An Empirical Investigation of the Impact of COVID-19 on Indian Stock Market Volatility

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Abstract

The stock markets are considered as barometer of the economies. The spread of pandemic across a number of countries brought a fear in the mind of investors about its significant impact on the economic and business environment in the coming times. The objective of this research was to analyze the effects of COVID-19 epidemic on the Indian stock market.Period of the study was taken from January 30, 2020, when the first case was identified in India, to June 30, 2020. GARCH model was used to investigate the influence ofnumber of Covid-19 cases and fatalities due to COVID-19 on the stock market index's volatility. BSE 200 was taken as a proxy for the Indian stock market. According to the study results, the volatility of the stock market index was not significantly affected by COVID-19, but the number of deaths was found to have a notable impact on the index's values.

Keywords

Stock market, BSE 200, COVID-19, Volatility, ARCH model, GARCH model.

INTRODUCTION

A viral illness known as COVID-19, which originated in China from an unidentified virus strain, has spread globally and resulted in a significant number of infections and fatalities. The proliferation of the virus compelled governments to implement precautionary measures to curb its transmission. As a consequence, lockdown was announced by governments of different countries to combat the infection. In response to this, economies were hit to a great extent. This was

confirmed by the World Bank Report titled 'Global Economic Prospects' that was released in June, 2020. It stated that relative to World War II recession, economies are facing the worst recession and further the economic growth is expected to decline by 5.2 percent in 2021. Moreover, it was reported that relative to 1870, the decline in per capita output for a large number of economies was the lowest in 2020. On the other hand, for India it is expected that the economy will shrink by 3.2 percent in financial year 2020-21(World Bank, 2020). Stock markets that are considered as the barometer of the economies, too stumbled. With the mounting fear for rapid spread of the virus, an adscititious fear for its blow to the financial markets was also crept in to the mind of the investors. With the increasing number of cases worldwide, stock markets started responding to COVID-19. For instance, in China, the stock markets faced a decline in January after China's national health commission confirmed the human-to-human transmission of infection. In mid of March, U.S. index Dow Jones reported worst trading in its 124 year history. From Europe, Financial times stock exchange 100 index, French stock market index, Swiss market index, and Deutscher Aktien Index 30 were also hit by the pandemic. From Asia, Nikkei 225 Index registered one day lowest decline since April1990. Indian stock market was also stumbled in March. The Sensex experienced a decline of 13.2%, closing at 25,981, marking its lowest point since December 26th and Nifty was dropped by 13 percent to 7,610(lowest since April 8, 2016) on March 23, 2020, diffusing the mood of the investors around the world. In three days only, SENSEX moved up to 29,947 points, then again it plummeted to 30,029 points on May 18. Thus, steep fall and gains in the markets was seen in the markets akin to the movements of a roller coaster. Primarily, uncertain business environment would have brought anapprehension among investors, as governments around the world had announced prolonged lockdowns in the countries. With increasing fear regarding the market movements, there were increasing expectations from the government regarding announcement of some relief package or policies to bring back the market on track. The roll back of the market reveals positive expectations or positive response to the regulators actions to correct the market. For instance, in India, RBI had infused liquidity into the market by lowering the interest rates. The aim of the present study is to assess the degree to which the Indian stock market's volatility has been affected by COVID-19. The paper is sequenced as follows. The second part covers the review of studies related to COVID-19 and stock market, third section includes research methodology, section-4 covers analysis and findings and last section contains the conclusion and limitations of the study.

LITERATURE REVIEW

The COVID-19 pandemic has had a significant effect on the world's economies, with the stock market experiencing a significant increase in volatility since the beginning of the pandemic. This literature review provides an overview of how the COVID-19 pandemic has affected the volatility of stock market.

During the initial phase of the pandemic, there was a significant drop in the stock markets across the globe, with many markets losing a significant portion of their value in just a few weeks. This decline was driven by a combination of factors, including uncertainty about the virus's impact on the global economy, supply chain disruptions, and a sharp decline in consumer spending.

As the pandemic continued to spread, the stock market continued to experience high levels of volatility, with daily swings of several percentage points becoming common place. Many investors began to sell their stocks, fearing that the pandemic would lead to a prolonged economic downturn.

