investing during times of major government announcements, like the presentation of union budget, because during this time risk taken by investors may lead to a higher losses, led by higher volatility.
3. It is apparent that Indian stock market has a very strong speculative base. Investing in such markets is riskier than investing in other economically developed and emerging stock markets. Hence, investors need to be cognizant of this fact while making investment decisions and investing in Indian capital markets.
4. The economic conditions of any country will influence its own stock market performance. In this regard, it is evident from the present study that stock market volatility is an aggregate of the

performance of economic indicators to a larger extent. Therefore, investors should consider the performance of economic indicators while making investment decisions to maximize their risk adjusted returns.

5. An innovative approach followed by this study explained the investor sentiment in Indian capital market. The present study outlines how investor sentiment performed over a period of thirteen years. This work certainly provides a platform to analyse sentiment index and then make investment decisions. Since investor sentiments are caused by market volatility, both positive and negative volatility, one should consider the relationship between these two important variables and then make investment decisions.

   This study also provides a method to construct and measure an investor sentiment index for a better and useful understanding of capital markets and investor behaviour thereof.

6. Decisions made by investors are biased during market volatility. These behavioural biases make investors commit mistakes while investing and that may lead to heavy losses. Therefore, investors should be in a position to understand their own emotions, feelings and biases so as to make investment decisions effectively and make better profits. Also investors should be aware of market mechanisms and biases so that they are able to understand self, and get influenced by emotions while making financial decisions under uncertainty.

12.3 CONCLUSION

Indian economy is presently witnessing an important historic phase of economic development. In the last one decade or two, significant changes were brought in the field of banking and finance, international trade, information technology, real estate and consumer goods industry. The policy initiatives were robust in the mentioned industries above and have seen greater growth during that period as well. The policy measures and regulations that were undertaken had significant impact on the performance of market and stock price behavior. Volatility in the stock market has become vital for individual investors and their earnings and also on the efficiency of capital market for channeling the required financial resources for the productive uses and economic growth. In the first stage of this study an attempt is made to get insights into behavior of stock market volatility and ability to forecast the same by modeling it. The results show that both the indices i.e., BSE Sensex and S&P CNX NSE Nifty exhibited volatility clustering. The descriptive results suggest that the return of BSE Sensex is positively skewed while that of S&P CNX NSE Nifty is negatively skewed. Within the GARCH family, our results showed that the asymmetric TGARCH (1,1) model is found to be satisfactory in explaining volatility in both the indices and is most plausible for the data series under analysis. The results of diagnostic tests of the three models show that the TGARCH (1, 1) model is found to be appropriate to predict the volatility with leptokurtosis, volatility clustering and leverage effects.

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