FINANCE AND BANKING

IJFB VOL 10 NO 1 (2022) P-ISSN 2574-6081 E-ISSN 2574-609X

Available online at https://www.cribfb.com
Journal homepage: https://www.cribfb.com/journal/index.php/ijfb
Published by CRIBFB, USA

THE SHORT-TERM CORONAVIRUS (COVID-19) PANDEMIC EFFECT: AN EMPIRICAL INVESTIGATION OF INDIAN STOCK MARKET (BSE)

Mohd Atif Afzal [(a)1] *Nasreen Khan* [(b)] *Abdul Saboor Mohammad* [(c)] *Mohd Taqi* [(d)]

[(a)] *Assistant Professor, Centre for Distance and Online Education, Aligarh Muslim University, Aligarh 202002, India; E-mail: atifafzalgd7581@gmail.com*
[(b)] *Assistant Professor, Department of Accounting, Al-Baha University, Kingdom of Saudi Arabia; E-mail: findnasreen@gmail.com*
[(c)] *Department of Commerce, Aligarh Muslim University, Aligarh 202002, India; E-mail: abdul.saboor.mohd@gmail.com*
[(d)] *Assistant Professor, Centre for Distance and Online Education, Aligarh Muslim University, Aligarh 202002, India; E-mail: taqiamu@rediffmail.com*

ARTICLE INFO

Article History:

Received: 14th March 2022
Accepted: 10th May 2022
Online Publication: 13th May 2022

Keywords:

Indian Stock Market, COVID-19, GARCH Standard Vector Autoregression, Impulse Response Function

JEL Classification Codes:

H54, R53

ABSTRACT

India's precautionary step toward COVID-19 led to 1.3 billion people enduring lockdown, consequently halting the wheels of the Indian economy. Though the crash of the stock market was evident and explanatory, it left all stakeholders (including the investors and government) with no choice. Deteriorating SENSEX and other indices forced investors to withdraw and lose attraction from the market and looped in more serious issues to the Indian stock market. This paper empirically analyses the short-term impact of COVID-19 on five selected BSE indices for SENSEX, FMCG, Bank, Corporate-Bond, and Industrial using econometric models. Stationarity was checked by Augmented Dickey-Fuller and Philips-Perron test. Autocorrelation was assessed and mitigated by Durbin-Watson, Breusch-Godfrey Serial Correlation LM test, and Cochrane-Orcutt transformation method. This study attempts to apply Multiple Regression, the GARCH model, Standard Vector Autoregression (S-VAR), and Impulse Response Function (IRF) to decode the relation. The results indicated that the COVID-19 pandemic is adversely affecting the performance of the Indian stock market in the short run. All the indices showed a negative relationship antecedent with the effect of COVID-19, except for the SPICBI index. This paper implies investment solutions for the investors and policymakers to cope with the unprecedented situation amidst COVID-19.

INTRODUCTION

"Fear of the unknown is a terrible fear" says -Joan D Vinge. In this integrated world, pandemic not only hits mortality (death) and morbidity (short period layoff) (McKibbin & Fernando, 2020); but uncertain fear and apparent situation affects all the economic and non-economic activities. Outbreak of Coronavirus (COVID-19) likely from China (W.H.O., 12 January 2020) to almost every part of the continent (Worldometer) is likely to affect economic activities at large due to imposition of lockdown in various parts of the world (Mudgill, The Economic Times, 25th March 2020). India's lockdown of 1.3 billion people which is reported as the biggest lockdown of any region (Al Jazeera, 14 April 2020), will definitely hit economic activities in almost every sector. Stock markets are considered the reflection of a country's economic health. The BSE SENSEX (Indian stock exchange) within duration of two weeks, dropped from 42,000 to 25,000 (Business Reporter, 23 March 2020), indicating the severity of the COVID-19. Indian Stock market had also showed negative relations in previous epidemics (Vijayakumar et al., 2013), though it had recovered within a short span of time in cases of Severe Acute Respiratory Syndrome (SARS), Zika and Ebola (Mehta, The Economic Times, 16 March 2020). The policy makers are eyeing a way out of the situation citing COVID-19 can be lethal to Indian economy (Iyer, 2020). Academicians and researchers of any field are obligated to participate in exploring past trends and try to suggest corrective measures and actions which is the need of the hour. In this research paper, economic impact of COVID-19 on short run is judged considering the Indian stock market index of Bombay Stock Exchange (BSE) and it also recommends investor's interest to be protected, mainly through diversifying their investments.

