Indian Stock Market's Response in Five - Phases to the COVID-19 Pandemic

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Abstract

The Covid-19 pandemic has affected the health as well as the financial and economic well-being of India and the world from the beginning of the year 2020. This research committed to investigate the response of critical indices in BSE and NSE to the Covid-19 pandemic in India and also its impact on five sectorial indices on S&P BSE Sensex. This research examined and analyzed the daily closing prices of stock indices in five identified phases in the year 2020 (272 days of trading). Moving average method of stock volatility measurement was used to analyze market data in the five - phases to capture the volatility and present in a formal manner. This study took into consideration the entire time span of the Covid-19 pandemic from its onset until the end of the first wave to witness the true nature of volatility in stock prices and graphically represented the instability that existed throughout the year 2020. After careful analysis, the findings showed that just as fast the Indian stock market experienced a situation of high panic during the onset with high volatility, it recovered from instability with reduced volatility as pre-Covid conditions in the later phases and also surged to cross the 50,000 mark in the shortest time by February 2021.

Keywords : **BSE sensex, Covid-19, India, lockdown, moving average, NSE, stock prices, volatility**

JEL Classification Codes : G01, G12, G14

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The year 2020 was marked with the biggest wildly spread global pandemic since the 1920s – the life-threatening novel Coronavirus or Covid-19. The SARS-Cov-2 virus, which is the cause of the Covid-19 pandemic, was traced back to Wuhan City in the Hubei province of China, which is being investigated as the ground zero of the outbreak in December of 2019, and was officially declared by the World Health Organization (WHO) as a death-dealing virus on February 11, 2020. On March 11, 2020 with over 118,000 active cases and nearly 43,000 lives taken globally by the virus, WHO declared the outbreak as a global pandemic. It is not only a global public health crisis, but a crisis which has affected all the sectors of countries and has had crippled their functioning in all aspects.

On January 30, 2020, India had its first Covid - 19 affected patient in Thrissur district of Kerala. The first phase of the nationwide lockdown was announced by the Indian Prime Minister, Shri Narendra Modi from March 25 onwards with the cases reaching 606 with 10 deaths throughout the country. The second phase commenced from April 15 with 11,933 affected and 392 deaths. The Economist Intelligence Unit had ranked India 10th out of 11 nations in its new Asia-Pacific Personalized Health Index, measuring the performance of "Vital Signs" which include policy context, health services, and information and personalized technologies. It is evident that India was not equipped to tackle such a global catastrophe in public health and with a plunging economy.

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On March 23, 2020, the BSE Sensex took a nosedive, taking a downfall of over 3934.72 points (13.15%), closing at 25,981. Some economists have considered the Covid-19 pandemic as a "Black-Swan Event" – referring to the discovery of the black swan which is metaphorically described as an unprecedented situation that appeared as a complete surprise. The consequence of the global pandemic was far severe than the market crash of 1992 due to Harshad Mehta Scam where the market fell by 12.77% and the 2007–2008 financial crisis ranging from 3.8% – 4.8% downfall.

The implications of the Covid-19 pandemic are being seen in the global markets with plunging oil prices due to reduced demand, global market crash, and the all-time increase in unemployment ; the Indian stock market took a massive hit around the onset of the lockdown and the entire duration of it. The panic of uncertainty upon the investors was on a global level coupled with high unpredictability. With a market capitalization of $2.16 trillion, the Indian stock market, deemed as the world's seventh largest stock exchange, had entered into a complete lockdown, shutting down all economic activities of the nation. This study is dedicated to measure and analyze the rapid response of the Indian stock market to the Covid-19 pandemic in five - phases (pre-Covid-19, onset, duration, vaccination run, and post - Covid-19) showing the causes of the drastic changes in investor sentiments.

Research Gap

The study of stock volatility during a market fluctuation due to a significant incident has been done before by numerous scholars in past literature. In the light of the Covid-19 pandemic, there are studies that have compared volatility in the Indian stock market between previous and post situations of the first wave's lockdown. However, the time period of such studies did not take into consideration the volatility that existed throughout the first wave of the pandemic. Past studies selected the time period that lasted from 3 – 6 months. It was required to analyze the closing price data for the entire length of the first wave lasting over a year to get the formalized picture of how volatility was present in accordance with the five uniquely identified phases. These phases would show the actual movement of volatility in the market with the status of the phase it is in, characterizing the nature of such fluctuations causes.

Research Problem

The Covid-19 pandemic has affected almost all aspects of the stock market being it fluctuations in volatility, volume, trade prices, etc. The past studies relating to the volatility in the Indian stock market due to the Covid-19 pandemic were restricted to a time period which did not take into consideration the entire length of the first wave. The effects of lockdown and unlocking of the economy, however, took place for a larger duration than previously studied. Thus, this research aims to show the widescale volatility in undivided full effect in the five uniquely identified phases across the entire first wave.

Literature Review

Most of the past studies are based on early stock market closing data from the year 2020. This topic has been considered for multiple empirical studies both in advanced and emerging economies alike as the impact of a pandemic in the modern medicine and economic world is an unexampled subject. The existing literature has brought about diverse results in this regard.

Bora and Basistha (2021) inferred that the stock market has experienced high volatility during the pandemic and also the return on indices in the pre-Covid-19 period was higher than the post-Covid-19 period indices, a comparison of two situations and does not include complete volatility of the year 2020. Prabheesh et al. (2020), in their findings, found a strong relationship between oil-prices and stock market returns, particularly during

March 2020, indicating contraction of future demand of oil and the associated negative returns. It indicated that the stock market had undergone rigorous volatility. Harjoto et al. (2021) revealed in their study that the global stock markets had a negative impact from the Covid-19 spread, measured from the daily percentage of new cases and mortality rate. Investors withdrew their investments based on the increased transmission of Covid-19, resulting in lower returns and high volatility. Mohania and Mainrai (2020), in their case study of National Bank, disclosed some of the difficult challenges that arose due to the Covid-19 pandemic in regards of asset quality, operations, and earnings of the bank. The study conducted with National Bank's Chief Manager revolved around the managerial challenges that they faced and dealt by formulating strategic managerial policies. The banking industry in India, however, as a whole suffered the most, as we will learn further, with regard to the stock market valuation.

Chaudhary et al. (2020) took into consideration the BSE 500 and BSE Sensex Index and also eight sectoral indices from BSE showing that the market had a lower mean daily return and a negative return during the crisis period than the pre-Covid conditions primarily using descriptive statistics. Their study was limited in the context of measure of risk present in stocks and used basic descriptive statistics as the methodology. Thomas et al. (2020) showed that the financial sector showed the highest degree of negative returns during the Covid-19 pandemic announcement and the commencement of lockdown on Nifty 50, after which the pharmaceutical sector followed. This further strengthens the fact that all sectorial indices will follow a degree of negative returns. Gupta (2020) carried out an effective comparative study of the Indian primary equity markets for the year 2018–19 and 2019–20. In the study, it was concluded that due to the onslaught of the Covid-19 pandemic, it was inevitable for SEBI to take initiatives for reforms in the markets which proved to be beneficial, but still had a sense of uncertainty for the rest of the year ending 2020. In contrast, the present study will enable us to understand the flow of such uncertainty, which eventually turned out to be positive.

Sinha et al. (2020) found that the reason Sensex and Nifty kept rising after hitting an all-time low was the positive optimism and forward-looking approach of the investors by only focusing on large corporations amid a slow economy. Singh and Neog (2020), in their study, assessed the economic impact of the Covid-19 pandemic on key indicators of a developing economy (travel and tourism, human capital stock, etc.) and provided remarks on appropriate policy measures. Rout et al. (2020) inferred from their study that all the G-20 nations experienced the highest risk in the stock market in the Covid-19 pandemic even more than the 2008 financial crisis. They also found that China was a safe zone with the minimum market risk. The study, however, had an international outlook while comparing the stock markets of the G-20 nations.

Himanshu et al. (2021), in their research, showed that due to the Covid-19 pandemic and crisis on stock markets, the investors reallocated their investment portfolios to safer, conservative, and risk-free stocks. The cause being the high degree of risk factor among stocks was the gap that this study attempts to cover. Alam et al. (2020) showed in their research that investors reacted positively during the Covid-19 lockdown in terms of positive average abnormal returns in contrast to the pre-lockdown situation where there was high uncertainty and negative ARR. Chundakkadan and Nedumparambil (2021) in their research of finding a relationship between Covid-19 pandemic searches on the Internet and investor sentiments to prove stock market volatility showed that the pandemic sentiment had triggered excess market volatility. Okorie and Lin (2021) inferred from their study of adaptive market efficiency in the market index of the top four worst affected economies by Covid-19 showed that India became more information inefficient in the long-term of the outbreak. However, we find that the stock market surged rapidly post the first wave of Covid-19, thus reasoning the measure of volatility as an indicator of future predictions.

