International Journal of Social Science Research and Review

http://ijssrr.com
editor@ijssrr.com
Volume 9, Issue 3
March, 2026
Pages: 409-419

COVID-19 as a Structural Break in Indian Stock Market Volatility: An ARIMAX–Interrupted Time Series Analysis of the NIFTY 50 (2013–2024)

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http://dx.doi.org/10.47814/ijssrr.v9i3.3315

Abstract

The present study examines the impact of the COVID-19 pandemic on the volatility dynamics of the Indian equity market, using the NIFTY 50 index as a proxy. An Interrupted Time Series Analysis (ITSA) embedded within an ARIMAX framework is employed to analyze daily data from 2013 to 2024, with the nationwide lockdown beginning on 24 March 2020 treated as an exogenous structural break. The model captures both the immediate level shift in volatility following the onset of the pandemic and the long-run change in its trend, while accounting for serial correlation and volatility clustering. The empirical results indicate a statistically significant surge in market volatility immediately after the lockdown, reflecting heightened uncertainty, liquidity pressures, and investor overreaction. Furthermore, the interaction between time and the post-COVID dummy variable reveals a significant change in the slope of volatility, suggesting a transition to a new volatility regime characterized by a higher baseline risk but gradual normalization over time. Counterfactual analysis further shows that, in the absence of the pandemic, volatility would have followed a much smoother and less steep trajectory. Overall, the findings provide strong evidence that COVID-19 constituted a structural break in the Indian equity market, altering both the level and the long-term dynamics of volatility. This study contributes to the existing literature by offering long-horizon empirical evidence from an emerging market and by demonstrating the effectiveness of quasi-experimental time-series methods in assessing the persistent financial impacts of systemic shocks.

Keywords: *COVID-19; Stock Market Volatility; NIFTY 50; Interrupted Time Series Analysis (ITSA)*

Introduction

The Interrupted Time Series Analysis (ITSA) is used to measure the magnitude of how the pivotal event, i.e., the COVID-19 pandemic, changed the time dynamics of the Indian equity markets. The start of the COVID-19 provoked drastic drops and further fluctuations in the Nifty 50 and Sensex since March 2020 (Bora, 2021; Mishra et al., 2021). This study relies on daily observations between 2013 and 2025 to determine the long-term effects of the pandemic on the Indian market volatility, thus filling a gap in long-term empirical studies of the market (Sharma et al., 2021; Gupta and Singh, 2020). India's stock market

has grown steadily since 2013, supported by rising retail participation through mobile apps and discount brokers (SEBI, 2023). While demonetization and GST caused temporary fluctuations, COVID-19 had the largest impact, with the Nifty index falling 38% in one month (Ashraf, 2020; Bora, 2021). The pandemic increased volatility across all sectors, especially energy and banking, while pharmaceuticals remained relatively stable (Yousaf et al., 2021; Bhatia et al., 2021). Overall market volatility rose sharply during lockdowns and, despite a V-shaped recovery driven by government stimulus, trading behaviour changed in the long run. Studies show that negative returns were most severe in banking and metals (Jayasooriya, 2021; Shankar & Dubey, 2021). Although volatility eased by 2025, it remained above pre-COVID levels, leading regulators to strengthen circuit breakers and margin requirements (SEBI, 2025; RBI, 2024; NSE, 2024). The immediate market shock caused by COVID-19 has been documented in existing literature but very few studies track the trend longitudinally on whether the shock changed the trend of daily volatility in the following years (Bora, 2021; Mishra et al., 2021). The effects of the lockdown on March 2020 on the daily volatility were not determined comprehensively, and the surge in retail trading in the post-pandemic period has increased the noise in the market (SEBI, 2023; Sharma et al., 2021). Such an evidentiary gap limits regulators who need the empirical evidence of the resilience of the market to systemic shocks (RBI, 2024; Gupta & Singh, 2020). The current research utilizes ITSA on the daily close value of the Nifty 50 between the year 2013 and 2025 where the point of intervention is the start of the COVID-19 lockdown. The analysis not only assesses abrupt shifts in daily volatility right after the incident but also explores long-term changes of the trend. Other aims are to produce counterfactual predictions without the event and evaluate volatility dynamics during the time high trading is taking place. The results provide empirical advice to the regulatory authorities like SEBI and RBI in creating regulatory frameworks that expect market disruptions e.g. by modifying the trade limits allowed (SEBI, 2025; NSE, 2024). Quantitative traders can use the obtained volatility predictions to execute risk management strategies that are relevant to the Indian market (SEBI, 2023). Additionally, the findings complement the education system of the students and participants of the new market, which will help to understand the dynamics of the crisis in a nuanced way, and corporate organisations can streamline the training programs to act in both calm and unsettled market settings (RBI, 2024). It will be analyzed based on the Nifty 50 daily closing values of January 2013 through December 2025 with the intervention date being March 24, 2020. It avoids sectoral indices, intra-day tick data, fixed-income securities, and exogenous information flows like news releases or policy announcements which allow the study to stay focused on the main trends in the market.