[1]*Corresponding author: ORCID ID: 0000-0001-8308-4622*

https://doi.org/10.46281/ijfb.v10i1.1716

To cite this article: Afzal, M. A., Khan, N., Mohammad, A. S., & Taqi, M. (2022). THE SHORT- TERM CORONAVIRUS (COVID-19) PANDEMIC EFFECT: AN EMPIRICAL INVESTIGATION OF INDIAN STOCK MARKET (BSE). *Indian Journal of Finance and Banking*, *10*(1), 18-30. https://doi.org/10.46281/ijfb.v10i1.1716

Stock market indices are based on demand of the market and heuristics (or biases) are guiding principle for decision makers while buying or creating demand for particular stocks, among which fear plays important role (Hassan et al., 2013). As the spread of COVID-19 is globally expanding geometrically and has seen no decline, ensuring fear has resulted in the fluctuations of indices of Indian stock market. Thus it can be classified that Indian economy is approaching towards "Economic Shock" (Baldwin & di Mauro, 2020). The spread of COVID-19 has dramatically affected the investor-market, directly and indirectly. The direct effect is due to close down and lockdown while indirect one is the due to fear caused. This study has tried to evaluate the fear basis of an investor. The exposure of the virus is reflected by the active cases and mortality which has been closely monitored by many agencies globally (Worldometer) as well as nationally (MyGov.in). The short-term impact has been investigated with the help of econometric analysis, where dependent variables are the five selected stock indices of BSE whereas and Active Cases (AC) and Daily Death (DD) due to COVID-19 has been taken as independent variables. This paper concludes the mitigating strategy of the Indian investors to safeguard their investment interest and also acts as buffer to stock market in the negative growth period. The paper's findings also imply the policy makers to re-focus on corporate bond corpus; which has been regarded as the "white elephant" of secondary market; and revive the fund as well as to utilize the disguised opportunity.

Pandemic Effect

A lot of diseases have been discovered, unfurled and controlled; few of them become epidemic, causing threat to humanity due to its rapid spread. Seeing, its exposure, W.H.O. declared "public health emergency / outbreak of pandemic" on 12 March 2020 (W.H.O.) and consequently India announced COVID-19 as "notified disaster" on 14 March 2020 (The Economic Times). The history check reveals four pandemics: 1889, 1918, 1957 & 1968 in the last 130 years (Maital & Barzani, 2020); though SARS had not qualified as pandemic.

Ample studies have been conducted in the post-epidemics period and similarly its effect on economy of a country has also been reported. Black Death (considered largest pandemic ever recorded) saw drop in labor supply (25-40%); fall in returns (5-8%) and increase in real wages (100%) (Clark, 2007; 2010). Yang et al. (1999) and Carpernter (2011) studied economic impact of foot and mouth disease in Taiwan and California respectively. In another study, Armien and Halasa (2012) evaluated the overall cost involved in an epidemic. Study related to the impact of AIDS on the economic parameters is also analyzed by Bloom and Mahal (1997) and suggested that only long term correlations can give predictive results. Another study concerning AIDS, concluded negative relation with Gross Domestic Product (GDP) in the context of Ukraine, which was done by Barnett et al. (2000).

SARS, which has been extensively studied (Gupta, 2005; Chen et al., 2007; Beutels et al., 2009) has noticed significant impact on the socio-economic health of affected countries. The Chinese stock market has been analyzed by Beutels et al. (2009) and was reported to have negative effect. In the Indian context, very few studies related to epidemics can be found such as Vijayakumar et al. (2013); where researcher exposed the relation of Chikungunya epidemic on per capita income (monthly) and hence concluded no relationship.

In a very recent study, anticipating impact of COVID-19 on Chinese economy, Ayittey et al. (2020) found that world may lose 280 billion US$ which would wipe approximately 0.5% of world's GDP (Riley and Horowitz, CNN Business, 10 February 2020). In another study, the estimate of COVID-19 impact on world GDP was calculated to drop 1% (Luo & Tsang, 2020). Estrada et al. (2020) simulated the impact and concluded astonishing figures of 4 trillion US$ drop in Chinese GDP.

Economic Impact of COVID-19

The first patient of COVID-19 was reported in December in Wuhan (China), after which it got spread to various parts of the world (Worldometer). Historically, epidemics have affected this planet from time to time and all the aspects (economic and non-economic) are influenced in the course. Human intervention includes the development of vaccine, prevention of its communicability and the societal awareness. Aforementioned prevention leads to major governmental obligation, of controlling the movement of people somehow, which deliberately restricts the economic activity (Ellis-Peterson, The Guardian, 24th March 2020). Similarly, COVID-19, when declared pandemic, became a serious threat to the society, both clinically and economically. In India, where majority of the sectors are unorganized (Nagaraj, 2013), this employing 82 % of casual workforce of India reported by National Institution for Transforming India (NITI) Aayog (Mohanty, 2019), thus, it is difficult to cope up with the situation. The government decisions are typically a tradeoff between functioning of the economy and prevention of the epidemic.

Indian Stock Exchange

India's leading news headlines read "*The virus that has spooked the world's markets and sparked fears of global recession has also played havoc with India's macro indicators*" (Mehta, 23 March 2020). The fall was in sync with the world market. The stock exchange of India consists of nine official exchanges, of which BSE (selected for the study) is reputed globally. BSE is here considered for the study which is Asia's oldest stock exchange, established in 1875 (BSE, n.d.) and having more than 2.2 trillion estimation of market capitalization (10th spot by size). BSE is the largest stock market in terms of number of companies with 5749 listed companies (Shukla, 2019 February). When essential and non-essential sectors are plunged to lowest level, investment and secondary markets are the first objects that losses their strength. This is evident by the drop of BSE SENSEX which got closed at 25,981 points in the last week of March (Business Reporter, 23 March 2020). The study has taken account of the movement of stock market indices (here BSE) as dependent variables, discussed in next section.

