

Do Sectoral Indices React Differently to Lockdowns Imposed Due to Covid-19? Lessons for Wealth Generation

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Abstract

This research paper is an attempt to study the impact of Covid-19 on the sectoral indices using Event Study Methodology (EVM) and regression models. It tries to analyze the differences in mean returns of one composite and ten sectoral indices on India's premier National Stock Exchange during four periods-before lockdowns, during the lockdown, during unlocking and post unlock. The analysis is based on 15346 daily observations. Imposition of Lockdown is found to have a positive impact on the daily mean return of the eleven Nifty indices under study. The mean returns of sectoral indices are compared using non-parametric tests. The mean returns across four periods are compared using Friedman's ANOVA and are found to be significantly different over the four periods. Post Hoc Analysis using Wilcoxon signed-rank test revealed that the daily mean returns during the lockdown were more than the daily mean returns during the period before lockdown, during unlock period or post unlock period. Kruskal Wallis test was used to investigate the equality of means of eleven indices found, mean returns of indices to be equal to each other during all the four alternate periods studied separately. GARCH (1,1) model is then used to estimate returns and variance of sectoral indices A significant portion of variances in sectoral index returns was explained by the variances in market proxy Nifty 50. The study highlights the emerging relevance of the Energy, FMCG, Healthcare, IT and Pharma sector during the lockdown as the abnormal positive returns have increased in these sectors. Infrastructure, Media and realty sectors have been severely affected due to the lockdown. The robustness of estimated parameters is checked by using a dummy variable regression model and it is found that stock markets were strengthening during the period of lockdown. The results of the dummy variable regression model are in line with the results of the Event Study Methodology (EVM) and GARCH (1,1). Overall, the imposition of lockdown as a policy initiative by the Government of India helped in mitigating the effect of Covid-19 on the stock market.

Keywords: Abnormal Returns, Covid-19, Event Study, GARCH, Investors, Stock Market Indices, Lockdown

JEL classification: G10, G14, C22, C25

1. Introduction

Pandemic like Covid-19 is unique as it not only resulted in loss of multiple lives but also impacted livelihoods in the worst impacted countries. Governments in most of

the countries responded by imposing lockdowns, ensuing vaccinations and travel bans, seeking foreign aid, as well as adopting effective monetary and fiscal measures. Lockdowns in particular bring the entire nation to a halt. The impact of such a halt is an area drawing the attention

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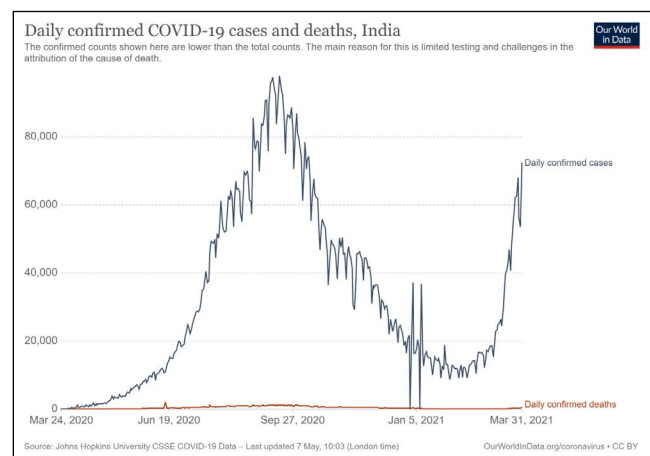
of researchers across the globe. This paper makes a novel attempt to identify the impact of stringent measures like lockdowns on the financial markets in India. A sectoral analysis is undertaken to understand which sectors exhibited positive/negative or abnormal returns as a result of the lockdown. Statistical and econometric models based on some recent pioneering works have been adapted and tested for deriving newer findings and analyses¹⁻³. Empirical testing is done using daily values for 11 indices from India's most prominent stock exchanges i.e., National Stock Exchange. An attempt is made to understand the presence of any significant difference in the mean returns of 11 Nifty indices for different periods i.e., before lockdown, lockdown, unlock and post unlock. Furthermore, the presence of cumulative abnormal returns is explored using the Event-Study Methodology. The robustness of Event Study methodology estimated parameters is tested using the Dummy Variable Regression model and the results are found to be consistent.

Covid-19 deaths have a more severe negative effect on the returns of companies belonging to the travel and leisure industry across the globe. A positive correlation was also observed between the stringent response of the government and index returns⁴. Trading activity and stock returns have been linked to contagious diseases. Due to the flu, the bid-ask spread tends to widen⁵. The doubling of SARS or Covid-19 infections is linked to a 4 to 11 percent drop in the index. The more certain the infection rate due to Covid-19, the lesser the volatility we tend to see in capital markets⁶. The inverse relationship between confirmed cases due to Covid-19 and Chinese stock returns was also established recently^{7,8}. Amongst all the sectors, it was Information Technology and Pharmaceutical companies that performed better than other companies. This is primarily due to the increased demand for their products and services. The health care index also gave abnormal positive returns due to Covid-19 which were much higher than other sectoral indices⁹. Foreign Institutional investors tend to pull out their money with an increase in uncertainty due to Covid-19. Large daily market movements were observed for U.S. stock markets due to Covid-19. Covid-19 impacts national policies like lockdown travel restrictions etc. which finally impacts the returns on stocks and indices¹⁰. In a study of 30 countries' data, significant negative index returns were identified due to Covid-19¹¹. The impact of Covid-19 is found to be higher on stock markets as compared to other events like global financial crisis, demonetization

and implementation of the GST^{12,13}. It is observed that the negative impact of Covid-19 can be reversed by the policy initiatives of the government. In an analysis of G7 countries, it was found that constructive government responses to curtail the pandemic have a positive impact on the stock market indices². The present study tries to investigate the impact of government initiatives-Lockdown and Unlock on the returns of Indian Sectoral indices.

With 161,909,130 globally confirmed cases of Covid-19 and more than 3,358,007 deaths due to Covid-19 it has become by far one of the most contagious and deadly diseases to date¹⁴. On 24th March 2020, in India there were 37 confirmed cases of Covid-19 and 0 deaths. This peaked between 12-17th September 2020. There were 97570 cases and 1201 deaths on 12th September 2020. The cases were reduced by 1st February 2021 with 8635 cases and 94 deaths (please see Figure 1 Cases and Deaths in India due to Covid-19). India's triumph over Covid-19 in the first wave is primarily attributed to a responsible Governance of Lockdown and Unlock. The impact of opening and closing decisions by Governments on confirmed cases of Covid-19 and deaths is largely known. The impact of lockdown on the financial markets largely remains unexplored in the existing literature. The remainder of the paper is organized as follows.

Section 2 discusses the research objectives. Section 3 presents the data and methodology. Section 4 explains the statistical analysis and empirical results. Finally, Section 5 highlights the main conclusions and policy implications.