Literature Review

Past studies have shown that mass health emergencies expose the financial markets to a lot of uncertainty through disruption of economic activities and loss of investor confidence. Within the narrow scope of the COVID-19 pandemic, a growing literature has addressed the effects of increasing infection rates, interventions by policy makers and informational shocks on stock market volatility in both developed and developing economies, especially in India (Sharma et al., 2021). The paper analyzes the direct relationship between the spread of COVID-19 and changes in the stock prices. Several studies have found a relationship between the increase in the volume of cases and the sharp falls and the increasing volatility of leading stock indices. In India, the empirically supported evidence is that stock prices declined steadily with growing confirmed infections which is the symptom of panicked sales and increased risk aversion among investors. Similar trends have been found in other markets across the world which has indicated that the pandemic created coordinated volatility and uncertainty across financial systems although with differences in magnitude depending on the country and the particular index(Sharma et al., 2021). Recent results point to the government intercessions, such as lockdowns at the nationwide level, travel bans, and social-distancing, having a central role in defining market behaviour. These measures first slowed down economic operations, reduced corporate profitability expectations and sparked off adverse stock market responses. However, the following fiscal stimulus and accommodative

monetary policy measures served to bring about some degree of confidence and liquidity back(Sharma et al., 2021). Research across Asia, Europe, Africa and North America highlights that the time and magnitude of policy reaction determined how deep the market recession would be and the acceleration of recovery. Empirical evidence has shown that news of the pandemic has a non-reciprocal impact on the financial market, which has a greater response to negative information than to positive news. The constant news about the growing number of cases, deaths, and prolonged lockdowns cause the growth of fear and uncertainty that leads to outsize stock market reductions. This highlights the importance of investor sentiment and expectations in addition to underlying economic determinants explaining market volatility in the times of crisis(Sharma et al., 2021). Taken together, the available literature suggests that COVID 19 heightened volatility in stock markets in three major directions including rapid spread of the virus, restrictive policies by the public-health, and negative informational flows. Although short term effects have been well extensive, a tangible vacuum still exists concerning the long term and sector specific analysis, especially in case of emerging economies like India. The qualitative character of the available information (quantitative and short-horizon) of the current research restricts the understanding of structural changes and behavioural patterns. Future studies must focus on longer periods and mixed methods in order to develop more insights about the long-term effects of the pandemic-related shocks across the financial market stability(Sharma et al., 2021). Empirical studies have proved that unusual events like armed conflicts, systemic financial shocks, and pandemics have induced strong and often heterogeneous responses in equity markets. The traditional event-study methods, which mostly assess the firm-specific effects, traditionally assume that the aggregate market index remains constant. This assumption is unsustainable in the era of pervasive shocks, like the COVID-19 pandemic, where the episode cuts across pretty much the entire industry segments simultaneously. In turn, recent academic literature highlights the need to shift the paradigms of methodology that can help separate the idiosyncratic firm effects and market-level forces. Many studies have examined how pandemics and other massive crises can affect stock returns/volatility. Such tests indicate that in the situation when an event causes an effect on the whole market, the explanation of abnormal returns in terms of the firm-specific responses cannot be regarded as reliable, as a significant part of the movement can be related to the fall of the overall index. It is this realization that has prompted the development of event-study designs that separate abnormal returns into various parts which are attributable to idiosyncratic risk, the immediate impact of the event, the impact on the market index, and possible pricing errors. The ensuing structures allow researchers to distinguish between real firm-level vulnerability and market panic in general, which seems to be especially important in the case of phenomena like COVID-19, which causes multiple sectors to be shaken simultaneously. The available literature reports high levels of sectoral heterogeneity in regards to market responses to pandemics. Although the tendency of equity markets is to go down after the announcement of a crisis, the effect is not evenly distributed in all industries. Empirical research categorizes firms as either safe or risky industries in terms of their vulnerability to supply-chain shocks, loss of demand and closure of operations. The statistics of the Indian market reflect that both classes showed negative returns initially that can be attributed to the decline of the systemic index. Once the market-wide decline was regulated, however, the positive abnormal returns were found in the safer industries including technology and healthcare, and negative returns in the riskier industries including tourism, aviation and traditional manufacturing. These results implicate that the differentiation between naturally resilient and vulnerable companies increased with the accruing pandemic-related information among investors. The empirical