

VOLATILITY SPILLOVER AND PANDEMIC – ANALYSIS OF SELECTED SECTORAL INDICES IN INDIA

K. Riyazahmed 

SDM Institute for Management Development (SDMIMD), Mysore, India

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VOLATILITY SPILLOVER AND PANDEMIC - ANALYSIS OF SELECTED SECTORAL INDICES IN INDIA

K. Riyazahmed

SDM Institute for Management Development (SDMIMD), Mysore, India

Abstract: The COVID-19 pandemic has impacted economies worldwide, and it has been reflected in their stock markets, as well. The effect was evident in the Indian stock markets, yet the nature and level of this impact are not very clear. This paper examines the short- and long-term spillover in the volatility between coronavirus cases on the broader market index, Nifty 50, and the indices of selected sectors: information technology, healthcare, and pharmaceuticals. Data for the period from January 2020 to July 2022 has been analyzed. The Dynamic Conditional Correlation GARCH model was used for analyzing the volatility spillover of coronavirus cases on Nifty 50, Nifty IT, Nifty Healthcare, and Nifty Pharma. The results show that there has been a significant long-term volatility spillover of infections on the broader market index, Nifty 50. However, there is no long-term persistence of COVID-19 on the sectoral indices. Only Pharma and Healthcare have exhibited significant short-term persistence. All the indices were negatively correlated with case numbers. Even though the sectoral indices did not exhibit significant long-term volatility spillover, they were positively correlated with the broader market index, Nifty 50, which in turn showed the significant long-term persistence of COVID-19. The results of the study are useful to policymakers and investors to understand the level of market impact due to the pandemic.

Keywords: COVID-19; Volatility spillover; DCC GARCH analysis

JEL codes: G01; G1; C5

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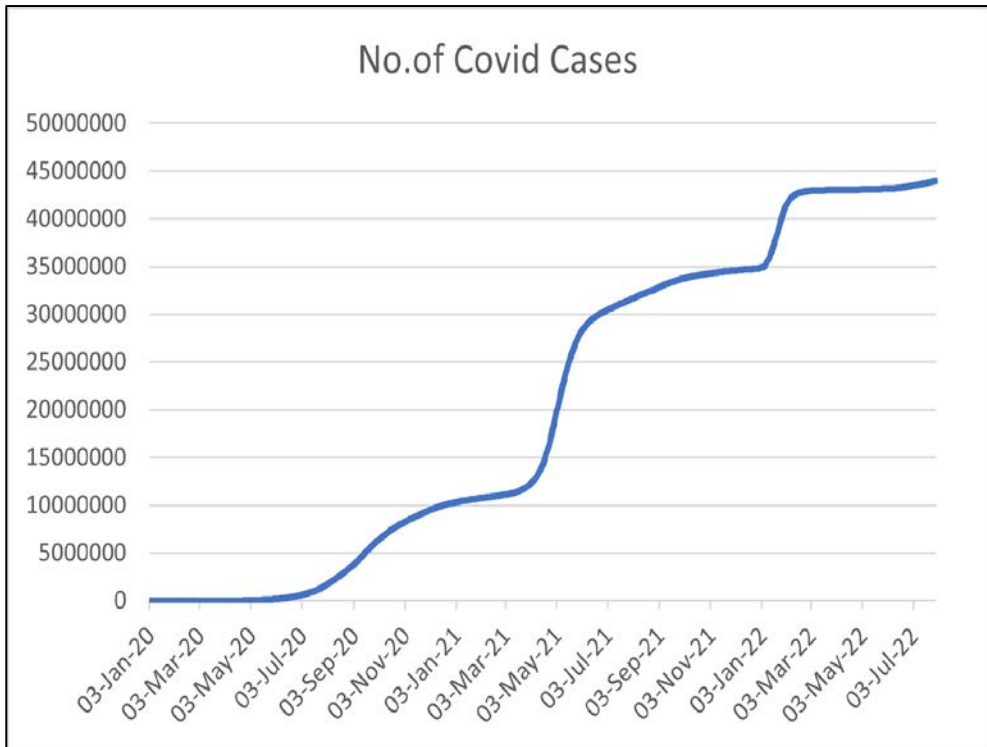
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Introduction

The COVID-19 outbreak in January 2020 shook the entire world; for almost two years (2022), coronavirus infections kept increasing the world over, even though the growth in new cases was mostly controlled. Data from the World Health Organization shows an increasing trend of coronavirus cases till the end of 2021 that later turned out to be flat in 2022 (Figure 1). However, the 2020 outbreak impacted business worldwide due to

frequent and prolonged lockdowns, which resulted in the suspension of manufacturing and service activities, disrupted the movement of goods and travel, and negatively affected other essential activities. Hence, the coronavirus pandemic was considered a significant threat to worldwide economies and financial markets (Barro et al., 2020; Ramelli & Wagner, 2020).