Source: John Hopkins University CSSE COVID-19 data.

Figure 1. Cases and deaths in India due to COVID-19- the first wave.

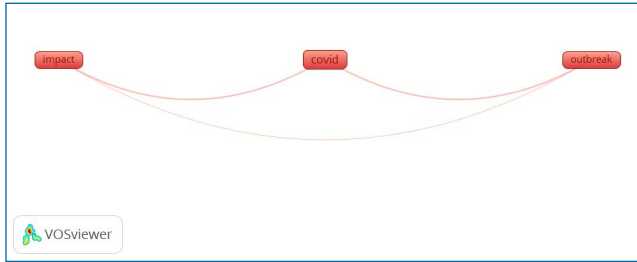


Figure 2. Network visualization using VOS viewer.

The Network Visualization using VOS viewer has created three clusters showing the focus of existing research on Covid-19, Outbreak and its impact. Figure 2 was created using DOI (Digital Object Identifier) of references.

2. Research Objectives

The main objective of the present study is to compare the effect of different Covid-19 announcements made by the Government of India on Sectoral Indices returns. In particular, the present study would address the following research objectives:

- To empirically verify if the mean returns for the four periods i.e., before lockdown, lockdown, unlock and post unlock are equal or significantly different for the 11 Nifty indices under study.
- To study the impact of various announcements made by the Government regarding national lockdown and unlock on the abnormal returns of 11 Nifty indices under study.

3. Data and Methodology

3.1 Data

The sample for the purpose of study consists of eleven Nifty Indices that have continuously available index values for the period under consideration. The list of stock indices is given in Panel A and the list of events is given in Panel B.

Panel A: List of indices

Stock index	Industry
Nifty 50	All
Nifty Auto	Automobile

Nifty Bank	Banking
Nifty Energy	Energy
Nifty FMCG	Fast Moving Consumer Goods
Nifty Healthcare Index	Healthcare
Nifty Infrastructure	Infrastructure
Nifty IT	Information Technology
Nifty Media	Media
Nifty Pharma	Pharmaceutical
Nifty Realty	Real Estate

Panel B: List of events (Periods under study)

Before Lockdown Period	1 April 2015 – 23 March 2020
Event Date	24 March 2020 (Announcement of Nationwide lockdown)
Lockdown Period	25 March 2020 - 31 May 2020
Unlock Period	1 June 2020 - 30 September 2020
Post Unlock Period	1 October 2020 - 31 March 2021

The ten indices represent the major sectors of Indian Economy impacted by the Lockdown. The negative impact of Lockdown on the Hospitality Industry has already been proved¹⁵. Daily closing values were downloaded for the eleven Indices from 1.4.15 to 31.3.21 from CMIE Prowess. The Centre for Monitoring of Indian Economy maintains an online database called Prowess (CMIE).

As the proxy for market portfolio, the return on the S&P CNX Nifty-50 stock index, India's most commonly regarded equity market index, is used. It is a value-weighted market index with a broad basis that is commonly employed in research investigations. Data on index values was also gathered from the NSE website and the Prowess database.

The time series employed in the preliminary analysis of time series data must be normal and steady. The present study uses Kolmogorov-Smirnov test and Shapiro-Wilk test to check the normality and a test developed by Dicky and Fuller, known as the Augmented Dicky-Fuller (ADF) test to check the stationarity of time series. The time series are found to be non-normal and hence non-parametric test (Friedman's ANOVA test and Kruskal-Wallis Test) have been performed to investigate our objectives. The indices time series used in the study are found to be stationary at the first logarithmic difference.

3.2 Methodology

3.2.1 Friedman’s ANOVA Test

Friedman’s ANOVA technique has been used to test for differences between several related groups of data created for the same index. Post Hoc Analysis after applying Bonferroni correction has been undertaken using Wilcoxon Signed Ranks Test.

3.2.2 Kruskal-Wallis Test

Kruskal Wallis Test has been used to test the equality of differences between several independent groups. These independent groups were the eleven indices part of the study.

3.2.3 Event-Study Methodology (EVM)

Widely used in the literature (Alam¹⁶; Chowdhury & Abedin¹⁷; Dilla¹⁸; H. Liu¹⁹; H. Y. Liu²⁰; Kandil²¹; Khan²²; Singh²³) has been applied in the present study for empirical investigation of the impact of the event of lockdown on the economic value of Indices on Nifty. Specific events like lockdown can be a source of change in the economic value of the stock indices. The impact of specific events like lockdown is analyzed by computing the ‘Abnormal Returns (ARs)’. Some indices may give positive ARs while others may give negative ARs depending upon the impact of lockdown on their respective industry.

The event date in this study is March 24, 2020, when the Indian government initially declared the statewide lockdown. Figure 3 presents the event study timeline used in this study. We have used the following event windows: [-1, 1], [-3, 3], [-5, 5], [-10, 10], [-20, 20], [-30, 30] and [-254, 254]. A period of 975 days starting from 1st April 2015 has been used as the estimation period. The event window [-1, 1], [-3, 3] and [-5, 5] shows the immediate impact of lockdown and has also been used by Narayan². The event window of [-10, 10], [-20, 20] and [-30, 30] has been employed by Agarwal¹⁵ and Chen¹ showing the medium-term impact of lockdown. An event window of 254 days has also been employed for showing the long-term impact of lockdown. The statistical significance of Cumulative mean Abnormal Returns (CAR) throughout the several event windows is used to examine the impact of the news of a statewide shutdown due to Covid-19. The statistical significance of CARs suggests that the lockdown has a considerable impact on the ten Nifty sectoral indices’ results. This study provides an in-depth

analysis of the impact of the lockdown event by analyzing data over seven event windows before and after the event showing short term, medium term and long-term effects.

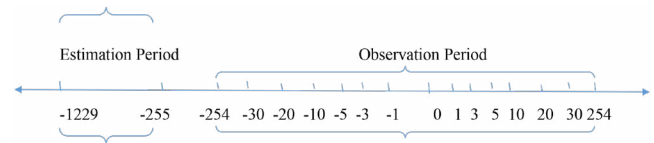


Figure 3. Event study timeline.

In the case of those indices where the problem of heteroscedasticity is determined to be important due to Volatility Clustering and Leverage Effects, the GARCH (1, 1) procedure is employed to generate estimated returns²⁴. As a result, rather than using normal distributions, it was necessary to use a conditional distribution with fatter tails (ARCH-GARCH type models) to achieve a good match²⁵. We looked into the issue of heteroscedasticity in our data. Because the ARCH impact was discovered to be considerable, it was decided to use a GARCH (1, 1) model, which accounts for these characteristics of financial time series.

