PRAYUKTI
Journal of Management Applications
ISSN 2583-1909 (Online)
Volume 6, Issue 1, January 2026

DYP DPU
Dr. D. Y. Patil B-School, Pune

Crisis, Volatility, and Market Resilience: Evidence from GARCH Modelling of the BSE Sensex

Dipankar Pradhan[1*], Binota Reang[2]
[1]Assistant Professor, ICFAI University, Tripura
[2]M. Com Student, ICFAI University, Tripura

DOI: http://doi.org/10.52814/PJMA.2026.6102

ARTICLE TYPE: Research paper

ARTICLE HISTORY: Submitted, Revisions, Accepted: Jan. 2026

HOW TO CITE: Pradhan, D., & Reang, B. (2026). Crisis, Volatility, and Market Resilience: Evidence from GARCH Modelling of the BSE Sensex. *Prayukti - Journal of Management Applications*, Vol. 6, Issue 1, pp 21-36.

***Corresponding author e-mail:** pradhandipankar10@gmail.com

ABSTRACT

This study examines the volatility behaviour of the Indian stock market by analysing the BSE Sensex during the pre-COVID and COVID periods. The COVID-19 pandemic introduced unprecedented uncertainty into global financial markets, significantly influencing investor behaviour, market risk, and overall stability. Against this background, the study aims to compare market performance and volatility dynamics across normal and crisis periods, with a specific focus on volatility persistence and clustering. The analysis is based on secondary daily time-series data of the BSE Sensex. Stock returns are computed using continuously compounded log returns. Descriptive statistical measures are employed to examine the basic characteristics of the return series, while the Augmented Dickey–Fuller (ADF) test is used to confirm stationarity. Market volatility and risk are modelled using the GARCH (1,1) framework, which is widely used to capture time-varying volatility and the persistence of market shocks. The empirical results indicate that the BSE Sensex exhibited relatively stable volatility during the pre-COVID period, whereas volatility increased sharply during the COVID-19 phase, confirming the presence of strong volatility clustering and persistence. The GARCH estimates show that shocks during the pandemic had a significant and long-lasting impact on market volatility. Overall, the findings confirm that COVID-19 had a substantial effect on stock market risk and stability. The study contributes to the existing literature by providing a focused GARCH-based analysis of volatility behaviour during crisis conditions, offering valuable insights for investors, policymakers, and risk managers in emerging markets.

KEYWORDS: BSE Sensex; Stock Market Volatility; COVID-19 Pandemic; GARCH Model; Financial Crisis; Market Risk; Emerging Markets

1. INTRODUCTION

Financial markets have been instrumental in the economic well-being of a nation, as it facilitates resource allocation, transmission of information, and the control of investor expectation. Stock exchanges are one of such markets that are particularly sensitive to the economic shocks, policy changes and world uncertainties. Financial crises, geopolitical conflicts, or health-related crises are examples of unexpected outside factors that tend to interfere with the normal operations of the market, causing price changes and increasing volatility. It is thus the understanding of the behaviour of stock market during such extreme events that is crucial to the investors, policy makers and financial regulators.

The new coronavirus crisis that started at the beginning of 2020 is one of the most significant shocks in the history of the modern economy in the world. What started as a national health crisis quickly turned into an economic crisis all over the world, and at the same time, it touched upon production, trade, employment, and financial systems. The effect of lockdown, travel restrictions, disruption of supply chains, and widespread uncertainty greatly changed the investor sentiment of global financial markets. Fear, panic and the sudden fluctuations of expectations caused stock markets to respond with a volatility, steep downfalls, and abrupt turns that had never been experienced before.

There was severe turbulence in the stock market in India in the period of the pandemic. The BSE Sensex a major benchmark index of the performance of leading Indian firms experienced sharp falls in the first stage of COVID-19 especially in March 2020. Such movements were spurred by local conditions including countrywide lockdowns and shrinking economies, and international ones including capital flight, international demand breakdown, and risk-aversion. Nevertheless, as the government stimulus packages were implemented, the monetary policy was accommodative, the vaccination campaigns were launched and the economy gradually opened, the market started to recover and reached a new level. This dynamic reaction of large-scale crises on stock markets is emphasised by this contrasting behaviour.

Conventional financial theories tend to believe in market efficiency and predictable trends in risks, but when crisis periods arise, these beliefs are put into question. In case of extreme events such as COVID-19, stock markets are prone to volatility clustering, shock persistence, and risk that varies over time. Simple linear models cannot adequately model such characteristics. Higher-order econometric models, especially the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model, are thus far and large utilised to examine time-changing volatility and risk persistence in financial markets.

Whereas a substantial literature has been used to investigate the effect of COVID-19 on financial markets, a lot of the available literature has dwelled either on immediate effects or individual stages of the pandemic. Empirical data on the comparative volatility behaviour in normal (pre-COVID) and crisis (COVID) regimes under a common econometric model is not available, particularly on emerging markets such as India.

It is against this background that the current research study is being conducted to examine the volatility behaviour of the BSE Sensex both in the pre-COVID and COVID eras through the application of descriptive statistics, unit root testing and GARCH modelling. The paper aims to offer a more insight into market risk and market stability in times of crisis conditions by examining volatility dynamics and persistence to help address the gaps in existing literature on financial market behaviour and provide practical implications to investors and policymakers.

Background of The Study

Economic shocks are extremely sensitive to the financial markets and the volatility of the stock markets is more likely to indicate the shifts in investor sentiment and uncertainty in an economy. COVID-19 pandemic was a global crisis that affected the economic activity and financial systems of the entire world. The COVID-19 outbreak in India and the ensuing nationwide lockdowns resulted in drastic drops and utter unpredictability of the stock market and specifically to the BSE Sensex that is a prime indicator of the stock market performance in general. The initial stages of the pandemic escalated market risk due to panic selling, capital movements and unpredictability on economic recovery. Nevertheless, the policy interventions, easing of monetary policy, and vaccination programmes slowly reinstated investor confidence, which resulted in robust recovery in the market later. These opposite market behaviours point to the dynamic character of volatility in normal and crisis times. These changes are impossible to understand without sophisticated econometric methods that would be able to capture time-varying risk and volatility persistence. Thus, the analysis of the pre-COVID and COVID periods of the BSE Sensex is important in terms of stability of the markets, dynamics of risks, and the stability of the new financial markets.

