

ANALYSIS OF INDIAN STOCK MARKET DURING COVID-19

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INTRODUCTION.

The most unexpected pandemic to strike our world was COVID 19. countries across the world are facing severe damages. Saving lives is the most challenging task that want to manage countries of the entire world. Covid-19 which has spread across the world has started from Wuhan, China. Though the spread is high in USA and Europe, India is also witnessing sharp increase in COVID'19 cases. As on 1st May 2020 about 25000 people in India have been affected by Covid-19. Lockdown and Social Distancing was the primary action that was took by the Government of majority of the countries. However, country wise lock down leads to economic slowdown. The result was fall in foreign capital flows, crude oil prices, job losses and stagflation. Social distancing rise in social unrest. According to Ministry of Health and Family Welfare, Government of India, the most important factor in preventing the spread of the corona virus locally is to empower the citizens with right information and taking precautions as per the advisories being used by Government. In this study I had tried to seek the reasons for Indian stock market volatility during Covid-19 pandemic. In the last two years, several industries that had strong financial situations have suffered greatly due to the global lockdown happened in our world. The pandemic is currently the most important force influencing India's economic structure also. We have started to revive the industries that are negatively impacted by the epidemic in the current situation. One of the most important sources for bolstering the financial foundation of our economy is the stock market. Therefore, I believed that the stock market's volatility and recovery during this pandemic was a pertinent topic that would also aid in the recovery of other industries. The main objective of this study is to identify the variables that are influenced by changes in stock market prices during the Covid-19 pandemic. The primary indexes used in this analysis of stock price volatility in the Indian stock market during the epidemic are NSE NIFTY 50 and BSE SENSEX. Variables used in this study are monthly corona cases, monthly death rates, monthly recovery cases, and crude oil price. Examining stock price changes on the Indian stock market during the Covid-19 pandemic is the secondary objective. Final objective is to know the recovery movements in stock market from this pandemic.

REVIEW OF LITERATURE

(Chaudhary, Rashmi ;Bakhshi, Priti ;Gupta, 2022) in this study titled as "Performance of Indian Stock Market during Covid-19" was an attempt to analyse impact of covid-19 on two Indian Stock Market Composite indices and eight sectoral indices of BSE and compare the composite indices with three global indexes S&P 500, Nikkei 225 and FTSE 100.They used Basic Regression models, multiple measures of volatility ,namely standard deviation ,skewness and kurtosis of Index returns for their analysis part to reach a conclusion. Finally, they reach with a conclusion that relationship between indices is increased during the crisis and also found that Indian stock market show the same standard deviation compared to developed economies.

(Bakry et al., 2022) studied how covid 19 announcements and stringent government actions impacted stock market volatility. The main concentrated area is developed and emerging markets. they conclude that announcement of successful development of covid 19 vaccine increased the volatility in both markets and similar announcement of government had a different impact on volatility depending on whether they were made in developed or emerging markets contexts. Confirmed cases, death, recovery and stringency of policy government response on emerging and developed stock market are the variables used in this study. For estimating volatility asymmetric GJsten-Jagannathan-Runkle (GJR)-GARCH Model is applied.

Onali(2020) it is an investigation about impact of Covid-19 cases and related deaths on the US stock market. The result is based on GARCH (1,1) model, VAR Model, structural break and Markov switching models. They conclude that changes in the number of cases and death in the US and other countries heavily affected by the Covid-19 crisis in the first three months of 2020.Dow Jones and S&P returns are used to evaluate impact of covid-19 on US stock market.

Albulescu (2021) in which they talk about Covid-19 and the United States financial market volatility and they focus on the effect of the official announcements regarding the Covid-19 new cases

of infection and fatality ratio on the financial market volatility in the United States. Corona Virus pandemic is an important source of financial volatility. S&P 500 is used to measure the volatility for the US financial market and also conclude that fatality ratio has a significant and positive impact on volatility.

Chaudhary et al. (2020) here they try to figure out the influence of covid-19 on the return and volatility of the stock market indices of top 10 countries based on GDP. They applied GARCH model. Daily returns of market indices were considered for analysis. Finally, they conclude that exogenous variance is the reason for the positive and significant impact for all market indices.

(Sadiq et al., 2021) They focuses on the effect of covid-19 on emerging markets in seven of the Association of South East Asian Nation member countries. They focused that most negatively impacted industries were health care & consumer services due to the Covid 19 drug race and international travel restrictions. This study directly focuses on the analysis of the volatility index and the Covid-19 outbreak fear index during the development of Covid-19 pandemic. GARCH (1,1) Model, Heterogeneous auto regressive Model and ST-HAR are the models used in this study. They conclude that throughout the global financial history, periods of abnormally high capital market volatility have occurred.

(Daniel & Camelia, 2021) Investigate about the volatility of daily return on the Romanian Stock Market. They used index of Bucharest Stock Exchange. That is Bucharest Exchange trading index along with 12 companies traded on BSE. The study was conducted using GARCH approach. This study revealed strong evidence of volatility that lasts over time, a trend of high & low volatility periods is found. They identified that in the first quarter of 2020, capital market volatility in Romania increased to a level very close to that recorded during the global financial crisis of 2007-2009.

(Wajid & Noida, n.d.) They focuses on the stock market responses to the Covid-19 health crisis based on the world largest economies. In this study analyses the performance of world 20 largest economies stock market indices considering five major developments in relation to the global pandemic spread. They conclude that the stock market responded adversely to the covid 19 news. Various parametric and non-parametric tests are used to confirmed the results. They suggest that the declaration of novel Covid 19 as a pandemic was the most devastating event for stock markets.

(Kapalu & Kodongo, 2022) In this paper they study the effects of the covid 19 outbreak on the return on capital assets, namely bonds and stocks. they adopted a comparative analysis approach involving developed markets and emerging markets. They done event study, regression analysis and GARCH BEKK Model. They found that independent variables used in this study had a greater predictability power in bond yield than in stock returns. They also found that when covid 19 takes the form of infections. it has a significant positive effect on market such as Brazil ,India ,Russia ,South Africa and USA.

DATA AND METHODOLOGY

In this study my choice is to measure the performance of NSE and BSE stock markets during the pandemic period. For measuring the performance, I choose popular indices of NSE and BSE, that is NIFTY, SENSEX (Historical Values) respectively. This paper is used the following factors, monthly corona cases, death rates, recovery cases and crude oil prices in India to measure the performance of BSE and NSE indices. Pandemic details and stock prices are collected from Worldometer and official website of stock markets respectively

Table 1: Data Description about variables used in this study.