Mittal and Sharma (2021) indicated through their study of the healthcare and pharmaceutical sector during Covid-19 pandemic that investors were continuously pouring money, and it was anticipated that this sector would benefit in this healthcare crisis. Guru and Das (2021) studied the volatility spillovers across markets and firms in the Covid-19 pandemic, and discovered that all the sectors except manufacturing showed high volatility,

and the major contributor was energy sector followed by oil and gas. Tripathi and Pandey (2021) examined the information dissemination during the Covid-19 pandemic spread and effect on market volatility and revealed that information from non-systematic sources had plunged the prices of indices and increased the volatility.

Aslam et al. (2020), using a complex network method, studied 56 global market indices including BSE Sensex and found that there was a structural change during the Covid-19 pandemic in the form of node change and reduced connectivity. It was also found that the number of positive correlations among the 56 indices increased during the outbreak.

Objectives of the Study

- To analyze the effect of Covid-19 on S&P BSE Sensex and NSE Nifty indices.
- To study the predictability indicators of the Indian stock market in the five periods identified.
- To analyze the impact of Covid-19 on Banking, FMCG, and Healthcare index of S&P BSE Sensex.

Research Methodology

The study is based on secondary sources of data. For the topic considering the volatility study of stocks, the daily closing prices of BSE Sensex, BSE Bankex, BSE FMCG, BSE Healthcare, and NSE Nifty 50 were collected from the official websites of BSE and NSE. The data collected were from January 1, 2020 to January 31, 2021. The total days of trading considered are 272 days for all the indices, covering a time period of 1 year and 1 month.

The five periods identified are :

(1) From January 1, 2002 – February 29, 2020.

(2) From March 1, 2020 – March 31, 2020.

(3) From April 1, 2020 – June 30, 2020.

(4) From July 1, 2020 – September 30, 2020.

(5) From October 1, 2020 – January 31, 2021.

Specific reasons contribute to the identification of the above time phases. The first phase is the condition of the market during the onset of Covid-19 in the international markets and the first ever case identified in India, indicating the entry of the pandemic in India. The second phase is crucial to the study as it based upon the announcement by WHO declaring Covid-19 a pandemic on March 11 and the beginning of the 21- day lockdown announced by the Prime Minister and also marking the lowest point of BSE and NSE on March 23, 2020. This lowest point is indicated on all the data and findings of the study.

The third phase is identified based on the ending of the 21-day lockdown and further extension of it with more strict restrictions and with almost all economic activities brought to a halt to prevent further spread of the virus. The lockdown ended on June 1, commencing the Unlock 1, issuing fresh guidelines to open areas with an economic focus and lockdown restrictions only in highly containment zones.

The fourth phase is identified based on the gradual unlocking of the economy with offices and factories opening with 100% attendance and gatherings allowed till 100 people. Businesses like shopping malls and cinema halls began to open. In September 2020, the Federal Science Minister of India announced the availability of the first vaccine from the first quarter of 2021.

The fifth phase is also crucial for the study, showing the positivity among the investors for the future prospects of the Indian market with availability of the first Covid-19 vaccine of AstraZeneca marketed as Covishield and the market overcoming the volatility of the pandemic, coming back to the levels of the first phase.

The returns of the Index from the closing prices are calculated by taking the natural logarithm of the daily prices and deducting the previous day's price. The formula used is as follows :

$$Return = \text{LN}(Price_t) - \text{LN}(Price_{t-1}) \quad \text{..... (1)}$$

Here, LN is the natural logarithm, $Price_t$ is the present-day closing price, and $Price_{t-1}$ is the previous day's closing price. The natural logarithm is taken for each closing price to reduce the skewness in the closing price data distribution.

The descriptive statistics of the closing price and the returns are calculated and presented to analyze the relationship of skewness and kurtosis.

To analyze the daily volatility of the five-phases, the moving average method is used to calculate the standard deviations of the returns and show the level of volatility that has spanned in the five - phases. We use the formula,

$$Daily\ Volatility = SQRT(Average\ Squared\ Returns) \quad \text{.....(2)}$$

Applying the above formula, we get the daily volatility of the five-phases of the five stocks indices and then analyze the data visually and empirically to see the changes in volatility level through the Covid-19 pandemic, thus giving a glance of the stock market's response to the same.

The moving average method is used for the stock analysis as it is the most common approach for stock volatility analysis and helps to smooth out the closing price data over a long period and impacts of the short-term fluctuations are alleviated. It is also the most customizable indicator that an investor can apply on any time period analysis. It is the consistency that pertains with the predictions of volatility that makes it a popular indicator amongst investors.

The Bombay Stock Exchange Sensitive Index, popularly known as the BSE Sensex, is the free float weighted stock market index which constitutes of 30 renowned companies that represent the important industrial sectors of the Indian economy. It is considered as one of the important indices in the BSE and is indicative of the concurrent changes in the Indian economy. BSE is the 10th largest stock exchange in the world with $ 2.19 trillion market capitalization and $1.7 trillion valuation as of July 2020. The National Stock Exchange or NSE is another free float weighted stock market index in India and is the world's 11th largest government owned stock exchange with a market capitalization of $ 2.1 trillion. NSE Nifty 50 is the stock index constituting 50 large Indian companies, representing their weighted average.

BSE Bankex is the index constituting the companies related to banking industry in the country, and it constitutes of 10 bank stocks traded on the Bombay Stock Exchange. BSE Healthcare is an index constituting of 68 pharmaceutical and healthcare companies instituted in India and traded on the Bombay Stock Exchange. The BSE FMCG has 72 stocks of the fast-moving consumer goods sector of India that are well established.

For the technical analysis, the closing price of the stock index was taken, which is readily available and is used for the calculation of volatility.

The measure of volatility of a stock states the condition of the stock that it has undergone during that time-frame. It is simply the measure of risk or uncertainty related to the stock. The relationship of volatility and risk is directly proportional to each other, that is,

The higher the volatility = The higher the risk of a stock

A higher volatility means that the price of the stock index can spread out over a large range of values and can change swiftly at either lower or higher values. Highly volatile stocks can be affected significantly by any market fluctuation.

The effect of the Covid-19 pandemic on the Indian economy made the investors weary and tensed about

the growth of their stock portfolios. With a market capitalization of more than $2.19 trillion in the BSE Sensex alone, the investors entered into frenzy when the future started looking uncertain. In this study, the measure of volatility will help in figuring out the effect of such acts of investors throughout the year 2020.

Data

The data used for the study are from secondary sources and from the official websites of Bombay Stock Exchange (BSE) and National Stock Exchange (NSE). The indices taken in consideration for the study are based upon their importance in the stock market and the volume of investors dealing with it. The indices taken are :

(1) S&P BSE Sensex

(2) NSE Nifty 50

(3) S&P BSE Bankex

(4) S&P BSE Healthcare

(5) S&P BSE FMCG

The historical indices were available in CVS or Excel format. The data taken were the opening and closing stock prices from January 1, 2020 till January 31, 2021. The days of trading are total of 272 days for all the indices. This data are further analyzed with the aforementioned research methodology to find certain results to ascertain the stock market's response to the Covid-19 pandemic.

This research paper covers the time period of the first wave of the Covid-19 pandemic, that is, between 1/01/2020 to 31/01/2021, with trading days of 272 days. The secondary data were collected from the official website of BSE and NSE accessible as https://www.bseindia.com/indices/IndexArchiveData.html and https://www1.nseindia.com/products/content/equities/indices/historical_index_data.htm, respectively. The data for the duration of lockdowns and the number of Covid-19 affected cases were collected from the official website of Ministry of Health and Welfare, Government of India accessible as https://mohfw.gov.in/.