Numerous studies have analyzed how the COVID-19 outbreak has affected the volatility of the stock market. For example, the research conducted by Al-Awadhi *et al.* (2020) revealed that COVID-19 had a notable influence on volatility of the stock market in Kuwait, with the pandemic accounting for more than 50% of the variation in stock market returns. Likewise, a study by Liu *et al.* (2020) concluded that the stock markets of all countries affected by the COVID-19 outbreak experienced a notable decline, with Asia witnessing a greater reduction in abnormal returns compared to other regions. Sansa and Hasan (2020) studied the effect of COVID-19 on the stock markets of United States and China. The findings showed that the stock markets were significantly affected by the COVID-19 pandemic.

Several other research works have explored the effects of COVID-19 on specific sectors of the stock market. For example, a research by Guru and Das (2020) investigated how COVID-19 affected volatility spillovers across ten prominent sector indices in the BSE India. Their findings indicated that the overall volatility spillovers reached 69% during the pandemic, with the energy sector and oil & gas sector being the primary net transmitters of volatility. Similarly, a study byIyke (2020) revealed that US gas and oil companies displayed varied responses to the COVID-19 pandemic, with the latter contributing to 28% of returns and 27% of return volatility. The study highlights that the pandemic had a significant impact on the returns of the majority of the 11 US energy firms listed. Aravind and Manojkrishnan (2020) investigated the influence

of COVID-19 on the returns of stocks in the pharmaceutical firms listed on National Stock Exchange. The research signified that companies with strong brand reputation sustained in the crisis period. He *et al.* (2020) analysed the effect of COVID-19 outbreak on the prices of stocks for various Chinese industries. The results showed opportunistic and positive effect of the pandemic on the high tech industries, while a grave and adverse impact on the traditional industries in China. Similarly, He *et al.* (2020) found that the COVID-19 pandemic had a significant impact on China's aviation, tourism, and other service sectors. Nevertheless, the study noted that certain sectors such as new infrastructure, Chinese patent medicine, and internet industries witnessed impressive growth during this period.

Numerous researches have also analyzed the effects of government interventions on stock market volatility during the pandemic. For example, a study by Sinaga *et al.* (2022) investigated the immediate effects of government interventions on 11 industrial sectors in the Indonesian Stock Exchange (IDX) during the COVID-19 pandemic. The findings indicate that the first economic stimulus package played a crucial role in reviving most sectors, following the announcement of the first COVID-19 case in Indonesia. Although the Jakarta lockdowns had a negative impact on stock returns across most sectors, the impacts were relatively minor compared to those experienced in other neighboring countries.

In summary, the COVID-19 outbreak has resulted in noteworthy fluctuations in stock market volatility around the world. The pandemic has led to increased uncertainty, supply chain disruptions, and reduced consumer spending, resulting in sharp declines in stock market values. However, the influence of COVID-19 on the volatility of the stock market varies across different sectors and countries. Additionally, government interventions have played a significant role in reducing stock market volatility during the pandemic.

RESEARCH METHODOLOGY

Sources of Data Collection

The impact of COVID-19 on the stock market of India has been assessed by taking into account the S&P BSE 200 as a representative index. The period of the study ranges from the date when first case was reported in India, i.e. from 30th January, 2020 to 30th June, 2020. The daily closing prices of the index were taken from BSE website. Further, two distinct variables, namely the count of

COVID-19 cases and COVID-19 related deaths, have been considered as independent factors. Data related to number of cases and deaths was taken from website of worldometer.

DATA ANALYSIS

The present study has carried out analysis using a number of statistical techniques including descriptive statistics, unit root test, Autoregressive Conditional Heteroscedasticity (ARCH) tests, GARCH model-Generalized Autoregressive Conditional Heteroscedasticity (GARCH 1,1). For the purpose, Eviews 11 statistical software was used.

Descriptive Statistics : The summary statistics include measures of central tendency (mean and median) and variability measures (maximum and minimum values, standard deviation, skewness and kurtosis). In order to have a better insight of movement of stock market and of independent variables, time plots have also been captured.

Unit Root Test : The present study is based on the time series data. It is widely acknowledged that time series data exhibit a random walk behavior i.e. it is non-stationary and contains unit root. Thus, the stationarity of the data was examined. Two fundamental methods exist for examining the stationarity of the data. One approach is to infer the stationarity of the time series data from the time plot of the variable and another method is to check for stationarity by performing the stationarity test known as Dickey-fuller test.In the present study, stationarity of the data has been examined through Dickey-fuller test.