3.2.4 Dummy Variables Regression Model

To check for robustness of the empirical findings of the event study methodology, the present study examines the impact of various announcements made by the Government of India regarding Lockdown and Un-lockdown on stock indices returns using dummy variable regression. The stock indices return modeled by using the following regression model.

$$R_t = c + \beta_1 R_{t-1} + \beta_2 Vol_t + \beta_3 Lockdown + \beta_4 Unlock + \beta_5 Post unlock + \epsilon_t \tag{1}$$

Where R_t is the stock indices return at time t ; R_{t-1} is the return on stock index at time $t-1$, Vol_t is the volatility of stock indices at time t ; Lockdown, unlock and post unlock are the three dummy variables. Lockdown represents the restrictions on movement of people announced by the Government of India amid Covid-19 to curb the spread of Coronavirus and it is taken in the form of a dummy variable that is equal to 1 if the country was in lockdown and 0 otherwise. After the imposition of lockdown, the Government of India started moving the country to unlock position from 1st June 2020 onwards and is represented by a dummy variable called unlock which will take the value 1 if the country was in unlock position and zero otherwise. Similarly, the dummy

variable is taken for the country position after the whole economy was unlocked called post lock. The impact of these three country positions on stock indices return is compared with the country position before lockdown. The stock indices return before imposition of lockdown is equal to $R_t = c + \beta_1 R_{t-1} + \beta_2 Vol_t$, when the dummy value of variables- lockdown, unlock and post unlock is equal to zero; ϵ_t is the error term representing that part of return which is not explained by the regression model.

4. Statistical Analysis and Empirical Results

It may be mentioned at the outset that stock indices price time series used in the present study is non-stationary; it was however found to be stationary at the first logarithmic difference. Hence, the returns on stock indices time series are calculated by taking their first logarithmic difference.

Table 1 presents the mean returns of the eleven indices under study. The table clearly shows negative daily log returns for Nifty 50, Nifty Auto, Nifty Bank, Nifty Healthcare Index, Nifty Infrastructure, Nifty Media, Nifty

Pharma and Nifty Realty. During the lockdown, the daily mean returns became positive. There was a trend reversal from negative to positive daily log returns. The same positive trend was observed across all the eleven indices during the unlock period. However, post the un-lock, the mean return became negative for Nifty Media. The primary reason for this could be the high valuations of Nifty Media during the lockdown and unlock period. Our data indicates that the lockdown imposed in India due to Covid-19 has had a positive impact on the equity-based Indices.

4.1 Friedman's ANOVA Test: Results for Equality of Means

In this section we attempt to understand if the mean returns for the four periods i.e., before lockdown, lockdown, unlock and post unlock are equal or significantly different for the 11 indices under study.

$$H_0 : \mu_{BL} = \mu_L = \mu_{UL} = \mu_{PUL}$$

$$H_A : \mu_{BL} \neq \mu_L \neq \mu_{UL} \neq \mu_{PUL}$$

μ_{BL} : Mean returns before lockdown

μ_L : Mean returns during lockdown

Table 1. Mean Return before Lockdown, during Lockdown, during Unlock and Post Unlock

	Before Lockdown (1.4.15-24.3.20)	Lockdown (25.3.20-29-5.20)	Unlock (1.6.20-30.9.20)	Post Unlock (1.10.20-31.3.21)
Nifty 50	-0.000078	0.004892	0.001823	0.002154
Nifty Auto	-0.000503	0.006701	0.002731	0.001781
Nifty Bank	-0.000069	0.002868	0.001203	0.003547
Nifty Energy	0.000152	0.006300	0.001594	0.001538
Nifty FMCG	0.000140	0.004813	0.000209	0.001270
Nifty Healthcare Index	-0.000429	0.007737	0.002328	0.000030
Nifty Infrastructure	-0.000354	0.006947	0.000905	0.002280
Nifty IT	-0.000006	0.003957	0.004017	0.002090
Nifty Media	-0.000617	0.003154	0.003104	-0.000013
Nifty Pharma	-0.000558	0.009296	0.002121	0.000335
Nifty Realty	-0.000204	0.001283	0.001848	0.003673

Table 2. Descriptive Statistics for Friedman's ANOVA

Events	N	Mean	Std. Deviation	Minimum	Maximum
Before Lockdown	11	-.000216	.0002876	-.0006	.0002
Lockdown	11	.005268	.0023755	.0013	.0093
Unlock	11	.001989	.0010584	.0002	.0040
Post Unlock	11	.001697	.0012594	.0000	.0037

μ_{UL} : Mean returns during unlock

μ_{PL} : Mean returns post unlock

Tables 2 and 3 below show the results of Friedman’s ANOVA. The returns on the indices significantly change over the four periods under study, (Chi-Square) $X^2(3) = 23.84, p < 0.05$. Since the initial analysis is significant, we proceed to perform the non-parametric post hoc procedures.

4.1.1 Post Hoc Analysis

In the present section, there are three groups we attempted to compare

Test 1: Mean returns before lockdown compared with mean returns during lockdown

Test 2: Mean returns during lockdown compared with mean returns during unlock

Test 3: Mean returns during unlock compared with mean returns post unlock

We also apply Bonferroni correction i.e., since there are three groups for comparisons, we would use $0.05/3$ number of comparisons. As a result, rather than 0.05, we’d pick $0.05/3 = 0.0167$ as our critical threshold of significance. To follow up on this discovery, Wilcoxon tests are utilised. Because of the Bonferroni correction, all effects are reported at a significance level of 0.0167. Returns appeared to alter significantly from before lockdown to during lockdown ($T=66, r=-0.63$), and from lockdown to unlock ($T=5, r=-0.53$). The returns did not significantly change from period of unlock to post unlock, $T=28, r=-0.09$. This shows that the returns significantly increased during the lockdown as compared to the period before lockdown or during unlock or post unlock (Tables 4 and 5).

Table 3. Friedman Test Ranks

Events	Mean Rank
Before Lockdown	1.00
Lockdown	3.64
Unlock	2.73
Post Unlock	2.64
N	11
Chi-Square	23.836
Df	3
Asymp. Significance	0.000*

Note: *indicates significance at 5%.

4.2 Kruskal-Wallis Test: Results for Equality of Daily Returns across the Eleven Indices

An attempt has been made to study the difference in mean returns of the eleven indices during the before lockdown period, lockdown period, unlock period and post unlock period with each period taken separately. The alternate hypothesis is that returns are different during at least one period (before lockdown period, lockdown period, unlock period and post unlock period). The purpose of this hypothesis is to check during which each of the four alternative periods under study was there a significant difference in the mean returns of these eleven indices.