2. LITERATURE REVIEW

COVID-19 pandemic has spawned a plethora of scholarly interest in the manner in which it affects financial markets and financial markets especially stock market volatility and investor behaviour. According to financial theory, unforeseen external shocks enhance uncertainty, and therefore create volatility, structural breaks and non-normal market behaviour. The pandemic was a special environment to put these theoretical hypotheses to the test in developed and developing markets.

Preliminary empirical data prove that COVID-19 was a great enhancer of stock market volatility across the globe. Chaudhary, Bakhshi, and Gupta (2020a, 2020b) contrasted the economic situation in developed and developing countries and observed the devastating impacts on the markets during the first outbreak and the slower recovery of economic growth in emerging markets because of the insufficient institutional preparedness. In the same manner, Sarwar et al. (2020) and Baig et al. (2020) have shown that the news of the pandemic caused a substantial growing volatility and liquidity stress in global markets and reinforced crisis-response and investor-behaviour theories.

A number of studies in the Indian setting note spikes in volatility in the middle of the pandemic. Madheswaran, Lingararajan, and Duraisamy (2023) utilized GARCH-based econometric models as the analysis of BSE Sensex and found a relatively stable behaviour pre-COVID-19 and extremely volatile behaviour during the COVID-19 wave. Their results emphasize the existence of volatility persistence and augmented risk in the market when conditions are of crisis. In line with this, Dhanjal and Raman (2022) noted that in March 2020, the market collapsed dramatically and then recovered slowly with the intervention of the policy and lack of restrictions.

Asymmetric pandemic impacts are also indicated by sectoral studies. Nitha, Sivakumari, and Suraj (2021) have demonstrated that IT and pharmaceutical industries have been faster recovering, whereas tourism and real estate recovery was long-lasting. The study by Mahajan (2025) showed that the transmission of volatility was uneven across sectors, and diversification is crucial in managing the market risk.

Other than volatility modelling, behavioural and informational factors have also been studied. According to the study by Pandey (2021), the correlations between COVID-19 case statistics and the BSE Sensex were strong, indicating that investor sentiment was more affected by the reported outcomes, rather than the real-time risks to health. Tripathi (2022) emphasized

the impact of misinformation and ineffective communication during the COVID-19 that led to heightened fear and ambiguity, which have indirect influence on financial confidence.

On methodological grounds, the recent literature is dominated by advanced econometric volatility models. Silva (2022) implemented the asymmetric EGARCH regimes in both emerging and developed markets and demonstrated that negative news were more effective in volatility compared to positive news. The research studies that predict on short-term basis by Ghosh (2022) proved that time-series models can still be used to predict even upon the instability brought about by a crisis.

On the whole, the literature confirms that COVID-19 was a systemic shock (Bhullar et al., 2022; Subburayan, 2024; Manogna & Singh, 2025), which heightened volatility and changed the dynamics of returns and market efficiency, which was tested. Nonetheless, an overwhelming majority of studies are limited by the time scope or individual modelling techniques and do not perform GARCH-based volatility analysis on a broader level over a long period of time, especially with respect to emerging markets such as India.

Research Gap

Despite the large amount of literature on the effects of COVID-19 on stock markets, there are still some gaps. The majority of research is devoted to one stage in the pandemic or considers a limited time frame, which prevents comparing the behaviour of the market before and during COVID-19. Moreover, the current literature tends to base their results on short-term studies or sector-specific results, with little to no focus on long-term persistence of volatility. The empirical research using GARCH models to investigate time-varying volatility of BSE Sensex during normal and event-based periods with the use of consistent daily data are relatively few. This paper will aim to close these gaps by offering a dedicated GARCH-based dynamic volatility analysis of the Indian stock market.

Objectives of The Study

The main aim of my research will be to examine the volatility behaviour of BSE Sensex in the pre-COVID and COVID periods. In particular, the research will seek to analyse the dynamics of stock market returns and risk in the normal and crisis conditions. It aims at determining the existence of volatility clustering and persistence based on GARCH (1,1) model. The other goal is to evaluate the effects of market shocks during the COVID-19 pandemic on the dynamics of volatility and the market stability in general. The research also seeks to give empirical evidence on risk behaviour in the Indian stock market when the uncertainty is at its highest levels.

Hypotheses

The hypotheses guiding the study are the following testable hypotheses:

H_{01}: The difference in the behaviour of the BSE Sensex in terms of its returns in the pre-COVID and COVID period is insignificant.

H_{11}: The return behaviour of the BSE Sensex is significantly different between the pre-COVID and the COVID period.

H_{02}: The volatility of the BSE Sensex stock market does not materially differ in the COVID-19 era.

H_{12}: The stock market volatility of the BSE Sensex is significantly greater at the COVID-19 period.

Data and Methodology

The current research is purely based on secondary data, which are suitable to the study of the stock market behaviour and history of volatility. To make sure the results are accurate and consistent, the BSE Sensex data on the form of daily closing prices have been gathered out of valid and publicly available financial databases. The research will cover the time frame of April 2010 to March 2025, so that it is possible to compare the market behaviour prior to the period of the COVID-19 pandemic and during it. To be analytic, the dataset will be split into three sub-periods: the pre-COVID period (April 2010 to February 2020), the COVID period (March 2020 to February 2021) and the post COVID period (March 2021 to March 2025). This classification includes the normal market dynamics and those brought about by crises.

Daily stock returns are computed using the continuously compounded log-return formula, which is widely used in financial econometrics due to its desirable statistical properties and suitability for volatility modelling: $R_t = ln\left(\frac{P_t}{P_{t-1}}\right)$… (1)

where R_t denotes the return at time t, P_t represents the closing price at time t, and P_{t-1} is the closing price at time $t-1$.

Descriptive statistics are employed to summarise the basic characteristics of the return series. Measures such as mean, standard deviation, skewness, and kurtosis are calculated to assess average returns, market risk, asymmetry, and the presence of extreme observations. These statistics provide preliminary insights into market behaviour and help identify changes in volatility and distributional properties across the pre-COVID and COVID periods.