Analysis and Results

From Figures 1 – 5, we can see that March 23, 2020, which is indicted by the lowest point in the time plot,

Figure 1. ***Time Plot of BSE Sensex – Indicates the Plotting of Closing Prices of BSE Sensex from January 1, 2020 – January 31, 2021***

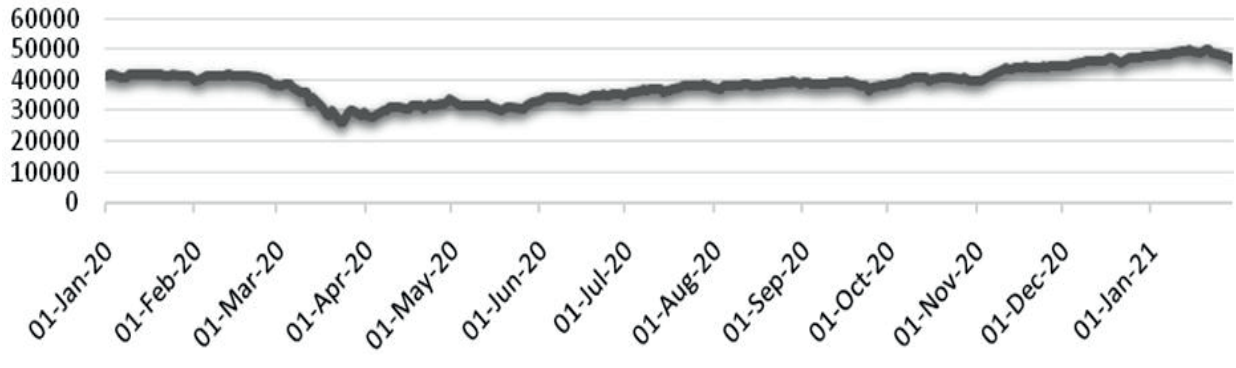


Figure 2. ***Time Plot of NSE Nifty 50 – Indicates the Plotting of Closing Prices of NSE Nifty – 50 from January 1, 2020 – January 31, 2021***

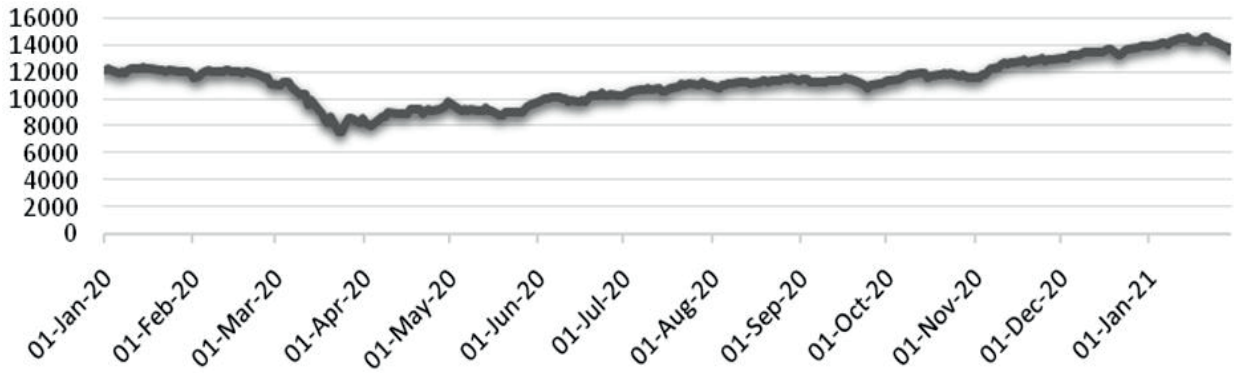


Figure 3. ***Time Plot of BSE Bankex – Indicates the Plotting of Closing Prices of BSE Bankex from January 1, 2020 – January 31, 2021***

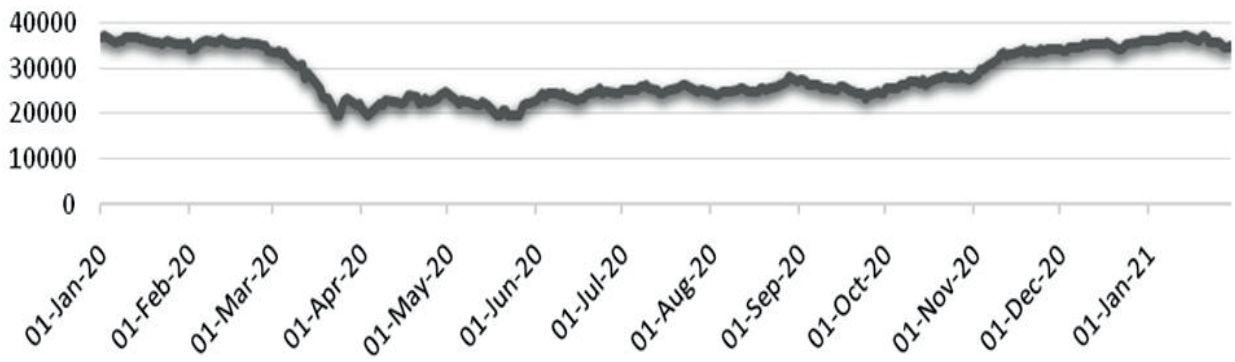


Figure 4. ***Time Plot of BSE Healthcare – Indicates the Plotting of Closing Prices of BSE Healthcare from January 1, 2020 – January 31, 2021***

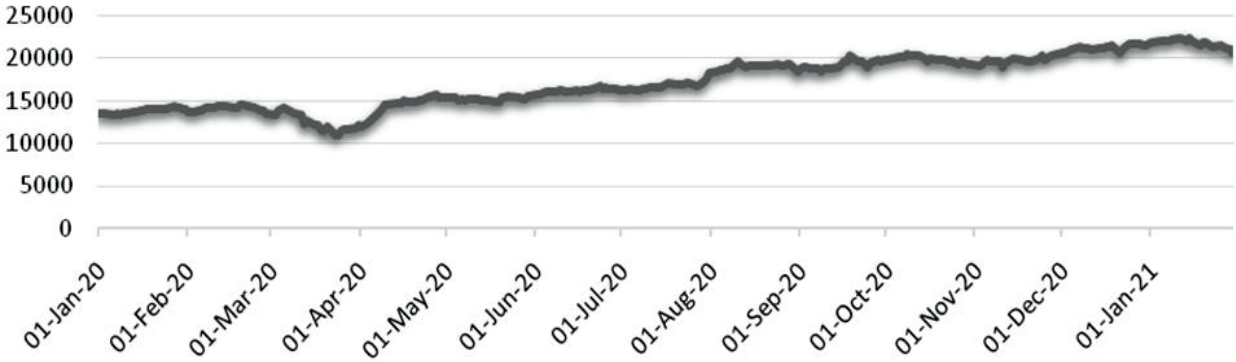
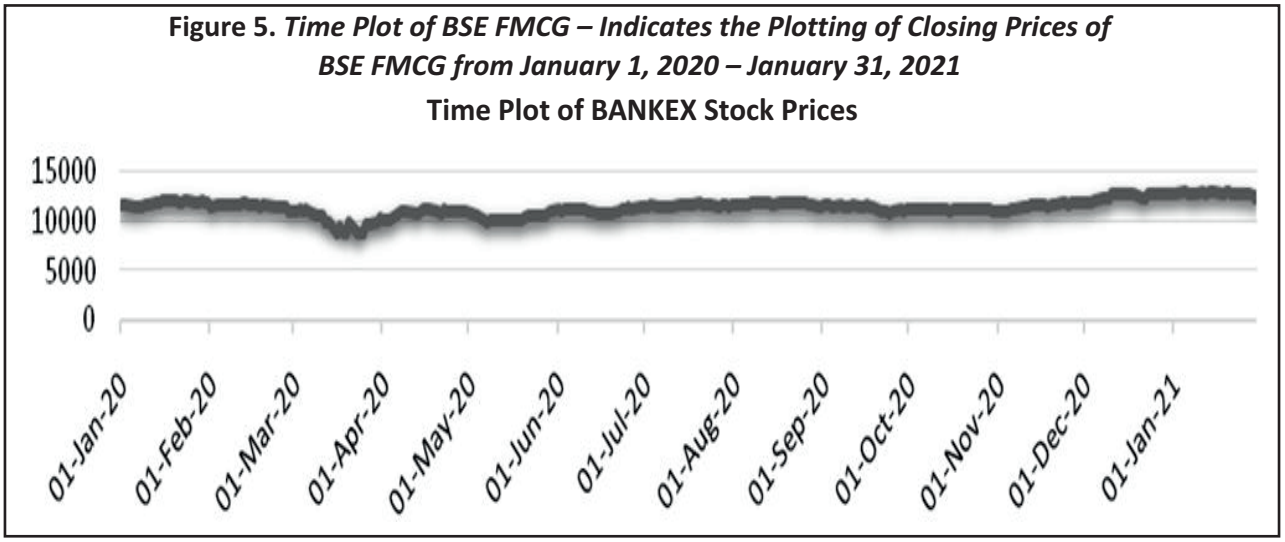


Figure 5. ***Time Plot of BSE FMCG – Indicates the Plotting of Closing Prices of BSE FMCG from January 1, 2020 – January 31, 2021***



was a black day for the Indian stock market, showing the lowest ever closing price in the history of both NSE and BSE. This indicates the level of panic among the investors coupled with aggressive decisions to either go short or switch to less risky form of investments. The technical aspect of the trends will be discussed under the following paragraphs.

In this study, we use the daily closing prices of BSE and NSE, which are the foundation of the study and the goal is to analyze the prices according to the method mentioned. First, we observe the descriptive statistics of the closing prices of the five stocks taken throughout the timeline from January 1, 2020 to January 31, 2021.

