NOVATEUR PUBLICATIONS
JournalNX- A Multidisciplinary Peer Reviewed Journal
ISSN No: 2581 - 4230
VOLUME 8, ISSUE 7, July-2022

MODELLING AND FORECASTING OF STOCK PRICE VOLATILITY OF SELECTED NIFTY 50 COMPANIES IN INDIA

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ABSTRACT
Price volatility, particularly in the stock exchange market, is a crucial topic that both practitioners and theorists are concerned about. This study helps to see how GARCH family models may be used to predict and forecast stock price volatility for chosen NIFTY 50 companies in India. Only 2% of India's population invests in the stock market, and many investors find it difficult to choose their investment stock due to a lack of knowledge about the securities risk and return. In this study two major sectors like financial services and information technology were considered for the financial year from 1/04/2011 to 31/03/2021. The research design used for the study is analytical research design which helps to shape the research problem and the information related to the research were not manipulated. The sampling method used for the study was purposive sampling by which the researcher selected the sample based on his knowledge which is reliable for the study. The database of the selected 14 companies under two major sectors was listed on the NSE and indexed under the NIFTY 50 index. The models of forecasting like GARCH (1,1), asymmetric GARCH models like Exponential GARCH–EGARCH (1,1) and Threshold GARCH–TGARCH (1,1) have been considered in this study. To see the ARCH effect, Heteroskedasticity Test like - The Lagrange Multiplier (LM) test for ARCH were used to see the presence of Heteroskedasticity in residual of the return series. Because if ARCH effect is present, we can use ARCH/GARCH models. The stationarity test like Augmented Dicky-Fuller test were conducted to see whether the return series are stationary. Two forecasting error statistics, Root Mean Square Error and Mean Absolute Error, were employed to assess the performance of these GARCH family models. Overall, the TGARCH (1,1) model outperformed, and it is regarded as the best-fitting model.

Keywords Stock Price Volatility, Modelling and Forecasting, Nifty50, GARCH, E-GARCH & T-GARCH Models.

INTRODUCTION

Stock price volatility modelling and forecasting in the stock exchange market is a critical topic for both theorists and practitioners. The financial markets are influenced by social, political, economic, and other issues daily. Investment in the stock market is always predicted to be risky because they are more volatile. In securities markets, volatility implies peaks and troughs which might lead for either loss or gain. The term volatility is the quantitative measure of the fluctuations of the price or rate of return of the percentage price adjustments. Volatility modelling of stock returns using GARCH type models has become important among practitioners and financial researchers because this type of models is highly useful and effective in obtaining most of the volatility aspects of financial information or data like

volatility mean reversion, leverage effect, shock persistence and volatility clustering. The stock prices and other major assets depends mainly on the expected volatility of returns.

Volatility is a dispersion that measures around the mean or a securities average return, by using the standard deviation or variance volatility can be measured [1]. Volatility modelling of stock returns using GARCH type models are very much helpful and successful in capturing most of the volatility features of financial information or data like volatility mean reversion, leverage effect, shock persistence and volatility clustering. The stock prices and other major assets depends mainly on the expected volatility of returns. The financial services sector makes evaluation of volatility as a part of overseeing their risk exposure. The volatility leads to increase in response for the "bad news" and to fall in response for the "good news" [2]. Volatility is an important factor that influencing the price of the financial instruments like futures and options, stocks, and it is a measure of trade-off between investment risk and return. The stock market volatility has a crucial impact on the market analysts, market regulations, financial rules, fiscal and monetary policies, policy makers, corporate and financial managers, because a huge volatility in the share market will lead to a negative effect for the economy of the country [3]. Volatility clustering is often displayed by financial time series returns. This reflects an imminent announcement that has been positive news: before, the market was increasingly more turbulent. The proclamation, however, the strong positive return at the point indicates that punters were contended, and the volatility were reduced soon. The main cluster of volatility reveals that there is commotion in the market following an unexpected piece of bad news. Secondly, in the equity market, it is generally observed that the volatility was higher in a falling market that it is in a rising market. The reaction of volatility to a huge adverse return is always much higher than that of huge positive return of the same magnitude. This study is primarily concerned with modelling and forecasting of stock price volatility of selected NIFTY 50 Companies under two different sectors like financial services and information technology using (GARCH) family models. To this study the daily adjusted closing price of the selected companies were taken from the NIFTY 50 index listed under the NSE of India (Source: Yahoo! Finance). The primary objective of the study is to identify the suitable GARCH family models for forecasting the stock price volatility. In previous research, many studies were used only daily or monthly closing price of the stock market to calculate returns. But in this present study the stock price volatility was modelled and forecasted based on the stock's daily adjusted closing price. Because the adjusted closing price shows the stock's actual price, giving investors a more current and accurate idea of the stock's price.

