STOCK MARKET VOLATILITY AND RETURN ANALYSIS: EVIDENCE FROM BSE SENSEX INDEX

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ABSTRACT

In today's time, most of the market participants are trading in the BSE Sensex Stocks segment which makes it essential for them to understand the behavior of volatility, both pre and post-budget, especially for stock trading. BSE Sensex is India's major benchmark index for equity market. The present study attempts to analyse whether the Historical Sensex index returns has an explanatory predication for today's Sensex returns. Daily data of BSE closing prices from 1st January 2022 to 1st January 2024 has been used for the study. BSE Sensex returns have been assessed as the first difference of the log of the daily closing prices. In this research, GARCH (1, 1) has been established to model the volatility and return of BSE Sensex index returns. The results revealed that Past Sensex returns have GARCH effect in the today's Sensex index returns.

Key Words: *BSE Sensex index return, Heteroscedasticity, ARCH, GARCH, Volatility, and Stock market returns.*

1.1 INTRODUCTION

Volatility generally tends to rise prior to an event on account of uncertainty and falls immediately after the event materializes, as uncertainty gets out of the way. Stock market volatility is one of the most important concept in the field of financial market. Various models being considered for assessing market risk & return necessitates and the calculation of a volatility parameter. The present study has been taken into consideration the GARCH for measuring volatility and also analyses the property of volatility models. The modeling has been prepared through Auto Regressive Conditional Heteroscedasticity. The GARCH (1, 1) has been estimated for measuring volatility and return analysis. The analysis of the previous studies relating

to volatility indicates that they focused on the impact of investments by different levels of investors on the stock market volatility.

Further, the major emphasis of the previous studies was on analyzing the impact on BSE Sensex market returns. The present study attempts to analyse the role of historical returns of stock market on the returns at a present date. BSE Sensex has been used in the study to represent the BSE equity market.

Daily Sensex returns for the period from 1st January 2022 to 1st January 2024 has been used for the study to ensure the detailed Sensex analysis. The previous studies on this aspect laid emphasis on the analysis using Daily data. The second section of the study deals with the previous studies. The subsequent sections deal with the objectives of the study and methodology adopted by the present study. This research initiated to test the Generalized Autoregressive Conditionally Heteroscedastic (GARCH) Model has been used to achieve the objectives of the present study.

1.2 REVIEW OF LITERATURE

Madhavan Madheswaran et al., (2024), In this paper, they have proposed an econometric approach and stochastic approach to analyze the stochastic nature of stock price before and during a COVID-19-specific pandemic period. For our study, we considered the BSE SENSEX INDEX closing pricing data from the Bombay Stock Exchange for the period before and during COVID-19. We have applied the statistical tools, namely descriptive statistics for testing the normal distribution of data, unit root test for testing the stationarity, and GARCH and stochastic model for measuring the risk, also investigated drift and volatility (or diffusion) coefficients of the stock price SDE by using R Environment software and formulated the 95% confidence level bound with the help of 500 times simulations. Finally, the results have been obtained from these methods and simulations are discussed.

Rajesh Elangovan et.al., (2022), have anlaysed the market efficiency of the Indian stock market. For analysis, nine Bombay Stock Exchange (BSE) broad market indices were selected covering the study period from 01 January 2011 to 31 December 2020. The data collected for this study are daily open, high, low and closing prices of selected indices. The tools used in this study are: (1) unit root test to check the stationarity of time series, (2) descriptive statistics, (3) autocorrelation and (4) runs test. The empirical findings of the study reveal that BSE broad

market indices do not follow a random walk and Indian stock market is as weak-form inefficient.

Ashish Khandelwal (2022), in this study, COVID-19 irritation has caused instigative changes inside the way during which individuals each round the earth live, and horribly impacts the overall moderation. It is being seen that lockdown hindrances incited various reactions in our representation of OECD and BRICS nations there was a for the foremost part antagonistic outcome working from the expansion in lockdown limits, however we chase solid slogan for under reaction during the lockdown protestation, trailed by several of launch that's changed therefore. This under-/resettlement plan, truly, is seen fundamentally during the elemental piece inside late memory series, including education points of interest. Relaxing from the lockdown imperatives, obviously, generally affected demands basically during the duvet piece of our model, while for the essential an area of the model, the impact is negative. The present study attempts to present the picture of market in two different circumstances i.e. pre covid and post covid.