ARCH Test and GARCH Model : After checking for the stationarity of the data, GARCH model was estimated. The model examined the extent of impact of the independent variables on the volatility of the stock market index. The volatility has been measured using time-variability models, i.e. ARCH and GARCH models. Engle (1982) suggested the utilization of the Auto Regressive Conditional Heteroscedasticity (ARCH) process to incorporate the time-varying nature of volatility. To overcome the shortcomings of ARCH models, Generalized Autoregressive Conditional Heteroscedasticity (GARCH) models were subsequently proposed by Bollerslew (1986). There are a number of GARCH models that can be used to measure the volatility, but present study has applied GARCH (1, 1) model, that is found to have out performed other measures in measuring the extent of volatility (Hansen and Lunde, 2005). The study employed following equation to analyse the extent of impact of

independent variables on the stock market (BSE-200 index) :

$$Y_t = a_0 + a_0\, \Delta X_{1t} + a_2\, \Delta X_{2t} + e_t$$
$$\sigma_t^2 = b_0 + b e_{t-1}^2 + b_2\sigma_{t-1}^2 + b_3\Delta X_{1t} + b_4\Delta X_{2t} + V_t$$

Y_t = dependent variable (BSE 200), X_1 and X_2 are independent variables (the number of cases and deaths respectively), a_0 is constant, σ_t^2 is conditional variance, e_{t-1}^2 and σ_{t-1}^2 are ARCH and GARCH terms.

ANALYSIS AND FINDINGS

Data Description

The data presented in Table 1 provides a summary of the statistical measures for the three variables analyzed in this study: the BSE 200 index, the number of COVID-19 cases, and fatalities due to COVID-19. It can be inferred from the Table that between 30th January and 30th June, 2020, the average stock price was around 4223, and maximum and minimum prices were 5138 and 3209 respectively. On the other hand, over the respective period, average number of COVID-19 cases were 94898 and on an average, there were 2885 deaths. The kurtosis value for BSE 200 index is less than 3, meaning thereby that the prices follow mesokurtic distribution. In other words, it indicates moderate level of changes in the prices. While kurtosis value forthenumber of COVID-19 cases and fatalities due to COVID-19 is slightly more than three, meaning thereby that these variable follow leptokurtic distribution. In other words, it indicates relatively higher level of risk, i.e. there is a higher likelihood of anrise in the count of COVID-19 infections and deaths.

Table 1
Descriptive Statistics

	BSE 200	No.of COVID-19 Cases in India	COVID-19 related Deaths Count
Mean	4222.948	94897.93	2884.716
Median	4149.315	13297.00	436.0000
Maximum	5137.840	566840.0	16893.00
Minimum	3208.620	1.000000	0.000000
Std. Dev.	521.1472	147121.6	4512.142
Skewness	0.409591	1.628278	1.697531
Kurtosis	2.080497	4.577213	4.795711

Time Series Analysis Using Plots

The time plot figures shows the trend of the dependent and independent variables over the period under study. Figure 1 portrays the time plot of BSE 200 from 30th January 2020 to 30th June 2020. After the first reported case of COVID-19 on January 30th, 2020, the index started declining and over the respective period, it was lowest on 23rd March when a sudden jump was observed in number of COVID-19 cases and fatalities due to COVID-19. Post 23rd March, the index followed a fluctuating trend. Similarly, log returns also revealed the same trend (see Figure 2).

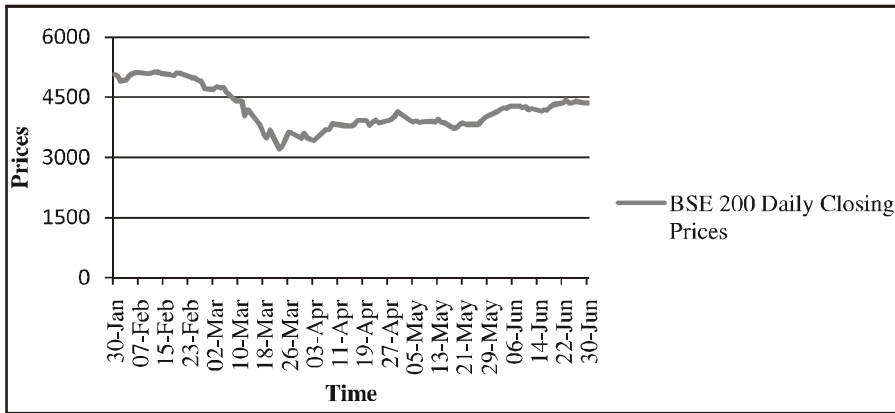**Figure 1**
Time Plot of BSE 200 Stock Prices