data shows that financial markets should have an over-reacting nature to sudden and dramatic news, particularly in situations of increased uncertainty and missing information. At the early stages of the COVID-19 epidemic, the general panic, negative media news, and hopes that the economy would slow down triggered the panic selling and drastic drops in stock prices. This behaviour can be explained by postulations of the behavioural finance school of thought, which hypothesizes that investors can temporarily underprice and overvalue risk during crises. The evidence of emerging markets, such as India, shows that this first over-reaction then was followed by a partial correction in a comparatively limited time, as the prices corrected when the magnitude of the policy reactions and the resilience of the sector were more evident. The trend supports the idea that rational reassessment of risks

and emotional reactions have a co-determining role in market processes in the case of pandemic. According to literature, COVID 19 impacts stock markets in three interconnected ways: it caused a market-wide shock that shocked the standard event-study assumptions, sectoral exposure to pandemic risks was uneven, and short-term overreacting to the crisis caused by uncertainty and sentiment. Although more recent research offers a more improved methodology to explain abnormal returns in such circumstances, there is still a gap in the knowledge of how a long-term adjustment process takes place, and how firm-specific features contribute to recovery patterns. Future studies using longer time horizons and combined behavioral and risk-based models would contribute to the explanation of how emerging markets like India absorb and correct large systemic shocks. The available empirical evidence of the literature indicates that large-scale emergency situations on public health produce not only economic shocks but also the strong psychological responses that affect financial decisions-making. In equity markets, these psychological reactions are reflected in the change of the investor sentiment, which can increase volatility and cause the price to diverge below or above intrinsic valuation. This is because the COVID19 pandemic is a unique shock that is both long-term and worldwide, which makes it useful to analyze the impact of uncertainty, fear, and policy interventions on market sentiment, especially in large emerging markets like China. Several studies have explored the impact of epidemics and other extreme events on the affective condition of investors and hence the dynamics of the market. Significant health crises predispose the generation of fear, anxiety, and pessimism, decreasing the propensity to take risks and increasing the pressure to sell. According to the behavioral-finance literature, negative affect (when dominant) is believed to induce investors to be more dependent on the use of heuristic signals instead of fundamental analysis, which in turn encourages herding and extreme price volatility. These psychological reactions were aggravated during COVID -19 due to media coverage, growing disease rates, and uncertainty about the economic recovery, which made sentiment the critical channel of transmission among the health crisis and the financial markets. Empirically, there is a strong relationship between the waning investor sentiment and the falling stock prices during the pandemic. The increased uncertainty witnessed wide plummets in equity markets of various countries with increased volatility. In China, there are indications that investor preference has taken an upward trend before the outbreak, which is in accordance with the stable economic growth and optimism. After the outbreak of COVID-19, the mood changed to continue to decrease in a negative direction, which is reflected in the declining market indicators. Interestingly, certain studies report a short-lived sentiment improvement immediately after the outbreak which could be explained by confidence in governmental control measures or hypothetical optimism. This initial response was quickly overrun by continued pessimism with lockdowns, supply-chain setbacks, and slowing growth starting to undermine corporate performance. There is an accumulation of literature that markets overreact to sudden and dramatic news especially in a high uncertainty environment. The high speed of negative information and unclear policy impact during COVID-19 triggered investors to re-evaluate risk in a sharp way, which most of the time resulted in them overreacting. This overreaction can be confined to the noise trading and sentiment-based pricing theories, where emotional reactions dominate rational valuation in the short-term. In the long run, however, when information is made more transparent and policy support provided, markets partially correct such mispricings. Long-lasting restrictions and the halt and start aspect of Chinese economic activity seem to have caused a long-lasting weakening of feelings, suggesting that the pandemic has not only generated a temporary shock effect but also a more end-lasting structural impact on growth and financial stability expectations. In general, the literature shows that COVID-19 affected stock markets in a strong sentiment channel, which was led by fear, uncertainty, and information shocks. The pandemic not only changed the degree of investor sentiment but also changed the direction, creating profound volatility, interim overreactions and endemic pessimism in many markets. Although the existing literature creates a strong demonstration of these short and medium term effects, it contains gaps in the knowledge about the long term recovery of sentiment, as well as how it interacts with policy credibility and institutional frameworks. Further studies utilizing longer time frames and international comparisons might provide deeper information as to how developing markets re-establish investor trust after massive epidemics of a disease.