Mahajan, Vanshu, Sunil Thakan, and Aashish Malik (2022), have analyzed India VIX (NIFTY 50 volatility index) to identify the behavior of the Indian stock market in terms of volatility and then evaluated the forecasting ability of GARCH- and RNN-based LSTM models using India VIX out of sample data. The results indicated that the NIFTY 50 index's volatility is asymmetric, and leverage effects are evident in the results of the EGARCH (1, 1) model. Asymmetric GARCH models such as EGARCH (1, 1) and TARCH (1, 1) showed slightly better forecasting accuracy than symmetric GARCH models like GARCH (1, 1). The results also showed that overall GARCH models are slightly better than RNN-based LSTM models in forecasting the volatility of the NIFTY 50 index. Both types of models (GARCH models and RNN based LSTM models) fared equally well in predicting the direction of the NIFTY 50 index volatility. In contrast, GARCH models outperformed the LSTM model in predicting the value of volatility.

Nisha Jindal and Ravi Kumar Gupta (2022), have provided an overview of the impact of the 'Outbreak of COVID-19 Pandemic Shockwaves on the returns and volatility of Thailand and Indian Stock Market. It also analysed whether both countries were reacting similarly to the pandemic. The data was divided into three categories, i.e. Before COVID-19 pandemic, During

COVID-19 pandemic and the Whole Period collectively. The 'Pre-Pandemic Time Period' was taken from 1st July 2019 to 31st January 2020, 'During Pandemic Time Period' from 1st February 2020 to 31st August 2020 and the 'Whole Time Period' from 1st July 2019 to 31st August 2020. Three Stock Exchange Indices of both markets were monitored in the study. The standard GARCH models like GARCH, EGARCH, TGARCH, and PARCH models were used to assess the volatility of both markets. The study revealed that the negative shocks had greater an impact on these markets than the positive shocks during the pandemic period. However, most of the parameter estimates were found to be statistically significant in all models, which meant there was the presence of leverage effect in returns of both stock markets.

Roni Bhowmik and Shouyang Wang (2020), in their study, review is to examine effective GARCH models recommended for performing market returns and volatilities analysis. The secondary purpose of this review study is to conduct a content analysis of return and volatility literature reviews over a period of 12 years (2008-2019) and in 50 different papers. The study found that there has been a significant change in research work within the past 10 years and most of researchers have worked for developing stock markets.

Aranidharan, and Dhivya (2020), has explained study is to analyze the Casual Relationship and Volatility of BSE Index with special reference to Indian stock market through the data collected from the period of April 2010 to March 2018. Using SPSS software, the Descriptive statistics and Correlation developed which shows the relationship between share price & various factors affecting the same and also its casual relationship are very helpful for policy makers, Institutional investors, traders and all other stakeholders to take investment decision.

1.3 OBJECTIVES OF THE STUDY

The following are the major objectives of the Study,

1. To study the concept of Volatility.
2. To examine the volatility of historical Sensex index returns in BSE.
3. To analyse the BSE Sensex Return.