LITERATURE REVIEW

Earlier studies such as [4,5,6] found the same conclusion that is; the best fitted model to measure and model the volatility of the stock market is the GARCH (1,1). They also authenticate that the ability to capture the asymmetry in the stock return volatility by using the asymmetric GARCH type models. There is an increasing empirical and analytical research by which their methodologies depend on employing the ARCH/ GARCH models on the developing stock markets to evaluate and forecast volatility such as the studies of [7,8,9,10] from Pakistan, and India. They all applied different GARCH type models and their major findings revealed that the GJR GARCH and EGARCH were the best fitted models for volatility measurement, leverage effect, leptokurtosis, and detecting clustering effect. [11] examined the modelling and forecasting of the Egypt stock market's time-varying stock return volatility. [12] analysed the volatility of Sudan and Egypt stock market by using univariate GARCH models. [13] evaluated the stock returns and its operating performance, volatility of stock returns evidence from the international drivers of the low volatility. [14] studied the factors influencing the Nigeria's stock market

using the time series analysis. [15] were analysed the volatility of five stock markets of southeast Asia by seeing its day of the week effect and annual returns. [16] estimated and forecasted the volatility of Turkish financial markets using asymmetric GARCH models. [17] modelled and forecasted the stock market of Ghana and Nigeria by using the asymmetric models are used to investigate the conditional heteroscedasticity of stock price returns. [18] studied the effect of macroeconomic factors and its fundamentals on the revised stock prices of Indian stock market. [19] examined the impact of market volatility of Korean stock markets liquidity and stock returns. [20] were studied the price volatility modelling-wheat: GARCH model application. [21] analysed the impact of major macroeconomic factors in India and the United States on the Indian stock market. [22] were analysed the impact of dividend policy of the Amman stock exchange by analytical evidence.

[23] were studied the Malaysian industrial product manufacturers' stock price fluctuation and dividend policy. [24] evaluated the stock market volatility Zimbabwe stock exchange by using different GARCH family models. [25] examined the stock market reaction towards demonetization in India: an empirical study. [26] were forecasted the Korea composite stock price index 200 spot volatility measures. [27] were modelled and forecasted the volatility of cryptocurrencies: a comparison of non- linear GARCH type models. [28] studied the effect of COVID – 19 on the NSE stock price in the automobile sector stock Market. [29] were examined the key variables influencing stock price volatility during COVID - 19. [30] analysed the evidence of a March 2020 stock market collapse from the S&P1500. Throughout literature review, we consistently observe different conclusions about how stock price volatility affects the market. Earlier studies help to identify how GARCH family models were used to model and forecast the stock price volatility. These findings help us to determine that in previous studies they have used daily closing price for calculating the returns. But in this study, the researcher has used the daily adjusted closing price for calculating the returns because it will provide more accurate information and results to the investors.

METHODOLOGY

Research is the “acquisition of new knowledge or the creative use of existing knowledge to produce new ideas, approaches, and conceptions” [31]. The research design used for the study is “Analytical Research Design” and the sampling method used for the study is “Purposive Sampling”.