Source: Prepared by the author based on data extracted from the WHO (World Health Organization) in July 2022.

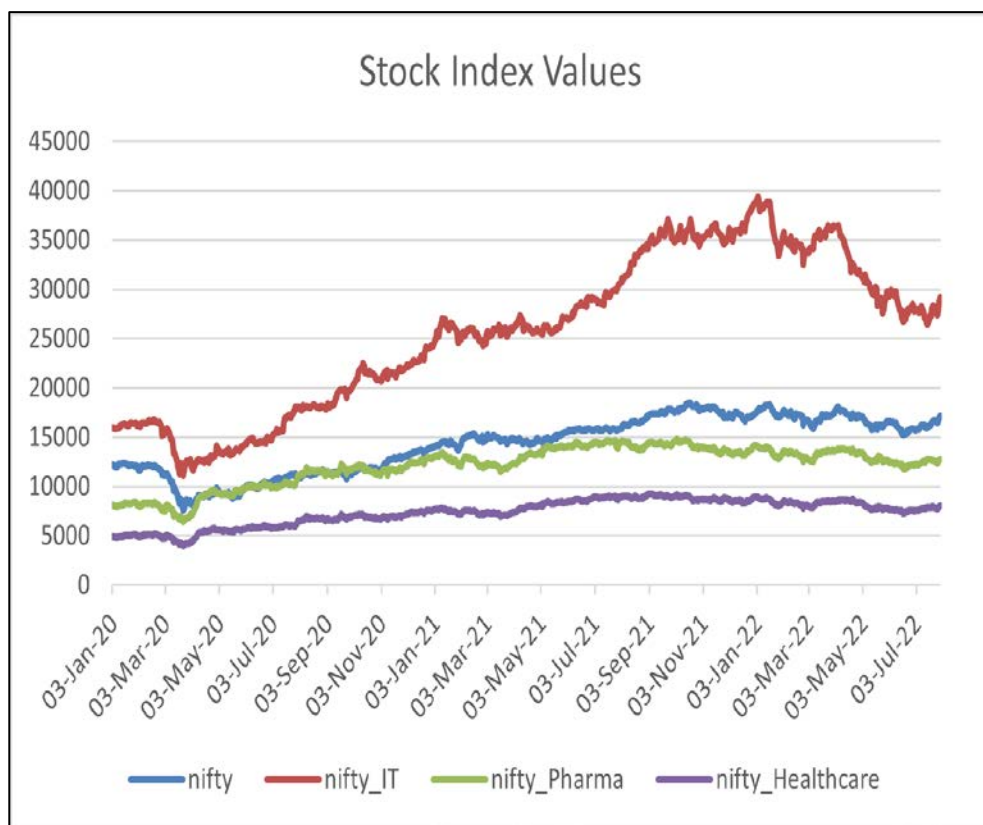
<https://covid19.who.int/WHO-COVID-19-global-data.csv>

Figure 1. Number of COVID-19 cases from January 2020 to July 2022

The scenario was immediately reflected via markets around the globe because capital markets reflect the economic scenario and stock markets are crucial indicators of any economy (He P. et al., 2020; He Q. et al., 2020). Wang et al. (2021) found a significant impact and change in investor behaviour on stock markets due to COVID-19. As investor psychology, for better or for worse, can change the picture of the entire

economy (Naseem et al., 2021), there was a sharp decrease in trading prices on some of the most well-developed stock markets like Shanghai, Dow Jones, and Nikkei (Ali et al., 2020). Due to the pandemic, most of the stock markets worldwide lost trillions of dollars (Jabeen et al., 2022; Lyócsa et al., 2020).

This scenario was just as apparent in the way Indian stock markets moved with trends signifying the pandemic situation (Figure 2). There was a sudden drop across all indices, including broader market ones like Nifty, and even the sectoral indices. However, there is no obvious trend demonstrating how the changes in COVID-19 cases have been reflected in the Indian stock markets or to what extent.