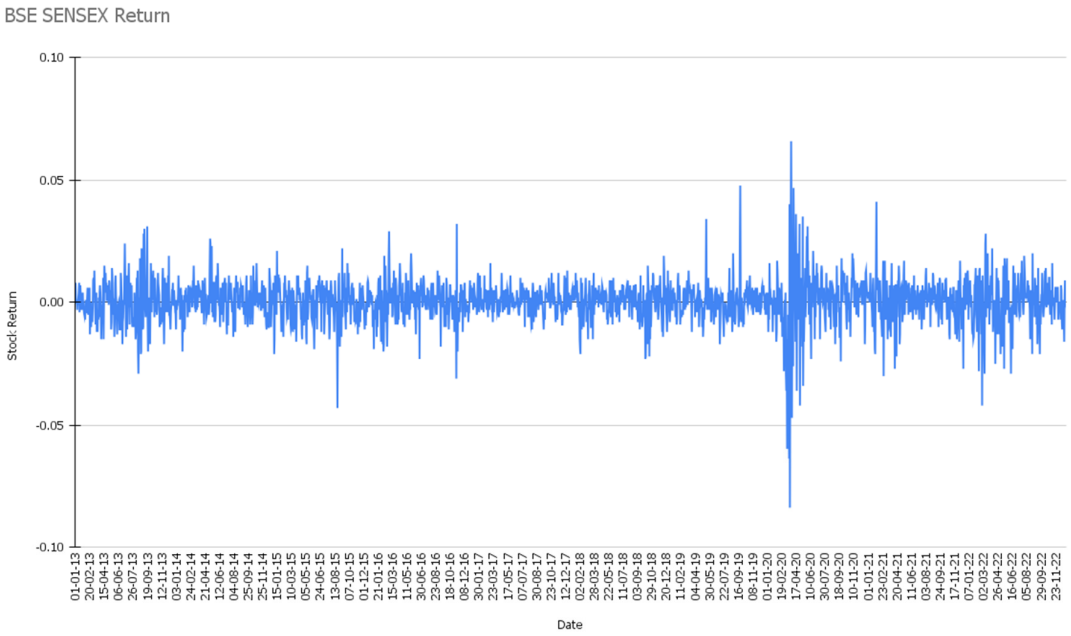
1.4 RESEARCH METHODOLOGY

The present study is based on the daily data covering a period of 10 years from 1st January 2022

to 1st January 2024. Stock prices are represented by daily closing of BSE Sensex. The data on daily closing values of BSE Sensex index has been obtained from the website of www.bseindia.com.

1.5 DATA ANALYSIS

GRAPH NO:1 SHOW THE BSE SENSEX RETURN ANALYSIS



Source: Compiled from Eviews

The graph demonstrates daily BSE Sensex returns from 1st January 2022 to 1st January 2024. Continuous compound returns of the BSE Sensex returns have been estimated so as Return

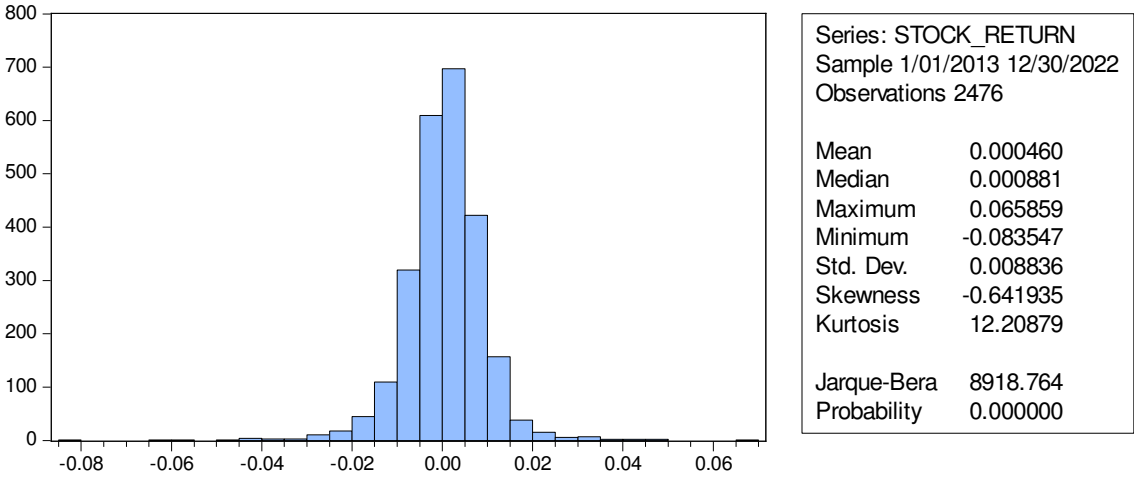
STATISTICAL AND ECONOMETRIC TOOLS

Analysis of the daily Sensex Stock data has been done by using Autoregressive Conditionally Heteroscedastic (ARCH) and Generalised Autoregressive Conditionally Heteroscedastic (GARCH) Models. To eliminate the problem of non stationarity of the data. The data series has been shown graphically to explore the existence of volatility clustering in the data series. This property of the data series provides motivation for the ARCH class of models. Volatility clustering is a phenomenon in which the current level of volatility is positively related with the

volatility of the immediately preceding periods. The graph shows the instances of volatility bunching whereby the periods of less volatility are followed by period of less volatility and the periods of high volatility are followed by periods of high volatility. This specifies the existence of ARCH effect in the series under consideration. The existence of ARCH effect will also be studied statistically in the subsequent divisions.