Methodology

Data collection and Variables

The research design adopted in this study is quantitative and aims to examine the impact of the COVID-19 pandemic on the dynamics of volatility in the Indian equity market, with specific focus on the NIFTY 50 index over the period 2013 to 2024. The study relies on secondary high-frequency financial data obtained from the National Stock Exchange of India, ensuring the reliability and accuracy of the time-series observations. Given that the COVID-19 outbreak and the nationwide lockdown in March 2020 represent a clearly defined exogenous shock, a quasi-experimental interrupted time-series design is employed to compare the pre-intervention and post-intervention behaviour of market volatility. The dependent variable is daily stock market volatility, computed from log-returns of the NIFTY 50 index and annualised using a rolling window. This variable is selected as it captures the degree of uncertainty and risk perceived by investors and is widely used in the literature to assess market reactions to systemic shocks. The intervention point is defined as 24 March 2020, corresponding to the commencement of the national lockdown in India. The study applies an Interrupted Time Series Analysis (ITSA) within an ARIMAX framework to evaluate both the immediate impact of the pandemic on volatility (level change) and the subsequent change in its long-run trend (slope change). This approach is appropriate as the dataset contains a sufficiently long pre- and post-intervention period, allowing the estimation of counterfactual trajectories and the identification of structural breaks in the volatility process. The inclusion of autoregressive and moving-average components accounts for volatility clustering and serial correlation, which are characteristic features of financial time series. By modelling the intervention through a binary COVID-19 dummy and its interaction with time, the analysis isolates the short-run shock effect and the long-term regime shift induced by the pandemic, providing a rigorous assessment of how the Indian stock market's volatility dynamics were altered by the COVID-19 crisis.

Hypothesis

The COVID-19 pandemic caused a significant structural change in the level and long-term trend of daily volatility in the NIFTY 50 index.

H_0: The COVID-19 lockdown did not cause any statistically significant change in the level or trend of daily volatility in the NIFTY 50 index.

H_1: The COVID-19 lockdown caused a statistically significant immediate increase in daily volatility and a significant change in its long-term trend in the NIFTY 50 index.

Objectives:

1. To measure the pre-COVID trend in daily volatility of the NIFTY 50 index from 2013 to March 2020.

2. To estimate the immediate impact of the COVID-19 lockdown on market volatility in March 2020.

3. To examine whether the long-run trajectory of volatility after COVID-19 differs significantly from the pre-pandemic trend using an interrupted time series framework.