Source: Prepared by the author based on the average daily closing of Nifty and sectoral indices from January 2020 to July 2022. Data extracted from the National Stock Exchange (NSE), India, as of July 2022, <https://www.nseindia.com/products-services/indices-sectoral>

Figure 2. Stock Index values from January 2020 to July 2022

However, research studies have found the impact of coronavirus shocks on *volatility* in other global stock markets (Zhang et al., 2021; Onan et al., 2014; Buszko, Orzeszko & Stawarz, 2021). There are sectors found to be positively impacted because of certain favourable business conditions that the pandemic introduced (RSM International Association, 2021). A study by McKinsey & Company reports that, among other sectors, pharmaceuticals, healthcare supplies, healthcare services, and high-tech company stocks have all appreciated greatly since the COVID-19 outbreak (Bradley & Stumpner, 2021). Hence, understanding the volatility structure of stock market returns is imperative for policy guidance among policymakers and potential investors, particularly in a pandemic scenario (Othman, Haron & Kassim, 2022).

There has been persistent volatility spillover from other global stock markets in Indian markets throughout the post-pandemic period (Thangamuthu, Maheswari & Naik, 2022). However, research on the spillover of *COVID-19 cases* in the Indian stock markets and, in particular, the sectors that are expected to benefit from the pandemic has not yet been conducted. This study addresses the gap by investigating the volatility spillover between coronavirus infections with the overall Indian stock market and with selected sectors – information technology (IT), pharmaceuticals, and healthcare – using the respective sectoral indices. The following research questions have been examined in the study.

RQ1: Have COVID-19 cases had a significant negative impact on Indian stock markets?

RQ2: Have COVID-19 cases had a significant positive impact on those selected sectors which could be expected to have benefited?

The remaining sections of the paper are constructed as follows. Section 2 discusses the relevant literature. Section 3 discusses the data and methodology used in the analysis. Likewise, section 4 explains the results with a discussion of the research. The final section provides the conclusion.

Literature Review

Stock market investors have acutely reacted to increasing COVID-19 numbers and the death rate (CFA Institute, 2020). Ashraf (2020), conducting research based on data from the stock markets of 64 countries, found that these numbers have significantly reduced stock market returns. Onali (2020) examined the effect of coronavirus cases on the US stock markets and found no significant impact exhibited. However, his study found a positive correlation in some other countries like Italy and France. Investors started panic selling, which caused a significant

impact on returns and the price predictability of stocks in the United States. However, the pandemic's associated market inefficiency also created opportunities for traders and speculators (Hong, Bian & Lee, 2021).

Zhang et al. (2021) investigated the stock markets of technologically advanced countries and found that there was no major influence of returns volatility coming from advanced countries towards the Shanghai stock market as a result of COVID-19. However, the same study found that market to have significantly influenced volatility in most of the advanced countries studied, e.g., Switzerland, Sweden, the Netherlands, and the U.K. Onan et al. (2014) found that both good and bad announcements asymmetrically cause market volatility. However, numerous sectors have reacted differently to the pandemic (Buszko, Orzeszko & Stawarz, 2021).

Bakry et al. (2022) found that investors' reactions to preventive government interventions which caused stock market volatility widely differed between countries due to national specificities and the prevailing quality of governance. Further, the study found that while there was a strong positive relationship between volatility and the stringency of government actions in emerging markets, a negative relationship existed in developed markets. Understanding the virus' effect on volatility in markets is of great importance for governments to identify suitable policy actions and for investors to find suitable investment decisions to withstand this volatility (Othman, Haron & Kassim, 2022).

The process and magnitude by which instability in one market affects other markets are referred to as 'volatility spillover' (Sahoo, Behera & Trivedi, 2017). The COVID-19 pandemic strengthened the volatility connectedness (spillover) between global stock markets (Cheng et al., 2022). Guru and Das (2020) studied the volatility spillover of ten sectorial indices in India and found that it reached 69 per cent during the pandemic. They found that energy and oil & gas were the major volatility transmitters to other sectors. Baek, Mohanty, and Glambosky (2020) found that the petroleum, natural gas, restaurant, and hospitality industries exhibited the largest volatility increases on US markets.