Figure 2
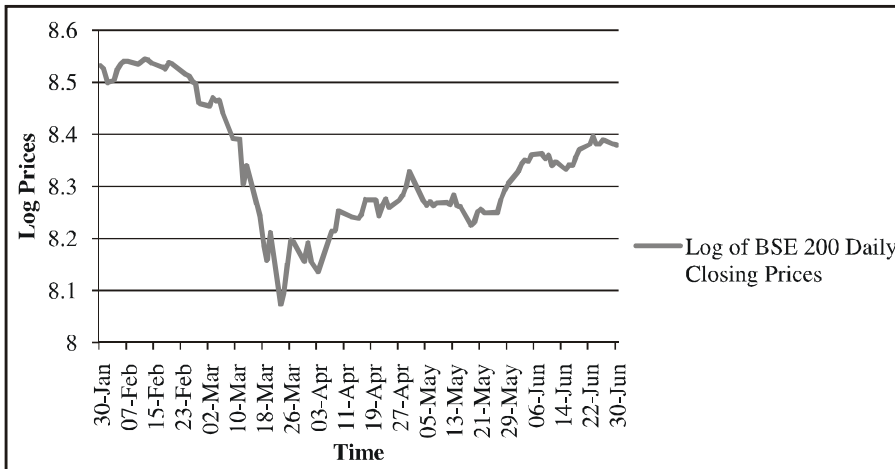**Time Plot of BSE 200 Log Stock Prices**

Figure 3 and Figure 4 depict the trend for confirmed cases and death cases from January 30th, 2020 to June 30th, 2020. The trend shows that after remaining constant for some period, both the variables followed a continuous increasing trend from April 2020. On the other hand, relative to movement of BSE 200 index, variables followed opposite movement upto mid of March. This suggests negative relation between the variables. In other words, with the outbreak of disease, the index continued falling with the passage of time while the infection was spreading and cases were increasing. After 23rd March 2020, index followed rapid ups and downs.

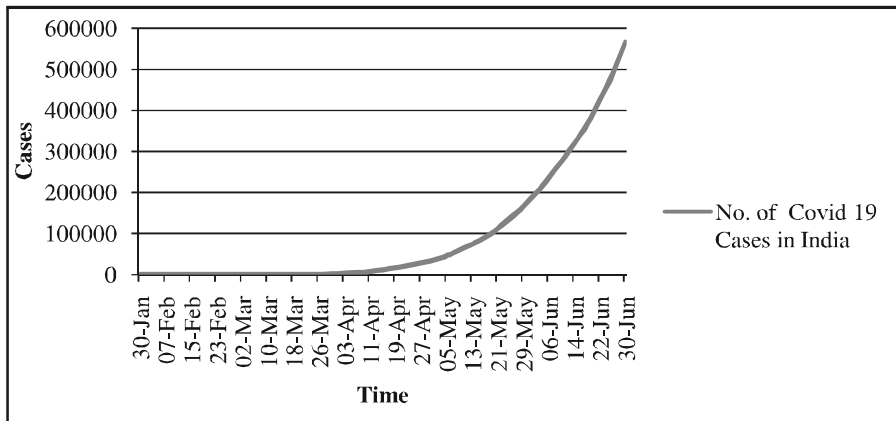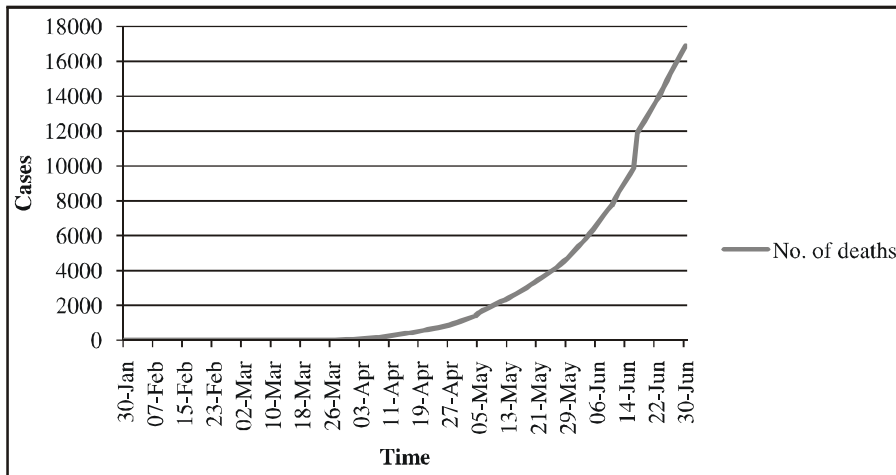**Figure 3**
Daily Confirmed Cases of COVID-19