Model Specification

The most important variables included in the empirical model are:

Time (t): it is a continuous variable that represents the daily observations that are evenly distributed within the time frame between January 2013 and December 2024.

Post-COVID (Dt): a binary variable indicating the pre-intervention period (=0) or the post-intervention period (=1) with the date of the intervention set to 24 March 2020, the date when the national lockdown in India started.

Time Post-COVID (t x D): the interaction between the temporal trend and the COVID dummy, which will help to identify the possible changes in the slope of volatility after the intervention.

The time series model estimated in general is:

$$V_t = \beta_0 + \beta_1 t + \beta_2 D_t + \beta_3 (t \times D_t) + u_t$$

where V_t denotes daily market volatility of the NIFTY 50 index and utu_tut is an error term following an ARMA process to account for serial correlation and volatility clustering. The coefficient β_2 measures the immediate level change in volatility following the COVID-19 shock, while β_3 captures the long-run change in the volatility trend after the intervention.

Analysis

The data sample includes daily records of the NIFTY50 index between 2013 and 2024. The returns which were calculated on a daily basis (in logarithmic returns) were used to calculate a rolling, annualised measure of market volatility, which acted as the dependent variable in the analysis. The analysis of the series reveals that the degree of variation over time is high with conspicuous peaks of the series that correlate with market stress, specifically with the beginning of the COVID-19 pandemic in March 2020. This kind of heterogeneity is an indicator of strong time-dependent dynamics and volatility clustering and thus it is worthwhile to apply an interrupted time-series approach in combination with an ARIMAX specification to simultaneously describe structural breaks and serial dependence in the volatility process. Table 1

Descriptive Statistics

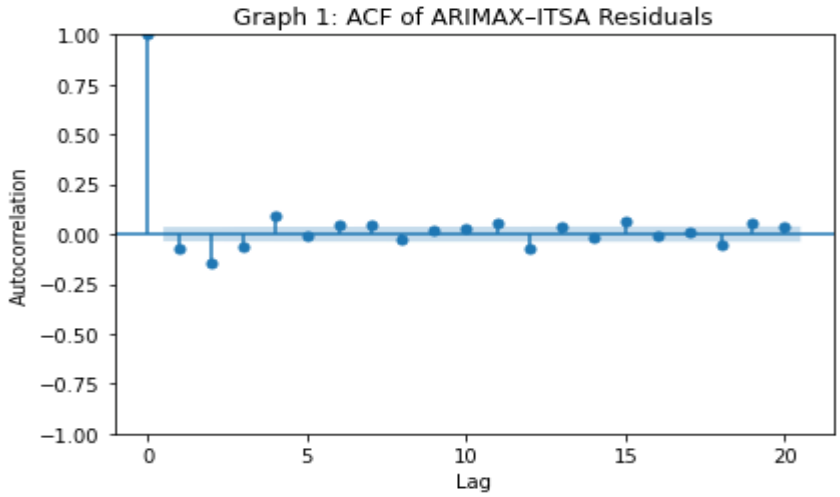
	Obs	Mean	Std. Dev	Min	Max
Volatility (Full sample)	2951.0	0.020365	0.017126	0.003174	0.331268
Volatility (Pre-Covid)	1774.0	0.019727	0.017126	0.004418	0.331268
Volatility (Post-Covid)	1177.0	0.021328	0.016504	0.003174	0.171485
Daily Log returns	220824.0	0.000006	0.001136	-0.094992	0.171485

The descriptive statistics show that the average NIFTY 50 volatility rose in the post-COVID period to 0.0213, which was higher than the 0.0197 in the pre-COVID period and this implies the shift to a high risk environment after the pandemic. The highest volatility is recorded during the COVID crisis, which demonstrates the strong growth of the uncertainty level during the lockdown period. The mean of the daily logarithmic returns is found to be close to zero and at the same time, the returns have sharp

extreme events, which supports the presence of heavy tails and market stress. Overall, the results suggest increased and more uneven volatility after COVID 19, which supports the application of an interrupted time-series approach.

