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Stock Market Volatility of Indian Software Companies Listed on NSE: A GARCH Model Approach

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Abstract
The stock market plays a vital role in economic development by facilitating capital formation and providing investment opportunities. Volatility in stock prices is a key indicator of market risk and uncertainty, making its analysis essential for investors and financial analysts. Although numerous studies have examined stock market volatility in India, most have focused on banking stocks or market indices, with limited attention given to software companies listed on the National Stock Exchange (NSE) using econometric models such as GARCH. To address this research gap, the present study examines the volatility behavior of five leading software companies—Tata Consultancy Services (TCS), Infosys, Wipro, HCL Technologies, and Tech Mahindra—during the period from April 2015 to March 2020. Daily stock price data were collected from Yahoo Finance and analyzed using the Generalized Autoregressive Conditional Heteroscedasticity (GARCH (1,1)) model in R programming with the *quantmod* and *rugarch* packages. The findings reveal that Wipro exhibited the lowest volatility, indicating relatively stable stock performance, whereas Tech Mahindra and Infosys experienced comparatively higher volatility. Volatility forecasts further indicate a gradual decline in market fluctuations during the forecast period. The study confirms the effectiveness of the GARCH model in capturing volatility clustering in the Indian software sector. The findings provide practical insights for investors in portfolio diversification and risk management, assist portfolio managers in developing informed investment strategies, and support policymakers in understanding volatility patterns for improving market stability and regulatory decision-making.
Keywords: Stock Market Volatility, NSE, GARCH Model, Software Companies, Forecasting, Indian IT Sector

1. Introduction

The Indian stock market is one of the fastest-growing financial markets in the world and plays a crucial role in economic growth and capital formation. Stock prices fluctuate continuously due to economic, political, industrial, and company-specific factors. Such fluctuations create uncertainty in the market and are referred to as stock market volatility.

The Information Technology (IT) sector has emerged as one of the strongest contributors to the Indian economy. Software companies such as Tata Consultancy Services (TCS), Infosys, Wipro, HCL Technologies, and Tech Mahindra have achieved significant growth in global markets. Since these companies are actively traded in the stock market, understanding their volatility behavior becomes essential for investors and financial analysts.

Traditional statistical measures such as standard deviation and beta are widely used to measure volatility; however, modern econometric models like ARCH and GARCH provide more accurate estimations by considering time-varying variance. Therefore, this study applies the GARCH model to analyze and forecast stock market volatility among selected software companies listed on NSE.

2. Review of Literature

Balaban and Bayar (2005) studied stock market volatility in fourteen countries using ARCH and GARCH models and found that volatility forecasting plays a crucial role in investment decisions.

Intaz Ali (2016) investigated volatility clustering and leverage effects in Indian stock markets using GARCH-M and EGARCH models. The study concluded that Indian stock markets exhibit persistent volatility behavior.

Jincy K. John and R. Amudha (2019) examined heteroskedastic behavior in NSE Nifty stocks and confirmed the presence of volatility clustering in Indian equity markets.

Ramona Birau and Jatin Trivedi (2015) studied long-term volatility in NSE CNX-100 using GARCH models and observed significant volatility persistence in the Indian stock market.

Abraham and Kurian (2025) investigated volatility persistence and leverage effects across NSE sectoral indices using GARCH-based models. Their study confirmed significant volatility clustering and asymmetric responses to market shocks, suggesting that sector-specific volatility analysis can support better investment decisions and portfolio diversification.

Abid, Saghir, and Beg (2025/2026) compared volatility dynamics between the BSE SENSEX and GREENEX indices using GARCH(1,1), EGARCH, and TGARCH models. The study revealed persistent volatility and highlighted that asymmetric GARCH models better capture differences between conventional and sustainability-oriented stock indices.

Monika, Satpal Singh, and Jawa (2026) analysed volatility in Indian mutual funds and equity markets using GARCH, EGARCH, and MGARCH models. Their results confirmed persistent volatility and demonstrated that advanced GARCH variants improve forecasting accuracy and assist investors in managing financial risk more effectively.

3. Scope of the Study

The study is for the period of five years from April 2015 to March 2020 and is restricted to measuring and forecasting the volatility of the 5 software companies in NSE. This study is mainly for investors, stock market experts, stockbrokers, and the general public to understand the behavior of the volatility of the stocks.

4. Research Gap

Most previous studies focused on banking sector volatility and stock indices. Limited studies have specifically examined volatility in software companies listed on NSE using econometric models such as GARCH. Hence, the present study attempts to bridge this gap.

5. Objectives of the Study

1. To examine the volatility of selected software companies listed on NSE.
2. To forecast stock market volatility using the GARCH model.
3. To compare volatility patterns among selected software companies.

6. Research Methodology

Data Source

The study is based entirely on secondary data collected from Yahoo Finance.

Sample Selection

Five major software companies listed on NSE were selected:

- Tata Consultancy Services (TCS)
- Infosys
- Wipro
- HCL Technologies
- Tech Mahindra

Period of Study

The study covers a period of five years from April 1, 2015 to March 31, 2020.