Table 4. Wilcoxon Signed Ranks Test Ranks

		N	Mean Rank	Sum of Ranks
Lockdown - Before Lockdown	Negative Ranks	0 ^a	.00	.00
	Positive Ranks	11 ^b	6.00	66.00
	Ties	0 ^c		
	Total	11		

		N	Mean Rank	Sum of Ranks
Unlock - Lockdown	Negative Ranks	9 ^d	6.78	61.00
	Positive Ranks	2 ^e	2.50	5.00
	Ties	0 ^f		
	Total	11		

		N	Mean Rank	Sum of Ranks
Post Unlock - Unlock	Negative Ranks	6 ^g	6.33	38.00
	Positive Ranks	5 ^h	5.60	28.00
	Ties	0 ⁱ		
	Total	11		

Note: a. Lockdown < Before Lockdown

b. Lockdown > Before Lockdown

c. Lockdown = Before Lockdown

d. Unlock < Lockdown

e. Unlock > Lockdown

f. Unlock = Lockdown

g. Post Unlock < Unlock

h. Post Unlock > Unlock

i. Post Unlock = Unlock

Table 5. Test Statistics^a

	Lockdown - Before Lockdown	Unlock - Lockdown	Post Unlock - Unlock
Z	-2.934 ^b	-2.490 ^b	-.445 ^b
Asymp. Sig. (2-tailed)	.003	.013	.657

Note: a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

Table 6. Ranks for Kruskal-Wallis Test

Group	Before Lockdown		Lockdown		Unlock		Post Unlock	
	N	Mean Rank	N	Mean Rank	N	Mean Rank	N	Mean Rank
1	1230	6786.07	42	229.02	88	491.14	124	702.40
2	1230	6664.84	42	239.12	88	508.88	124	682.75
3	1230	6809.52	42	222.76	88	489.66	124	718.6
4	1230	6920.34	42	234.45	88	473.64	124	682.54
5	1230	6783.66	42	216.74	88	442.13	124	651.73
6	1230	6657.1	42	234.62	88	487.64	116	633.98
7	1230	6703.19	42	239.98	88	467.29	124	705.85
8	1230	6792.83	42	234.12	88	505.92	124	682.45
9	1230	6734.66	42	234.69	88	503.36	124	632.20
10	1230	6609.12	42	239.64	88	483.54	124	645.86
11	1230	6959.16	42	221.36	88	476.29	124	722.26
Total	13530		462		968		1356	

If there is a significant difference then which indices are giving more returns vis-à-vis other indices.

$$H_0 : \mu_{\text{Nifty 50}} = \mu_{\text{Auto}} = \mu_{\text{Bank}} = \mu_{\text{Realty}}$$

$$H_A : \mu_{\text{Nifty 50}} \neq \mu_{\text{Auto}} \neq \mu_{\text{Bank}} \neq \mu_{\text{Realty}}$$

Table 6 below shows the mean ranks for the four Kruskal-Wallis Tests undertaken for the eleven indices under investigation. We observe the significance value (Table 7), which is .498 (before lockdown), .999

Table 7. Test Statistics^{a,b}

	Before Lockdown	Lockdown	Unlock	Post Unlock
	Return	Return	Return	Return
Chi-Square	9.359	1.496	4.241	8.63
df	10	10	10	10
Asymp. Sig.	0.498	0.999	0.936	0.568

Note: a. Kruskal Wallis Test

b. Grouping Variable: Group

(lockdown), .936 (unlock) and .568 (post unlock). As all these values are more than 0.05, we accept the null hypothesis of no difference. Hence, we can conclude that no significant difference exists in the mean returns across the eleven indices in the period before lockdown. Similarly, we could not find any evidence supporting that the mean returns of these indices were different from each other during lockdown or during unlock and post unlock periods. Hence, it is concluded that there exists no difference among the returns of these eleven indices during the periods under study.

4.3 Event Methodology

Figure 4(a) and 4(b) exhibit the abnormal returns of the ten sectoral indices of NSE, 30 days before the lockdown. Health, IT and FMCG sectors were showing positive abnormal returns before the lockdown. Realty and Media sectors stocks showed high volatility mostly exhibiting negative abnormal returns. The daily abnormal returns were more or less range bound between -15 to -30 days from the event of lockdown i.e., between 0.02 percent and -0.04 percent. Figure 5(a) and 5(b) illustrate abnormal returns of the same indices 30 days after the lockdown got imposed. With the increasing demand for the health, pharma and energy sectors they clearly exhibit positive abnormal growth during this period. Realty, Media and Infra sectors plummeted during this time. The markets became more volatile post lockdown than they were before lockdown.

Table 8 and Table 9 present Cumulative Abnormal Returns (CARs) of the 10 Nifty Indices computed using either the OLS market model or the GARCH (1,1) model. CAR for Nifty Auto, Nifty Bank, Nifty Energy, Nifty FMCG, Nifty IT and Nifty Media has been computed using the GARCH (1,1) model due to the presence of ARCH effect. CAR for Nifty Healthcare, Nifty Infrastructure, Nifty Pharma and Nifty Realty has been computed using

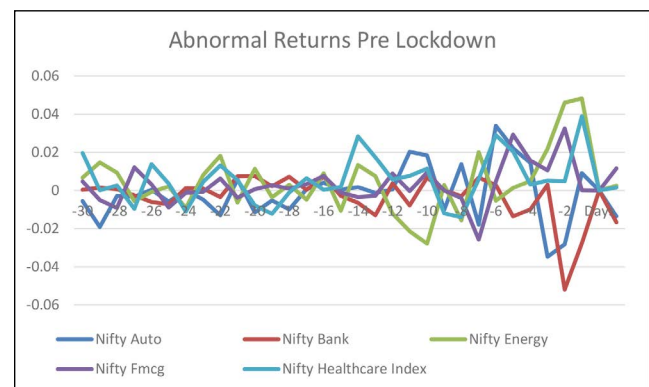
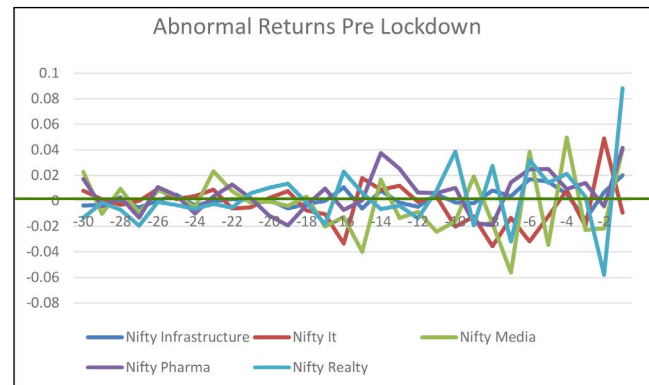


Figure 4 (a) and 4 (b). Abnormal returns before lockdown.

the MM Model as the ARCH effect was not found to be significant for them.