Due to the recent nature of the subject, not a lot of studies are found. Studies in scientific and non-scientific fields are absent and this paper primarily aims at filling this gap. Secondly, economic trends, considering stock indices are ample in general

phenomenon; but very few studies could be unearthed related to the epidemic, or the disease-caused change, or even pandemic. Thirdly, no studies are found related to epidemic in the Indian context, ignoring exploratory news editorials. Fourthly, except for two studies: viz Luo and Tsang (2020) and Estrada et al. (2020), where researcher had scientifically explored the relation using statistical model. This study attempts to apply different statistical tools and techniques such as multiple regression, GARCH model, Standard Vector Autoregression (S-VAR) and Impulse Response Function (IRF) to decode the relation. Lastly, this study aims at providing recommendations for the policy makers to encourage the investors who have lost their money and hope in the stock market, and to revive the overall condition of the market.

In line with the literature, the general objective of this study is to investigate the impact of COVID-19 on the Indian stock market. This can be further classified infers of SENSEX and other stock indices of Fast Moving Consumer Goods (FMCG), Banks, Bond-market and Industrial.

MATERIALS AND METHODS

The selection of BSE indices are based on its global popularity which are regarded as benchmark indices (cleartax.com). There are a few lists of indices traded on the podium of BSE. The research design of this paper is based on secondary data, which comprises daily-data of five stock indices of BSE and cases of COVID-19 from 30th January 2020 to 3rd July 2020. The selected indices are S&P BSE SENSEX, S&P BSE FMCG Index, S&P BSE BANKEX, S&P BSE India Corporate Bond Index and S&P BSE Industrials which are proxy to Indian stock market. The daily data of COVID-19 active cases and deaths have been retrieved from the worldometer website. The data of five indices have been extracted from the official website of BSE *(*See Table 1). The data of S&P BSE India Corporate Bond Index has been retrieved from website of Asia Index Pvt. Ltd. The return has been calculated as per $(P_t - P_{t-1}) / P_{t-1}*100$. The selection of the indices and their importance in the current scenario with references to the sectors are discussed below.

Table 1. Variables, Measurement and Abbreviation

Variables	Measurements	Abbreviations
Dependent Variables		
S&P BSE SENSEX Index	Daily Closing Price	SENSEX
S&P BSE India Corporate Bond Index	Daily Closing Price	SPICBI
S&P BSE FMCG Index	Daily Closing Price	FMCG
S&P BSE BANKEX Index	Daily Closing Price	BANK
S&P BSE Industrials Index	Daily Closing Price	IN
Independent Variables		
Active Cases of COVID-19	Excluding Recovery and Death from the total cases	AC
Daily Death (due to COVID-19)	Death Per Day	DD

Source: Authors compilation

S&P BSE SENSEX Index

When the SENSEX (regarded as pulse of domestic stock market), which is the core of BSE stocks, plummeted from 41,952 (highest achieved) in mid-January 2020 (Business Today, January 2020) to 25,981 in the fourth week of March 2020 (Business Reporter, 23 March 2020), the COVID-19 effect was evident. It became of utmost importance for the stakeholders (government, policy makers and researchers) to draft a way out of the crisis. This papers aims in developing a third way-out strategy to counter the stock fall and backing the interest of the investors. The selections of indices are correlated with international consequences and pandemic scenario.

S&P BSE FMCG Index

In the case of pandemic, there is a latent pressure within the sectors which are the direct basis of living. Food and beverages are the inevitable demands that humans cannot ignore. Moreover, being non-durable, these also affect the supplier's end. FMCG being fourth largest sector of Indian economy amounting to 52.75 Billion US$, 2018 (IBEF, March 2020) will be affected by the recent COVID-19, both at demand as well as supply side. Hence, this index will help to identify the short term economic impact.

S&P BSE BANKEX Index

There are three reasons for considering index of banking sector. i) Firstly, Indian economy where majority of the workforce is unorganized and sectors are not well-structured, Banking sector is regarded as sufficiently regulated, organized and structured. ii) Secondly, being the flow channel of the funds, this sector is greatly responsible for running the economy. Banks and credit flow cannot stop even on the last brink, whether it is personal or commercial banking. iii) Lastly, various channels of banking include micro- and rural-banking. This reflects the reach of the sector on one hand and the counter effect of this sector on the economy as a whole, on the other hand. The index fluctuations are the outcome of the demand which in turn is consequent to the market news. Although country's central bank, Reserve Bank of India (RBI) ensured customers interest in case of YES BANK crisis, yet fall of the stock eroded 85% of the value (The Economic Times, 7 March 2020). It is evident how banking sector reacts to the catastrophe.