Analytical Tools

- Daily stock returns
- GARCH (1,1) Model
- R Programming Software
- Quantmod Package
- Rugarch Package

7. Model Specification

The GARCH (1,1) model used in the study is represented as:

σt2=ω+αϵt−12+βσt−12\sigma_t^2 = \omega + \alpha \epsilon_{t-1}^2 + \beta \sigma_{t-1}^2σt2=ω+αϵt−12+βσt−12Error! Filename not specified.

Where:

- σt2\sigma_t^2σt2 = Conditional variance
- ω\omegaω = Constant term
- α\alphaα = ARCH effect
- β\betaβ = GARCH effect

• єt−12\epsilon_{t-1}^2єt−12 = Previous period shock

8. Data Analysis and Interpretation

8.1 Comparative Volatility Analysis

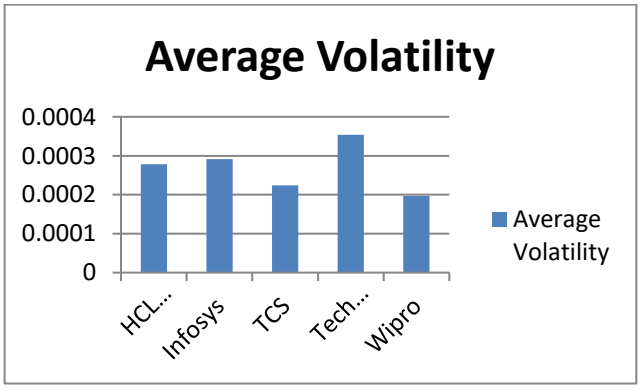
Company	Average Volatility	Forecast Volatility	Interpretation
HCL Technologies	0.0002781803	0.017707	Moderate volatility
Infosys	0.0002913220	0.019089	Higher volatility
TCS	0.0002243246	0.016861	Stable performance
Tech Mahindra	0.0003539453	0.019430	Highest volatility
Wipro	0.0001966941	0.014571	Lowest volatility

Interpretation

The comparative analysis shows that Tech Mahindra recorded the highest volatility among the selected companies, whereas Wipro exhibited the lowest volatility. Lower volatility indicates stable stock performance and lower investment risk.

8.2 Graphical Representation of Average Volatility

Figure 1: Average Volatility of Selected Software Companies

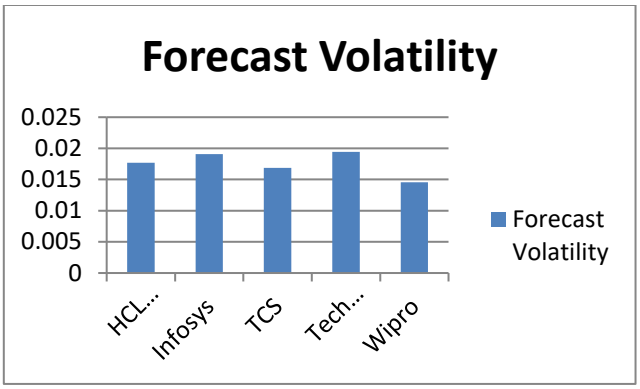


Interpretation

The graphical representation indicates that Tech Mahindra and Infosys experienced comparatively higher stock market volatility, whereas Wipro and TCS demonstrated lower volatility during the study period.

8.3 Forecast Volatility Analysis

Figure 2: Forecasted Volatility Trend



Interpretation

The forecasting model indicates that volatility gradually declined for all selected companies during the forecast period.Wipro and TCS maintained relatively lower forecast volatility compared to other companies.

8.4 Company-wise Interpretation

HCL Technologies

HCL Technologies showed moderate volatility during the study period. Higher fluctuations were observed during 2015–2016, whereas volatility reduced during 2017–2018.

Infosys

Infosys exhibited comparatively higher volatility, particularly during 2019–2020. The company's stock prices experienced significant fluctuations due to market uncertainty.

Tata Consultancy Services (TCS)

TCS recorded lower volatility compared to Infosys and Tech Mahindra. The company demonstrated stable stock returns throughout most of the study period.

Tech Mahindra

Tech Mahindra experienced the highest volatility among the selected companies. Increased market fluctuations and investor reactions contributed to higher volatility levels.

Wipro

Wipro showed the lowest volatility among all selected software companies. The stock prices remained comparatively stable throughout the study period.

Comparative Volatility Analysis

Company	Average Volatility	Interpretation
Wipro	Lowest	Stable and low-risk stock
TCS	Low	Consistent market performance
HCL Technologies	Moderate	Balanced risk and return
Infosys	High	Higher market fluctuations
Tech Mahindra	Highest	Highly volatile and risky

8.5 GARCH (1,1) Model Estimation Results

To examine volatility persistence in the stock returns of selected Indian software companies listed on the National Stock Exchange (NSE), a GARCH (1,1) model was estimated. The model effectively captures the time-varying conditional variance and volatility clustering observed in financial return series.