Monthly Data	MCI	MDI	RCI	COL	NSP	SSX
Jan-20	0	0	0	4396	0	40723
Feb-20	3	0	0	3812	11201	38297
Mar-20	1394	33	27	2393	8597	29468
Apr-20	33466	1047	690	1603	9859	33718
May-20	155746	4409	4309	2299	9580	32424
Jun-20	395183	11707	13497	2987	11302	34916

Jul-20	1053558	19336	36554	3156	11073	37607
Aug-20	2048589	7629	64449	3244	11387	38628
Sep-20	2622328	57770	85373	2984	11247	38068
Oct-20	1872614	22897	58292	2932	11642	39614
Nov-20	1280373	16927	42282	3142	12968	44150
Dec-20	8394669	10590	22024	3589	13981	47751
Jan-21	2363950	5446	14075	3919	13695	46286
Feb-21	337821	2958	11293	4399	14529	49100
Mar-21	1124229	5883	40442	4646	14691	49509
Apr-21	6936425	50663	299238	4685	14631	48782
May-21	9016561	136354	254975	4871	15582	51937
Jun-21	2236922	56901	62025	5281	15721	52483
Jul-21	1202217	20382	37314	5461	15763	52587
Aug-21	1198098	14425	36244	5109	17132	57552
Sep-21	954596	9934	28728	5359	17618	59126
Oct-21	520124	9996	14755	6147	17672	59307
Nov-21	311164	11199	9905	5953	16983	57065
Dec-21	242028	9515	7585	5505	17354	58254
Jan-22	6463636	15339	254076	6248	17340	58014
Feb-22	1621690	17974	16765	7019	16794	56247
Mar-22	101645	3122	1918	8570	17465	58569
Apr-22	50089	1404	2755	7878	17103	57061
May-22	85502	787	2236	8512	16585	55566
Jun-22	309916	509	13287	9120	15780	53019

Table 2: Representing the result of Average Returns, Standard Deviation and Variance of the past three years of NIFTY 50

Particulars	2020	2021	2022
Average Returns	1.65	1.52	-1.34
Standard Deviation	9.91	3.84	3.64
Variance	98.14	14.72	13.25

Note; From the above table, clearly seen that the highest volatility of NIFTY 50 returns was reported in 2020 compared to 2021 and half yearly data of 2022. Therefore we can conclude that covid 19 pandemic was reported in 2020 and it was adversely affected in volatility of returns in that particular period.

Table 3: Representing the result of Average Returns, Standard Deviation and Variance of the past three years of SENSEX 30

Particulars	2020	2021	2022
Average Returns	1.44	1.40	-1.34
Standard Deviation	9.96	4.03	3.59
Variance	99.14	16.24	12.91

Note: From the above table, we can see that highest volatility of SENSEX 30 returns was reported in 2020 compared to 2021 and half yearly data of 2022. reasons for such variability might be the pandemic effect.

Testing of Hypothesis:

In this study I am using Multiple Regression to check the performance level of Indian stock market by using four independent variables. Here I selected NIFTY 50 Price as Dependent variable to measure the performance of NSE and SENSEX 30 Price as Dependent variable to measure the performance of BSE. And selected Monthly Corona Cases, Monthly Death Rates, Monthly Recovery Cases and Crude Oil Prices as independent variable during the pandemic period.

NSE NIFTY

H0: Monthly Corona Cases and Death Rates in India have no significant impact on NSE NIFTY.

H1: Monthly Corona Cases and Death Rates have significant impact on NSE NIFTY.

H0: Monthly Death Rates and Recovery Cases in India have no significant impact on NSE NIFTY.

H1: Monthly Death Rates and Recovery Cases in India have significant impact on NSE NIFTY.

H0: Monthly Corona Cases and Crude Oil Prices in India have no significant impact on NSE NIFTY.

H1: Monthly Corona Cases and Crude Oil Prices in India have significant impact on NSE NIFTY.

BSE SENSEX

H0: Monthly Corona Cases and Death Rates in India have no significant impact on BSE SENSEX.

H1: Monthly Corona Cases and Death Rates have significant impact on BSE SENSEX.

H0: Monthly Death Rates and Recovery Cases in India have no significant impact on BSE SENSEX.

H1: Monthly Death Rates and Recovery Cases in India have significant impact on BSE SENSEX.

H0: Monthly Corona Cases and Crude Oil Prices in India have no significant impact on BSE SENSEX.

H1: Monthly Corona Cases and Crude Oil Prices in India have significant impact on BSE SENSEX.

$$Y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \dots + \beta_p x_{ip} + \epsilon$$

Where ,

for i = n observations

y_i = dependent variable

x_i = explanatory variables

β₀ = y-intercept (constant term)

B_p = slope coefficients for each explanatory variable

ε = the model's error term (also known as the residuals)

Result based on multiple regression

Table 4: Descriptive statistics of NSP, MCI and MDR

	NSP	MDR	MCI
Mean	13842.50	17504.53	1764485.
Median	14661.00	9965.000	1004077.
Maximum	17672.00	136354.0	9016561.
Minimum	0.000000	0.000000	0.000000
Std. Dev.	3817.587	27377.71	2523710.
Skewness	-1.650479	3.064115	1.870066
Kurtosis	6.669569	13.11373	5.273260
Jarque-Bera	30.45257	174.8035	23.94537
Probability	0.000000	0.000000	0.000006
Sum	415275.0	525136.0	52934536
Sum Sq. Dev.	4.23E+08	2.17E+10	1.85E+14
Observations	30	30	30

From the above table it shows about descriptive statistics of NSE NIFTY, Monthly Death Rates and Monthly Corona Cases.

Table 5: Result of Multiple Regression Analysis of NSP, MCI and MDR.