S&P BSE India Corporate Bond Index and S&P BSE Industrials index

The fourth construct extracted from BSE is of bond market and this dimension has been explored due to its orthogonal relation with other indices. This is due to the fact that bond indices are regarded as low risk, long term and high return index. Being a debt security, economics and behavioral rationale of the investor differs, in comparison to other indices. BSE corporate bond has been in focus since early 2020 due to its stagnant rise. T. K. Arun (The Economic Times, 14 January 2020) says that the post Nehruvian-governemt which provided base to the manufacturing portfolios, development of roads or infrastructure, is often blamed for ignoring development of private sector. Albeit this paradox, the private sector was developed on a large scale for all times. Seeing this, the new Development Financial Institution (DFI) is just an excuse to avoid the development of the corporate bond market which has been sluggish and became "headache to Indian borrowers" (Patil, The Print, 20th January 2020). The bond market indices have always been in the focus of the economic policy makers. Report by RBI has suggested an established and developed bond market can boost economy of any country (Acharya, 2011). Achraya further explains that the declining role of DFI and robust corporate bond corpus will help in building economy for which India has been re-aiming at its 10.08% of GDP growth (which was achieved during 2006-07) (The Economic Times, 2018 August).

This paper aims at indicating abnormality in the movement of the pandemic's overall effect with other indices and suggest insights for three purposes; firstly, countering the crash of the stock market; secondly, favoring the interest of the investors and lastly, to re-shuffle the corporate bond market that has been ignored for a long time. The Industrial index (S&P BSE Industrials) is chosen owing to its sectorial relevance. Further, experts have opinion that lockdown will have least likely impact on the industrial industry. Industrial manufacturing, in a recent study, is said to have the triple hit due to supply chain disruptions (Jorda et al., 2020).

RESULTS

Descriptive Statistics

The SPICBI has the highest mean return while BANK has the lowest mean return of -0.198 shown in *table 2*. The mean returns of all the indices are negative except in SPICBI and FMCG index. This signifies that investment in Indian stock market is not favourable to the investors during the on-going COVID-19 pandemic. However, the mean return value of SPICBI and FMCG index reflects that it may be the favourable avenue for the investors where they can generate good returns by consciously including Indian corporate bond and FMCG index in their investment portfolio. The standard deviation statistic (S.D.) reveals that the BANK is the most volatile and risky index among all the selected indices while the S.D. of SPICBI is 0.114, which signifies low volatility and being least risky.

Table 2. Summary Statistics

	SENSEX	FMCG	AC	DD	BANK	IN	SPICBI
Mean	-0.028	0.0318	7.003	7.534	-0.198	-0.152	0.051
Median	0.159	0.001	2.613	4.901	0.076	0.021	0.046
Maximum	8.974	8.237	71.654	91.540	10.704	5.386	0.421
Minimum	-13.152	-10.422	-10.703	-42.187	-16.806	-13.629	-0.282
Std. Dev.	2.902	2.372	11.693	26.436	3.789	2.641	0.114

Source: Authors compilation

Pre-test Assumptions

A set of data is said to be stationary when the mean, variance and auto-variance are constant (Brooks, 2008). The non-stationary data may produce high R^2 value and significant relationship, even when the variables are unrelated with each other (Salvatore & Reagle, 2002). To check the stationarity of the data, the researchers have applied Augmented Dickey-Fuller (ADF) test and in order to validate the results of ADF test further, researcher have applied Philips-Perron (PP) test. The p-values (shown in *table 3*) of all the selected variables are less than 0.05. It implies that all the variables are stationary at level.

Table 3. Unit Root Testing

Variables	At level (ADF)	At level (PP)	Summary
SENSEX	-11.979 0.000*	-11.908 0.000*	Stationary at level
AC	-2.067 0.037**	-6.339 0.000*	Stationary at level
DD	-2.058 0.0385**	-13.03 0.000*	Stationary at level
FMCG	-12.577 0.000*	-12.246 0.000*	Stationary at level
SPICBI	-7.416 0.000*	-7.375 0.000*	Stationary at level
BANK	-10.328 0.000*	-10.329 0.000*	Stationary at level
IN	-9.696 0.000*	-9.793 0.000*	Stationary at level

Note: * and ** denotes p-value at 1% and 5% level of significance, respectively.
Source: Authors compilation

Multiple Regression

The econometric models were developed for each index to identify the relationship with COVID-19 (*table 4*). The F-statistic of all the econometric models are less than 0.05 it indicates that all the models are statistically significant. The Durbin-Watson statistics of all the eight models are within the acceptable range of 1.5 to 2.5 (Garson, 2012; Anselin, 2013) which signifies that there is no autocorrelation in the residuals of the econometric models. There is significant effect of AC in all econometric models with negative coefficients in SENSEX, FMCG, BANK and IN except for SPICBI which has a positive effect (table 5). Considering the effect of DD on the stock indices, results of regressions are showing insignificant relationship.

If the residuals of the models are serially correlated then it will produce overestimated value of R^2, t-value and f-value; and the value of R^2 may not be valid (Gujarati et al., 2012). The Durbin-Watson (D-W) and Breusch-Godfrey Serial Correlation LM Test have been used to investigate whether the residuals of the models are auto-correlated or not.