Tables 1–3 show the descriptive statistics of the five stock indices calculated from their closing price and from the returns calculated from the closing prices mentioned in the formula (1) in the methodology. The mean return of the overall timeline does not show a negative return, thus does not indicate a loss taking place by investing in stocks, except in the case of BSE Bankex showing a negative mean return. Further, a negative skewness in all the

Table 1. ***Descriptive Statistics of BSE Sensex and NSE Nifty from January 1, 2020 – January 31, 2021***

	BSE SENSEX		NSE NIFTY 50	
	Closing Prices	**Returns**	**Closing Prices**	**Returns**
Mean	38750.48673	0.000420023	11391.11654	0.000415536
Standard Error	327.1204208	0.001206243	96.19143651	0.001181971
Median	38842.1	0.002427693	11465.45	0.002294306
Standard Deviation	5395.00819	0.019857263	1586.429812	0.019457698
Sample Variance	29106113.37	0.000394311	2516759.549	0.000378602
Kurtosis	–0.530376591	12.99891196	–0.494164517	13.20671779
Skewness	–0.006293139	–1.69104679	–0.043674541	–1.757396449
Range	23810.88	0.226964767	7034.45	0.223040448
Minimum	25981.24	–0.141017378	7610.25	–0.139037542
Maximum	49792.12	0.085947389	14644.7	0.084002906
Sum	10540132.39	0.113826318	3098383.7	0.112610184
Count	272	271	272	271

Table 2. ***Descriptive Statistics of BSE Bankex and BSE Healthcare from January 1, 2020 – January 31, 2021***

	BSE BANKEX		BSE HEALTHCARE	
	Closing Prices	**Returns**	**Closing Prices**	**Returns**
Mean	28633.69772	–0.000198096	17261.17857	0.001574289
Standard Error	329.9353091	0.001644082	181.1974053	0.001019387
Median	26541.73	0.001815276	16897.975	0.001841096
Standard Deviation	5441.432515	0.027064998	2988.384164	0.016781232
Sample Variance	29609187.82	0.000732514	8930439.91	0.00028161
Kurtosis	–1.530411639	9.252386417	–1.195993012	7.530835916
Skewness	0.220766396	–1.35600887	–0.083603655	–0.643876237
Range	17620.74	0.285698426	11374.44	0.172181385
Minimum	19355.42	–0.1840064	11007.36	–0.086485452
Maximum	36976.16	0.101692026	22381.8	0.085695933
Sum	7788365.78	–0.053684101	4695040.57	0.426632401
Count	272	271	272	271

Table 3. ***Descriptive Statistics of BSE FMCG from January 1, 2020 – January 31, 2021***

	BSE FMCG	
	Closing Prices	**Returns**
Mean	11305.53287	0.000235612
Standard Error	47.44014096	0.000982207
Median	11375.615	0.000964987
Standard Deviation	782.4028484	0.016169161
Sample Variance	612154.2171	0.000261442
Kurtosis	0.916924243	13.66711155
Skewness	–0.460216841	–0.621601075
Range	4165.49	0.189226928
Minimum	8672.18	–0.110070824
Maximum	12837.67	0.079156104
Sum	3075104.94	0.063850824
Count	272	271

stocks with a high calculated kurtosis indicates that there is a chance of high losses. Negative skewness highlights any Black Swan Event or an unprecedented situation, which the market is dealing with now.

We further study the descriptive analysis of the returns of the five - phases identified and analyze the data further.

From Table 4, we can identify that Phase-2 has the highest negative mean value, showing the level of losses the stocks were making for that time period. In Phase-5, we can see that mean return recovered from the negative and took the normal market level conditions.

Tables 4 – 8 show the descriptive statistics being analyzed on each stock according to the phases identified. In all the tables, the mean returns in the Phase-2 show the highest negativity, indicating the phase being the most loss

Table 4. ***Descriptive Statistics of BSE Sensex in Five Uniquely Identified Phases***

	BSE Sensex Phase-1	BSE Sensex Phase-2	BSE Sensex Phase-3	BSE Sensex Phase-4	BSE Sensex Phase-5
	Returns	Returns	Returns	Returns	Returns
Mean	–0.00093921	–0.012478932	0.00287488	0.001309587	0.002354968
Standard Error	0.001408635	0.011395361	0.002860216	0.001293181	0.001070826
Median	–0.002034363	–0.004390061	0.005157454	0.001359162	0.004156957
Standard Deviation	0.009019664	0.052220106	0.021969738	0.01050585	0.009755689
Sample Variance	8.13543E-05	0.002726939	0.000482669	0.000110373	9.51735E-05
Kurtosis	1.209290928	0.35960335	3.382114518	0.482422878	1.258302518
Skewness	–0.197408273	–0.650196699	0.344092349	–0.58605164	–1.071748788
Range	0.047298982	0.208485684	0.147167147	0.052630174	0.048082211
Minimum	–0.024559326	–0.141017378	–0.061219759	–0.030042401	–0.030413311
Maximum	0.022739655	0.067468306	0.085947389	0.022587773	0.0176689
Sum	–0.038507599	–0.26205758	0.169617892	0.086432747	0.195462375
Count	41	21	59	66	83

Table 5. ***Descriptive Statistics of NSE Nifty in Five Uniquely Identified Phases***

	NSE Nifty 50 Phase-1	NSE Nifty 50 Phase-2	NSE Nifty 50 Phase-3	NSE Nifty 50 Phase-4	NSE Nifty 50 Phase-5
	Returns	Returns	Returns	Returns	Returns
Mean	–0.001998345	–0.012598546	0.003065207	0.001330342	0.002318799
Standard Error	0.00166344	0.011121385	0.002786005	0.001271466	0.001045686
Median	–0.002479465	–0.004637705	0.005685483	0.001597737	0.003535794
Standard Deviation	0.010780325	0.050964588	0.021399713	0.010329441	0.009526656
Sample Variance	0.000116215	0.002597389	0.000457948	0.000106697	9.07572E-05
Kurtosis	2.533570562	0.415870377	3.381378172	0.683515484	1.583052168
Skewness	–0.876089465	–0.6907615	0.347361195	–0.679727532	–1.164622798
Range	0.060747208	0.20318301	0.143163701	0.052143639	0.049538008
Minimum	–0.037801659	–0.139037542	–0.059160796	–0.029750478	–0.031908706
Maximum	0.022945549	0.064145468	0.084002906	0.022393161	0.017629302
Sum	–0.08393048	–0.264569475	0.180847217	0.087802569	0.192460352
Count	42	21	59	66	83

Table 6. ***Descriptive Statistics of BSE Bankex in Five Uniquely Identified Phases***

	BSE Bankex Phase-1	BSE Bankex Phase-2	BSE Bankex Phase-3	BSE Bankex Phase-4	BSE Bankex Phase-5
	Returns	Returns	Returns	Returns	Returns
Mean	–0.002150054	–0.020337054	0.001642524	–0.000364448	0.004252215
Standard Error	0.00185682	0.013852315	0.004453653	0.002112577	0.001781175
Median	–0.002778453	–0.007541182	0.00287067	0.001646302	0.003859015
Standard Deviation	0.012033568	0.061949435	0.034209159	0.017032142	0.016227279

Sample Variance	0.000144807	0.003837732	0.001170267	0.000290094	0.000263325
Kurtosis	1.458646771	1.25912189	0.821231748	–0.371037975	0.407684823
Skewness	–0.760937016	–0.783047574	0.044426775	–0.217230042	–0.228707286
Range	0.059790059	0.266656893	0.187811349	0.075609628	0.080126117
Minimum	–0.037168486	–0.1840064	–0.086119323	–0.036412477	–0.03925514
Maximum	0.022621573	0.082650493	0.101692026	0.039197151	0.040870977
Sum	–0.090302287	–0.406741088	0.0969089	–0.023689148	0.35293385
Count	42	20	59	65	83

Table 7. ***Descriptive Statistics of BSE Healthcare in Five Uniquely Identified Phases***

	BSE Healthcare Phase-1	**BSE Healthcare Phase-2**	**BSE Healthcare Phase-3**	**BSE Healthcare Phase-4**	**BSE Healthcare Phase-5**
	Returns	**Returns**	**Returns**	**Returns**	**Returns**
Mean	2.76936E-05	–0.004965927	0.004943717	0.002981103	0.000494461
Standard Error	0.001641308	0.008494008	0.002199635	0.001810796	0.001297802
Median	0.001509832	0.003213144	0.002394225	0.003535095	0.001342564
Standard Deviation	0.010636893	0.037986357	0.016895716	0.014710973	0.011823541
Sample Variance	0.000113143	0.001442963	0.000285465	0.000216413	0.000139796
Kurtosis	1.472288279	0.293882218	8.136612623	2.835760631	1.149001851
Skewness	–0.932002497	–0.858823381	2.109110133	–0.358553607	–0.68997962
Range	0.05431551	0.13735645	0.109496201	0.093206501	0.066472141
Minimum	–0.033322605	–0.086485452	–0.023800267	–0.047329472	–0.037376095
Maximum	0.020992905	0.050870998	0.085695933	0.045877029	0.029096046
Sum	0.00116313	–0.099318545	0.291679277	0.196752809	0.041040242
Count	42	20	59	66	83