Figure 4
Daily Death Cases of COVID-19

Unit Root Test Results

It is a pre-condition to check the stationarity of the time series data, so Dickey Fuller test for breakpoint unit root testing was applied. The outcomes of the unit root test administered on the BSE 200 index, number of COVID-19 cases, and fatalities due to COVID-19 are presented in Table 2. The results indicates that BSE 200 index variable was stationary at level as p-value is less than the significance level of 0.05, but the other two

Table 2
Unit Root Test Result

Series		ADF Unit Root Test Statistics With Trend and Intercept
BSE 200	**At Level**	-5.21 (0.04)**
Covid 19 cases	**At Level**	-3.27(0.09)
	At First Difference	-11.73 (0.01)**
No. of deaths	**At Level**	-3.62(0.75)
	At First Difference	-13.42 (0.01)**

Source : Compiled with EViews11 Software

Figure 5
Dickey-Fuller t-statistics
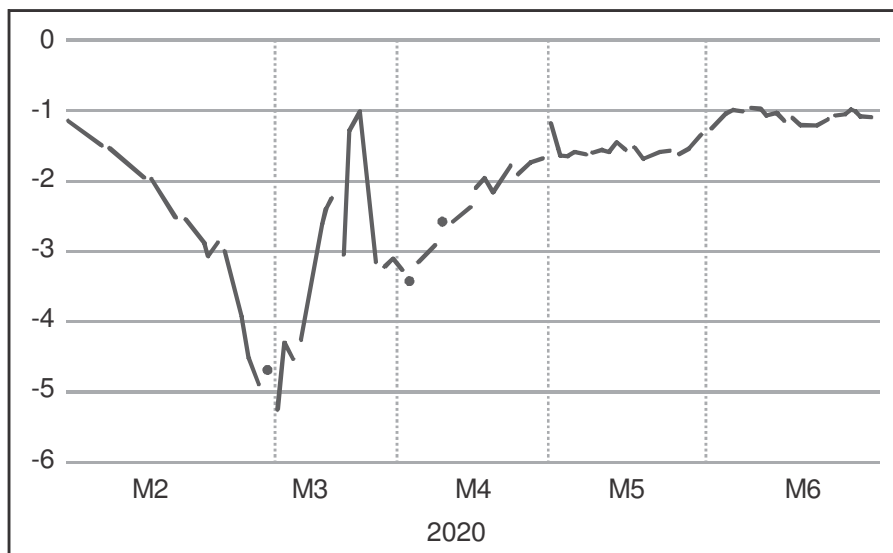
independent variables (number of COVID-19 cases, and fatalities due to COVID-19) were statistically significant at 1st order of differencing. Figure 5 portrays the breakpoint in the data on 11th March, 2020. It indicates that a sudden rise in the COVID-19 cases may have brought a fear in the mind of the investors regarding the announcement of lockdown in the economy that had led to shock in the stock market.

ARCH-GARCH Model Results

To examine the impact of number of COVID-19 cases and fatalities due to COVID-19 on the volatility of BSE 200 index, ARCH-GARCH model was applied. For this, all the independent variables were taken on both sides of the equations i.e. in mean equation, to study of impact on values of BSE 200 index and in the variance regressors, to measure the impact of variables on the volatility of index. Firstly, ARCH(1) model was applied, which came out to be significant at 10 percent level of significance. But, in order to test for the presence of conditional volatility, GARCH model was applied. While estimating GARCH model, one has to test the model of ARCH-GARCH items. In this process, it has been noticed that constant value in the mean equation is positive as well as statistically significant, as the p-value is less than 0.05. Further, in the variance equation, ARCH (1) and GARCH (1) items were also found to be statistically significant, but, all the higher order terms were statistically insignificant. Moreover, higher sum of ARCH and GARCH $(\alpha + \beta)$ items implies 'long memory'. In other words, the occurrence of any shock can result in a lasting alteration in the forthcoming values of the index.Thus, the model(GARCH 1,1) denotes conditional volatility to be present and significant in the market. The GARCH model in the following form had been estimated :

$$Y_t = a_0 + a_1 \Delta X_{1t} + a_2 \Delta X_{2t} + e_t$$
$$\sigma t^2 = b_0 + b e^2_{t-1} + b_2 \sigma_{t-1} + b_3 \Delta X_{1t} + b_4 \Delta X_{2t} + V_t$$

The estimates of the above parameters have been given in the following Table :