Table 4. Econometric Models

Econometric Models	Equations
Model 1	$SENSEX_t = \beta 0 + \beta 1 AC_t + \beta 2 DD_t + \varepsilon t$
Model 2	$FMCG_t = \beta 0 + \beta 1 AC_t + \beta 2 DD_t + \varepsilon t$
Model 3	$BANK_t = \beta 0 + \beta 1 AC_t + \beta 2 DD_t + \varepsilon t$
Model 4	$SPICBI_t = \beta 0 + \beta 1 AC_t + \beta 2 DD_t + \varepsilon t$
Model 5	$IN_t = \beta 0 + \beta 1 AC_t + \beta 2 DD_t + \varepsilon t$
Where, $SENSEX_t$= S&P BSE SENSEX at time t; AC_t= Active Cases at time t; DD_t= Daily Death at time t; $FMCG_t$= S&P BSE FMCG at time t;$SPICBI_t$= S&P BSE India Corporate Bond Index at time t;IN_t= S&P BSE Industrials;$BANK_t$=S&P BSE BANKEX;β0= Intercept; β1- β2= Coefficients of independent variables; εt= error term	

Source: Authors compilation

The results depict that all the p-values are > 0.05 implies that models are not facing the issue of serial correlation except model 4. A number of statistical tools such as Cochrane-Orcutt (CO) and Prais-Winsten transformation method can be applied to counter the issue of auto-correlation. The CO technique is also called as two-step method and it iterates the process till the two successive calculations are nearly the same (Sumantri, 2020). The researcher has applied CO estimation in order to remove serial correlation from the model 4. The presence of heteroscedasticity in the residuals of the models may lead to produce misleading results (Gujarati et al., 2012). The results of the test have been reported in *table 6* and p-values > 0.05 which signifies that residuals are homoscedastic.

Table 5. Regression Results

Variables		**Dependent Variables**				
Independent variables		**Model 1 (SENSEX)**	**Model 2 (FMCG)**	**Model 3 (BANK)**	**Model 4 (SPICBI)**	**Model 5 (IN)**
AC	**Coefficient**	-0.075	-0.039	-0.101	0.002	-0.086
	Prob.	0.003*	0.060**	0.002*	0.066**	0.000*
DD	**Coefficient**	0.009	0.010	0.015	-0.000	0.001
	Prob.	0.408	0.262	0.270	0.417	0.884
R^2		0.085	0.039	0.091	0.111	0.144
Adjusted R^2		0.066	0.020	0.073	0.083	0.127
Durbin-Watson		2.249	2.318	1.987	1.988	1.878
Prob(F-statistic)		0.0128	0.038	0.008	0.009	0.000

Note: * and ** denotes p-value at 1% and 10% level of significance, respectively.
Source: Authors compilation

Table 6. Results of Autocorrelation and Heterocedasticity

Models	**Autocorrelation**		**Heterocedasticity**	
	F-statistic	**Obs*R-squared**	**F-statistic**	**Obs*R-squared**
SENSEX	0.8155	1.6874	2.6481	2.6311
	(0.445)	(0.430)	(0.106)	(0.104)
FMCG	1.5591	3.1774	2.7100	5.2908
	(0.215)	(0.204)	(0.071)	(0.071)
BANK	0.1786	0.3745	0.0012	0.0012
	(0.836)	(0.829)	(0.972)	(0.971)
SPICBI	0.0046	0.0098	1.2507	1.2602
	(0.995)	(0.995)	(0.266)	(0.261)
IN	1.7010	3.4568	0.2333	0.2375
	(0.187)	(0.177)	(0.630)	(0.626)

Note: p-values are reported in parentheses.
Source: Authors compilation

According to Montgomery et al. (2001) the most commonly used technique to check the multicollinearity is Variance Inflation Factor (VIF). Therefore, (VIF) method has been applied and each model has been run separately to investigate whether the explanatory variables are strongly inter-correlated or not. The result of VIF is

presented in *table 7*. According to Hair et al. (1995) the threshold limit of VIF should be less than 10. The VIF values of the variables are below the acceptable limit i.e. 10, which signify that there is no multicollinearity.

Table 7. Variance Inflation Factor (VIF)

Independent Variables	VIF
AC	1.07438
DD	1.07438

Source: Authors compilation

GARCH Model

Autoregressive Conditional Heterocedasticity (ARCH) and Generalised ARCH (GARCH) methods are generally used for assessing and forecasting the variances. The model formulates variances in the dependent construct as a function of previous values of dependent as well as exogenous variables. This technique was developed individually for ARCH by Engle (1982) and GARCH by Bollerslev (1986). Widespread acceptance of this methodology is evident by application of ARCH and GARCH in many econometric studies such as financial time series (Bollerslev, Chou, and Kroner, 1992; Bollerslev, Engle, and Nelson, 1994) and stock market studies (Garg & Bodla, 2011; Shehzad et al.,2020).
The mean equation adopted from Shehzad et al. (2020)

$$R_{ti}=\beta_0 + \beta_1 AC_{ti}+ \beta_2 DD_{ti}+ \varepsilon_{ti}$$

Where, R_{ti} is the return of the indices, β_0 is the intercept, AC_{ti} and DD_{ti} are used as a proxy for Covid-19 and ε_{ti} are the residuals term.