Dependent Variable: NSP

Method: Least Squares

Date: 02/11/23 Time: 17:24

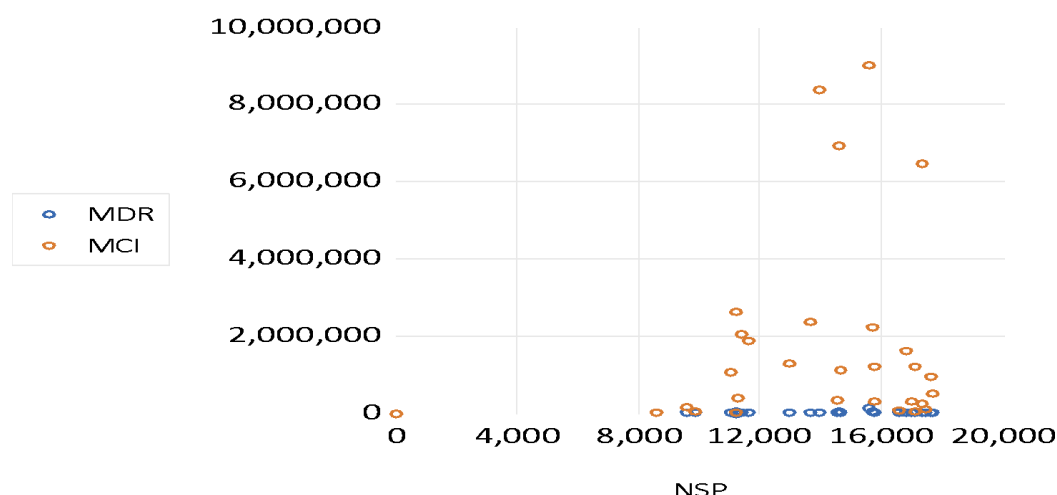
Sample (adjusted): 2020M01 2022M06

Included observations: 30 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13360.56	888.7645	15.03273	0.0000
MDR	0.005001	0.035534	0.140727	0.8891
MCI	0.000224	0.000385	0.579862	0.5668

R-squared	0.030207	Mean dependent var	13842.50
Adjusted R-squared	-0.041630	S.D. dependent var	3817.587
S.E. of regression	3896.239	Akaike info criterion	19.46805
Sum squared resid	4.10E+08	Schwarz criterion	19.60817
Log likelihood	-289.0208	Hannan-Quinn criter.	19.51288
F-statistic	0.420492	Durbin-Watson stat	0.384004
Prob(F-statistic)	0.660950		

Note: Based on the above table we can conclude that monthly corona cases and Monthly Death Rates have no significant impact on NSE NIFTY. Because both probability values of the variables are greater than .05. Coefficient of determination is only 3%. which means only 3 % of the variations in the NSE NIFTY are due to MDR and MCI.

**Figure 1: Showing the relationship between NSP, MCI and MDR.**

Note: Graph shows about the relationship between NSE NIFTY, Monthly Death Rates and Corona Cases in India.

Table 6: Covariance Analysis of NSP, MCI and MDR.

Covariance Analysis: Ordinary

Date: 02/11/23 Time: 17:25

Sample: 2020M01 2022M06

Included observations: 30

Balanced sample (listwise missing value deletion)

Covariance Correlation t-Statistic	NSP	MDR	MCI
NSP	14088168 1.000000 -----		
MDR	13603672 0.134646 0.719027	7.25E+08 1.000000 -----	
MCI	1.60E+09 0.171742 0.922480	4.46E+10 0.668507 4.756455	6.16E+12 1.000000 -----

Note: From the above table shows the covariance analysis about NSP, MDR and MCI. There is very low correlation between NSP and MDR as well as NSP and MCI.

Table 7: Descriptive statistics of NSP, MDR and RCI.

	NSP	MDR	RCI
Mean	13842.50	17504.53	47837.10
Median	14661.00	9965.000	15760.00
Maximum	17672.00	136354.0	299238.0
Minimum	0.000000	0.000000	0.000000
Std. Dev.	3817.587	27377.71	78629.60
Skewness	-1.650479	3.064115	2.339488
Kurtosis	6.669569	13.11373	7.183184
Jarque-Bera	30.45257	174.8035	49.23982
Probability	0.000000	0.000000	0.000000
Sum	415275.0	525136.0	1435113.
Sum Sq. Dev.	4.23E+08	2.17E+10	1.79E+11
Observations	30	30	30

Note: From the above table it shows about descriptive statistics of NSE NIFTY, Monthly Death Rates and Recovery Cases in India.

Table 8: Result of Multiple Regression Analysis of NSP, MDR and RCI

Dependent Variable: NSP

Method: Least Squares

Date: 02/11/23 Time: 21:24

Sample (adjusted): 2020M01 2022M06

Included observations: 30 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13413.40	863.8864	15.52681	0.0000
MDR	0.003223	0.036735	0.087750	0.9307
RCI	0.007791	0.012790	0.609086	0.5476
R-squared	0.031438	Mean dependent var		13842.50
Adjusted R-squared	-0.040308	S.D. dependent var		3817.587
S.E. of regression	3893.765	Akaike info criterion		19.46678
Sum squared resid	4.09E+08	Schwarz criterion		19.60690
Log likelihood	-289.0017	Hannan-Quinn criter.		19.51161
F-statistic	0.438186	Durbin-Watson stat		0.395304
Prob(F-statistic)	0.649713			

Note: Based on the above table we can conclude that Monthly Death Rates and Recovery Cases have no significant impact on NSE NIFTY. Because both probability values of the variables are greater than .05. Coefficient of determination is only 3%. Which means only 3 % of the variations in the NSE NIFTY are due to MDR and RCI.

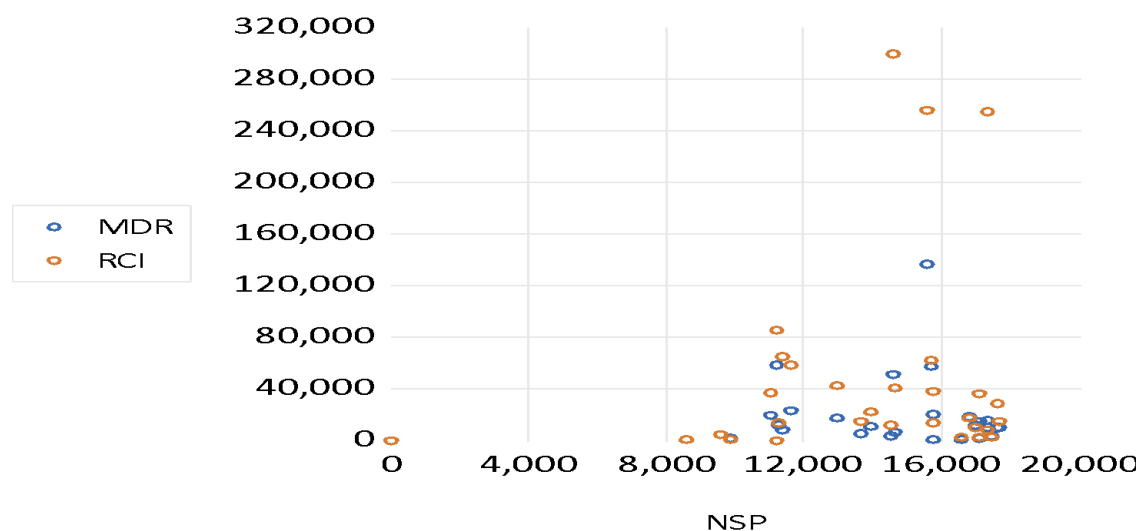


Figure2: Showing the relationship between NSP, MDR and RCI.