Positive and statistically significant CARs at 1% level of significance were observed for Nifty Energy, Nifty Healthcare, Nifty IT and Nifty Pharma before the lockdown [-1,0]. Only Nifty Bank experienced negative CAR a day before the event (significant at 1% level). A large number of sectors such as Auto, Healthcare, Infrastructure and Media experienced negative and statistically significant CAR after the event [0,-1]. IT sector showed positive and statistically significant CAR both before and after the event for a window period [-1,0,1]. The CAR of the Realty

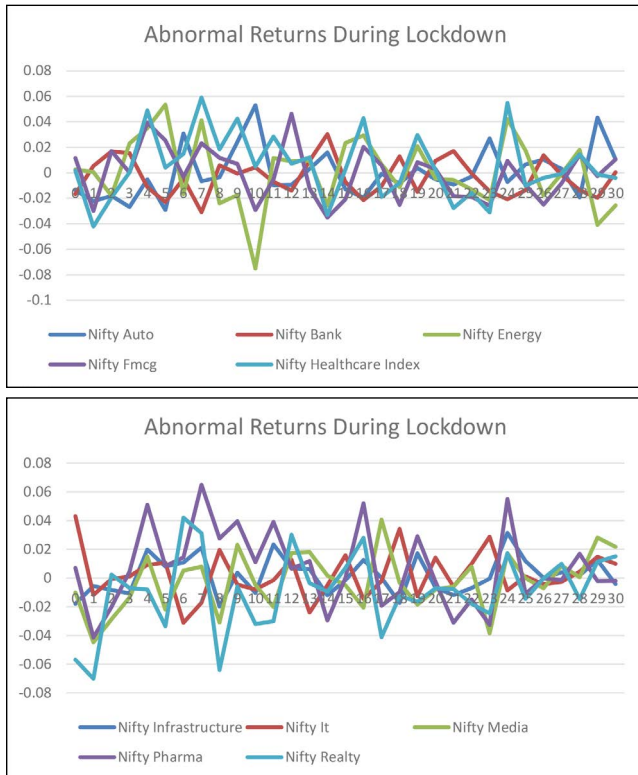


Figure 5 (a) and 5(b). Abnormal returns during lockdown.

sector was positive 2.27 percent one day before the event and negative 9.19 percent afterward, indicating a major drop in the Real Estate Sector returns.

Nifty Bank (-17.49%) and Nifty Auto (-9.93%) experienced very high negative CARs three days before the event (significant at 1% level). A large number of sectors such as Healthcare, Infrastructure, Media and Realty experienced negative and statistically significant CAR after the event [0,3]. The abnormal returns for the IT Index declined from 6.80% to 3.41% showing the impact of the lockdown. Most significant change was observed for Nifty Energy which was giving a high positive abnormal return of 11.16% before lockdown which was reduced to 0.78% three days after the event.

Five days before [-5,0] the lockdown maximum positive abnormal returns were observed for Nifty FMCG Index (13.05%) and maximum negative for Nifty Bank (-21.89%). Post lockdown, maximum positive abnormal return was observed for Nifty Energy (9.09%) and maximum negative abnormal returns for Nifty Auto (-16.92%). The decline in the Auto sector can be linked to the uncertainty related to vehicle sales due to the lockdown. Nifty Energy, Nifty FMCG and Nifty IT

Indices were giving positive and statistically significant returns before and after the lockdown showing the emerging relevance of these sectors.

Ten-day window [-10,0] exhibited similar pattern as the five-day event window [-5,0], with maximum negative abnormal returns for the Nifty Bank (-19.37%) and maximum positive for Nifty FMCG [10.98%] before lockdown. Post lockdown [0,10], the maximum positive abnormal returns were observed for Nifty Pharma (15.64%) and maximum negative abnormal returns were Nifty Realty (-14.61%). Nifty Energy which was giving an abnormal positive return of 9.30% before lockdown reduced to 0.44 % ten days post lockdown. Nifty FMCG, Nifty Healthcare and Nifty Pharma gave abnormal positive and statistically significant returns ten-day before and ten-day after lockdown [-10,0,10].

For the twenty-day event window [-20,0], Nifty Bank continued to give highly negative abnormal returns (-19.77%). High positive abnormal returns were observed for Nifty Healthcare (14.73%) and Nifty Pharma (14.14%) twenty days before the lockdown. Nifty FMCG which was giving an abnormal positive return of 13.13% [-20,0] reduced to negative abnormal returns of -2.06% [0,20] twenty days after the lockdown was imposed. The abnormal returns on Nifty Healthcare and Nifty Pharma, increased from 14.73% [-20,0] to 20.72% [0,20] for Nifty Healthcare and increased from 14.14% [-20,0] to 22.90% [0,20] for Nifty Pharma. A similar trend was observed for the thirty-day event window.

When the event window was extended to 254 days, i.e., it includes the period of lockdown, unlock and six months post lockdown, many changes in the analysis were observed. Maximum negative and statistically significant returns were found for Nifty Media (-39.76%). Post lockdown [0, 254], maximum positive and statistically significant abnormal returns were observed for Nifty IT (40.37%). Hence, those investors who invested in the IT sector gained significant abnormal returns.

When we analyze all the periods taken together index-wise, we observe that before lockdown Nifty Auto and Nifty Bank Index exhibits negative and statistically significant losses. Positive abnormal statistically significant returns were observed for Nifty Energy, Nifty FMCG, Nifty Healthcare, Nifty IT and Nifty Pharma. Post Lockdown abnormal statistically significant losses were observed for Nifty Auto, Nifty Bank, Nifty Healthcare, Nifty Infrastructure, Nifty Media and Nifty Realty. This clearly shows the negative impact of lockdown on most

of the indices. Positive abnormal statistically significant returns were observed for Nifty Energy, Nifty FMCG, Nifty Healthcare, Nifty IT and Nifty Pharma. This clearly shows the rising relevance of Energy, FMCG, Healthcare, IT and Pharma sector during the lockdown imposed due to the pandemic as the abnormal positive returns have increased in these sectors. Infrastructure, Media and realty sectors have been severely affected due to the lockdown.

Figure 6 shows the Cumulative Abnormal Returns (CAR) before the lockdown of the ten sectoral indices under study. Nifty Energy, Nifty Media and Nifty Bank showed negative CARs on most of the periods before lockdown. Healthcare, Pharma, FMCG exhibited positive CAR on most of the window periods. The CAR in Nifty Realty was close to zero. Figure 7 depicts the CAR of indices under study after the lockdown was imposed on 24th March 2020. Nifty Healthcare, Nifty IT, Nifty Pharma exhibited high positive CARs particularly in the 254-day window period post lockdown. CARs in the Bank, Auto,

Media and Realty sectors were negative. The positive CAR in FMCG sector experienced before the lockdown was now neutralized and close to zero post lockdown except for the 254-day window period where this sector experienced high negative CAR.