The variance equation

$$h_t = c +\alpha_1 e^2_{t-1}+\beta_1 h_{t-1}$$

In the above equation the α_1 and β_1 are referred to as ARCH and GARCH parameters, respectively conditional variance is only finite when stationarity condition is fulfilled that is when $\alpha_1+ \beta_1$ should be less than 1. The c term is volatility in long term and α_1 and β_1 can be directly interpreted to be the volatility by fear factor in mind of the investors caused by adverse effect of COVID-19. The short term dynamics of the series is due to size of the α_1 and β_1 parameters and when the value of GARCH coefficient is greater than ARCH coefficient it indicates that the shock effect caused by COVID-19 will be persistent in the market for a long period Shehzad et al. (2020). On the contrary if the value of ARCH coefficient is greater than GARCH than it indicates spiky fluctuations. To detect autoregressive conditional heteroscedasticity, it requires application of ARCH-LM test (Engle, 1982) and the p-value is less than 0.05 (See *table 8*) that indicates presence of ARCH effect in the residuals.

Table 8. ARCH LM TEST

Variables	F-Statistics	P-Value	Obs*R-squared	P-Value
SENSEX	5.565	0.005	10.270	0.005
AC	2.672	0.026	12.392	0.029
DD	2.554	0.033	11.915	0.036
FMCG	6.206	0.014	5.951	0.014
BANK	2.975	0.035	8.491	0.036
SPICBI	3.392	0.037	6.529	0.038
IN	5.713	0.004	10.513	0.005

Source: Authors compilation

The results of regression models were elaborated by application of GARCH (1,1) model that has been used by many researchers in the context of stock market particularly in Indian setting (Garg & Bodla, 2011). Variable of COVID-19 were exogenous in the models while considering selected indices of stock market as endogenous. Significant value of AC was found to be varying in the models, at 1% for SENSEX, 5% for IN and 10% (see *table 9*) for FMCG while insignificant value have witnessed in BANK and SPICBI. In variance equations both ARCH and GARCH terms were statistically significant (see *table 10*). The value of $\alpha_1 + \beta_1$ is less than 1 in all the models indicating 0.99, 0.97, 0.98, 0.96 and 0.9 and the coefficients of GARCH (β_1) are greater than coefficients of ARCH (α_1). This implies that the persistent volatility exists in the selected market indices. The sum of $\alpha_1+\beta_1$ coefficients in the models are close to one indicating that the shock effect caused by COVID-19 will be persistent in the market for a long period (Shehzad et al., 2020).

Table 9. The Results of Mean Equation

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Dependent Variable: SENSEX				
C	0.3331	0.2070	1.6095	0.1075
AC	-0.0295	0.0113	-2.6058	0.0092
DD	0.0111	0.0079	1.4087	0.1589

Dependent Variable: FMCG				
C	0.1917	0.2370	0.8091	0.4184
AC	-0.0234	0.0136	-1.7107	0.0871
DD	0.0068	0.0076	0.8905	0.3732
Dependent Variable: BANK				
C	0.3310	0.3457	0.9574	0.3383
AC	-0.0403	0.0249	-1.6178	0.1057
DD	0.0185	0.0136	1.3663	0.1718
Dependent Variable: SPICBI				
C	0.0494	0.0135	3.6494	0.0003
AC	0.0007	0.0013	0.5752	0.5651
DD	-0.0004	0.0004	-0.9750	0.3296
Dependent Variable: IN				
C	0.4687	0.2406	1.9481	0.0514
AC	-0.0572	0.0238	-2.4058	0.0161
DDR	0.0063	0.0085	0.7481	0.4544

Source: Authors compilation

Table 10. The Results of Variance Equation

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Dependent Variable: SENSEX				
C	0.2204	0.1731	1.2733	0.2029
RESID(-1)^2	0.2410	0.1455	1.6558	0.0978
GARCH(-1)	0.7577	0.1202	6.3005	0.0000
Dependent Variable: FMCG				
C	0.1801	0.1164	1.5466	0.1220
RESID(-1)^2	0.2163	0.0947	2.2829	0.0224
GARCH(-1)	0.7685	0.0838	9.1639	0.0000
Dependent Variable: BANK				
C	0.3496	0.1927	1.8140	0.0697
RESID(-1)^2	0.1785	0.0918	1.9448	0.0518
GARCH(-1)	0.8185	0.0796	10.277	0.0000
Dependent Variable: SPICBI				
C	0.0005	0.0005	0.8555	0.3923
RESID(-1)^2	0.1501	0.0709	2.1153	0.0344
GARCH(-1)	0.8188	0.0640	12.7826	0.0000
Dependent Variable: IN				
C	0.2542	0.2211	1.1496	0.2503
RESID(-1)^2	0.1711	0.0974	1.7561	0.0791
GARCH(-1)	0.8052	0.0948	8.4930	0.0000

Source: Authors compilation

Post application of GARCH (1,1), the residuals of the models were subjected to test heteroscedasticity and serial correlation for which Ljung-Box Q and ARCH LM test have been used for the diagnosis. The P-value of all the models tested with both the diagnostic tests were greater than 0.05 (See *table 11*), signifying none of the residuals were auto-correlated as well as heteroscedastic.