In this study the researcher relies on his own judgment by selecting NIFTY 50 companies which is purposely selected for this study. The sampling unit used for this study is 14 Companies of 2 sectors which is listed in the NSE of India and indexed under NIFTY 50 as on 31/03/2021.The list of companies in each sector was selected based on the sector weightage. The data are based on the NSE of India Ltd financial information. The database of the selected 14 companies of 2 sectors daily adjusted closing price for the period of 10 years from 1/04/2011 to 31/03/2021 were considered for the study (Source: Yahoo! Finance). The following Hypothesis are framed for testing: NH_1: There is no stationarity in the returns of the companies. NH_2: There is no significant difference among the non-linear forecasting models. The statistical tools used for the study to analyse the data were as follows. Returns $R_t = (Pt\text{-}Pt_1) / Pt_1$ Where, Pt – Current day adjusted closing price, Pt_1 – Previous day adjusted closing price and Descriptive Statistics were used. Econometric Models - The following are the test, which is applied under Econometric Models like Normality Test, Jarque–Bera Test, Stationarity Test - the Augmented Dickey-Fuller (ADF) were used to infer the series' stationarity. Heteroskedasticity Test - The Lagrange Multiplier (LM) test for Autoregressive Conditional Heteroskedasticity (ARCH) is used to validate the presence of Heteroskedasticity in residual of the return series. If ARCH-effect is present we can use

ARCH/ GARCH model(s). Non-Linear Models- GARCH, EGARCH and TGARCH Model were used for the study.

DATA ANALYSIS

Table 1. Descriptive statistics

S.No.	Company Name	Mean	S.D.	Skewness	Kurtosis
1	HDFC Bank	0.00072	0.01419	-0.00972	11.65702
2	HDFC	0.00063	0.01850	7.75003	220.1784
3	ICICI Bank	0.00061	0.02102	0.29366	7.88636
4	KOTAK Bank	0.00093	0.01748	0.00810	7.52125
5	AXIS Bank	0.00055	0.02181	-0.62349	16.65413
6	SBI	0.00053	0.02295	1.65342	21.15634
7	Bajaj Finance	0.00226	0.02340	0.41311	14.03109
8	Bajaj Finserv	0.00127	0.02201	0.08435	17.43811
9	IndusInd Bank	0.00054	0.02353	1.72358	64.86342
10	Infosys	0.00075	0.01778	-0.64264	22.19701
11	TCS	0.00080	0.01605	0.11575	7.07776
12	HCL Tech	0.00093	0.01762	-0.25961	6.41322
13	Tech Mahindra	0.00062	0.01905	-0.20172	8.95040
14	Wipro	0.00030	0.01566	-0.36901	7.18677

Source: Computed from Eviews

Table 2. Augmented Dickey-Fuller Test

S.No.	Company Name	Augmented Dickey-Fuller Test		
		Intercept	Trend &Intercept	None
1	HDFC Bank	-36.8755	-37.1134	-36.7082
2	HDFC	-49.6403	-49.6356	-49.5784
3	ICICI Bank	-47.9763	-47.8684	-47.8338
4	KOTAK Bank	-50.6648	-50.7790	-50.6457
5	AXIS Bank	-46.7274	-46.7530	-46.7285
6	SBI	-46.7232	-46.6411	-46.6278
7	Bajaj Finance	-48.4633	-48.4958	-48.1123
8	Bajaj Finserv	-47.7250	-47.8285	-47.7752
9	IndusInd Bank	-47.0228	-47.2084	-47.9635
10	Infosys	-49.8247	-49.8189	-49.7310
11	TCS	-49.3363	-49.3463	-49.2310
12	HCL Tech	-49.8167	-49.8653	-49.6452
13	Tech Mahindra	-48.8243	-48.8051	-48.7576
14	Wipro	-50.7495	-50.7510	-50.7277

Source: Computed from Eviews

The descriptive statistics of the financial services and information technology sector shows that all the companies mean values are positive which indicates the fact that price has increased over the period. The standard deviation of returns indicates that the selected companies are relatively volatile. For the normal skewness the value should be zero. Hence the positive values or long right tailed indicates the high probability of getting positive returns.

Similarly, the negative values or long left-tailed indicates the probability of getting negative returns, and they positively/ negatively deviate from the normal distribution. For all the selected companies the value of kurtosis is greater than 3. It indicates that the return series are fat tailed and were not normally distributed.