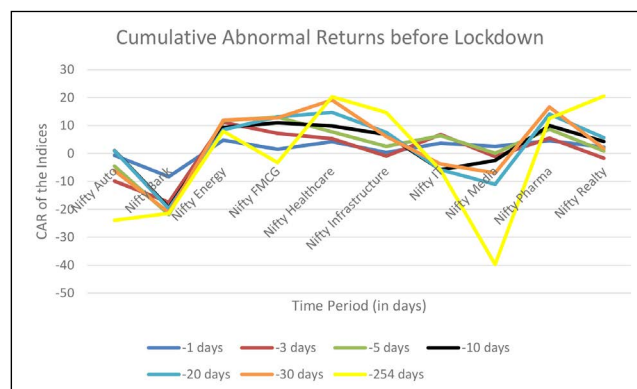


Figure 6. CARs of the indices before lockdown.

Table 8. Standardized Cumulative Abnormal Returns (CAR) before Lockdown

Index/ Event Window	-1	-3	-5	-10	-20	-30	-254
Nifty Auto GARCH (1,1)	-0.6543 (-0.4627)	-9.9302* (-4.9651)	-4.5408*** (-1.8538)	1.0441 (0.3148)	0.9889 (0.2158)	-6.1625 (-1.1068)	-23.9795 (-1.5017)
Nifty Bank GARCH (1,1)	-8.3151* (-5.8797)	-17.4954* (-8.7477)	-21.8883* (-8.9358)	-19.3743* (-5.8416)	-19.7687* (-4.3139)	-21.1330* (-3.7956)	-21.4380 (-1.3425)
Nifty Energy GARCH (1,1)	4.7753* (3.3766)	11.1592* (5.5796)	11.7486* (4.7963)	9.3024* (2.8048)	8.4935*** (1.8534)	11.9742 ** (2.1506)	7.9679 (0.4990)
Nifty FMCG GARCH (1,1)	1.5246 (1.0781)	7.1735* (3.5867)	13.0450* (5.3256)	10.9843* (3.3119)	13.1250* (2.8641)	12.7833** (2.2960)	-3.2244 (-0.2019)
Nifty Healthcare MM Model	4.2364* (2.9956)	5.2825* (2.6412)	7.7551* (3.1660)	9.8622* (2.9736)	14.7318* (3.2148)	19.1435* (3.4383)	20.3244 (1.2728)
Nifty Infrastructure MM Model	0.3667 (0.2593)	-0.9128 (-0.4564)	2.5105 (1.0249)	6.8249** (2.0578)	7.5738*** (1.6527)	6.0453 (1.0858)	14.6619 (0.9182)
Nifty IT GARCH (1,1)	3.6504* (2.5812)	6.8083* (3.4041)	6.4117* (2.6176)	-5.7961*** (-1.7476)	-5.7961 (-1.2648)	-3.7757 (-0.6781)	-6.0403 (-0.3783)
Nifty Media GARCH (1,1)	2.5016*** (1.7689)	-1.1504 (-0.5752)	0.0962 (0.0393)	-2.5289 (-0.7625)	-11.0227** (-2.4053)	-6.9881 (-1.2551)	-39.7638** (-2.4901)
Nifty Pharma MM Model	4.5501* (3.2174)	5.4731* (2.7365)	8.7142* (3.5576)	9.9590* (3.0027)	14.1436* (3.0864)	16.6309* (2.9870)	12.5586 (0.7864)
Nifty Realty MM Model	2.2783 (1.6110)	-1.6625 (-0.8312)	0.9032 (0.3687)	4.3077 (1.2988)	5.6302 (1.2286)	1.7913 (0.3217)	20.5497 (1.2869)

Note: Values in parenthesis indicates t-values of the test-statistics.

- *indicates significance at 0.01
- **indicates significance at 0.05
- ***indicates significance at 0.10

Table 9. Standardized Cumulative Abnormal Returns (CAR) after Lockdown

Index/ Event Window	+1	+3	+5	+10	+20	+30	+254
Nifty Auto GARCH (1,1)	-5.2711* (-3.7272)	-11.8815* (-5.9407)	-16.9244* (-6.9094)	-2.4824 (-0.7485)	-8.8807*** (-1.9379)	0.2906 (0.0522)	9.7144 (0.6083)
Nifty Bank GARCH (1,1)	-2.1059 (-1.4891)	3.9159** (1.9580)	-2.5090 (-1.0243)	-7.3853** (-2.2268)	-9.8763** (-2.1552)	-19.8386* (-3.5631)	-15.4504 (-0.9675)
Nifty Energy GARCH (1,1)	0.2938 (0.2077)	0.7757 (0.3878)	9.0879* (3.7101)	0.4430 (0.1336)	6.9807 (1.5233)	2.5340 (0.4551)	-23.3559 (-1.4626)
Nifty FMCG GARCH (1,1)	-2.4182*** (-1.7099)	-0.1467 (-0.0734)	8.3479* (3.4080)	7.6765** (2.3146)	-2.0602 (-0.4496)	9.6043*** (1.7250)	-26.4812*** (-1.6583)
Nifty Healthcare MM Model	-4.2533* (-3.0075)	-6.2489* (-3.1244)	-0.7169 (-0.2927)	13.9242* (4.1983)	20.7188* (4.5212)	18.0588* (3.2435)	14.5491 0.9111
Nifty Infrastructure MM Model	-3.9302* (-2.7791)	-7.0894* (-3.5447)	-2.4564 (-1.0028)	-1.5791 (-0.4761)	3.1302 (0.6831)	9.4317*** (1.6940)	8.1202 (0.5085)
Nifty IT GARCH (1,1)	3.3844** (2.3932)	3.4151*** (1.7076)	5.5622** (2.2707)	1.0689 (0.3223)	2.8983 (0.6325)	7.9895 (1.4350)	40.3727** (2.5282)
Nifty Media GARCH (1,1)	-4.5135* (-3.1915)	-8.0055* (-4.0027)	-8.5811* (-3.5032)	-8.5584* (-2.5804)	-8.3652*** (-1.8254)	-5.6888 (-1.0217)	-21.0181 (-1.3162)
Nifty Pharma MM Model	-3.2457** (-2.2951)	-4.7321** (-2.3661)	0.8441 (0.3446)	15.6354* (4.7142)	22.9042* (4.9981)	20.6689* (3.7122)	22.3557 (1.4000)
Nifty Realty MM Model	-9.1941* (-6.5012)	-9.5262* (-4.7631)	-12.5308* (-5.1157)	-14.6123* (-4.4058)	-18.6309* (-4.0656)	-20.5360* (-3.6884)	-18.3375 (-1.1483)

Note: Values in parenthesis indicate t-values of the test-statistics.

*indicates significance at 0.01

**indicates significance at 0.05

***indicates significance at 0.10

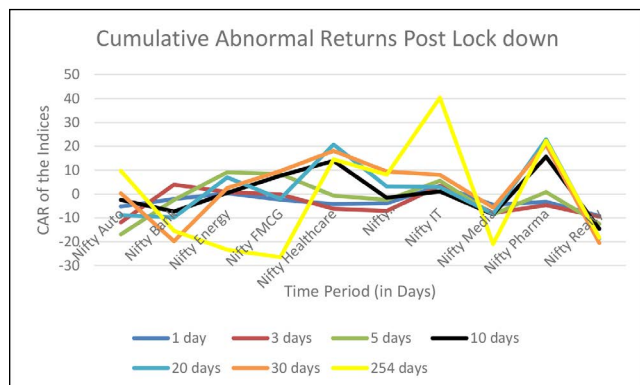


Figure 7. CAR of the indices post lockdown.