Table 11. Ljung-Box Q and ARCH LM test

	Ljung-Box Q		ARCH LM test	
Models	**Q- Statistics**	**P-Value**	**F- Statistics**	**P-Value**
SENSEX	0.5594	0.455	0.5320	0.467
FMCG	0.4530	0.501	0.4294	0.513
BANK	1.3798	0.240	1.3236	0.252
SPICBI	1.3058	0.253	1.2514	0.266
IN	0.7921	0.373	0.7543	0.387

Source: Authors compilation

STANDARD-VAR

Investigating the effect of COVID-19 on selected stock indices was also observed by applying Standard Vector Auto-Regression in this study, which is considered as a standard method in financial researches (Vo, 2017). Studies such as (Ulku & Ikizlerli, 2012; Patnaik et al., 2013; Usmani & Akhter, 2020) applied this technique while studying impact of foreign investment on Indian capital market and market returns in developing economies respectively.

Table 12. VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-634.0193	NA	0.389070	13.24529	13.64095*	13.40533
1	-595.2306	71.24455	0.294147*	12.96389*	14.01898	13.39065*
2	-580.4126	25.70479	0.364279	13.17169	14.88620	13.86517
3	-553.1394	44.52770*	0.352393	13.12529	15.49924	14.08551

Note: *Lag order selected by criterion

There are two criteria that should be taken care of before applying VAR, firstly, the data should be stationary and secondly, lag length must be optimum (Gangadharan & Yoonus, 2012). The latter condition is fulfilled by obtaining minimum value that is based on decision criteria such as Schwarz Criterion (SC), Akaike Information Criterion (AIC), Final Prediction Error(FPE), Hannan–Quinn (HQ) and Sequential Modified LR test statistic (LR) (Sahoo,2020).

$$\text{Market returns}_{t} = C(1)*\text{market returns}_{t-1} + C(2) + C(3)*AC + C(4)*DD$$

Table 13. Vector Autoregression Estimates

	SENSEX	FMCG	BANK	SPICBI	IN
SENSEX(-1)	-0.552728	-0.499105	-0.752712	-0.000352	-0.602645
	(0.44011)	(0.36363)	(0.58276)	(0.01636)	(0.38752)
	[-1.25588]	[-1.37258]	[-1.29163]	[-0.02153]	[-1.55511]
FMCG(-1)	0.152795	0.027674	0.189049	-0.000454	0.055145
	(0.21434)	(0.17709)	(0.28381)	(0.00797)	(0.18873)
	[0.71286]	[0.15627]	[0.66611]	[-0.05702]	[0.29219]
BANK(-1)	0.424032	0.228459	0.543199	0.000353	0.521447
	(0.26408)	(0.21818)	(0.34967)	(0.00982)	(0.23252)
	[1.60571]	[1.04710]	[1.55347]	[0.03601]	[2.24256]
SPICBI(-1)	-0.568822	2.123704	-0.584850	0.287199	1.073163
	(2.52888)	(2.08938)	(3.34853)	(0.09399)	(2.22671)
	[-0.22493]	[1.01643]	[-0.17466]	[3.05550]	[0.48195]
IN(-1)	-0.294327	-3.58E-05	-0.163577	0.017173	-0.084803
	(0.24800)	(0.20490)	(0.32838)	(0.00922)	(0.21837)
	[-1.18680]	[-0.00017]	[-0.49813]	[1.86303]	[-0.38835]
C	0.475989	0.113778	0.445967	0.031040	0.396357
	(0.36198)	(0.29907)	(0.47931)	(0.01345)	(0.31873)
	[1.31495]	[0.38044]	[0.93044]	[2.30710]	[1.24355]
AC	-0.073118	-0.028190	-0.098364	0.001339	-0.082027
	(0.02579)	(0.02131)	(0.03415)	(0.00096)	(0.02271)
	[-2.83539]	[-1.32312]	[-2.88068]	[1.39738]	[-3.61252]
DD	0.005572	0.006082	0.014690	-8.06E-05	0.003543
	(0.01134)	(0.00937)	(0.01502)	(0.00042)	(0.00999)
	[0.49116]	[0.64891]	[0.97791]	[-0.19124]	[0.35465]
R-squared	0.145929	0.122626	0.121784	0.245298	0.200285
Adj. R-squared	0.080945	0.055869	0.054964	0.187875	0.139437
F-statistic	2.245617	1.836907	1.822554	4.271769	3.291574

Note: Standard errors in ( ) & t-statistics in [ ]
Source: Authors compilation

Where , market returns denotes returns of different indices that includes SENSEX, FMCG, BANK, SPICBI and IN at time t. wherein, C(1) denotes returns of different indices at lag 1, C(2) is constant, C(3) and C(4) are exogenous variables which represents the coefficients of active cases and daily death due to Covid-19 respectively.

The lag length selection criterion was based on AIC, FPE and HQ and was found optimum at lag 1 (*table 12*). The result of VAR indicates that AC is significantly influencing only three of the selected indices, namely SENSEX, BANK and IN. The t-statistics is greater than critical value of 1.96 (at 5% significance) with negative coefficients -0.073, -0.098 and -0.082 for SENSEX, BANK and IN respectively (See table 13). Although the coefficients of DD are positive but the relationship have found insignificant in all the indices. The residual of the VAR should be subjected to check serial correlation which was not found to be serially correlated, as the *P*-value is> 0.05 (See *table 14*). Stability condition of VAR was also checked by using inverse root of AR characteristic polynomial method and was satisfactory, as none of the root was found to lie outside the circle (See *Figure 1*).