DESCRIPTIVE STATISTICS

Table-1: DESCRIPTIVE STATISTICS FOR THE PERIOD JANUARY 2013 TO JANUARY 2024



Source: Compiled from Eviews

UNIT ROOT TEST OF THE DATA SERIES NULL HYPOTHESIS

Ho: BSE SENSEX returns has a unit root.

Ha: BSE SENSEX returns does not have a unit root.

H0: BSE Sensex is having unit root.

Table-2: UNIT ROOT TEST FOR THE PERIOD JANUARY 2013 TO JANUARY 2024

Variables	ADF Statistics with Intercept	Probability
BSE Sensex	-20.43743	0.0000

1 per cent	-3.432822	
5 per cent	-2.862518	
10 per cent	-2.567336	

Source: Compiled from Eviews

The results of ADF unit root test indicate that all the variables are stationary. The 'p' value is less than 0.05. This indicates that the data series is stationary in nature.

AUTOREGRESSIVE CONDITIONALLY HETEROSCEDASTIC (ARCH) MODEL

The hypothesis of ARCH-LM test are as:

Ho: There is no ARCH effect.

Ha: There is an ARCH effect.

The output below shows the BFGS / Marquardt results.

Heteroscedasticity Test: Testing of ARCH effect in the Sensex returns

TABLE:3 ARCH EFFECT

Dependent Variable: DATE
Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)
Date: 02/27/23 Time: 13:22
Sample: 1/01/2013 12/30/2022
Included observations: 2476
Convergence not achieved after 500 iterations
Coefficient covariance computed using outer product of gradients
Presample variance: backcast (parameter = 0.7)
Q = C(2) + C(3)*(Q(-1) - C(2)) + C(4)*(RESID(-1)^2 - GARCH(-1))
GARCH = Q + C(5) * (RESID(-1)^2 - Q(-1)) + C(6)*(GARCH(-1) - Q(-1))

Variable	Coefficient	Std. Error	z-Statistic	Prob.
BSE Sensex_RETURN	4905087.	6451643.	0.760285	0.4471

Variance Equation				
C(2)	5.41E+11	1.18E+12	0.457125	0.6476
C(3)	0.906951	7.659924	0.118402	0.9057
C(4)	0.029613	1.920902	0.015416	0.9877
C(5)	0.212708	2.243316	0.094819	0.9245
C(6)	-0.077436	8.440648	-0.009174	0.9927

R-squared	-485190.202615	Mean dependent var	736694.7
Adjusted R-squared	-485190.202615	S.D. dependent var	1056.432
S.E. of regression	735865.0	Akaike info criterion	29.85952
Sum squared resid	1.34E+15	Schwarz criterion	29.87361
Log likelihood	-36960.09	Hannan-Quinn criter.	29.86464
Durbin-Watson stat	0.005306		

Source: Complied from Eviews

The table reveals that there is an ARCH effect in the residuals, since the value of $p<0.05$, which leads to rejection of null hypothesis.

THE GARCH (1, 1) MODEL

GARCH (1, 1) refers to the presence of a first-order ARCH and GARCH term.

TABLE: 4 PARAMETER ESTIMATES OF GARCH MODELS FOR BSE SENSEX RETURNS

Dependent Variable: DATE
Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)
Date: 02/27/23 Time: 13:19
Sample: 1/01/2013 12/30/2022
Included observations: 2476
Convergence not achieved after 500 iterations
Coefficient covariance computed using outer product of gradients
Presample variance: backcast (parameter = 0.7)
GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
BSE SENSEX_RETURN	4685968.	7697424.	0.608771	0.5427

Variance Equation

C	1.47E+11	1.84E+12	0.079507	0.9366
RESID(-1)^2	0.130846	1.387416	0.094309	0.9249
GARCH(-1)	0.598372	4.058522	0.147436	0.8828

R-squared	-485175.894145	Mean dependent var	736694.7
Adjusted R-squared	-485175.894145	S.D. dependent var	1056.432
S.E. of regression	735854.1	Akaike info criterion	29.85804
Sum squared resid	1.34E+15	Schwarz criterion	29.86744
Log likelihood	-36960.26	Hannan-Quinn criter.	29.86145
Durbin-Watson stat	0.004843		

Source: Compiled from Eviews

Further, the coefficient of the variables that is AR (1), RESID (-1)^2 and GARCH (-1) are found to be significant. The coefficient of AR (1) is 4685968 and the value of p= 0.5427. It shows that Sensex returns are significantly affected by their own past returns at lag 1. In case of RESID(-1)^2 , the value of prob. is 0.9366and the coefficient of RESID(-1)^2 is 0.130846, indicating RESID(-1)^2 is significant. The value of Durbin Watson statistics is 0.004843, which is less than 2.It shows that the error terms are not auto correlated, so the statistical model is fit and appropriate.