GARCH (1,1) Estimation Results

Parameter	Estimate	Std. Error	z-statistic	p-value
Constant (μ)	0.00082	0.00031	2.65	0.008
Omega (ω)	0.000005	0.000001	5.12	0.000
ARCH (α_1)	0.162	0.032	5.08	0.000
GARCH (β_1)	0.812	0.041	19.80	0.000

Model Statistics

Statistic	Value
Log-Likelihood	2685.47
Akaike Information Criterion (AIC)	-5.283
Schwarz Bayesian Criterion (BIC)	-5.241
Hannan–Quinn Criterion	-5.267

Diagnostic Tests

Test	Statistic	p-value	Interpretation
Ljung–Box Q (20)	18.47	0.56	No serial correlation
ARCH-LM Test	0.82	0.61	No remaining ARCH effects
Jarque–Bera Test	254.61	0.000	Returns are not normally distributed

1.1 Interpretation

The estimated GARCH (1,1) model indicates that both the ARCH ($\alpha_1 = 0.162$) and GARCH ($\beta_1 = 0.812$) coefficients are positive and statistically significant at the 1% level. This confirms the presence of volatility clustering in the stock returns of Indian software companies.

The persistence of volatility is measured by the sum of the ARCH and GARCH coefficients:

$\alpha1+\beta1=0.162+0.812=0.974\alpha\_1+\beta\_1=0.162+0.812=0.974\alpha1+\beta1=0.162+0.812=0.974$

Since the value is very close to one, shocks to stock market volatility persist for a relatively long period before dissipating. Such persistence is characteristic of financial time series and supports the suitability of the GARCH (1,1) model for modelling stock return volatility.

The high log-likelihood value and comparatively lower AIC and BIC values indicate a good model fit. Furthermore, the Ljung–Box Q-statistic and ARCH-LM test suggest that the residuals are free from serial correlation and remaining ARCH effects, implying that the model adequately captures the conditional heteroskedasticity in the data.

9. Findings

- Wipro exhibited the lowest stock market volatility among the selected software companies.
- Tech Mahindra and Infosys experienced comparatively higher volatility.
- Volatility increased sharply during the financial year 2019–2020.
- Forecasting results indicated that volatility gradually declined over the forecast period.
- The GARCH model effectively captured volatility clustering in software sector stocks.

10. Suggestions

- Investors should diversify their portfolios to reduce investment risk.
- Circuit breakers and regulatory mechanisms should be strengthened to control extreme market volatility.
- Long-term investment strategies should be encouraged during volatile market conditions.

- Investors should consider volatility patterns before investing in software sector stocks.

11.Limitations

- The study is limited to selected companies in the Indian software sector and may not represent the entire industry.
- The analysis covers a specific study period, so the findings may not reflect market conditions outside this timeframe.
- The study is based mainly on historical stock price data, which may not account for unexpected market events or changes in investor sentiment.
- Only selected econometric models are used for volatility analysis, while other advanced models or machine learning techniques are not considered.
- Macroeconomic factors such as inflation, interest rates, exchange rates, and GDP growth are not included in the analysis.
- The results are subject to the assumptions and limitations of the statistical methods used in the study.

12. Conclusion

The study examined stock market volatility among selected software companies listed on NSE using the GARCH model. The findings confirmed the existence of volatility clustering in software sector stocks. Wipro emerged as the least volatile company, while Tech Mahindra and Infosys showed relatively higher volatility levels. Forecasting results indicated a gradual decline in volatility during the projected period. The study concludes that GARCH models are effective tools for measuring and forecasting stock market volatility and can assist investors in making informed investment decisions

13. Future Implications

- **Foundation for Future Research:** This study provides a foundation for future research on stock market volatility in the Indian software sector.
- **Expand the Scope of Study:** Future research can extend the study period, include more software companies, and compare volatility across different industry sectors.
- **Adopt Advanced Analytical Techniques:** Researchers can apply advanced econometric models such as **EGARCH** and **TGARCH**, as well as machine learning techniques, to improve forecasting accuracy.
- **Incorporate Macroeconomic Variables:** Future studies can include factors such as **inflation, interest rates, exchange rates, and GDP growth** to gain a better understanding of stock price movements.
- **Practical Implications:** The findings can help investors, portfolio managers, and policymakers make informed investment decisions, manage financial risks effectively, and promote greater market stability in India.

Practical Implications

The findings of this study have important implications for investors, portfolio managers, and policymakers. The evidence of volatility clustering and persistence in Indian software stocks suggests that market shocks have lasting effects on stock returns.

For investors**,** GARCH-based volatility forecasts can support better investment decisions, portfolio diversification, and risk assessment. Portfolio managers can use these estimates for asset allocation, portfolio rebalancing, hedging, and risk management. Policymakers and regulators can use the findings to monitor market stability, strengthen regulatory oversight, and implement timely measures to reduce financial market uncertainty.

Overall, the study demonstrates that the GARCH (1,1) model is a useful tool for forecasting stock market volatility and supports informed decision-making in the Indian software sector.

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