Before applying volatility models, it is essential to examine whether the return series is stationary. The Augmented Dickey–Fuller (ADF) unit root test is applied to test the null hypothesis of non-stationarity. Stationarity is a necessary condition for GARCH modelling and ensures valid statistical inference. The test is conducted under different specifications, including with constant, with constant and trend, and without both, to confirm robustness.

To test whether the return series is stationary, the Augmented Dickey–Fuller (ADF) test is employed.

ADF Equation: $\Delta Y_t = \alpha + \beta Y_{t-1} + \sum_{i=1}^{k} yi\Delta Y_{t-i} + \varepsilon_t$…. (2)

Where ΔY_t= First difference of the series, α= Constant, β= Coefficient for unit root testing, γ_i denotes lagged difference coefficients, ε_t= Error term

To analyse time-varying volatility and risk persistence, the study employs the Generalized Autoregressive Conditional Heteroskedasticity (GARCH (1,1)) model. The GARCH framework is particularly suitable for capturing volatility clustering, a common feature of financial return series during crisis periods. The mean and variance equations are specified as follows: $R_t = \mu + \varepsilon_t$ …. (3)

$\sigma_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2$…… (4)

where σ_t^2 denotes the conditional variance, α captures the short-term impact of past shocks (ARCH effect), and β measures volatility persistence (GARCH effect). A value of α+β close to unity indicates high volatility persistence, which is commonly observed during crisis periods such as the COVID-19 pandemic.

All statistical and econometric analyses are carried out using standard econometric software packages. The combined application of descriptive statistics, unit root testing, and GARCH modelling ensures a comprehensive examination of market volatility and risk behaviour during normal and crisis periods.

3. RESULTS

This paragraph gives the empirical results acquired after the descriptive analysis and GARCH-driven volatility modelling of the BSE Sensex. The findings are presented in a chronological manner to shed light on the market behaviour, price trend, and volatility trends both during the pre-COVID and COVID eras. The graphical and statistical outputs are employed to present undistorted evidence of how Indian stock market reacted to the shock caused by the pandemic.

Figure 1. Demonstrates the trend of the BSE Sensex closing stock prices throughout the period of study, showing the long-term trends and the trends of the volatility. The index has a definite growth tendency, which suggests the continued growth of the Indian stock market with time. The Sensex was steadily growing with comparatively average variation in the pre-COVID phase indicating economic stability and confidence of investors. A drastic and steep drop is seen around the beginning of 2020 and this is when the COVID-19 pandemic broke out, the economy was severely disrupted with extreme market disruption. This stage is defined by strong volatility and sudden price changes. The index has a robust recovery in the post-COVID period with growth to new heights following this decline. Nevertheless, the changes observed in the recovery period are more numerous and acute as compared to the pre-COVID period. This trend shows that volatility clustering exists and high volatility is followed by high volatility and the uncertainty has not yet been removed even though market has recovered.

Figure 1. Trend of BSE Sensex Closing Prices During Pre-COVID, COVID, and Post-COVID Periods

Source: own calculation based on secondary data

The table 1 shows the descriptive statistics of BSE Sensex closing stock prices in the period of conducting the study. The average level that the Sensex traded was 37,409.15. The large standard deviation of 18,682.31 indicates a high level of price changes indicating high risks of the market and its volatility, especially in times of uncertainty like during COVID-19. The skewness value of 0.84 is positive which means that more often high price values were obtained compared to low ones indicating that the market is growing up. The value of kurtosis of -0.46 shows that the distribution is flatter, which means that there are no frequent extreme price movements. On the whole, these findings can be validated as the results show that the

BSE Sensex was volatile, but the price movement was more stable and had a long-term expansionary trend.

Table 1. Descriptive Statistics of BSE Sensex Closing Prices

BSE closing stock price	
Mean	37409.1535
Standard Deviation	18682.3073
Skewness	0.8362
Kurtosis	-0.4583

Source: own calculation based on secondary data

Table 2 indicates the Augmented Dickey-Fuller (ADF) unit root test result of the BSE Sensex Returns. In the level form, the test statistics are large in absolute magnitude and statistically significant with the values of -60.8017, -60.7996, and -60.7251 being under specifications with constant, constant and trend and without both respectively. The associated probability values are near to zero which means that it is significant at the 1% level. This causes null hypothesis of unit root to be rejected indicating that the series of returns is at level stationary. The t-statistics are very significant at the first difference with the t-statistics being close to -24.30 and probability value of zero in all the model specifications. These findings are very much affirmative in the fact that there are no unit root issues in the series of returns. As such, the data meet the prerequisite of being stationary, which makes them acceptable to undergo additional econometric analysis including the GARCH volatility modelling.

Table 2: Augmented Dickey–Fuller (ADF) Unit Root Test Results for BSE Sensex Returns

Test Specification	t-Statistic	p-value	Decision
At Level (RETURN)			
With Constant	−60.8017	0.0001	Stationary***
With Constant and Trend	−60.7996	0.000	Stationary***
Without Constant and Trend	−60.7251	0.0001	Stationary***
At First Difference (ΔRETURN)			
With Constant	−24.3027	0.000	Stationary***
With Constant and Trend	−24.2994	0.000	Stationary***
Without Constant and Trend	−24.3059	0.000	Stationary***
Notes: *** denotes significance at the 1% level. Lag length selected based on Schwarz Information Criterion (SIC). p-values are based on MacKinnon (1996) one-sided critical values.			

Source: own calculation based on secondary data

GARCH (1,1) model is estimated to analyse the volatility behaviour of the BSE Sensex in the long-term perspective of 2010-2025. The findings on Table 3 and Figure 2 clearly show that stock market volatility is time-varying and extremely persistent, which confirms that volatility clustering exists in the Indian stock market. The constant (C = 0.0679) in the mean equation is positive and statistically significant at 1 percent indicating that the BSE Sensex produced positive average returns during the study period. This shows a long-term growth in the market notwithstanding the periods of instability. This low R-squared figure is anticipated in the financial models that are based on returns and does not discredit the viability of volatility estimation. There is good evidence of conditional heteroskedasticity in the variance equation. The ARCH name, modelled by RESID $(-1)^2$ = 0.0842, is positive and significantly significant, which means that shocks of the past or unexpected news directly affect the current market

volatility. This does testify to the fact that abrupt price fluctuations in the past period augment short-term risk in the stock market. More to the point, the GARCH term GARCH (1) = 0.8948 is big and statistically significant which shows the presence of high volatility persistence. It implies that when volatility increases, it is likely to stay high over a long time.