Table 3
Results of GARCH(1, 1) Model

Dependent Variable : BSE_200_DAILY_CLOSING_PRICES				
Method : ML ARCH - Normal distribution (BFGS/Marquardt steps)				
Sample (adjusted) : 1/31/2020 6/30/2020				
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1) + C(7)				
*D(NO__OF__COVID_19_CASES_IN_INDIA) + C(8)				
*D(NO__OF_DEATHS)				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**Prob.**
C	8.347612	0.005942	1404.794	0.0000*
D(NO__OF__COVID_19_CASES_IN_INDIA)	0.057520	0.062878	0.914778	0.3603
D(NO__OF_DEATHS)	-0.234094	0.053363	-4.386805	0.0000*
Variance Equations				
C	-0.000289	0.000260	-1.113541	0.2655
RESID(-1)^2	0.422192	0.170634	2.474251	0.0134**
GARCH(-1)	0.583961	0.078185	7.468955	0.0000**
D(NO__OF__COVID_19_CASES_IN_INDIA)	-0.003001	0.003777	-0.794515	0.4269
D(NO__OF_DEATHS)	0.006644	0.005330	1.246678	0.2125
R-squared	0.198317			
Adjusted R-squared	0.181956			

Source : Compiled with EViews11 Software

It is evident from the Table 3 that deaths due to COVID-19 cases are negatively and significantly affecting the value of BSE 200 index. Further, the GARCH and ARCH terms are statistically significant while the impacts of number of COVID-19 cases and fatalities due to COVID-19 are statistically insignificant in variance equations. Hence, it can be concluded that though COVID-19 pandemic is adversely affecting the value of BSE 200 index through number of deaths but impact is not sound enough to influence the volatility of BSE 200 index.

CONCLUSION AND LIMITATIONS

The stock markets are considered as the true reflectors of the state of economies. The spread of pandemic across a number of countries brought a fear

in the mind of investors about its significant impact on the economies. Accordingly, it was important to study the effect of the pandemic on the movements of the stock markets. Though the impact was depictable from Chinese stock markets, but in India, the effect on the stock markets was reflected in the month of March, when the stock market registered a lowest trend since 2016. But after that it registered ups and downs, similar to movements of a roller coaster. This was evidenced from the empirical analysis too. In order to investigate the impact of the variables on the stock market, GARCH model was applied. GARCH model was used to examine the impact of the number of COVID-19 cases and fatalities due to COVID-19 on the volatility of the stock market index. Results revealed that both the ARCH-GARCH terms were statistically significant, thus the model was found to be significant. The results of the model indicated that though fatalities due to COVID-19 had an impact on the values of the index, but no significant impact was observed from both the variables on the volatility of the index. This may be due to a number of measures taken by the government, for instance, announcement of lockdown to control the pandemic, infusion of liquidity into the economy by RBI etc.

The present study has some limitations too. Firstly, it was conducted to see the immediate effect of COVID-19 pandemic on the Indian stock market. Thus, the study period spanned from the date when first case was reported in India to the time when the present study was conducted. Secondly, the impact was examined only on Indian stock market. A broader review of the impact could be made considering the stock markets of most affected countries also. Thirdly, the present study considered one particular index of the stock market. A deeper impact can be studied by including sectorial indices of the stock market index also.

References

Adenomon, M. O.; Maijamaa, B.; and John, D .O. (2020), On the Effects of COVID-19 Outbreak on the Nigerian Stock Exchange Performance: Evidence from GARCH Models, doi : 10.20944/preprints202004.0444.v1.

Alam, M. N.; Alam, M. S.; and Chavali, K. (2020), Stock Market Response during COVID-19 Lockdown Period in India : An Event Study, *The Journal of Asian Finance, Economics and Business*, 7(7), 131-137, doi: 10.13106/jafeb.2020.vol7.no7.131.

Al-Awadhi, A.; Alsaifi, K.; Al-Awadhi, A.; and Alhammadi, S. (2020), Death and Contagious Infectious Diseases : Impact of the COVID-19 Virus on Stock

Market Returns, *Journal of Behavioural and Experimental Finance,* 27, doi : 10.1016/j.jbef.2020.100326.

Ali, M.; Alam, N.; and Rizvi, S.A. (2020), Coronavirus (COVID-19) - An Epidemic or Pandemic for Financial Markets, *Journal of Behavioural and Experimental Finance,* 27, 1-6, doi : 10.1016/j.jbef.2020.100341.