Graph 1

ACF Plot



The autocorrelation process (ACF) of the ARIMAX-ITSA residual shows that the autocorrelations at all the lags it has studied are within the 95 percent confidence limits and tend towards no value. Therefore, all the autocorrelations in the residual are not found to be statistically significant and it is assumed that there is no long-term serial correlation once the autoregressive and moving-average models have been used to explain the autocorrelations. Therefore, the residuals are close to white noise which implies that the model has successfully managed to model the temporal dependence and volatility clustering that exists in NIFTY 50 volatility series. This result confirms the suitability of the ARIMAX specification, and supports the validity of the estimated intervention effects.

Table 2

ARIMAX–ITSA Results for NIFTY 50 Volatility Around the COVID-19 Shock

Variable	Coef	Std. Err	z	p	CI Low	CI High	Sig
time	0.000016	0.000002	7.801348	0.000000	0.000012	0.000019	***
post_covid	0.065582	0.014028	4.675075	0.000003	0.038087	0.093076	***
time_post_covid	-0.000033	0.000007	-4.804862	0.000002	-0.000047	-0.000020	***
ar.L1	0.919380	0.004077	225.503934	0.000000	0.911390	0.927371	***
ma.L1	-0.565611	0.008091	-69.906246	0.000000	-0.581469	-0.549753	***
sigma2	0.000210	0.000002	117.253321	0.000000	0.000206	0.000213	***

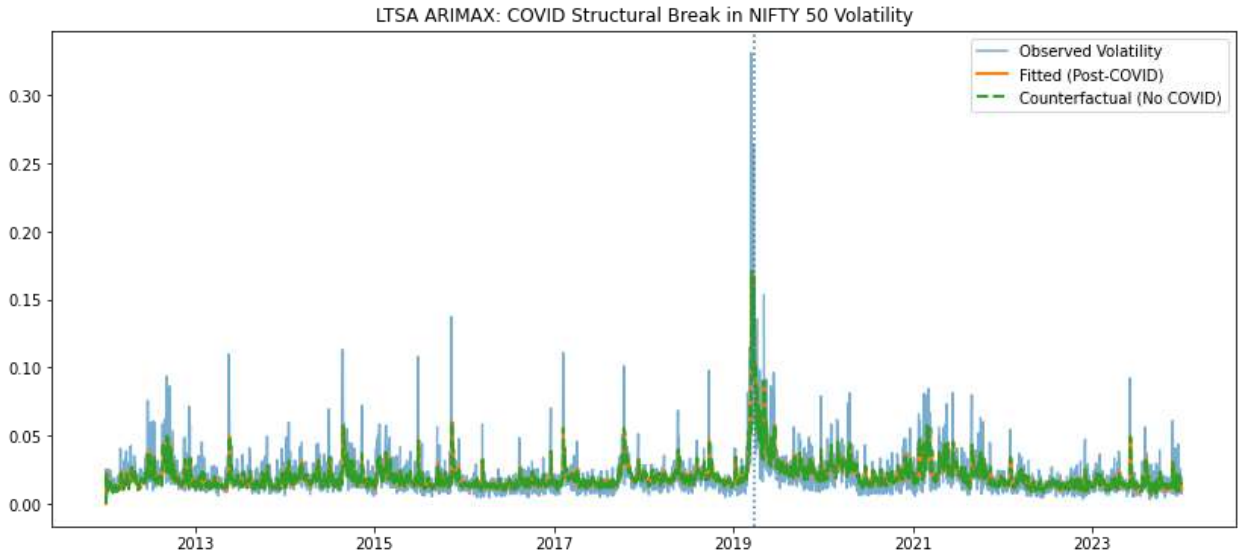
Model Statistics

Statistic	Value
Observations	3131
Log Likelihood	8368.896
AIC	-16725.791
BIC	-16689.501