Table 8. ***Descriptive Statistics of BSE FMCG in Five Uniquely Identified Phases***

	BSE FMCG Phase-1	**BSE FMCG Phase-2**	**BSE FMCG Phase-3**	**BSE FMCG Phase-4**	**BSE FMCG Phase-5**
	Returns	**Returns**	**Returns**	**Returns**	**Returns**
Mean	–0.001058964	–0.003183234	0.001582265	–0.000281325	0.001159609
Standard Error	0.001524179	0.009435504	0.002257482	0.001067053	0.000976752
Median	–0.000286981	0.002079589	0.000129585	0.000725663	0.002101655
Standard Deviation	0.009877807	0.043238911	0.017340049	0.008668781	0.008844862
Sample Variance	9.75711E-05	0.001869603	0.000300677	7.51478E-05	7.82316E-05
Kurtosis	–0.068145516	1.035365918	6.562891614	1.685470834	1.336815726
Skewness	–0.21173828	–0.517271996	1.44315668	–0.697196529	–0.244715898
Range	0.042297668	0.188059864	0.119020325	0.051178075	0.055795199
Minimum	–0.023485613	–0.110070824	–0.039864221	–0.031323446	–0.029215428
Maximum	0.018812054	0.07798904	0.079156104	0.019854629	0.026579772
Sum	–0.044476508	–0.06684792	0.093353634	–0.01856747	0.095087914
Count	42	21	59	66	82

making or unfavorable time for the investors in the market. This is also the phase of the announcement of the lockdown and the World Health Organization declaring Covid-19 a global pandemic on March 11, 2020.

The standard deviation of the returns (displayed in Tables 4 – 8) is the highest in Phase-2 and gradually declines at the end of Phase-4. This indicates that investors had a positive outlook towards the end of Phase 4 and the beginning of Phase-5, with no more negative mean, showing that the market was recovering and being profitable. This is also evident from the visual graphs represented in Figures 1–5, where the market had a calm and smooth line in the beginning of the year. In the beginning of March till the end of April 2020, the market plunged to 25,981, losing almost 15,325 points since January 1, 2020, marking the highest plunge in the history in the case of BSE and 7,610, that is, losing over 4,572 points in the case of NSE. This was the lowest point of the Indian stock exchange – much lower than the 2007–2008 financial crisis and the Harshad Mehta scam in 1992.

To show the existence of volatility, we calculate the logarithmic returns as mentioned in the Research Methodology of the five identified stocks and graphically represent them in Figures 6 – 10.