Aravind, M.; and Manoj Krishnan, C.G. (2020), COVID-19 : Effect on Leading Pharmaceutical Stocks Listed with NSE, *International Journal of Research in Pharmaceutical Sciences,* 11, 31-36, doi : 10.26452/ijrps.v11iSPL1.2014.

Ashraf, B. N. (2020), Stock Markets' Reaction to Covid-19 : Cases or Fatalities? *Research in International Business and Finance,* 54, 1-7, doi : 10.1016/j.ribaf.2020.101249.

Bahlini, R.; and Filfilan, A. (2020), Impact of the Novel Coronavirus on Stock Market Returns : Evidence from GCC Countries*, Quantitative Finance and Economics,* 4(4), 640-652, doi : 10.3934/QFE.2020029.

Baker, Scott R.; Bloom, N.; Davis, S. J.; Kost, K.; Sammon, M.; and Viratyosin, T. (2020), The Unprecedented Stock Market Impact of Covid-19, NBER Working Paper No. w26945.

Bollerslev, T. (1986), Generalized Autoregressive Conditional Heteroskedasticity, *Journal of Econometrics,* 31(3), 307-327.

Chaudhary, R.; Bakhshi, P.; and Gupta, H. (2020), Volatility in International Stock Markets : An Empirical Study during COVID-19, *Journal of Risk and Financial Management,* 13(9), 1-17, https://doi.org/10.3390/jrfm13090208.

Engle, R. F. (1982), Autoregressive Conditional Heteroskedasticity with Estimates of the Variance of United Kingdom Inflation, *Econometrica.*

Engle, R. F.; and Bollerslew, T. (1986), Modelling the Persistence of Conditional Variances, *Econometric Reviews*.

Gates, B. (2020), Responding to Covid-19 – A Once-in-a-Century Pandemic?, *The New England Journal of Medicine,* 382(18), 1677-1679, doi : 10.1056/NEJMp2003762.

Goodell, J. W. (2020), COVID-19 and Finance : Agendas for Future Research, *Finance Research Letters,* 35, 1-5, doi : org: 10.1016/j.frl.2020.101512.

Guru, B. K.; and Das, A. (2020), COVID-19 and Uncertainty Spillovers in Indian Stock Market, *MethodsX,* 8, 101199. https://doi.org/10.1016/j.mex.2020.101199

Hansen, P. R.; and Lunde, A. (2005), A Forecast Comparison of Volatility Models : Does Anything Beat A Garch(1,1)?, *Journal of Applied Econometrics*, 20(7), 873–889.

He, P.; Niu, H.; Sun, Z.; and Li, T. (2020), Accounting Index of COVID-19 Impact on Chinese Industries : A Case Study Using Big Data Portrait Analysis, *Emerging Markets Finance and Trade,* 56(10), 2332-2349, https://doi.org/10.1080/1540496X.2020.1785866

He, P.; Sun, Y.; Zhang, Y.; and Li, T. (2020), COVID–19's Impact on Stock Prices Across Different Sectors – An Event Study Based on the Chinese Stock Market, *Emerging Markets Finance and Trade,* 56(10), 2198-2212, doi : /10.1080/ 1540496X.2020.1785865.

Ibrahim N. K.; Mohammad, B. H.; and Mohammed, N. A.-A. (2020), The Impact of COVID-19 Pandemic on Global Stock Markets : An Event Study, *International Journal of Economics and Business Administration,* VIII(4), 505-514, doi : 10.35808/ijeba/602.

Iyke, B. N. (2020), Economic Policy Uncertainty in Times of COVID-19 Pandemic, *Asian Econ. Lett.,* (2), 1. https://doi.org/10.46557/001c.17665

Kalyani, P.; and Rani, T. S. (2020), The Implications of COVID 19 on Stock Prices of Select Sectors – Empirical Evidence from India, *Journal of Critical Reviews,* 7(11), 3595-3605.

Karamat, K.; Huawei, Z.; Han, Z.; Huilin, Y.; Muhammad, H. S.; and Atif, J. (2020), The Impact of COVID-19 Pandemic on Stock Markets : An Empirical Analysis of World Major Stock Indices, *Journal of Asian Finance, Economics and Business,* 7(7), 463–474.

Khan, K.; Zhao, H.; Zhang, H.; Yang, H.; Shah, M. H.; and Jahanger, A. (2020), The Impact of COVID-19 Pandemic on Stock Markets : An Empirical Analysis of World Major Stock Indices, *Journal of Asian Finance, Economics and Business*, 7(7), 463-474, https://doi.org/10.13106/jafeb.2020.vol7.no7.463.