Globally, sectors like IT (due to the demand for remote working tools and software) healthcare, and pharmaceuticals (due to increased demand for medical supplies and care) benefitted due to COVID-19 (Somanas, 2020). Market volatilities were found to be more sensitive to pandemic news than economic or business indicators (Baek, Mohanty & Glambosky 2020). Thangamuthu, Maheswari, and Naik (2022) examined the volatility spillover on Indian stock markets from other developed markets like the United States, Japan, China, Germany, and Australia and found persistent spillover in the post-pandemic period. Yet the direct spillover effect of COVID-19 on the national stock market or

sectoral indices has not been examined in the Indian scenario.

Hence it becomes imperative to find the volatility spillover between coronavirus cases and Indian stock markets as well as on the selected sectoral indices that could be expected to have benefited from the pandemic, i.e., IT, healthcare, and pharmaceuticals. This study addresses the gap and hypothesizes as follows.

H01a, 2a, 3a, 4a: There has been no short-term volatility impact of COVID-19 cases on Nifty, Nifty IT, Nifty Healthcare, or Nifty Pharma.

H01b, 2b, 3b, 4b: There has been no long-term volatility impact of COVID-19 cases on Nifty, Nifty IT, Nifty Healthcare, or Nifty Pharma.

Data and Methodology

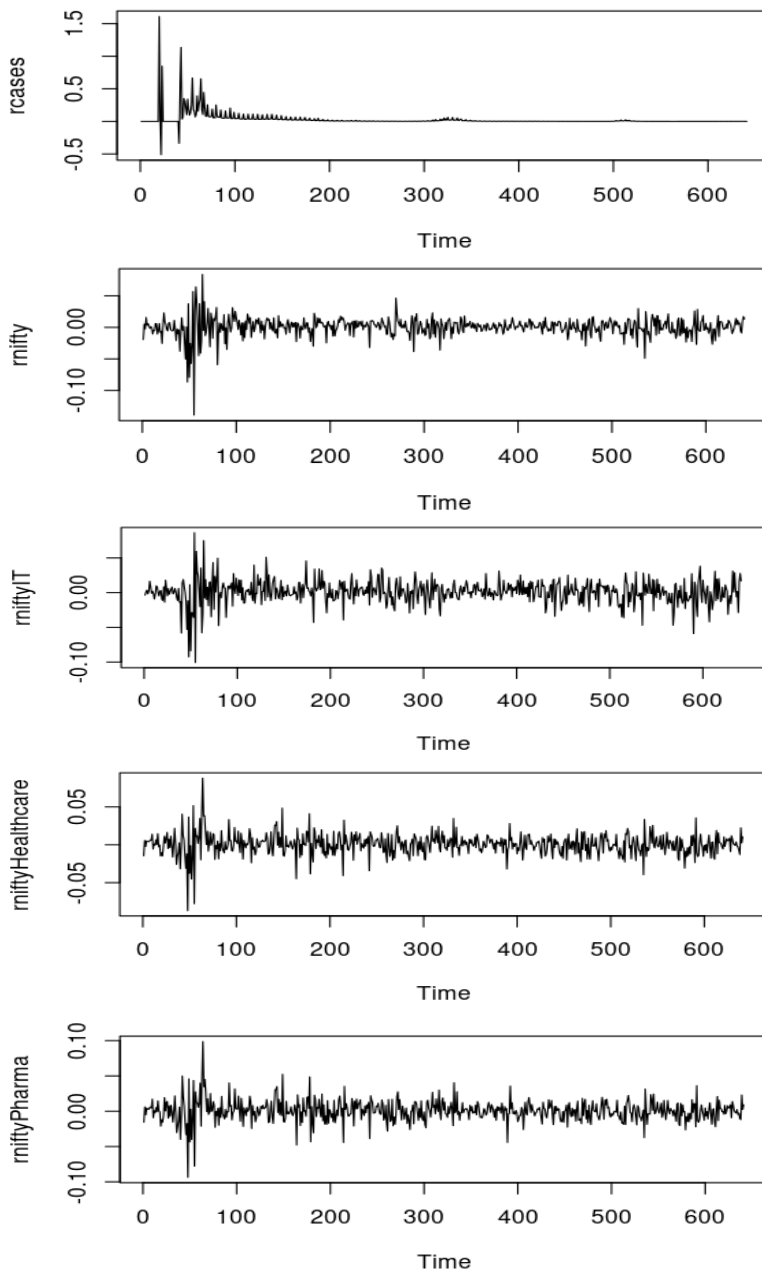
A data set of daily coronavirus cases in India from 3rd January 2020 to 29th July 2022 was taken from the World Health Organization (WHO) for analysis. Likewise, the broader market index of the National Stock Exchange (NSE), India's 'Nifty 50' (*hereafter Nifty*), was taken to represent the overall stock market picture. Further, the sectoral indices of NSE, Nifty IT, Nifty Healthcare, and Nifty Pharma were taken for sectoral analysis. Figures A1 and A2 show the data considered for this analysis.