Note: Graph shows about the relationship between NSE NIFTY, Monthly Death Rates and Recovery Cases in India.

Table 9: Covariance Analysis of NSP, MDR and RCI

Covariance Analysis: Ordinary

Date: 02/11/23 Time: 21:23

Sample: 2020M01 2022M06

Included observations: 30

Balanced sample (listwise missing value deletion)

Covariance Correlation t-Statistic Probability	NSP	MDR	RCI
NSP	14088168 1.000000 ----- -----		
MDR	13603672 0.134646 0.719027 0.4781	7.25E+08 1.000000 ----- -----	
RCI	51222584 0.176526 0.948993 0.3507	1.45E+09 0.695064 5.115712 0.0000	5.98E+09 1.000000 ----- -----

Note: From the above table shows the covariance analysis about NSP, MDR and RCI. There is very low correlation between NSP and MDR as well as NSP and RCI.

Table 10: Descriptive Statistics of NSP, MCI and COL.

	NSP	MCI	COL
Mean	13842.50	1764485.	4840.633
Median	14661.00	1004077.	4665.500
Maximum	17672.00	9016561.	9120.000
Minimum	0.000000	0.000000	1603.000
Std. Dev.	3817.587	2523710.	1961.860
Skewness	-1.650479	1.870066	0.570090
Kurtosis	6.669569	5.273260	2.597368
Jarque-Bera	30.45257	23.94537	1.827652
Probability	0.000000	0.000006	0.400987
Sum	415275.0	52934536	145219.0
Sum Sq. Dev.	4.23E+08	1.85E+14	1.12E+08
Observations	30	30	30

Note: From the above table it shows about descriptive statistics of NSE NIFTY, Monthly Corona Cases and Crude Oil Prices.

Table 11: Result of Multiple Regression Analysis of NSP, MCI and COL

Dependent Variable: NSP

Method: Least Squares

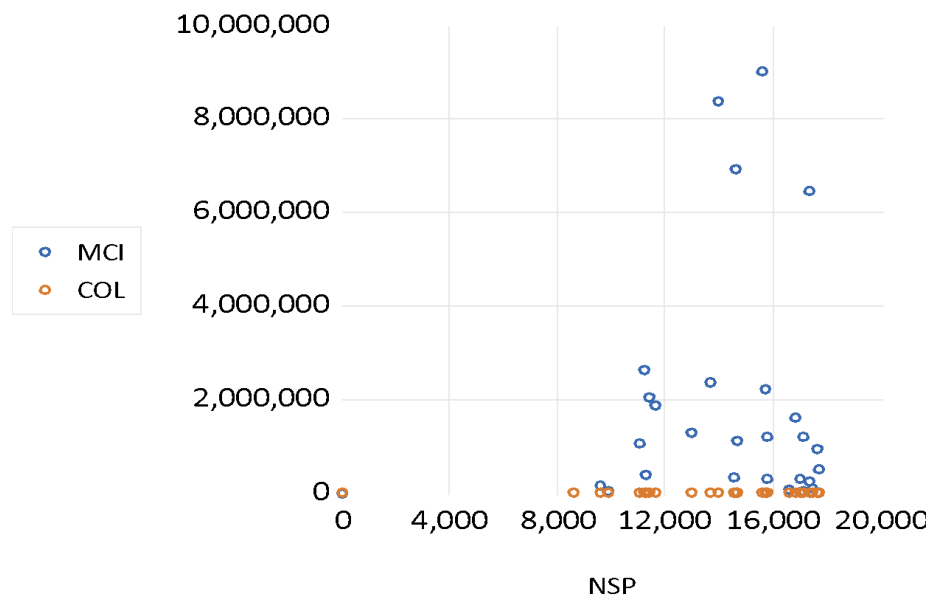
Date: 02/11/23 Time: 21:30

Sample (adjusted): 2020M01 2022M06

Included observations: 30 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7091.335	1527.539	4.642325	0.0001
MCI	0.000344	0.000216	1.589577	0.1236
COL	1.269354	0.278251	4.561902	0.0001
R-squared	0.451933	Mean dependent var	13842.50	
Adjusted R-squared	0.411335	S.D. dependent var	3817.587	
S.E. of regression	2929.025	Akaike info criterion	18.89737	
Sum squared resid	2.32E+08	Schwarz criterion	19.03749	
Log likelihood	-280.4605	Hannan-Quinn criter.	18.94219	
F-statistic	11.13200	Durbin-Watson stat	0.812537	
Prob(F-statistic)	0.000298			

Based on the above table we can conclude that Monthly Corona Cases have no significant impact on NSE NIFTY. However Crude Oil Prices have significant impact on NSE NIFTY. Because probability values of the COL are greater than 0.05. Coefficient of determination is 45%. Which means 45 % of the variations in the NSE NIFTY are due to MCR and COL.

**Figure 3: Showing the relationship between NSP, MCI and COL.**

Note: Graph shows about the relationship between NSE NIFTY, Monthly Corona Cases and Crude Oil Prices.

Table 12: Covariance Analysis of NSP, MCI and COL

Covariance Analysis: Ordinary
Date: 02/11/23 Time: 21:29
Sample: 2020M01 2022M06
Included observations: 30
Balanced sample (listwise missing value deletion)

Covariance Correlation t-Statistic Probability	NSP	MCI	COL
NSP	14088168 1.000000 ----- -----		
MCI	1.60E+09 0.171742 0.922480 0.3642	6.16E+12 1.000000 ----- -----	
COL	4582602. 0.632963 4.326279 0.0002	-4.08E+08 -0.085168 -0.452309 0.6545	3720597. 1.000000 ----- -----

Note: From the above figure is the results about covariance analysis. There is low correlation between MCI and NSP. COL has moderate correlation.

Table13: Descriptive statistics of BSE SENSEX, MCI and MDR

	SSX	MCI	MDR
Mean	47860.93	1764485.	17504.53
Median	49304.50	1004077.	9965.000
Maximum	59307.00	9016561.	136354.0
Minimum	29468.00	0.000000	0.000000
Std. Dev.	9332.631	2523710.	27377.71
Skewness	-0.401242	1.870066	3.064115
Kurtosis	1.809986	5.273260	13.11373
Jarque-Bera	2.575143	23.94537	174.8035
Probability	0.275940	0.000006	0.000000
Sum	1435828.	52934536	525136.0
Sum Sq. Dev.	2.53E+09	1.85E+14	2.17E+10
Observations	30	30	30

Note: From the above table it shows about descriptive statistics of BSE SENSEX, Monthly Corona Cases and Monthly Death Rates.