The ADF test is used to check whether the time series has a unit root. It is mandatory that one check whether the series are stationary. It shows that the ADF test (t-Statistic) are more negative than the test critical values, hence the null hypothesis of a unit root is rejected at 1%. Therefore, it is concluded that all the selected companies' returns are stationary. Jarque-Bera test were used to check the test of normality.

Table 3. Test of Normality

S.No.	Company Name	J-B	Probability
1	HDFC Bank	6616.603	0.000
2	HDFC	5869.109	0.000
3	ICICI Bank	2482.930	0.000
4	KOTAK Bank	2102.812	0.000
5	AXIS Bank	14330.430	0.000
6	SBI	6050.050	0.000
7	Bajaj Finance	10370.590	0.000
8	Bajaj Finserv	12756.150	0.000
9	IndusInd Bank	16710.310	0.000
10	Infosys	5860.727	0.000
11	TCS	1710.822	0.000
12	HCL Tech	1336.732	0.000
13	Tech Mahindra	3440.873	0.000
14	Wipro	1870.172	0.000

Source: Computed from Eviews

It shows that the Jarque-Bera test statistic P-value falls between 0 and 1. The null hypothesis were rejected at 1% significance level, which indicates the fact that the return series were distributed normally were rejected and it may have concluded that all the return series were not normally distributed which is leptokurtic distribution with positive peaked curve.

It is mandatory to test ARCH effect before applying ARCH/ GARCH model. Because if ARCH effect is present, we can use GARCH family models. It indicates that the ARCH-LM Statistics and p-value for ARCH Test using Lagrange Multiplier (LM). The p-value of the test is almost 0. The critical value Chi-square (1) at 1% is 6.625.

The Null Hypothesis is rejected at 1% significance level for all the selected companies. This demonstrates the presence of ARCH effect in return series. Therefore, GARCH family models were applied like GARCH, EGARCH and TGARCH were calculated by using Eviews 12 software.

MAJOR FINDINGS

In the GARCH (1,1) model the ARCH and GARCH parameters are positive and statistically significant at the 1% level for most of the companies. Both these coefficients are positive. i.e., If we add both the ARCH term and GARCH term, the values are less than 1 (<1). It proves that the less volatility, i.e., the companies which have the value less than one, will have less impact over the changes in return.

As the value of Gamma ($\gamma 1 \neq 0$) is non-zero, the output of the EGARCH model specifies the existence of leverage effect in volatility in the return series for all the selected companies. Hence the difference between the good news and the bad news is the value of asymmetry, which is the coefficient of asymmetric term (δ). TGARCH model's conditional variance is described above. Thus, the TGARCH model inferred that the volatility is substantially increases due to bad news. Also, stock return volatility which is in time varying is asymmetric.

In this study The GARCH (1,1) model does not capture the leverage effect or asymmetric volatility effect. Therefore, EGARCH model for the stock is used for volatility estimation of the return series. However, the EGARCH model cannot offer information on whether good or negative news increases or lowers volatility. TGARCH, on the other hand, captures this property of volatility modelling. Based on GARCH family models, the TGARCH model beats the other GARCH models in estimating and forecasting volatility in the market for the return series evaluated in this study.

For all the selected companies, it is observed that the RMSE and MAE values are lowest under TGARCH (1,1) model. Therefore, it indicates that the TGARCH (1,1) in terms of RMSE and MAE, the model surpasses all other models and delivers a more precise prediction.

CONCLUSION

The detailed research demonstrates the forecasting capacity, prediction, and assessment of stock market volatility for the return series of the selected NIFTY 50 companies across two sectors like financial services and information technology from 1 April 2011 to 31 March 2021. The TGARCH model outperforms and is regarded as the best-fitted model based on an assessment of forecasting performance using two separate error statistics, Root Mean Square Error and Mean Absolute Error. As a result, the TGARCH (1,1) model aids in capturing the leverage effect, forecasting accuracy, and distinguishing the asymmetry influence between good and negative news.

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