The total of the ARCH and GARCH coefficients (0.0842 + 0.8948≈ 0.979) are close to unity, indicating that there is a high level of volatility persistence. This behaviour is common in economic crisis and structure uncertainty times, such as the COVID-19 pandemic. This observation confirms that volatility shocks in the BSE Sensex do not correct at a fast rate to their normal levels but fade away progressively with time.

These results are also backed up by the conditional variance plot. The volatility is rather low and stable throughout the majority of pre-COVID years and is the normal condition in the market. Nevertheless, there is a very sharp spike at the period of 2020, which was associated with the outbreak of COVID-19 and the ensuing market panic. Though the volatility decreases after this point, it does not revert to the pre-crisis levels at once, which means that doubt in the post-pandemic era will persist.

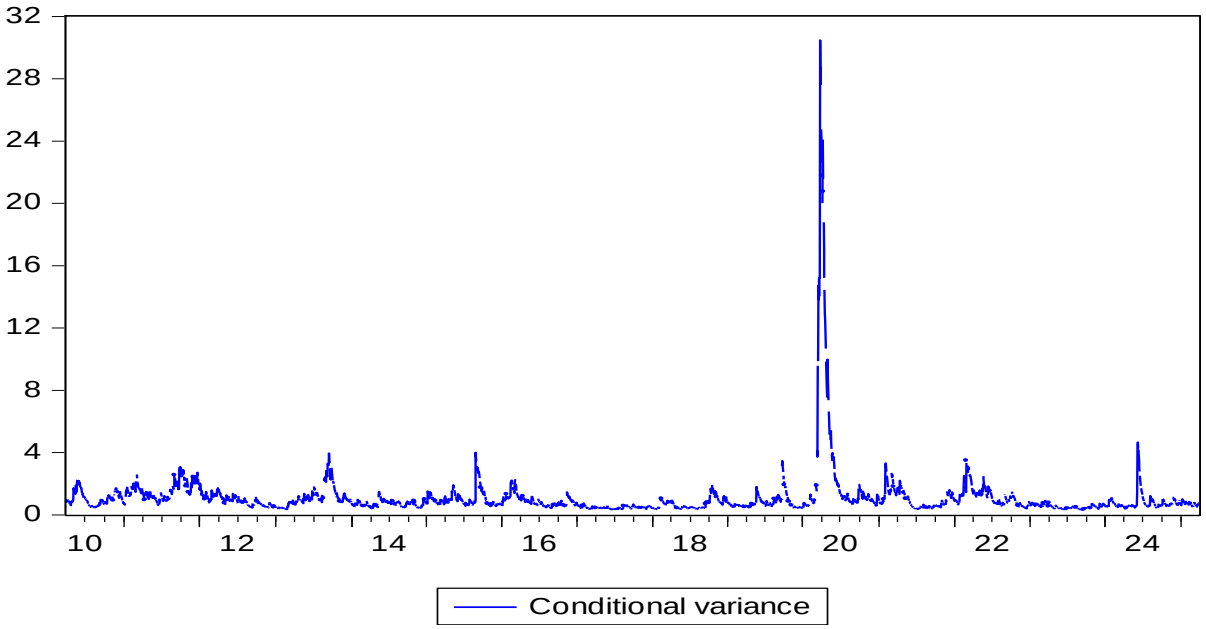
On the whole, ARCH-GARCH findings are that the BSE Sensex has a high volatility clustering and long-run volatility of the market. The model is quite effective in capturing the effect of significant economic shocks, especially the COVID-19, and the increased and protracted risk of investors during crisis periods. This implies that GARCH-type models should be employed when analysing and predicting the risk in stock markets in emerging economies such as India.

Table 3. GARCH (1,1) Estimation Results for BSE Sensex Returns

Mean Equation				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**p-value**
Constant (C)	0.0679	0.0134	5.0627	0.00
Variance Equation				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**p-value**
Constant (ω)	0.0222	0.004	5.5316	0.00
ARCH (α): RESID (–1) ²	0.0842	0.0058	14.4989	0.00
GARCH (β): σ² (–1)	0.8948	0.0084	107.1186	0.00
Model Diagnostics				
Statistic				**Value**
R-squared				−0.0007
Adjusted R-squared				−0.0007
S.E. of regression				1.0504
Sum of squared residuals				4105.803
Log-likelihood				−4976.148
Akaike Information Criterion (AIC)				2.6761
Schwarz Criterion (SC)				2.6827
Hannan–Quinn Criterion (HQ)				2.6784
Durbin–Watson statistic				1.9917

Source: own calculation based on secondary data

Figure 2. GARCH (1,1) Estimated Conditional Volatility of BSE Sensex Returns (2010–2025)



Source: own calculation based on secondary data

The GARCH (1,1) is estimated to analyse stock market volatility in the normal conditions of the economy before the COVID-19 (2010-2020). The Table 4 results show that the value of the mean return of the BSE Sensex is positive and statistically significant (C = 0.0598, p = 0.0005), indicating the market growth to be steady and consistent throughout the pre-pandemic period. This is an indication of comparatively good investor confidence and macroeconomic environment prior to the outbreak of COVID-19.

The equation of variance gives valuable information on the behaviour of volatility. The ARCH term **(**RESID (–1) ² = 0.0605**)** is positive and very significant which means that the short-term market shocks affected the current volatility. Nonetheless, the size of such coefficient is moderate, which indicates that only temporary volatility increases were caused by sudden news or unexpected events. The value of the GARCH term (GARCH (–1) = 0.9252) is large and statistically significant which means high volatility persistence. This implies that when volatility was high, it was likely to persist in the near future, which is a common characteristic of financial markets in the normal state.

The sum of the ARCH and GARCH coefficients is nearly equal to unity (0.9857), which verifies the existence of volatility clustering, where there are high-volatility and high-volatility periods followed by low-volatility and low-volatility periods respectively. In spite of this carry-over, the conditional variance graph Figure 3 indicates that the volatility spikes in the pre-COVID period were relative and short-lived. Following every rise, volatility slowly went back to lesser levels which means that the market was in a position to absorb shocks and stabilise with time.