Table 14: Result of Multiple Regression Analysis of SSX, MCI and MDR

Dependent Variable: SSX

Method: Least Squares

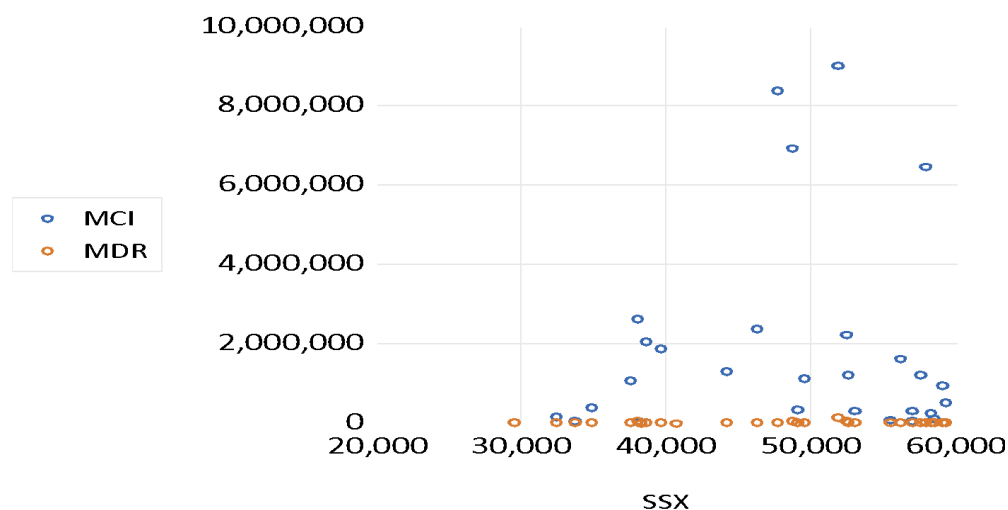
Date: 02/11/23 Time: 22:11

Sample (adjusted): 2020M01 2022M06

Included observations: 30 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	47032.66	2186.869	21.50685	0.0000
MCI	0.000534	0.000949	0.562861	0.5782
MDR	-0.006498	0.087435	-0.074323	0.9413
R-squared	0.017527	Mean dependent var	47860.93	
Adjusted R-squared	-0.055249	S.D. dependent var	9332.631	
S.E. of regression	9586.976	Akaike info criterion	21.26884	
Sum squared resid	2.48E+09	Schwarz criterion	21.40896	
Log likelihood	-316.0326	Hannan-Quinn criter.	21.31366	
F-statistic	0.240829	Durbin-Watson stat	0.104696	
Prob(F-statistic)	0.787646			

Note: Based on the above table we can conclude that Monthly Death Rates and Monthly Corona Cases have no significant impact on BSE SENSEX. Because both probability values of the variables are greater than .05. Coefficient of determination is only 1.7 %. Which means only 1.7 % of the variations in the BSE SENSEX are due to MCI and MDR.

**Figure 4: Showing the relationship between NSP, MCI and COL.**

Note: Graph shows about the relationship between SSX, Monthly Death Rates and Monthly Corona Cases.

Table: 15: Covariance Analysis of SSX, MCI and MDR

Covariance Analysis: Ordinary

Date: 02/11/23 Time: 22:09

Sample: 2020M01 2022M06

Included observations: 30

Balanced sample (listwise missing value deletion)

Covariance Correlation t-Statistic Probability	SSX	MCI	MDR
SSX	84194743 1.000000 ----- -----		
MCI	3.00E+09 0.131626 0.702615 0.4881	6.16E+12 1.000000 ----- -----	
MDR	19129101 0.077449 0.411057 0.6842	4.46E+10 0.668507 4.756455 0.0001	7.25E+08 1.000000 ----- -----

Note: From the above figure is the results about covariance analysis. There is low correlation between MCI and MDR.

Table 16: Descriptive statistics of SSX, MDR and RCI

	SSX	MDR	RCI
Mean	47860.93	17504.53	47837.10
Median	49304.50	9965.000	15760.00
Maximum	59307.00	136354.0	299238.0
Minimum	29468.00	0.000000	0.000000
Std. Dev.	9332.631	27377.71	78629.60
Skewness	-0.401242	3.064115	2.339488
Kurtosis	1.809986	13.11373	7.183184
Jarque-Bera	2.575143	174.8035	49.23982
Probability	0.275940	0.000000	0.000000
Sum	1435828.	525136.0	1435113.
Sum Sq. Dev.	2.53E+09	2.17E+10	1.79E+11
Observations	30	30	30

Note: From the above table it shows about descriptive statistics of BSE SENSEX, Monthly Death Rates and Recovery Cases in India.

Table 17: Result of Multiple Regression Analysis of SSX, MDR and RCI.

Dependent Variable: SSX

Method: Least Squares

Date: 02/11/23 Time: 22:21

Sample (adjusted): 2020M01 2022M06

Included observations: 30 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	47140.15	2123.500	22.19927	0.0000
MDR	-0.013642	0.090297	-0.151078	0.8810
RCI	0.020059	0.031440	0.638015	0.5288
R-squared	0.020762	Mean dependent var	47860.93	
Adjusted R-squared	-0.051774	S.D. dependent var	9332.631	
S.E. of regression	9571.178	Akaike info criterion	21.26554	
Sum squared resid	2.47E+09	Schwarz criterion	21.40566	
Log likelihood	-315.9831	Hannan-Quinn criter.	21.31037	
F-statistic	0.286226	Durbin-Watson stat	0.128844	
Prob(F-statistic)	0.753343			

Note: Based on the above table we can conclude that Monthly Death Rates and Recovery Cases in India have no significant impact on BSE SENSEX. Because both probability values of the variables are greater than 0.05. Coefficient of determination is only 2 %. Which means only 2 % of the variations in the BSE SENSEX are due to MDR and RCI.