Lee, K., Y-M.; Jais, M.; and Chan, C-W. (2020), Impact of COVID-19 : Evidence from Malaysian Stock Market, *International Journal of Business and Society,* 21(2), 607-628.

Liu, H. Y.; Manzoor, A.; Wang, C.; Zhang, L.; and Manzoor, Z. (2020), The COVID-19 Outbreak and Affected Countries Stock Markets Response, *International Journal of Environmental Research and Public Health*, 17, 1-19, doi : 10.3390/ ijerph17082800.

Lu, X.-F.; and Lai, K.-K. (2012), Relationship between Stock Indices and Investors' Sentiment Index in Chinese Financial Market, *System engineering Theory and Practice,* 32(3), 621–629.

Machmuddah, Z.; Utomo, S. D.; Suhartono, E.; Ali, S.; and Ghulam, W. A. (2020), Stock Market Reaction to COVID-19 : Evidence in Customer Goods Sector with the Implication for Open Innovation, *Journal of Open Innovation : Technology, Market, and Complexity*, 6(4), 1-13. doi: 10.3390/joitmc6040099.

Mazur, M.; Dang, M.; and Vega, M. (2020), COVID-19 and the March 2020 Stock Market Crash, Evidence from S&P 1500*, Finance Research Letters,* 1-8, doi : 10.1016/j.frl.2020.101690.

Okorie, D. I.; and Lin, B. (2020), Stock Markets and the Covid-19 Fractal Contagion Effects, *Finance Research Letters,* doi : 10.1016/j.frl.2020.101640.

Onali, E. (2020), Covid-19 and Stock Market Volatility, doi : 10.2139/ssrn.3571453.

Pavlyshenko, B. M. (2020), Regression Approach for Modeling Covid-19 Spread and Its Impact on Stock Market, arXiv:2004.01489.

Qing, H.; Junyi, L.; Sizhu, W.; and Jishuang, Y. (2020), The Impact of COVID-19 on Stock Markets, *Economic and Political Studies*, 8(3), 275-288, doi : 10.1080/20954816.2020.1757570.

Ramelli, S.; and Wagner, A. F. (2020), Feverish Stock Price Reactions to COVID-19, *Forthcoming, Review of Corporate Finance Studies*, Swiss Finance Institute Research Paper No. 20-12, doi : 10.2139/ssrn.3550274.

Salisu, A. A.; and Xuan V. V. (2020), Predicting Stock Returns in the Presence of COVID-19 Pandemic : The Role of Health News, *International Review of Financial Analysis*, 71, doi : 10.1016/j.irfa.2020.101546.

Sansa, N.; and Hasan, A. (2020), The Impact of the Covid-19 on the Financial Markets : Evidence from China and USA, doi : 10.2139/ssrn.3562530.

Shehzad, K.; Xiaoxing, L.; and Kazouz, H. (2020), COVID-19's Disasters are Perilous than Global Financial Crisis : A Rumor or Fact?, *Finance Research Letters*, doi : 10.1016/j.frl.2020.101669.

Sinaga, J.; Wu, T.; and Chen, Y. W. (2022), Impact of Government Interventions on the Stock Market during COVID-19 : A Case Study in Indonesia, *SN Business & Economics*, 2(9), 136. https://doi.org/10.1007/s43546-022-00312-4

Stock Market Response during Covid-19 Lockdown Period in India : An Event Study, *Journal of Asian Finance Economics and Business,* 7(7), 131-137, doi : 10.13106/jafeb.2020.vol7.no7.131

Thakur, S. (2020), Effect of Covid 19 on Capital Market with Reference to S&P 500, *International Journal of Advanced Research,* 8(6), 1180-1188, doi : 10.21474/IJAR01/11203.

World Bank, 2020, Global Economic Prospects, June 2020, Washington, DC : World Bank, © World Bank, https://openknowledge.worldbank.org/handle/10986/33748 License: CC BY 3.0 IGO.

Zaremba, A.; Kizys, R.; Aharon, D. Y.; and Demir, E. (2020), Infected Markets; Novel Coronavirus, Government Interventions, and Stock Return Volatility Around the Globe, *Finance Research Letters,* 35, doi : 10.1016/j.frl.2020.101597.

Zhang, D.; Hu, M.; and Ji, Q. (2020), Financial Markets under the Global Pandemic of COVID-19, *Finance Research Letters,* 1-6, doi : 10.1016/j.frl.2020.101528.