4.4 Dummy Variable Regression Model

The robustness of the results obtained by using Event Study Methodology- MM and GARCH (1,1) model is verified by using Dummy Variable Regression Model. Table 10 below shows the impact of various announcements made by the Government of India regarding Lockdown, unlock on nifty 50 and its sectoral index returns.

From the results it can be observed that the Nifty 50 and all its sectoral indices are negatively affected by the volatility of their returns providing evidence for the presence of volatility in the market and its significant impact. The coefficient of lockdown is positive and statistically significant in 10 out of 11 cases indicating that the stock markets were strengthening during the period of lockdown and showing a mark of the significant step taken by the Government of India. Similar signs are observed during unlock and post-unlock periods. The message of our results is that the effect of various announcements made by the Government of India regarding the Lockdown and unlock on stock indices listed on the National stock exchange is positive. In other words, each day of lockdown imposed improved the stock indices returns. Stock index returns of nifty auto and nifty pharma were improving by more than 1.08% each day of lockdown showing a healthy sign of recovery from the loss caused by the havoc of Covid-19 and therefore lockdown, helped in mitigating the effect of Covid-19 on stock markets. The results of the regression model

Table 10. Effect of National Lockdown and Unlock on Stock Indices Returns

Stock Indices	c Intercept	β_1 Returns _{t-1}	β_2 Volatility	β_3 Lockdown	β_4 Unlock	β_5 Post-lock	Adjusted R ²
Nifty 50	0.0006* (0.0787)	-0.0265 (0.2826)	-5.7614*** (0.0000)	0.0089*** (0.0000)	0.0020* (0.0923)	0.0024** (0.0171)	0.1120
Nifty Auto	0.0001 (0.7695)	0.0029 (0.9105)	-3.3213*** (0.0000)	0.0108*** (0.0000)	0.0033** (0.0409)	0.0024* (0.0891)	0.0389
Nifty Bank	0.0007 (0.1315)	0.0232 (0.3547)	-3.9793*** (0.0000)	0.0086*** (0.0004)	0.0019 (0.2494)	0.0041*** (0.0036)	0.0770
Nifty Energy	0.0011*** (0.0054)	-0.0448* (0.0774)	-5.4578*** (0.0000)	0.0087*** (0.0000)	0.0017 (0.2399)	0.0016 (0.2123)	0.0604
Nifty FMCG	0.0004 (0.1823)	-0.0236 (0.3642)	-2.5677*** (0.0000)	0.0058*** (0.0011)	-2.91E-05 (0.9813)	0.0011 (0.2995)	0.0155
Nifty Healthcare Index	0.0001 (0.7219)	0.0253 (0.3252)	-3.9675*** (0.0000)	0.0092*** (0.0000)	0.0029** (0.0319)	0.0008 (0.4751)	0.0296
Nifty Infrastructure	0.0004 (0.1877)	-0.0247 (0.3257)	-5.5518*** (0.0000)	0.0097*** (0.0000)	0.0013 (0.3502)	0.0027** (0.0201)	0.0756
Nifty IT	0.0004 (0.2136)	-0.0695*** (0.0070)	-3.2870*** (0.0000)	0.0060*** (0.0034)	0.0045*** (0.0015)	0.0025** (0.0407)	0.0289
Nifty Media	0.0009* (0.0583)	-0.0145 (0.5540)	-5.4822*** (0.0000)	0.0065** (0.0114)	0.0046** (0.0105)	0.0007 (0.6522)	0.1142
Nifty Pharma	-0.0001 (0.7047)	0.0065 (0.7992)	-2.4826*** (0.0005)	0.0108*** (0.0000)	0.0029* (0.0556)	0.0009 (0.4630)	0.0203
Nifty Realty	0.0018*** (0.0010)	0.0393 (0.1126)	-5.7822*** (0.0000)	0.0046 (0.1181)	0.0025 (0.2329)	0.0038** (0.0327)	0.0876
Total number of significant cases	4/11	2/11	11/11	10/11	6/11	6/11	

Note: Values in parenthesis indicate t-values of the test-statistics.

*indicates significance at 0.10

**indicates significance at 0.05

***indicates significance at 0.01

Table 11. Effect of National Lockdown and Unlock on Stock Indices Volatility

Stock Indices	β_1 Lockdown	β_2 Unlock	β_3 Post-lock
Nifty 50	0.0008*** (0.0000)	0.0001* (0.0852)	0.0001** (0.0216)
Nifty Auto	0.0013*** (0.0000)	0.0002** (0.0128)	0.0002*** (0.0041)
Nifty Bank	0.0016*** (0.0000)	0.0004*** (0.0025)	0.0003*** (0.0006)
Nifty Energy	0.0006*** (0.0000)	0.0002*** (0.0016)	0.0002*** (0.0006)
Nifty FMCG	0.0005*** (0.0000)	7.45E-05 (0.1665)	9.30E-05** (0.0406)
Nifty Healthcare Index	0.0005*** (0.0000)	0.0002*** (0.0000)	0.0001*** (0.0004)
Nifty Infrastructure	0.0006*** (0.0000)	0.0001** (0.0239)	0.0002*** (0.0056)

Nifty IT	0.0007*** (0.0000)	0.0002*** (0.0003)	0.0002*** (0.0000)
Nifty Media	0.0008*** (0.0000)	0.0004*** (0.0002)	0.0003*** (0.0029)
Nifty Pharma	0.0006*** (0.0000)	0.0003*** (0.0000)	0.0002*** (0.0001)
Nifty Realty	0.0009*** (0.0000)	0.0004*** (0.0001)	0.0004*** (0.0001)
Total number of significant cases	11/11	10/11	11/11

Note: Values in parenthesis indicate t-values of the test-statistics.

*indicates significance at 0.10

**indicates significance at 0.05

***indicates significance at 0.01

are in line with the results of event study methodology providing support to the robustness of results.

Further, the impact of various announcements made by the government on stock indices volatility is presented in Table 11 and it is found that the announcements made by government regarding lockdown and unlock down significantly affected the stock indices volatility which in turn affected the stock indices returns.