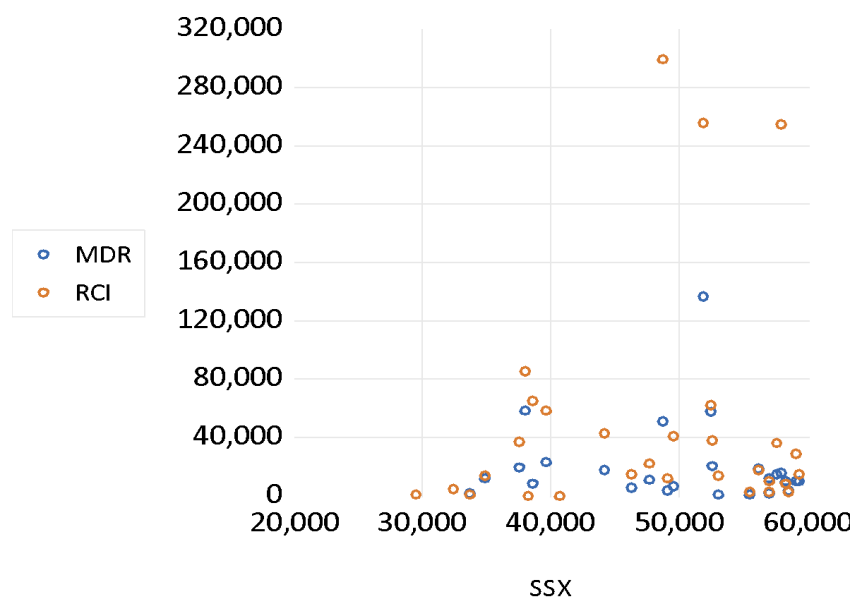


Figure5: Showing the relationship between SSX, MDR and RCI.

Note: Graph shows about the relationship between SSX, Monthly Death Rates and Recovery Cases in India.

Table 18: Covariance Analysis of SSX, MDR and RCI.

Covariance Analysis: Ordinary

Date: 02/11/23 Time: 22:16

Sample: 2020M01 2022M06

Included observations: 30

Balanced sample (listwise missing value deletion)

Covariance Correlation t-Statistic Probability	SSX	MDR	RCI
SSX	84194743 1.000000 ----- -----		
MDR	19129101 0.077449 0.411057 0.6842	7.25E+08 1.000000 ----- -----	
RCI	1.00E+08 0.141188 0.754654 0.4568	1.45E+09 0.695064 5.115712 0.0000	5.98E+09 1.000000 ----- -----

Note: From the above figure is the results about covariance analysis. There is moderate correlation between SSX and MDR as well as low correlation about SSX and RCI.

Table 19: Descriptive statistics of SSX, MCI and COL.

	SSX	MCI	COL
Mean	47860.93	1764485.	4840.633
Median	49304.50	1004077.	4665.500
Maximum	59307.00	9016561.	9120.000
Minimum	29468.00	0.000000	1603.000
Std. Dev.	9332.631	2523710.	1961.860
Skewness	-0.401242	1.870066	0.570090
Kurtosis	1.809986	5.273260	2.597368
Jarque-Bera	2.575143	23.94537	1.827652
Probability	0.275940	0.000006	0.400987
Sum	1435828.	52934536	145219.0
Sum Sq. Dev.	2.53E+09	1.85E+14	1.12E+08
Observations	30	30	30

Note: From the above table it shows about descriptive statistics of BSE SENSEX, Monthly Corona Cases and Crude Oil Prices in India.

Table 20: Result of Multiple Regression Analysis of SSX, MCI and COL.

Dependent Variable: SSX

Method: Least Squares

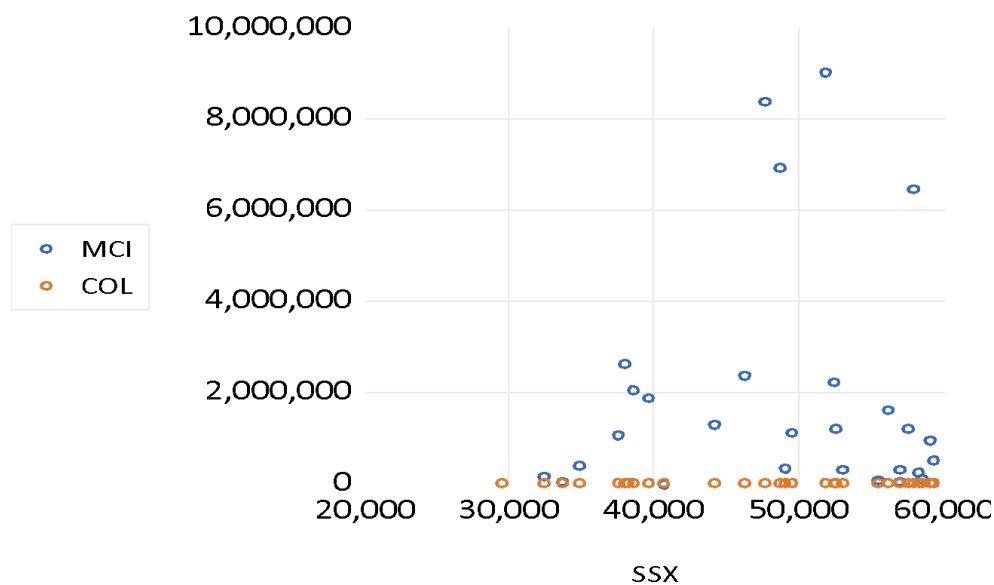
Date: 02/11/23 Time: 22:26

Sample (adjusted): 2020M01 2022M06

Included observations: 30 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	27216.42	2687.561	10.12681	0.0000
MCI	0.000751	0.000381	1.973344	0.0588
COL	3.991091	0.489556	8.152463	0.0000
R-squared	0.716120	Mean dependent var	47860.93	
Adjusted R-squared	0.695091	S.D. dependent var	9332.631	
S.E. of regression	5153.341	Akaike info criterion	20.02732	
Sum squared resid	7.17E+08	Schwarz criterion	20.16744	
Log likelihood	-297.4098	Hannan-Quinn criter.	20.07214	
F-statistic	34.05525	Durbin-Watson stat	0.485863	
Prob(F-statistic)	0.000000			

Note: Based on the above table we can conclude that Monthly Corona Cases have and Crude Oil Prices have significant impact on BSE SENSEX. Because probability values of the COL are less than 0.05. Coefficient of determination is 71%. which means 71% of the variations in the BSE SENSEX are due to MCR and COL.

**Figure 6: Showing the relationship between SSX, MCI and COL.**

Note: Graph shows about the relationship between SSX, Monthly Corona Cases and Crude Oil Prices in India.

Table 21: Covariance Analysis of SSX, MCI and COL.

Covariance Analysis: Ordinary
Date: 02/11/23 Time: 22:26
Sample: 2020M01 2022M06
Included observations: 30
Balanced sample (listwise missing value deletion)

Covariance Correlation t-Statistic Probability	SSX	MCI	COL
SSX	84194743 1.000000 ----- -----		
MCI	3.00E+09 0.131626 0.702615 0.4881	6.16E+12 1.000000 ----- -----	
COL	14543120 0.821691 7.628942 0.0000	-4.08E+08 -0.085168 -0.452309 0.6545	3720597. 1.000000 ----- -----

Note: From the above figure is the results about covariance analysis. There is low correlation between SSX and MCI as well as high correlation about SSX and COL

ARCH and GARCH (1,1) Models Result.