In general, the pre-COVID findings indicate that the BSE Sensex had volatility clustering and persistence as well as the market risk was rather contained. Lack of extreme and protracted volatility shows the presence of a stable and strong stock market environment before the COVID-19 crisis.

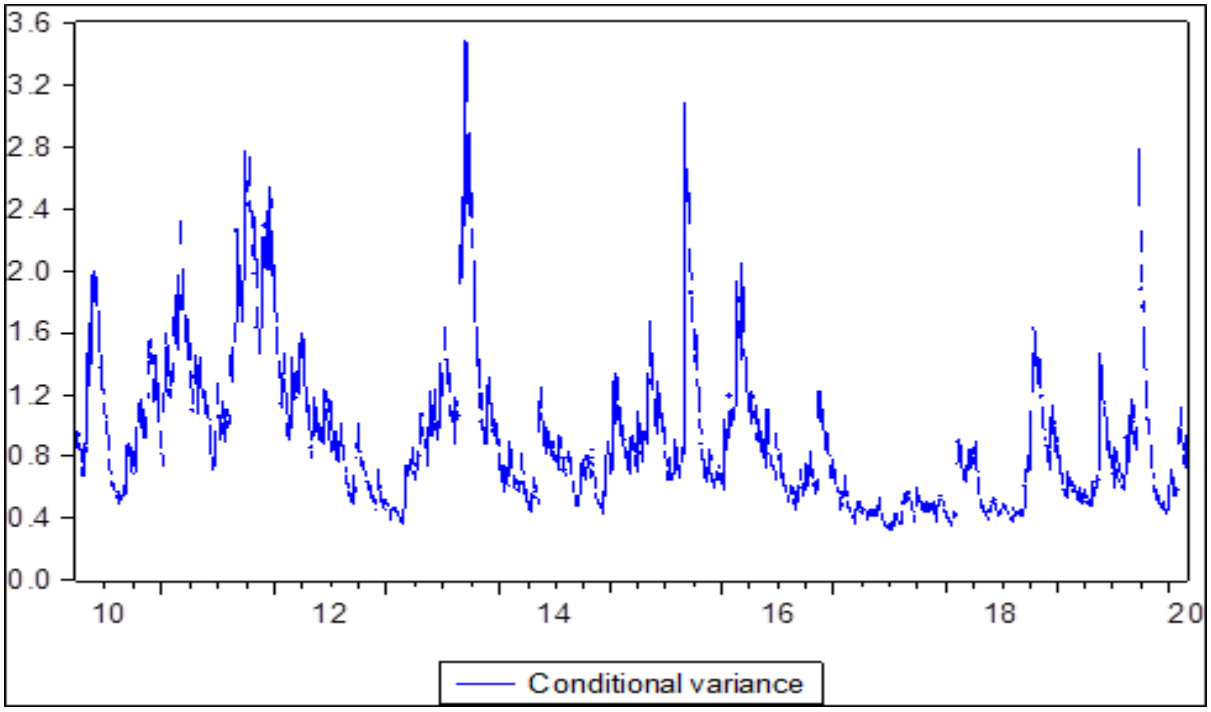
Table 4. GARCH (1,1) Estimation Results for BSE Sensex Returns (Pre-COVID Period)

Mean Equation				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**p-value**
Constant (C)	0.0598	0.0171	3.4889	0.0005

Variance Equation				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**p-value**
Constant (ω)	0.0145	0.0041	3.5736	0.0004
ARCH (α): RESID (–1) ²	0.0605	0.0085	7.0857	0
GARCH (β): σ² (–1)	0.9252	0.011	84.0891	0
Model Diagnostics				
Statistic				**Value**
R-squared				−0.0009
Adjusted R-squared				−0.0009
S.E. of regression				0.9537
Sum of squared residuals				2236.614
Log-likelihood				−3253.831
Akaike Information Criterion (AIC)				2.6486
Schwarz Criterion (SC)				2.6581
Hannan–Quinn Criterion (HQ)				2.6521
Durbin–Watson statistic				1.8629

Source: own calculation based on secondary data

Figure 3. GARCH (1,1) Estimated Conditional Volatility of BSE Sensex Returns (2010–2020)



Source: own calculation based on secondary data

The GARCH (1,1) model that was estimated using the data on the Indian stock market in the period between March 2020 and February 2021 captures the volatility behaviour of the Indian stock market throughout the first wave of the pandemic. According to the mean equation results given in Table 5, the constant term is positive and statistically significant (C = 0.0019, p = 0.0279). Though the returns are small, this value indicates that average returns slightly stabilised during the larger COVID, which was a partial recovery and adaptation of investors after the first shock of the market.

The equation of the variance shows good indicators of increased and continuous volatility. The ARCH term (RESID (–1) ²= 0.1145, p < 0.01) is both positive and significant, which means that new shocks during the pandemic influenced the volatility of the market

significantly on the short run. This is indicative of the sensitivity of the market to the pandemic-related developments including lockdown policies, infection rates, and announcements. The volatility persistence is high and significant as the GARCH term (GARCH (–1) = 0.8458, $p < 0.01$) is large. The ARCH and GARCH are near to each other and as a result, the volatility shocks that occurred in the initial wave of COVID-19 did not dissipate quickly and persisted in affecting market risk throughout time.

These findings are also upheld by the conditional variance plot. The volatility is extremely high in the initial months of 2020, which is associated with the beginning of COVID-19 and country-wide lockdowns. The volatility decreases gradually as the year goes by meaning that the market is gradually adjusting and gaining investor confidence after the policy interventions and economic support measures. At the beginning of 2021, the volatility is low and stable, but there are still minor spikes, and it is likely that some uncertainty will remain.