The variables of COVID-19 cases, Nifty, Nifty IT, Nifty Healthcare, and Nifty Pharma were then log converted for further analysis. To model the volatility in time series data, DCC GARCH models were used. GARCH models (Generalized Auto-Regressive Conditional Heteroskedasticity) are autoregressive, depending on past squared observations and past variances to model for current variance. GARCH processes are widely used in finance due to their effectiveness in modelling asset returns and inflation (Fung, Jeong & Pereria, 2022; Floros, 2008).

Dynamic conditional GARCH (DCC GARCH) is used to address correlation clustering in time series data and is hence widely employed to study interdependence in the volatility of stock market data, i.e., volatility spillover. The study used R software for the DCC GARCH analysis.

Results and Discussion

Figure 3 depicts the volatility (returns) of Nifty, Nifty IT, Nifty Healthcare, and Nifty Pharma. It can be observed that the volatility of all the indices shows similar patterns and could thus be presumed correlated.



Source: Prepared by the author based on the daily data for COVID-19, Nifty 50, Nifty IT, Nifty Healthcare, and Nifty Pharma.

Figure 3. Volatility in coronavirus cases and the returns of indices NIFTY, NIFTY IT, NIFTY Healthcare, and NIFTY Pharma

Using the 'ugarchspec' function of the 'GARCH' package in R software, a GARCH model was created with arma order (0,0), variance order (1,1), and a standard GARCH specification. The model specification was then determined using a multivariate normal function. Finally, using the 'DCCfit' function, the model fit of variables was created. A DCC model to find the persistence of coronavirus cases on Nifty, Nifty IT, Nifty Healthcare, and Nifty Pharma was tested individually.

Hence, there were four tested models whose results are presented in Table 1. Based on these results, it can be inferred that a conditional correlation exists between COVID-19 cases and all the stock indices. Since the sum of DCC alpha (dcca1) and DCC beta (dccb1) of all the models is less than one, the conditional correlation between the variables is not constant over time, i.e., they exhibit a dynamic relationship.

Table 1. Results of the DCC GARCH MODEL FIT

Models	Optimal Parameters				
	Parameter	Estimate	Std.Err	t value	Pr(> t)
COVID-19 and Nifty	dcca1	0.000000	0.000000	0.000524	0.99958
	dccb1	0.918274	0.08765	10.47605	0.0000
COVID-19 and Nifty IT	dcca1	0.000000	0.01447	0.000011	0.99999
	dccb1	0.972946	4.21952	0.230582	0.81764
COVID-19 and Nifty Healthcare	dcca1	0.074144	0.04372	1.69573	0.0499
	dccb1	0.029033	0.25805	0.11251	0.91042
COVID-19 and Nifty Pharma	dcca1	0.067259	0.03448	1.950484	0.0411
	dccb1	0.000003	0.56213	0.000004	0.99996

Source: Calculated by the author based on the analyzed data using DCC GARCH.

The significance level for alpha and beta in a DCC GARCH model exhibits a persistent level of interdependency between the volatility of variables. If a dcca1 value is significant ($p < 0.05$), then the independent variable has a short-term volatility impact

on the dependent variable. Likewise, if the dccb1 value is significant ($p < 0.05$), then the independent variable has a lingering effect or long-term volatility impact on the dependent variable.

The results of the DCC GARCH analysis presented in Table 1 show that coronavirus cases had long-term persistence on the volatility of the overall market index, Nifty. However, there was no significant short-term volatility. Contrastingly, there was significant short-term persistence for both ‘Nifty pharma’ and ‘Nifty Healthcare’, yet no significant long-term volatility impact can be found for either of them.

‘Nifty IT’ exhibited no long-term nor short-term persistence due to COVID-19. In contrast to the expected impact, the results of the analysis reveal that sectoral indices have not had any long-term volatility impact because of the virus, yet there was some short-term volatility impact found only in the cases of the healthcare and pharmaceutical sectors.