Figure 6. ***Log Returns of S&P BSE Sensex***

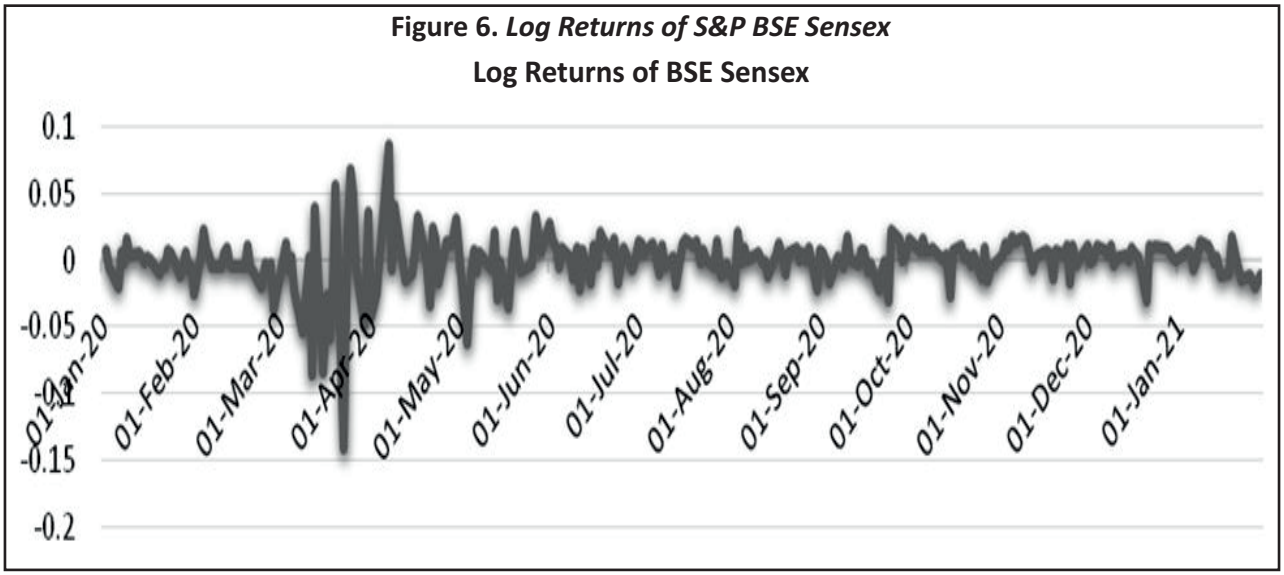


Figure 7. ***Log Returns of NSE Nifty***

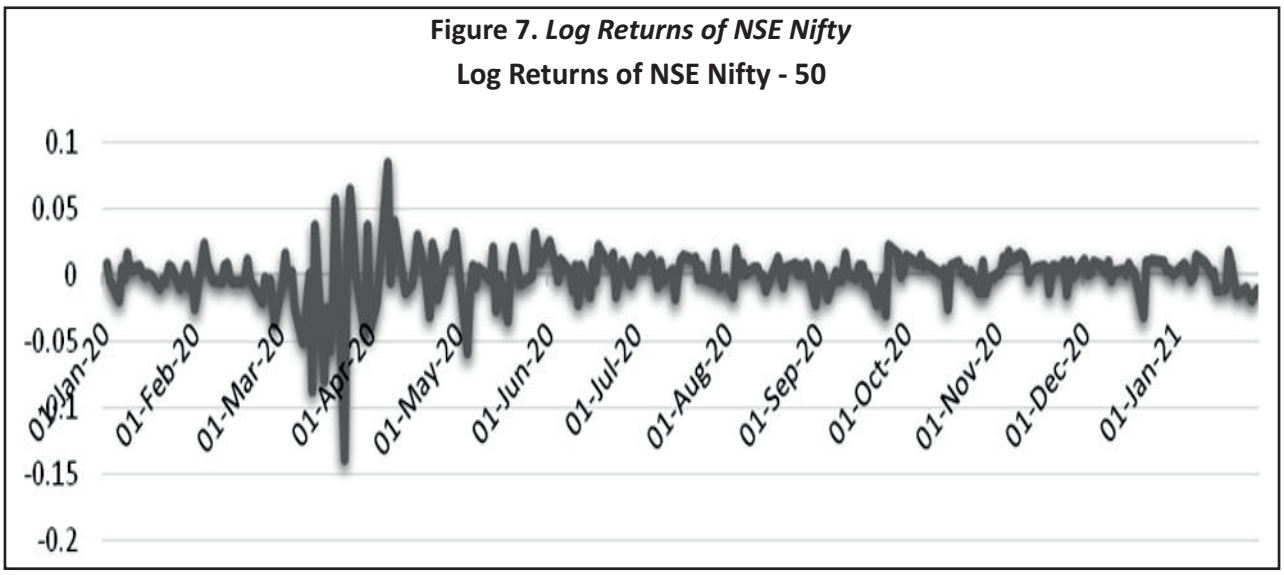


Figure 8. ***Log Returns of S&P Bankex***

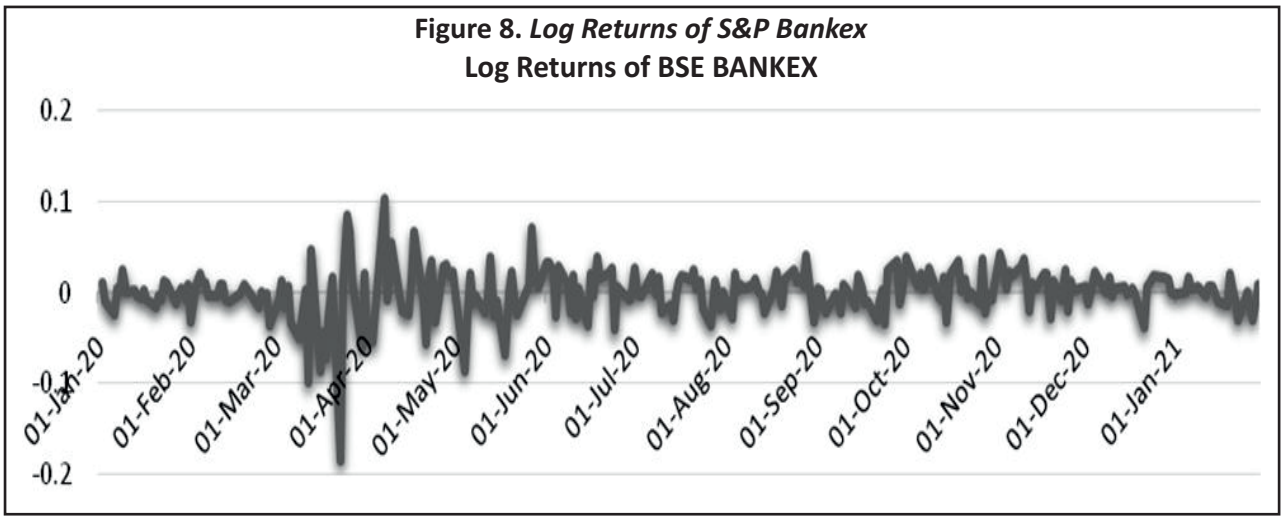


Figure 9. ***Log Returns of S&P BSE FMCG***

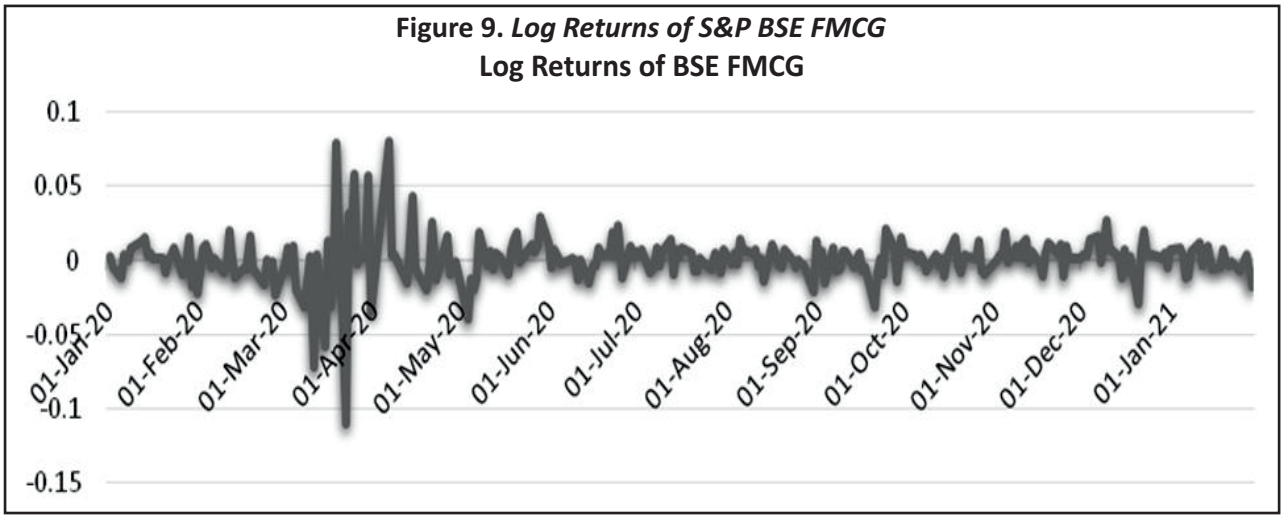
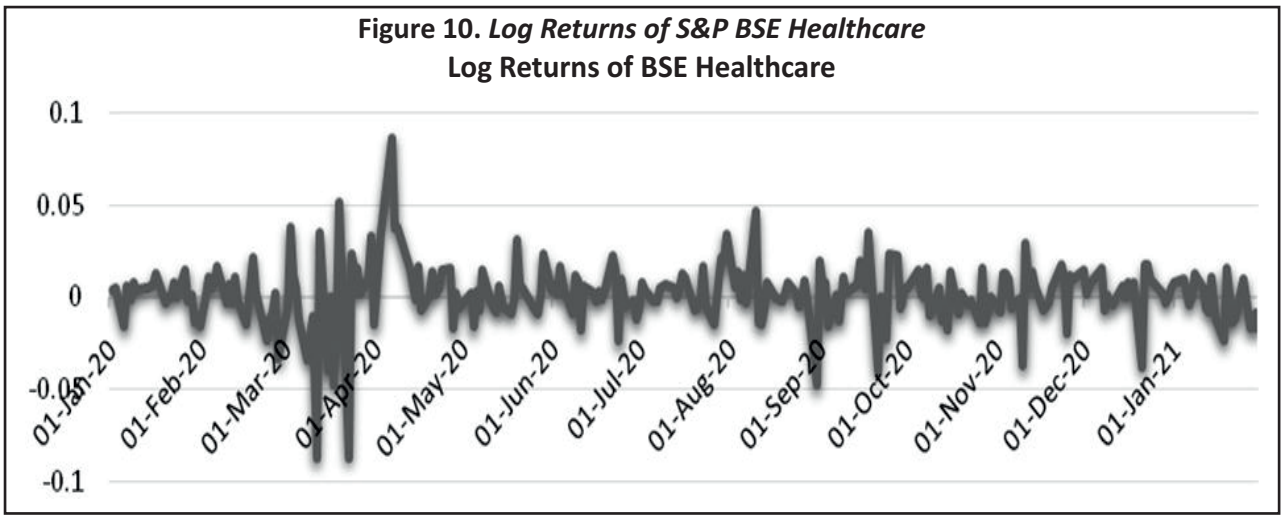


Figure 10. ***Log Returns of S&P BSE Healthcare***



It is evident from Figures 6 – 10 that the level of volatility for all the five indices increased from the months of March to April 2020, which in the study is the second phase of the pandemic. Upon further investigation of the daily volatility, we come across the values of the volatility that existed in these five-phases. We also find that the level of volatility gradually comes down to pre-Covid conditions by October 2020 – January 2021, which in the study is the fifth phase.

The next part of the study is the analysis of daily volatility of the five-phases of the five indices according to the methods mentioned under Research Methodology earlier.

Tables 9 – 13 display the daily volatility for the five identified time phases. The sum represents the sum total of the square of returns that was calculated in the previous Tables 1 – 3. Average represents the average of the squared of log returns and by applying the square root of this figure, we get the daily volatility of the time period.

We can see that the market at the beginning or in Phase-1 of all the markets indicates the lowest of the volatility in prices ranging from 0.896% for BSE Sensex and 1.084% in NSE Nifty as this was the onset of the Covid-19 pandemic and investors were up for a wild ride in the upcoming days.

Table 9. ***Calculation of the Daily Volatility for S&P BSE Sensex for Five-Phases***

	BSE Sensex Phase-1	BSE Sensex Phase-2	BSE Sensex Phase-3	BSE Sensex Phase-4	BSE Sensex Phase-5
Sum	0.00329034	0.057808987	0.030759713	0.004998414	0.008264532
Average	8.02522E-05	0.002752809	0.00037975	0.000116242	9.95727E-05
Daily Volatility	0.896%	5.247%	1.949%	1.078%	0.998%

Table 10. ***Calculation of the Daily Volatility for NSE Nifty for Five-Phases***

	NSE Nifty 50 Phase-1	NSE Nifty 50 Phase-2	NSE Nifty 50 Phase-3	NSE Nifty 50 Phase-4	NSE Nifty 50 Phase-5
Sum	0.004932554	0.055280975	0.027115302	0.007052135	0.007888365
Average	0.000117442	0.002632427	0.000459581	0.000106851	9.50405E-05
Daily Volatility	1.084%	5.131%	2.144%	1.034%	0.975%

Table 11. ***Calculation of the Daily Volatility for S&P BSE Bankex for Five-Phases***

	BSE Bankex Phase-1	BSE Bankex Phase-2	BSE Bankex Phase-3	BSE Bankex Phase-4	BSE Bankex Phase-5
Sum	0.006131232	0.081188832	0.068034636	0.018574641	0.023093366
Average	0.000145982	0.004059442	0.001153129	0.000285764	0.000278233
Daily Volatility	1.208%	6.371%	3.396%	1.690%	1.668%

Table 12. ***Calculation of the Daily Volatility for S&P BSE Healthcare for Five-Phases***

	BSE Healthcare Phase-1	BSE Healthcare Phase-2	BSE Healthcare Phase-3	BSE Healthcare Phase-4	BSE Healthcare Phase-5
Sum	0.004638915	0.027909512	0.017998962	0.014653368	0.011483576
Average	0.00011045	0.001395476	0.000305067	0.000222021	0.000138356
Daily Volatility	1.051%	3.736%	1.747%	1.490%	1.176%

Table 13. ***Calculation of the Daily Volatility for S&P BSE FMCG for Five-Phases***

	BSE FMCG Phase-1	BSE FMCG Phase-2	BSE FMCG Phase-3	BSE FMCG Phase-4	BSE FMCG Phase-5
Sum	0.004047513	0.037604861	0.017586994	0.004889829	0.006447023
Average	9.63694E-05	0.001790708	0.000298085	7.40883E-05	7.86222E-05
Daily Volatility	0.982%	4.232%	1.727%	0.861%	0.887%

In all the stock indices, the Phase-2 depicts the highest level of volatility in the closing prices expected due to the effect of the Covid-19 pandemic, with BSE Bankex showing the highest of all at 6.371% followed by BSE Sensex at 5.247% and NSE Nifty at 5.131%, which indicates the level of uncertainty among the investors in this period.