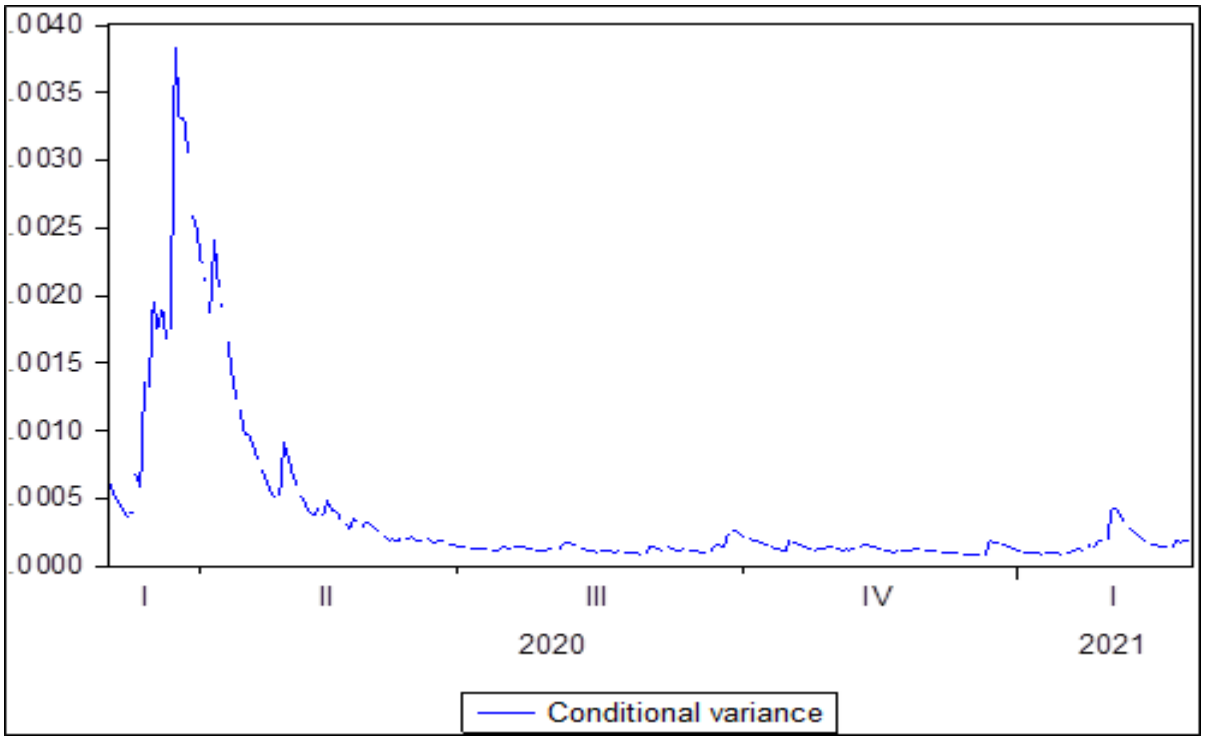
On the whole, the findings suggest that though COVID-19 has caused serious instability on the market, the Indian stock market has been resilient throughout the first wave of the situation, and volatility has stabilised instead of being consistently high.

Table 5. GARCH (1,1) Estimation Results for BSE Sensex Returns during Covid-19 ((March 2020– February 2021))

Mean Equation				
Sample Period: March 2020 – February 2021 Estimation Method: Maximum Likelihood (Normal Distribution)				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**p-value**
Constant (C)	0.0019	0.0009	2.1989	0.0279
Variance Equation				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**p-value**
Constant (ω)	8.83E−06	3.00E−06	2.9417	0.0033
ARCH (α): RESID (–1) ²	0.1145	0.0291	3.9357	0.0001
GARCH (β): σ² (–1)	0.8458	0.0359	23.5504	0.000
Model Diagnostics				
Statistic				**Value**
R-squared				−0.0019
Adjusted R-squared				−0.0019
S.E. of regression				0.0209
Sum of squared residuals				0.1079
Log-likelihood				694.4373
Akaike Information Criterion (AIC)				−5.5457
Schwarz Criterion (SC)				−5.4892
Hannan–Quinn Criterion (HQ)				−5.5229
Durbin–Watson statistic				2.2183

Source: own calculation based on secondary data

Figure 4. Conditional Volatility of BSE Sensex During COVID-19 Market Shock (March 2020– February 2021)



Source: own calculation based on secondary data

Estimates of the GARCH (1,1)-model using data in the post-COVID period (March 2021-March 2025) are also useful in understanding the volatility behaviour of the Indian stock market during the recovery and normalisation stage after the pandemic shock. As can be seen, the mean equation results, as given in Table 6, indicate that the constant term is positive and statistically significant (C = 0.0007, p = 0.004), which means that the BSE Sensex produced stable and positive average returns during the post-COVID period. Their scale of returns is quite small but has a high level of statistical significance because they are associated with enhanced investor confidence, economic reopening, and a more predictable market environment than the period of the crisis.

The stable but continuous volatility structure is pointed out in the variance equation. The ARCH term **(**RESID (–1) ² = 0.0997, p < 0.01) is a positive one, but the value is very significant so the new information and unexpected shocks still affect short-term volatility. The middle-range value of this coefficient, however, presupposes that the short-term effect of shocks is not very impressive in comparison with the COVID period. The GARCH value (GARCH(–1) =0.8530, p = 0.01) is big and significant and attests to high volatility self-correlation. Notably, the total of the ARCH and GARCH coefficients is less than one, which means that it is mean-reverting and volatility is non-explosive, which is a critical sign of the stability of a market.

These findings are also supported by the conditional variance plot presented in Figure 5. The level of volatility in the post-COVID period is significantly low and more stable compared to the pandemic peak. Although there are some cases where there are spikes especially when there are world or national events, the spikes are one-time and after that, the shock normalises. This trend is indicative of the existence of a strong market structure that can absorb shocks effectively.