TABLE: 5 Q-STATISTICS

The Correlogram of the Q- statistics have been used to check autoregressive conditional heteroskedasticity (ARCH) in the residuals.

The hypothesis mentioned above shows that Q-statistics should not be significant, so this is reveals, there is no autocorrelation.

Date: 02/27/23 Time: 13:21
Sample: 1/01/2013 12/30/2022
Included observations: 2476

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
|* |	|* |	1	0.112	0.112	31.162	0.000
*| |	*| |	2	-0.107	-0.121	59.604	0.000
| |	| |	3	-0.050	-0.024	65.924	0.000
| |	| |	4	-0.037	-0.042	69.345	0.000
| |	| |	5	0.009	0.010	69.532	0.000
| |	| |	6	-0.044	-0.058	74.401	0.000
| |	| |	7	-0.003	0.009	74.422	0.000
| |	| |	8	0.030	0.018	76.713	0.000
| |	| |	9	0.004	-0.004	76.755	0.000

|	|	|	|	10	-0.021	-0.020	77.851	0.000
|	|	|	|	11	-0.045	-0.038	82.868	0.000
|	|	|	|	12	0.024	0.030	84.348	0.000
|	|	|	|	13	-0.011	-0.030	84.642	0.000
|	|	|	|	14	0.017	0.028	85.392	0.000
|	|	|	|	15	-0.021	-0.034	86.481	0.000
|	|	|	|	16	-0.031	-0.020	88.822	0.000
|	|	|	|	17	0.043	0.039	93.436	0.000
|	|	|	|	18	-0.026	-0.039	95.112	0.000
|	|	|	|	19	-0.011	0.002	95.442	0.000
|	|	|	|	20	0.034	0.030	98.355	0.000
|	|	|	|	21	-0.023	-0.034	99.717	0.000
|	|	|	|	22	-0.026	-0.021	101.37	0.000
|	|	|	|	23	-0.004	0.005	101.41	0.000
|	|	|	|	24	-0.037	-0.047	104.75	0.000
|	|	|	|	25	0.012	0.018	105.12	0.000
|	|	|	|	26	0.013	-0.001	105.57	0.000
|	|	|	|	27	0.018	0.017	106.42	0.000
|	|	|	|	28	0.015	0.009	106.96	0.000
|	|	|	|	29	-0.011	-0.013	107.29	0.000
|	|	|	|	30	-0.017	-0.008	107.99	0.000
|	|	|	|	31	-0.007	-0.006	108.11	0.000
|	|	|	|	32	-0.037	-0.041	111.57	0.000
|	|	|	|	33	0.010	0.021	111.83	0.000
|	|	|	|	34	0.008	-0.012	111.98	0.000
|	|	|	|	35	0.050	0.052	118.26	0.000
|	|	|	|	36	-0.030	-0.043	120.47	0.000

*Probabilities may not be valid for this equation specification.

1.6 LIMITATIONS OF THE STUDY

- BSE Sensex has been used to represent the Indian stock market. Other stock market indices not been used for this volatility testing analysis.
- This analysis has been undertaken b y using daily data. Annual or Monthly data could also have been used for making the analysis of data.
- The concept of volatility can be studied more comprehensively by studying the impact of different classes of investors, both domestic as well as foreign, on the Indian context stock market volatility.

1.7 CONCLUSION

The study examined the stock market volatility and return analysis: Evidence from BSE Sensex Index. The study analyzed whether previous day Sensex returns has an impact on the today's Sensex returns by fitting GARCH (1, 1) model. It is evident from the analysis that parameter is statistically significant and positive which indicates that historical Sensex returns has GARCH effect in the today's Sensex returns. Therefore, an investor can able to earn profit on the BSE Market.

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