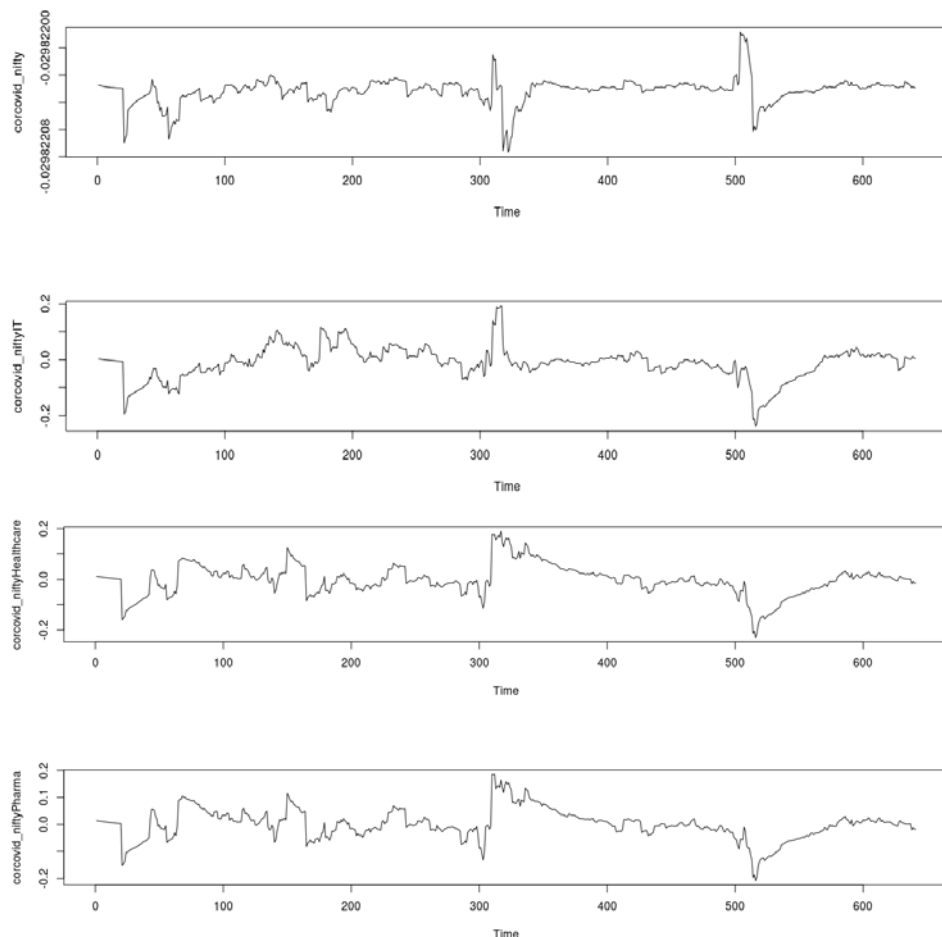
Table 2. Correlation between COVID-19 and Nifty, Nifty IT, Nifty Healthcare, and Nifty Pharma

Variables	COVID-19 cases (Correlation coefficient)
Nifty	-0.029822030
Nifty IT	-0.015486390
Nifty Healthcare	-0.003783511
Nifty Pharma	-0.003605745

Source: Author’s calculation based on DCC GARCH analysis.

Table 2 shows the correlation between coronavirus cases and the market indices. There was a negative correlation between the overall market index Nifty and the sectoral indices Nifty IT, Nifty Healthcare, and Nifty Pharma with COVID-19 cases.

Hence, infection increases not only negatively impacted overall market returns but also had an effect on the sectoral indices. Figure 4 depicts this correlation throughout the studied period, and it can be observed that it was positive at certain points in time for the indices Nifty IT, Nifty Healthcare, and Nifty Pharma, yet the overall correlation for the period was a negative one.



Source: Prepared by the author based on the analyzed data using DCC GARCH.

Figure 4. Correlation between COVID-19 and Nifty, Nifty IT, Nifty Healthcare, and Nifty Pharma

Along the same lines, it can be observed in both Figures 3 and 4 that the volatility of the variables Nifty, Nifty IT, Nifty Healthcare, and Nifty Pharma depicts a similar pattern, and this is reflected in the impact level for overall market (Nifty) volatility on the IT, healthcare, and pharmaceutical sectors.