Table 2 shows the results of the estimation of the ARIMAX-Interrupted Time Series model exploring the impact of the COVID-19 shock on the daily volatility of the NIFTY 50 index. The time trend coefficient is positive and statistically significant ($\beta_1 = 1.6 \times 10^{-5}$, $p < 0.01$), which indicates that the market volatility in the pre-pandemic period had a small upward secular trend. This observation shows that the baseline uncertainty is on a gradual increase during the sample period in line with the long-run augmentation of market participation, financial integration and exposure to global shocks. The post-COVID dummy variable also has a positive and highly significant value ($\beta_2 = 0.0656$, $p = < 0.01$), indicating an immediate and steep increase in volatility after the lockdown in March 2020. This finding supports the fact that there was a sudden panic-inflicted shock on market stability, which is in line with behavioural overreaction, liquidity stress and increased uncertainty that was felt in the early stages of the pandemic. The economic interpretation of this coefficient is that it is a structural break in the volatility process, which shows that COVID-19 has caused not just temporary change of volatility but a certain change of volatility regime. The correlation between time and the post-COVID indicator is negative, and statistically significant ($\beta_3 = -3.3 \times 10^{-5}$, $p < 0.01$) indicating a significant change in slope of the volatility trend following the intervention. Despite the initial volatility increase, the growth rate thereafter in comparison to the pre-pandemic trend decreased which may indicate a slow normalization process, which is driven by policy interventions, circuit breakers, monetary easing, and adaptive investor learning. This finding supports the hypothesis that the financial markets were over-reacting then corrected by under-reacting, as opposed to being in an explosively unstable situation. The presence of the volatility clustering, which has been a well-documented stylized fact in financial markets, is proven by the autoregressive coefficient (AR(1) = 0.919, $p < 0.01$) which shows strong persistence in the volatility. The moving-average element (MA(1) = -0.566, $p < 0.01$) also accommodates short-run shock adjustments, thus indicating that the unexpected volatility innovations are rapidly absorbed but they fade away with time. Both parameters are statistically significant and justify the ARIMAX specification and point to the fact that ignoring the serial dependence would have resulted in biased inference. The model is also stable, with the estimated variance of the error term ($\sigma^2 = 0.00021$, $p = < 0.01$) being accurately determined. The model-fit statistics also assist in the robustness of the specification, whereby the log-likelihood (8368.9) and information criteria (AIC = -16725.8; BIC = -16689.5) are high, meaning that it is well-explained and parsimonious. In general, the findings provide strong indications of the structural break in the volatility of the Indian stock market due to COVID. The pandemic created a statistically significant risk volatility explosion in the moment, followed by a moderate but steady volatility regime. The combination of positive shift in levels and negative shift in slope is consistent with an over reaction to a crisis followed by institutional stabilization and market learning. These results confirm that the COVID-19 shock not only changed the level of volatility in the NIFTY50 index but also the long-run volatility dynamics.

Graph 2

Volatility across 10 years



The figure shows the time-related trend of daily NIFTY 50 volatility between 2013 and 2024 and the fitted values obtained by an ARIMAX-Interrupted Time Series (ITSA) model, as well as the counterfactual trend of volatility development in the absence of the COVID-19 shock. The date of the intervention (24 March 2020) is indicated with a vertical dashed line, and it is on this date that the nationwide lockdown announcement occurred in India and is the exogenous structural break in this paper. During the pre-COVID volatility cycles were fairly consistent and close to a long-run trend with occasional outbreaks related to regular instances of market stress. These movements were closely captured by the fitted pre-intervention path indicating that the underlying movements in terms of time dependence and volatility clustering were sufficiently modeled in the model. This constancy offers a plausible point of reference on which the dynamics post-intervention can be judged. In the point of intervention, the number shows a sudden and significantly high increase in volatility, significantly exceeding the volumes in previous years. This is a sharp change in the uncertainty, liquidity, and panic of investors brought about by the pandemic and the strict implementation of isolation measures. The immediate vertical difference of the observed series with the counterfactual no-COVID path gives a visual representation of the magnitude of the estimated level shift in volatility as the positive and significant post-COVID coefficient will be in the ARIMAX-ITSA model. After the initial shock, the measured and estimated post-COVID volatility continued to be consistently above the counterfactual path, showing that the market switched to a higher-risk regime and did not quickly being drawn back to the pre-pandemic regime. However, the fitted post-intervention trend is moderated and not steep as in the first spike, in line with the negative and significant slope-change coefficient. This trend can be seen as indicating a partial normalization process that is occasioned by monetary and fiscal policy actions, regulatory action like circuit breakers and the fact that the market players will have gradually adapted to the new information environment. The long-term deviation of the fitted post-COVID trajectory and the counterfactual series highlights the structural effect of the pandemic on market volatility in the long-run. Even though the period of short-term uncertainty decreased following the crisis peak, the normal level of risk remained high thus suggesting that there was a permanent change in the volatility regime. All in all, the figure is a vivid visual illustration of both short-term shock and long-term process of adjustment, which confirms the econometric result that COVID-19 had created a substantial and lasting structural break in volatility dynamics of the NIFTY 50 index.