In general, the post-COVID outcomes indicate that the Indian stock market has not been severely affected by the pandemic-related disruption. Despite volatility, the volatility is always regulated and is foreseeable, and is the effectiveness of the policy interventions, better market

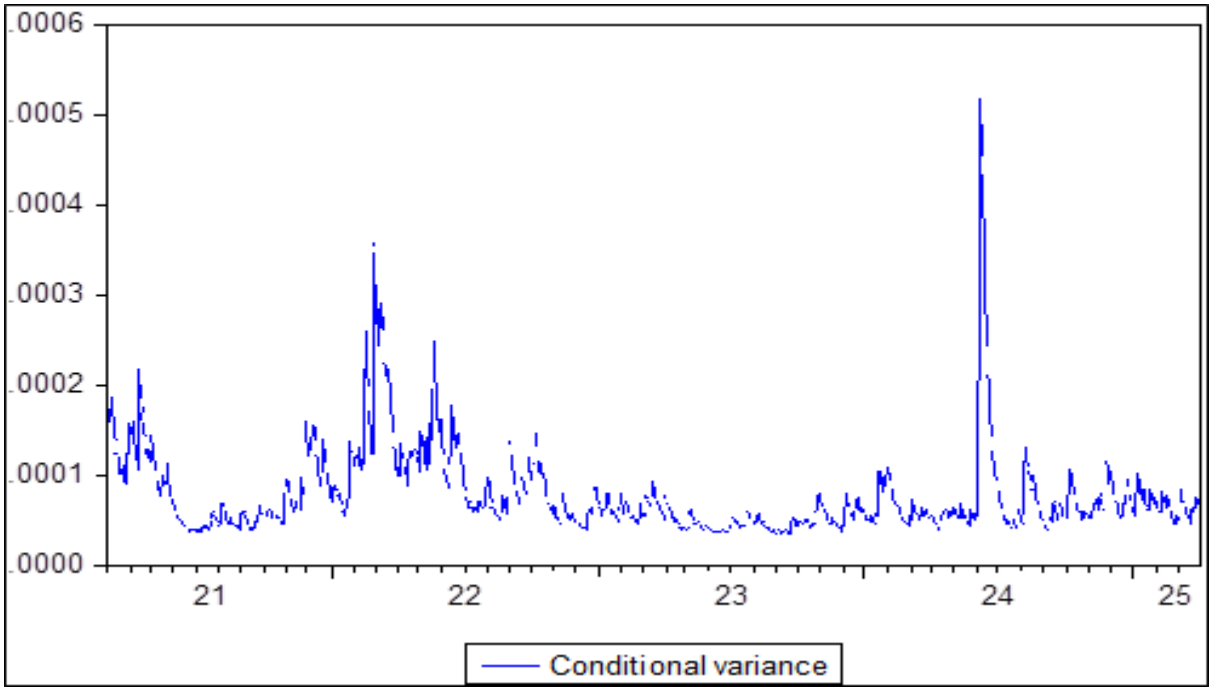
mechanisms, and adaptive investor behaviour that have enabled long-term market stability to be restored.

Table 6. GARCH (1,1) Estimation Results for BSE Sensex Returns During Post-COVID Recovery Period (2021–2025)

Mean Equation				
Sample Period: March 2021 – March 2025 Estimation Method: Maximum Likelihood (Normal Distribution)				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**p-value**
Constant (C)	0.0007	0.0002	2.878	0.004
Variance Equation				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**p-value**
Constant (ω)	3.71E−06	8.83E−07	4.1973	0.000
ARCH (α): RESID (–1) ²	0.0997	0.0122	8.1754	0.000
GARCH (β): σ² (–1)	0.853	0.018	47.457	0.000
Model Diagnostics				
Statistic				**Value**
R-squared				−0.0082
Adjusted R-squared				−0.0082
S.E. of regression				0.0088
Sum of squared residuals				0.0791
Log-likelihood				3411.088
Akaike Information Criterion (AIC)				−6.7267
Schwarz Criterion (SC)				−6.7073
Hannan–Quinn Criterion (HQ)				−6.7194
Durbin–Watson statistic				1.9947

Source: own calculation based on secondary data

Figure 5. Conditional Volatility Dynamics of BSE Sensex in the Post-COVID Recovery Period (2021–2025)



Source: own calculation based on secondary data

4. DISCUSSION

The empirical results of this paper give complete evidence on how the COVID-19 pandemic changed the volatility structure and risk dynamics of the Indian stock market, as modelled by BSE Sensex. Through a uniform GARCH structure, the analysis of the market behaviour in the pre-COVID, COVID (first wave) and post-COVID regimes indicates the obvious regime volatility persistence, shock transmission and market stability.

According to the descriptive statistics and price trend analysis, although the BSE Sensex has an upward tendency over a long period, the market had significant fluctuations especially when the market was full of uncertainty. The sudden fall at the very beginning of the COVID-19 period is the panic selling and sudden re-reading of the risks, whereas the recovery after that point demonstrates the adaptive power of the market. Nevertheless, the fact that there still were frequent fluctuations during the recovery phase points to the fact that the uncertainty did not vanish instantly, which is congruent with the volatility clustering behaviour that is typical of the recovery period following significant crises.

The return series are stationary, as the Augmented Dickey Fuller test indicates, and this fact justifies the use of GARCH modelling in the analysis of volatility. Lack of unit root problems would guarantee that the market volatility trends are not caused by spurious trends but instead the real pattern.

The entire sample GARCH (2010-2025) outcomes indicate that volatility within the Indian stock market is a time-varying and persistent volatility. The big and significant GARCH coefficient proves that volatility shocks are long-term effects, which is enhanced during times of structural stress when the COVID-19 pandemic happens. Close to unity of the ARCH-GARCH sum implies that the shocks dissipate slowly hence the necessity to model volatility dynamically as opposed to the case when variance is kept constant.

A sub-period volatility behaviour comparison provides some meaningful differences in volatility behaviour. In the pre-COVID phase, volatility clustering, as well as volatility persistence, existed, but those volatility spikes were rather moderate and short-term. This implies that the market could absorb shocks effectively when market is operating under normal economic conditions and there is support through the stable macroeconomic fundamentals and investor confidence.

However, in contrast to this, the first wave of the COVID (March 2020-February 2021) has very different dynamics. The large ARCH effect suggests that volatility was strongly impacted in the short-run by new information and pandemic-related shocks, and represents the increased sensitivity to uncertainty around lockdowns, infection rates, and policy responses. The large GARCH coefficient also suggests that these shocks were long-lived, and one would have had high risk. Nevertheless, the decreasing trend in conditional variance at the end of this period indicates that there was a learning and adjustment process where investors were reacting to the policy interventions and better information.