DCC GARCH models were used to examine this. The results reveal a dynamic conditional correlation between the overall market and sectoral indices, since the sum of the DCC alpha and DCC beta of all the indices is less than one. Moreover, the results reflect the natural scenario that the overall market volatility had both short- and long-term impacts on the sectoral indices – a scenario that did not change due to the coronavirus.

Table 3. Results of the DCC GARCH MODEL FIT (NIFTY & SECTORAL INDICES)

Models	Optimal Parameters				
	Parameter	Estimate	Std.Err	t value	Pr(> t)
Nifty and Nifty IT	dcca1	0.024099	0.01001	2.40578	0.0161
	dccb1	0.951922	0.02234	42.59410	0.0000
Nifty and Nifty Healthcare	dcca1	0.094262	0.03458	2.725673	0.0064
	dccb1	0.773583	0.07284	10.61934	0.0000
Nifty and Nifty Pharma	dcca1	0.088148	0.03125	2.820597	0.0047
	dccb1	0.774376	0.07160	10.81436	0.0000

Source: Author’s calculation based on DCC GARCH analysis.

The correlation coefficient of the overall market with the sectoral indices shows that all the sectors were positively correlated with the market during the period of analysis (Table 4).

Table 4. Correlation between the overall market and Nifty IT, Nifty Healthcare, and Nifty Pharma

Variables	Nifty (Correlation coefficient)
Nifty IT	0.6461567
Nifty Healthcare	0.6412729
Nifty Pharma	0.6136642

Source: Author’s calculation based on DCC GARCH analysis.

Hence, the results generally demonstrate – in contrast to the hypothesized scenario that the chosen sectors (IT, healthcare, and pharmaceuticals) were expected to benefit from the pandemic – that these sectors were significantly driven by overall (negative) economic trends such as that of the broader market index, Nifty. The sectoral indices showed a correlation of around 60 per cent with the overall market and were

negatively correlated with COVID-19 cases. Even though there was a short-term persistent volatility impact found to exist alongside infections for the pharmaceutical and healthcare sectors, no long-term significant volatility impact was found. However, the overall market showed significant long-term volatility persistence with coronavirus numbers.

These results are in line with Ashraf's (2020) findings that COVID-19 reduced the returns of stock markets. Contrastingly, the sectoral indices did not show any persistence, echoing Onali's (2020) statement that not all stock markets showed persistence toward coronavirus cases. Likewise, Bakry et al. (2022) discovered significant differences among stock markets based on country-specific aspects and governance quality.

This substantiates the hypothesis that not all markets were impacted in the same manner, particularly within some economic sectors. Even though there were expectations for a positive scenario in selected sectors, investors exhibited panic behaviour and there was no significant appreciation in stock prices.

Conclusion

COVID-19 impacted the economy worldwide by disrupting economic activities and creating a crisis. Stock markets reflect economic realities, and investors' expectations are reflected in stock prices. Researchers have found significant variations between the stock markets of different economies in response to the pandemic. Hence, this study examined the pandemic's volatility spillover on the overall market and selected sectoral indices, which were expected to have benefited from it. DCC GARCH analysis was used to estimate the volatility persistence of COVID-19 on Nifty 50 (broader market index) and the sectoral indices Nifty IT, Nifty Healthcare, and Nifty Pharma. The results show both the long- and short-term persistence of case numbers on the broader market, i.e., Nifty 50.

Likewise, there was short-term persistence found for the sectoral indices Nifty Healthcare and Nifty Pharma. However, no long-term persistence was found between infections and all the sectoral indices. Understanding these findings is imperative for policymakers to assess the volatility caused by the COVID-19 outbreak and implement effective measures to stimulate policies countering the distraction caused by the pandemic and supporting economic activities.

For investors, the findings similarly suggest that long-term investment decisions must be made based on real economic conditions, while short-term decisions could

focus on the pandemic's effect on the respective sectoral indices in terms of short-term volatility. However, it is important to note that the broader market showed a negative impact due to the pandemic.

This analysis can be further extended to examine the persistence level between additional sectoral indices during different periods to investigate whether the persistence level changed during the first wave (2020), the second wave (2021), or later on (2022).

Contribution of individual authors

K. Riyazahmed carried out all the processes of the research work involved in the paper.

Conflict of interest

The author declares no conflict of interest.

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K. Riyazahmed is Assistant Professor – Finance, SDM Institute for Management Development (SDMIMD), Mysore, India. ORCID: 0000-0001-5573-7729, riyazahmed@sdmimd.ac.in

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