5. Conclusions and Policy Implications

As the world witnessed uncertainty with the extremely fast spread of the coronavirus it was the prerogative of the national governments to address this complex situation. To control the community spread of pandemic Covid-19, the Government of India took many important steps and measures. One strategic measure was to impose a lockdown on March 24, 2020. This research paper is an attempt to study the behavior of Indian stock markets amidst Covid-19 uncertainties with the imposition of Lockdown and post-lockdown. The immediate effect of the outbreak of Covid-19 is found to be negative on the stock market as can be observed from the negative abnormal returns in the post-event periods. The mean returns were mostly negative before the lockdown showing the negative impact of Covid-19. The negative effect of the pandemic got reversed due to stringent measures like lockdown. The coefficient of Lockdown is found to be positive in all cases indicating the strengthening of the stock market taking place to the precautionary measures taken by the government of India by announcing Lockdown and travel bans. These policy measures of government helped

in strengthening the economy in general and the stock market in particular.

The results of regression tests conducted as well as event study methodology show that Lockdown had a positive impact on the mean returns during the lockdown and unlock period. The mean returns which were mostly negative before the lockdown showed the negative impact of Covid-19 got reversed due to the stringent measures like lockdown. During the post-unlock phase, only the media sector had negative mean returns. Analysis of Friedman's ANOVA test results showed that the returns on the eleven indices significantly changed over the four periods namely before Lockdown, Lockdown, Unlock and Post Unlock. The highest mean return and highest standard deviation of returns were observed during the lockdown. Post hoc analysis using Wilcoxon Signed Ranks tests and after applying Bonferroni correction revealed that the returns significantly changed from before lockdown to during lockdown and from lockdown to unlock. However, returns did not significantly change from period of unlock to post unlock. Maximum negative abnormal negative returns are observed for Realty and the media sector during the lockdown. Also, fifteen days before the lockdown not much difference in the abnormal returns is observed for all the ten indices. The ARCH effect was present for Nifty Auto, Nifty Bank, Nifty Energy, Nifty FMCG, Nifty IT and Nifty Media and hence the estimated returns on them have been calculated using the GARCH (1,1) model. Estimated returns on Nifty Healthcare, Nifty Infrastructure, Nifty Pharma and Nifty Realty have been computed using the Ordinary Least Square (OLS) Market model (OLS-MM) as the arch effect was not present in them.

For the one-day event window, only Nifty Bank experienced negative Cumulative abnormal return (CAR) before the lockdown, but after the lockdown, Auto, Healthcare, Infrastructure and Media experienced negative CARs. Realty sector which had a positive CAR of 2.27% before the lockdown experienced a -9.19% CAR after the lockdown. This change could primarily be due to the increased uncertainty that had arisen due to the nationwide lockdown. Sectors such as IT were not much impacted as they can easily shift to Work from Home “WFM” format without much disrupting the business. Nifty Bank (-17.49%) and Nifty Auto (-9.93%) were bleeding with high negative CARs three days before the lockdown. This may be because the central bank in India i.e., Reserve Bank of India was expected to reduce the policy rates and secondly introduce a moratorium on the collection of money on outstanding loans by banks. Reduction in policy rates is associated with lower rates on bank loans and hence lower income for banks. Negative CARs are witnessed in the auto sector as the demand for automobiles declined due to uncertainty associated with the tenure of lockdown. The market could anticipate such changes and hence abnormal returns are visible even three days before the lockdown. Auto sector was in red even three days after the announcement of lockdown with negative returns of -9.93%. Most of the sectors experienced negative CARs like Healthcare, Infrastructure, Media and the Realty sector. Even returns for the IT sector reduced from 6.8% to 3.41% percent showing the negative impact of lockdown over the three days. The energy sector was worst affected as it had a positive CAR of 11.16% before lockdown but this reduced to 0.78% three days after the lockdown. Five days before the lockdown maximum positive CAR was observed for the Nifty FMCG index of 13.05% and maximum negative CAR for Nifty Bank of -21.89%. Five days after the lockdown maximum positive CAR was observed for Nifty Energy of 9.09% and maximum negative CAR for Nifty Auto of -16.92%. Nifty Energy, Nifty FMCG and Nifty IT had positive CAR five days before and after the lockdown. This exhibited the intrinsic strength of Energy, FMCG and the IT sector.

Ten-day event window exhibited a similar pattern as the five-day event window in the period before lockdown but ten days post lockdown maximum positive CAR was observed for Nifty Pharma of 15.64% and maximum negative for Nifty Realty of -14.61%. Returns in the pharma sector increased due to an anticipated increase in

consumption of medicines for those who would get sick due to Covid-19. The realty sector had negative returns as the demand for the same plummeted. The demand for Commercial real estate suffered as several businesses would continue with WFH for almost another year. Real Estate for housing also suffered as several people shifted from urban areas to rural areas leading to a fall in the demand for housing property for self-living and rentals. For a twenty days event window before and after the lockdown Nifty Health and Nifty Pharma had positive CARs within the range of 12.14% to 22.90%. Nifty FMCG, which was giving a positive CAR of 13.13% twenty days before lockdown, was now giving a -2.06% return. A similar trend continued over the thirty-day event window.

Over a very long period of 254 days before the lockdown maximum negative CAR was for Nifty Media of -39.76%. Post lockdown, maximum positive CAR was observed for Nifty IT of 40.37%. We found that before lockdown, Nifty Auto and Nifty Bank Index were giving negative CARs and positive CARs were observed for Nifty Energy, Nifty FMCG, Nifty Healthcare, Nifty IT and Nifty Pharma. Post lockdown negative CARs were observed for Nifty Auto, Nifty Bank, Nifty Infrastructure, Nifty Media and Nifty Realty. Positive CARs were observed in Nifty Energy, Nifty FMCG, Nifty Healthcare, Nifty IT and Nifty Pharma. Most affected sectors due to the lockdown included Infrastructure, Media and Real Estate.

The coefficient of lockdown was positive and statistically significant indicating that the stock markets were strengthening during the period of lockdown and showing a mark of the significant step taken by the Government of India. Nifty 50 and its sectoral index returns were improving on each day of lockdown. Hence, it can be concluded that the announcement regarding lockdown and unlock on aggregate had a positive effect on the stock market and helped in mitigating the effect of Covid-19.

The paper highlights the relevance of investing in sectors like Energy, FMCG, Healthcare, IT and Pharma during uncertain times that have arisen due to lockdown due to Covid-19. Also, investors should invest very carefully in Banking, Auto, Media, Infrastructure and Real Estate sectors which have got negatively affected due to the lockdown. Investors can take clues from the current research and use the results for making right portfolio allocations during the second and third waves that may hit the world globally in coming times. A lot of existing literature exists that analyses the impact of Covid-19 on

stock indices of countries. Our work is novel in a way that once it has been established that country's indices showed greater negative abnormal returns by Liu¹⁷, we have further gone ahead and investigated the sectors that have benefitted or lost heavily due to Covid-19. The results may be further tested by researchers all across the world to generalize the finding.

6. Statement of Data Availability

On reasonable request, the corresponding author will provide the data that supports the conclusions of this study.

7. Declaration of Interest

None

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