Limitations

- The ARIMAX–ITSA model focuses only on the COVID-19 intervention and does not explicitly control for other factors such as interest rate changes, global market spillovers, oil prices, or geopolitical events, which may also have influenced volatility during the period.
- The analysis is restricted to the NIFTY 50 index, so the results may not fully represent the behaviour of mid- and small-cap stocks or other segments of the Indian market.
- The model assumes a single intervention date, whereas the pandemic evolved through multiple waves and policy phases that could have had additional effects not separately captured.
- Despite these limitations, the study still provides useful insights into how a major systemic shock can alter the level and trend of stock market volatility

Conclusion

The paper examines how the COVID-19 pandemic has impacted the volatility lives of the Indian equity market (the NIFTY 50 index) using an Interrupted Time Series (ITSA) framework under an ARIMAX model. Taking the nationwide lockdown of March 2020 as an exogenous structural break, the analysis is able to isolate the pre-pandemic volatility trend, the short-term shock caused by the crisis, and the long-run adaptation of the market. The results are a definite sign that COVID-19 was a significant regime-changing event and not a transient effect. The empirical investigation proves that the beginning of the pandemic triggered a statistically significant rise in market volatility, which signifies the augmented skepticism, liquidity panic, and the overall over-reaction of investors. Such an instantaneous move in the level bears out the fact that the shock had caused the normal operations of the financial markets to be interrupted and this led to the abrupt re-pricing of risk. At the same time, the fact that the post-COVID trend changed significantly means that the volatility process itself was different, and the market shifted to a new regime with an inexorably increased baseline risk but a slowly decelerating volatility growth rate. It is in line with a crisis-adjustment model where panic is first followed by a policy response, stabilisation by institutional measures and learning by market participants. The strong autoregressive and moving-average elements also emphasize the fact that there is clustering and persistence in volatility and, therefore, the need to model serial dependence in the examination of financial time series. This means that the ARIMAX-ITSA model is highly appropriate in capturing the structural break caused by the pandemic in addition to the dynamic nature of the volatility series. The analysis in a counterfactual situation shows that, without COVID -19, volatility would have had a much smoother and lower trend, which means that the observed post-2020 behaviour cannot be attributed to trends that existed before. In general, the research proves that the COVID-19 crisis produced a significant and long-lasting effect on the Indian stock market, not only a short-term work of uncertainty but also a shift in the dynamics of volatility in the long run. These results can be added to the existing body of literature on the financial market reactions to systemic shocks and to emphasize the utility of the quasi-experimental time-series methods to isolate the impacts of significant events in the world. In terms of policy, the outcomes highlight the importance of timely regulatory and monetary responses to extreme market instability in order to bring it down to a more stable post-crisis regime. Further studies may build on this model by adding more macroeconomic controls, analyzing industry or firm-specific heterogeneity, and comparing the Indian case with other large financial markets to further clarify the propagation and proliferation of pandemic-induced shocks.

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