Phase-3 and Phase-4 in all the stocks depict the recovery from the volatility, showing slightly less levels of volatility ranging significantly below as BSE Bankex shows 2.975% lower volatility and BSE Sensex shows 3.298% lower volatility than the Phase - 2 volatility. This phase shows rising of prices at an increasing rate, showing that investors looked towards the future in a positive attitude.

In Phase-5, we can clearly see that the volatility levels somewhat reached Phase-1 levels in all the stock indices, with volatility percentage reducing even lower than the 1st phase in the case of NSE Nifty and BSE FMCG. While BSE Sensex had volatility of 0.998% and BSE Bankex had volatility of 1.668%, which is close to the values in the 1st Phase, this shows that the effect of the Covid-19 pandemic on the stock market came to an end in this phase and that further growth or surges in prices were inevitable at this point. Going forward in this period, we observed that the BSE Sensex touched the 50,000 mark during the trade for the first time in history on January 21, 2021, but closed at 49,624. The BSE Sensex closed at 50,255 for the first time on February 3, 2021 and further crossing the 51,000 mark also.

To show the intensity of the volatility that existed throughout the year 2020 amid the global pandemic in the five identified stock indices from the above calculations of volatility, the following figures are showcased for the five-phases (Figures 11 – 15).

It is evident from Figures 11–15 that volatility existed in its highest level in the second phase of the year 2020

Figure 11. ***S&P BSE Sensex Daily Volatility Trend in the Five-Phases Identified***

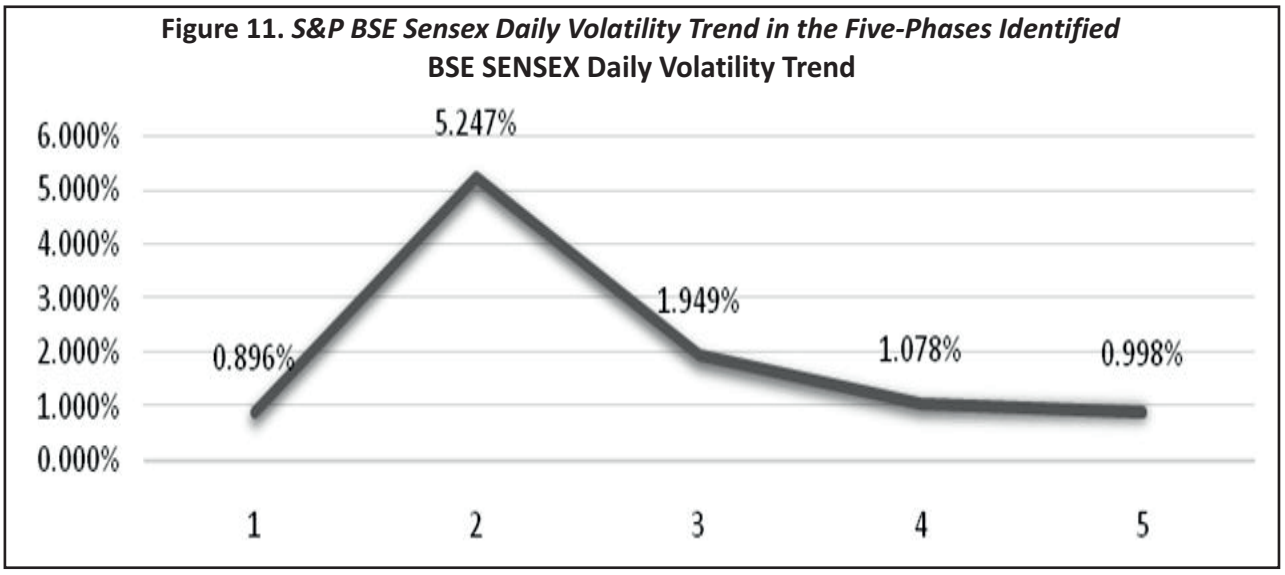


Figure 12. ***NSE Nifty Daily Volatility Trend in the Five-Phases Identified***

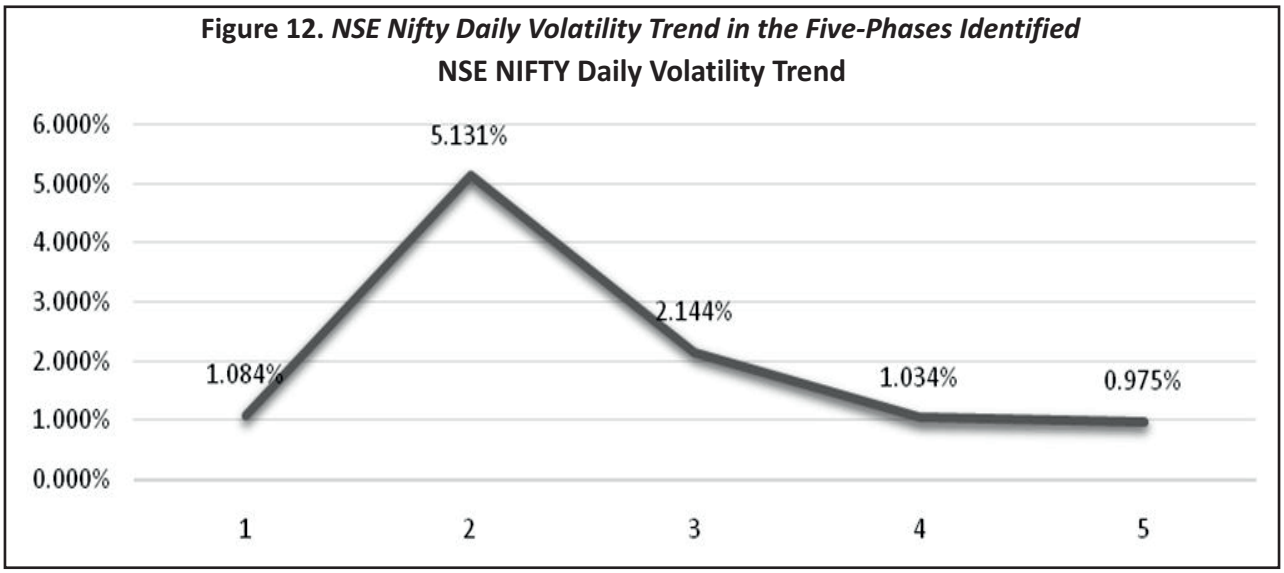
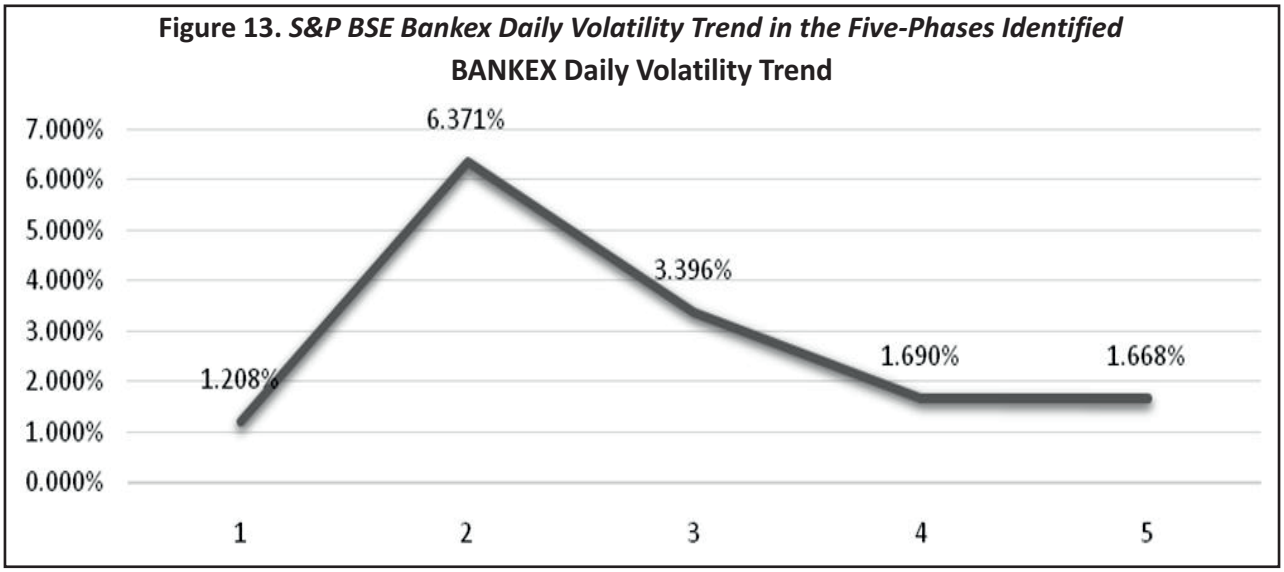


Figure 13. ***S&P BSE Bankex Daily Volatility Trend in the Five-Phases Identified***



amid the Covid-19 pandemic. The curves of volatility of the five identified indices are almost identical with the same features. The percentages represent the percentage of daily volatility that existed in that phase.