(Williams, 2011) “ARCH (autoregressive conditional heteroskedasticity) models were introduced by Robert Engle in a 1982 paper to account for this behaviour. Here the conditional variance process is given an autoregressive structure and the log returns are modelled as a white noise multiplied by the volatility:

$$X_t = \epsilon_t \sigma_t$$

$$\sigma^2_t = \omega + \alpha_1 X_{t-1}^2 + \dots + \alpha_p X_{t-p}^2,$$

where ϵ_t (the ‘innovations’) are i.i.d. with expectation 0 and variance 1 and are assumed independent from σ_k for all $k \leq t$. The lag length $p \geq 0$ is part of the model specification and may be determined using the Box-Pierce or similar tests for autocorrelation significance, where the case $p = 0$ corresponds to a white noise process. To ensure that σ^2_t remains positive, $\omega, \alpha_i \geq 0 \forall i$ is required.

Tim Bollerslev (1986) extended the ARCH model to allow σ^2_t to have an additional autoregressive structure within itself. The GARCH(p,q) (generalized ARCH) model is given by

$$X_t = \epsilon_t \sigma_t$$

$$\sigma^2_t = \omega + \alpha_1 X_{t-1}^2 + \dots + \alpha_p X_{t-p}^2 + \beta_1 \sigma_{t-1}^2 + \dots + \beta_q \sigma_{t-q}^2.$$

This model, in particular the simpler GARCH (1,1) model, has become widely used in financial time series modelling and is implemented in most statistics and econometric software packages. GARCH (1,1) models are favoured over other stochastic volatility models by many economists due to their relatively simple implementation: since they are given by stochastic difference equations in discrete time, the likelihood function is easier to handle than continuous-time models, and since financial data is generally gathered at discrete intervals”

Following representations are the result based on ARCH, GARCH (1,1) model.

According to ARCH and GARCH (1,1) Model tested the hypothesis that

H0: There is no volatility clustering.

H1: There is a volatility clustering.

Table22: Result of ARCH Test in Residuals of NIFTY Returns.

Heteroskedasticity Test: ARCH

F-statistic	55.40150	Prob. F(2,613)	0.0000
Obs*R-squared	94.30004	Prob. Chi-Square(2)	0.0000

Test Equation:

Dependent Variable: RESID^2

Method: Least Squares

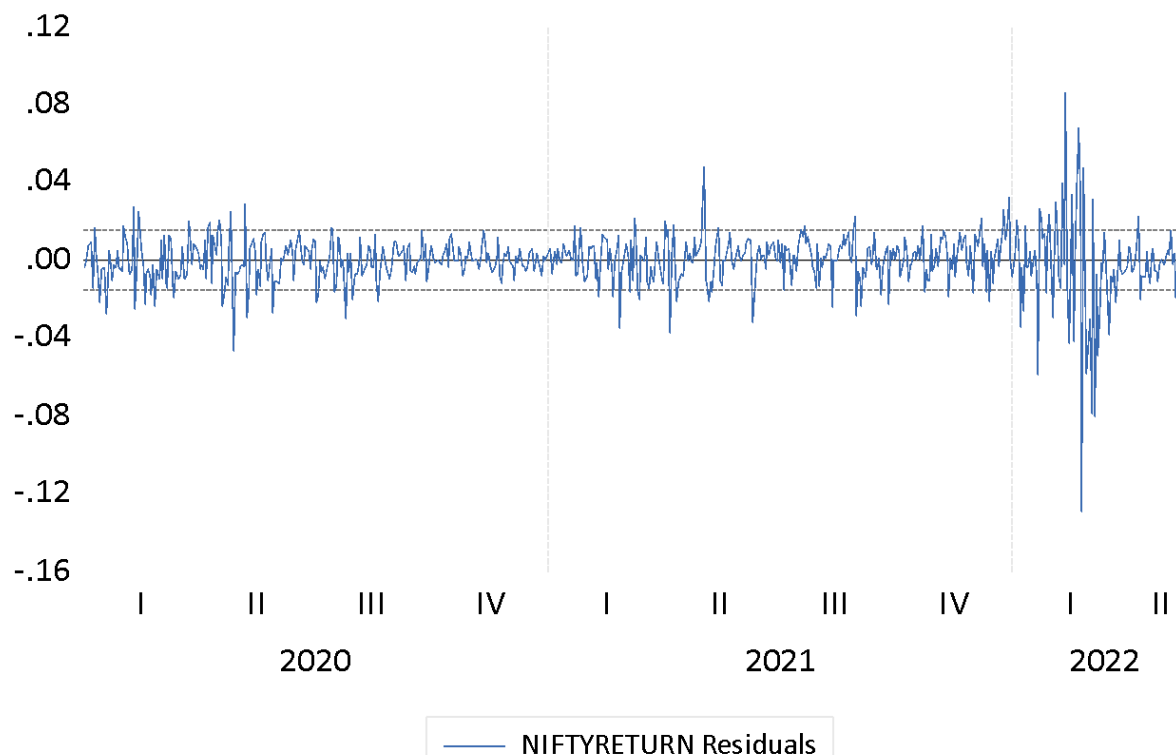
Date: 02/13/23 Time: 12:41

Sample (adjusted): 1/03/2020 5/13/2022

Included observations: 616 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000123	3.50E-05	3.502200	0.0005
RESID^2(-1)	0.103402	0.037666	2.745257	0.0062
RESID^2(-2)	0.360970	0.037665	9.583660	0.0000
R-squared	0.153084	Mean dependent var	0.000229	
Adjusted R-squared	0.150321	S.D. dependent var	0.000893	
S.E. of regression	0.000823	Akaike info criterion	-11.36147	
Sum squared resid	0.000416	Schwarz criterion	-11.33992	
Log likelihood	3502.332	Hannan-Quinn criter.	-11.35309	
F-statistic	55.40150	Durbin-Watson stat	2.117691	
Prob(F-statistic)	0.000000			

Note: Based on the ARCH Model result, we can conclude that there is no volatility clustering happened in residuals of Nifty returns according to F and Chi-Square Statistic.

**Figure7: NIFTY Returns Residuals Graph.**

Note: Showing about the volatility of NIFTY returns residuals during 2020 to 2022 JUNE.

Table:23: Result showing the GARCH(1,1) Model of NIFTY Return.