The evidence of market recovery and stabilisation represents the post-COVID period. Although the volatility persistence is statistically significant, the ARCH effect is relatively moderate and the aggregate of ARCH and GARCH coefficients is less than one, which is a sign of a mean-reversing volatility. This indicates a more developed and resilient market situation, in which shocks are absorbed without causing the long-term instability. Sentimental volatility that is experienced during this period is temporary, as it is related to certain global or local events as opposed to systemic stress.

Altogether, the results prove the COVID-19 as a strong systemic shock that temporarily impaired market efficiency and increased risk. The post-COVID evidence however demonstrates the resilience of the Indian stock market which was supported by effective policy

measures and improved market mechanisms as well as adaptive investor behaviour. The experiment supports the applicability of the GARCH models to explain the volatility processes in the emerging markets especially in crisis and recovery periods.

5. CONCLUSION

This paper was an analysis of volatility behaviour of the Indian stock market by the BSE Sensex during the pre-COVID, COVID (first wave) and post-COVID regimes using a GARCH (1,1) model. Empirical findings indicate that the market volatility varies with time, and it is very persistent especially in the time of crisis. Although the pre-COVID period was marked by relatively stable and short-term volatility, the COVID era was marked by intense volatility increases and increased risk-prone to greater uncertainty and information shocks. On the contrary, post-COVID shows slow market stabilisation, accompanied by the mean-reverting volatility, which implies recovery and resilience. In general, the results support the notion that COVID-19 had a severe effect on the stability of the markets, and successful policy reactions and adjusting investor behaviour helped to overcome the crisis.

The implications of the results to the policymakers and players in the market are significant. The fiscal and monetary measures are very essential in curbing severe volatility during emergencies. The market transparency, liquidity support and communication between investors can be improved to minimize panic-driven trading. Volatility clustering and volatility persistence can remind investors and portfolio managers that dynamic risk management and diversification can be valuable in making informed decisions with the help of volatility-based forecasting models like GARCH, particularly when uncertainty is elevated.

The study is limited in some ways despite the contributions it has made. The discussion is limited to the BSE Sensex, which might not be reflective of the dynamics in a specific sector or the firm heterogeneity. Additionally, the research uses a conventional GARCH (1,1) model with normal errors distribution, which might be incapable of capturing the asymmetric effect or extreme tail risks that are present during crisis.

Further studies can be done by extending this analysis to other market indices or sectoral indices in order to have more in depth information about the varying volatility behaviour. Asymmetric GARCH models or models with structural breaks would also be a significant addition to the knowledge. Cross-comparative research on various crises in the world can also assist in determining how strong the market resilience is in new economies.

6. BIBLIOGRAPHY

Baig, A. S., Butt, H. A., Haroon, O., & Rizvi, S. A. R. (2020). Deaths, panic, lockdowns and US equity markets: The case of COVID-19 pandemic. *Finance Research Letters, 38*, 101701. https://doi.org/10.1016/j.frl.2020.101701

Bhullar, P. S., Gupta, P. K., & Bhatnagar, D. (2022). Impact of COVID-19 on volatility of BSE Sensex stock index. *International Journal of Electronic Finance*, *11*(2), 175-187. https://doi.org/10.1504/IJEF.2022.122185

Chakraborty, I. (2023). Exploring What Drives Indian Stock Market During Covid-19. *SpringerBriefs in Economics*. https://doi.org/10.1007/978-981-19-8001-5

Chaudhary, R., Bakhshi, P., & Gupta, H. (2020a). The performance of the Indian stock market during COVID-19. *Investment Management & Financial Innovations*, *17*(3), 133.

Chaudhary, R., Bakhshi, P., & Gupta, H. (2020b). Volatility in international stock markets: An empirical study during COVID-19. *Journal of Risk and Financial Management*, *13*(9), 208. https://doi.org/10.3390/jrfm13090208

Dhanjal, J., & Raman, P. (2022). Impact of COVID-19 era on BSE and NSE index: An exploratory study. *ARKA Jain University, Jamshedpur*.

Ghosh, P. (2022). The modelling and forecasting of BSE Sensex (for the month of September 2022) using ARIMA. In *Proceedings of the 10th International Conference on Emerging Trends in Corporate Finance and Financial Markets*. Kristu Jayanti College, Bangalore.

Madheswaran, M., Lingaraja, K., & Duraisamy, P. (2023). Econometric and stochastic analysis of stock price before and during COVID-19 in India. *Environment, Development and Sustainability, 26*(7), 7579–7594. https://doi.org/10.1007/s10668-023-03022-5

Mahajan, A. (2025). Impact of COVID-19 on the Indian Stock Market: A Study of Investor Behavior.

Manogna, R. L., & Singh, A. A. (2025). Empirical analysis of lead-lag relationship in the Indian stock market amid the COVID-19 pandemic. *Afro-Asian Journal of Finance and Accounting*. https://doi.org/10.1504/AAJFA.2026.150627

Nitha, K. P., Sivakumari, S., & Suraj, S. E. (2021). The upshot of COVID-19 on sensex & sectoral Indices in Indian stock market–A comparative analysis during pre COVID & COVID period. *Turkish Journal of Computer and Mathematics Education Vol*, *12*(8), 2081-2089.

Pandey, V. K. (2021). The correlation analysis of COVID-19 result and stock market: Study of BSE-Sensex. *Turkish Journal of Computer and Mathematics Education, 12*(3), 5669–5672.

Sarwar, S., Waheed, R., Sarwar, S., & Khan, A. (2020). COVID-19 challenges to Pakistan: Is GIS analysis useful to draw solutions? *Science of the Total Environment, 730*, 139089. https://doi.org/10.1016/j.scitotenv.2020.139089

Silva, C. A. G. (2022). Stock market volatility and the COVID-19 pandemic in emerging and developed countries: An application of the asymmetric exponential GARCH model. *European Journal of Business and Management Research, 7*(4), 71–80. https://doi.org/10.24018/ejbmr.2022.7.4.1492

Subburayan, B. (2024). Causality and volatility spillovers of banks' stock price returns on BSE Bankex returns. *Journal of Corporate Accounting & Finance*, *35*(1), 59-75. https://doi.org/10.1002/jcaf.22648

Tripathi, S. (2022). Mental stigma due to communication crisis in the age of COVID-19: A study of Delhi-NCR, India and Dhofar, Oman. *ResearchGate*. https://www.researchgate.net/publication/351979947