From Figures 11 – 15, we can see a trend of a drastic increase in the daily volatility from the identified first phase to the second phase. For example, in case of BSE Sensex in Figure 11, we see the volatility present in the index in the first phase as 0.896%, increasing substantially to 5.247% in the second phase. It is observed that the investors were in a state of panic in the transition from first phase to the second phase as seen in Figure 11. We notice this kind of similar behaviour in Figures 12 – 15. Gradually, we see a recovery of the volatility trend in the index in the third and fourth phases. As seen in Figure 11, the trend comes down to 1.949% and 1.078%, respectively. Conditions in the index or the expansive volatility that was prevailing returns back to almost normal percentage, that is, 0.998% in Phase 5 (as seen in Figure 11).

Figure 14. ***S&P BSE FMCG Daily Volatility Trend in the Five-Phases Identified***

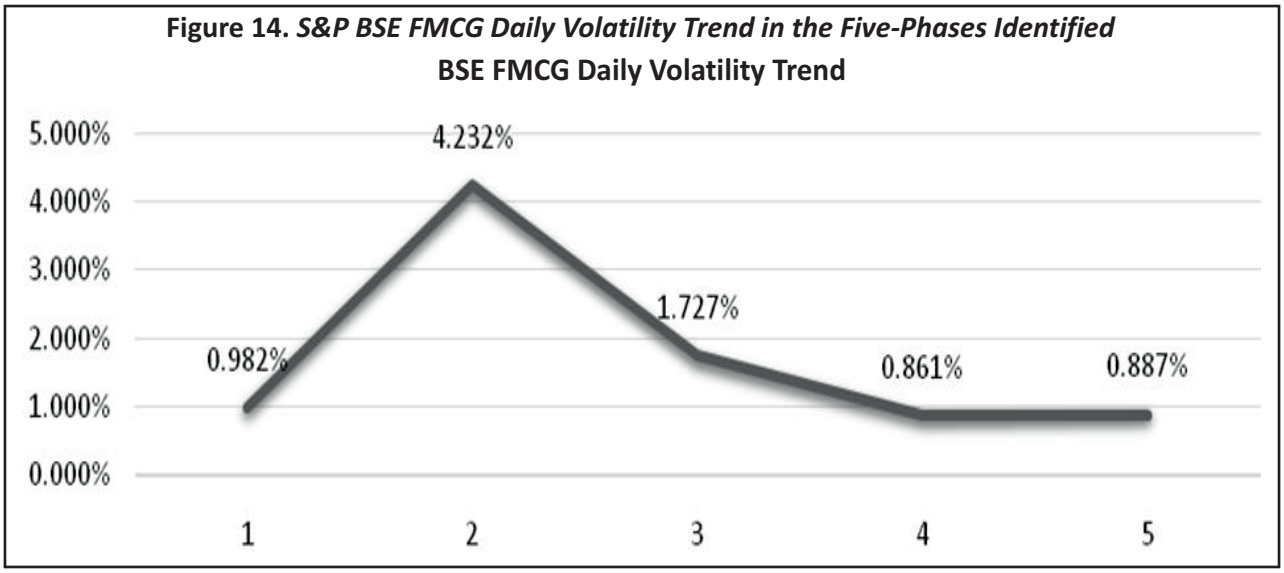
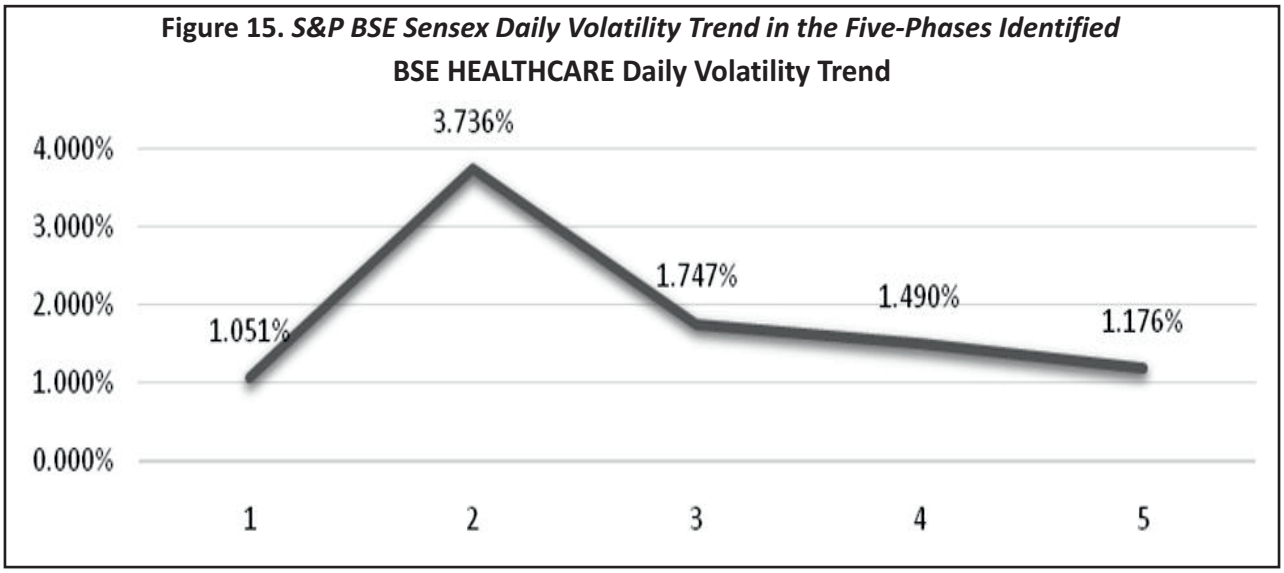


Figure 15. ***S&P BSE Sensex Daily Volatility Trend in the Five-Phases Identified***



Conclusion

This study attempts to show the effect of the Covid-19 pandemic on the Indian stock market and its response to the same considering a timeline of over a year, from January 2020 to January 2021. The performance of the two major stock markets, the BSE Sensex and NSE Nifty 50 are taken into consideration to show the effect in five uniquely identified phases. Moving average or standard deviation method of showing volatility is used to test the volatility of the closing prices of the two stock indices along with three sectoral indices – banking, healthcare, and FMCG sectors. The closing prices of the five-phases are analyzed and represented. The findings and calculations indicate that the stock market experienced a high level of volatility, particularly in the second phase of the timeline and more in BSE Sensex due to the Covid-19 pandemic. In correspondence, we also find high levels of similar volatility in the second phase of the sectoral indices also. The descriptive statistics of the data

show the negative returns of mean primarily in the second phase, indicating that the stocks were undergoing losses ; whereas, the later phases returned a positive mean, indicating the recovering economy and the moderate attitude of the investors in this stage. The changes in the prices are also shown to have increased during the Phase 4 and Phase 5. This recovery was due to reasons of government giving relaxations and permission to the factories and businesses to open and function on a full-scale. The global run for the Covid-19 vaccine also helped trigger the recovery of the prices.

In brief, the study concludes with sufficient evidence that the Covid-19 pandemic affected the Indian stock market and increased the level of price volatility, which in-turn affected the overall GDP of the nation during the last quarter of 2020, bringing it to a negative value. All the sectors of the Indian stock market have been affected by the Covid-19 pandemic as shown in the study with sufficient data. Accordingly, this study attempts to present a simple and original statistical analysis of the Covid-19 pandemic by taking into consideration the case of the Indian stock market.

Practical Implications

This study has made use of original data from secondary sources from the official website of historical indices of NSE and BSE. A study of volatility is important for investors to know the situation of the market if it is favorable to invest in stocks and to make further decisions for the future. The volatility study gives a visual depiction of the actual performance of the stock market under a Black Swan Event like that of Covid-19.

Limitations of the Study and Scope for Further Research

Limitations of the study may include the accuracy of the historical data of the closing prices available on the official BSE and NSE websites of the time period of one year or 272 trading days. A significant limitation when using moving average method for volatility calculation is that it eliminates the short-term irregularities and indicates a long-term trend of the data for the period which, given for the study, was essential as we required to ascertain the after-effects of the Covid-19 pandemic for that unique phase.

Authors' Contribution

Ayan Brown conceived the presented idea and Kushal Dey approved the viability. Ayan Brown undertook the literature review and performed the statistical calculations with support from Kushal Dey, who supervised the findings of his work. Both authors discussed the results and contributed to the final manuscript.

Conflict of Interest

The authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest, or non-financial interest in the subject matter, or materials discussed in this manuscript.

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