Dependent Variable: NIFTYRETURN
Method: ML ARCH - Normal distribution (OPG - BHHH / Marquardt steps)
Date: 02/13/23 Time: 12:41
Sample (adjusted): 1/02/2020 5/13/2022
Included observations: 617 after adjustments
Failure to improve likelihood (non-zero gradients) after 405 iterations
Coefficient covariance computed using outer product of gradients
MA Backcast: 1/01/2020
Presample variance: backcast (parameter = 0.7)
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000789	0.000221	3.572649	0.0004
AR(1)	-0.300550	0.408183	-0.736313	0.4615
MA(1)	0.342299	0.403805	0.847685	0.3966
Variance Equation				
C	1.15E-05	1.23E-06	9.284035	0.0000
RESID(-1)^2	0.149862	0.011857	12.63965	0.0000
GARCH(-1)	0.599862	0.024873	24.11720	0.0000
R-squared	-0.008823	Mean dependent var		0.000522
Adjusted R-squared	-0.012109	S.D. dependent var		0.015171
S.E. of regression	0.015263	Akaike info criterion		-5.711951
Sum squared resid	0.143029	Schwarz criterion		-5.668922
Log likelihood	1768.137	Hannan-Quinn criter.		-5.695222
Durbin-Watson stat	2.241370			
Inverted AR Roots	-.30			
Inverted MA Roots	-.34			

Note: Based on the GARCH (1,1) Model, we can conclude that NIFTY returns have no GARCH errors or volatility clustering happened during 2020 to 2022.

Table 24: Showing Result of ARCH Test in Residuals of SENSEX Returns.

Heteroskedasticity Test: ARCH

F-statistic	18.29157	Prob. F(1.610)	0.0000
Obs*R-squared	17.81727	Prob. Chi-Square(1)	0.0000

Test Equation:

Dependent Variable: RESID^2
Method: Least Squares
Date: 02/13/23 Time: 15:36
Sample (adjusted): 1/02/2020 5/16/2022
Included observations: 612 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000198	3.82E-05	5.177213	0.0000
RESID^2(-1)	0.170621	0.039894	4.276864	0.0000
R-squared	0.029113	Mean dependent var		0.000238
Adjusted R-squared	0.027522	S.D. dependent var		0.000928
S.E. of regression	0.000915	Akaike info criterion		-11.15103
Sum squared resid	0.000511	Schwarz criterion		-11.13660
Log likelihood	3414.216	Hannan-Quinn criter.		-11.14542
F-statistic	18.29157	Durbin-Watson stat		2.134418
Prob(F-statistic)	0.000022			

Note: Based on the ARCH Model result, we can conclude that there is no volatility clustering happened in residuals of SENSEX returns according to F and Chi-Square Statistic.

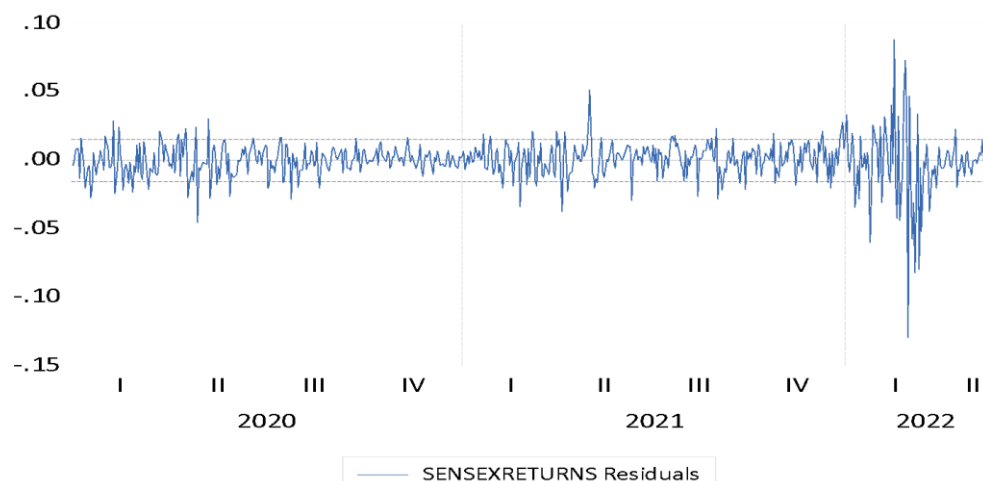


Figure 8: SENSEX Returns Residuals Graph.

Note: Showing about the volatility of SENSEX returns residuals during 2020 to 2022 June.

Table 25: Result showing the GARCH(1,1) Model of SENSEX Return.

Dependent Variable: SENSEXRETURNS
Method: ML ARCH - Normal distribution (OPG - BHHH / Marquardt steps)
Date: 02/16/23 Time: 10:19
Sample (adjusted): 1/02/2020 5/10/2022
Included observations: 614 after adjustments
Convergence not achieved after 500 iterations
Coefficient covariance computed using outer product of gradients
MA Backcast: 1/01/2020
Presample variance: backcast (parameter = 0.7)
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000708	0.000727	0.974121	0.3300
AR(1)	-0.179822	1.836406	-0.097920	0.9220
MA(1)	0.200718	1.842807	0.108920	0.9133
Variance Equation				
C	6.06E-05	1.68E-05	3.601175	0.0003
RESID(-1)^2	0.149905	0.045100	3.323822	0.0009
GARCH(-1)	0.599905	0.101478	5.911653	0.0000
R-squared	-0.003803	Mean dependent var		0.000483
Adjusted R-squared	-0.007088	S.D. dependent var		0.015475
S.E. of regression	0.015530	Akaike info criterion		-5.843325
Sum squared resid	0.147361	Schwarz criterion		-5.800133
Log likelihood	1799.901	Hannan-Quinn criter.		-5.826528
Durbin-Watson stat	2.191765			
Inverted AR Roots	-.18			
Inverted MA Roots	-.20			

Note: Based on the GARCH (1,1) Model, we can conclude that SENSEX returns have GARCH errors or volatility clustering happened during 2020 to 2022.

CONCLUSION:

My study outcome is based on Multiple Regression, ARCH and GARCH(1,1) Model. Major focused area of study are SENSEX and NIFTY Closing Stock Prices during 2020 to 2022. Based on these two Indices I have done my stock market analysis. Because NIFTY and SENSEX are the two major indices which shows the performance level of major companies in India. By that way, I can figure out the performance deviations of stock market analysis during pandemic period. In this study I tried to focus on the major factors that affect the stock market performance during pandemic period and found the result by using Multiple regression that the variables Monthly Corona Cases, Monthly Death Rates, Monthly Recovery Cases have no impact in NIFTY and SENSEX during the Pandemic

period. However Crude Oil Price fluctuations happened during pandemic period have an impact on Both NIFTY and SENSEX closing prices.

The result of ARCH model conclude that there is no volatility clustering happened in the NIFTY returns and SENSEX returns during pandemic period . However there is GARCH errors happened on SENSEX returns.

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