Table 14. VAR Residual Serial Correlation LM Tests

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	23.70649	25	0.5364	0.948895	(25, 309.8)	0.5370
2	32.69350	25	0.1389	1.327316	(25, 309.8)	0.1394

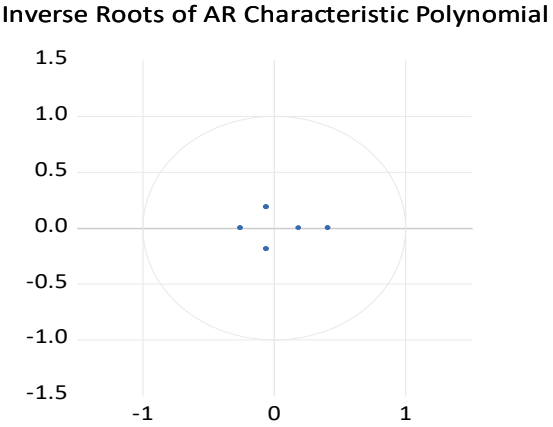

Figure 1. Inverse Roots of AR Characteristics Polynomial

Impulse Response Function

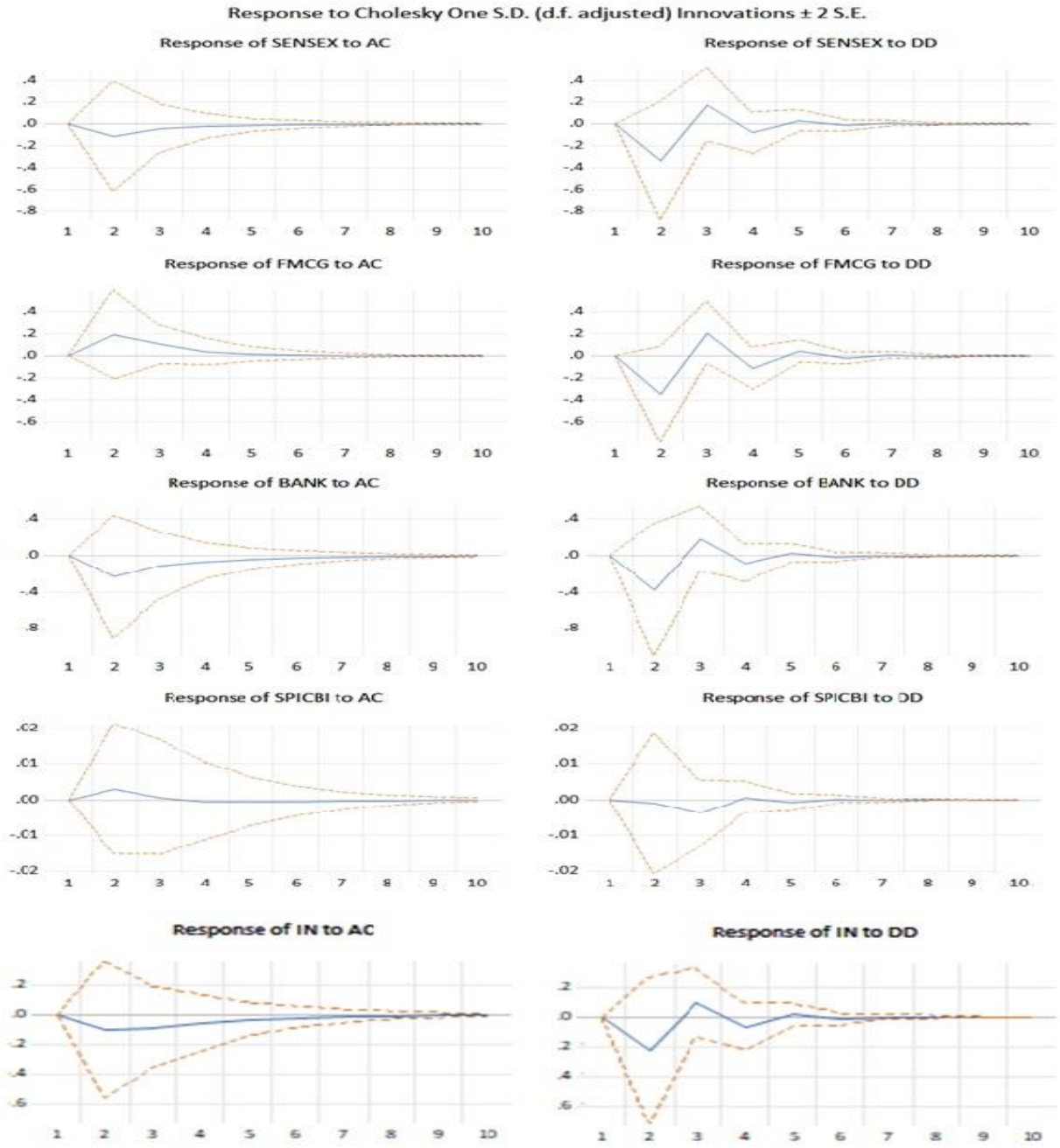

Figure 2. Impulse Response Function of COVID-19 and Returns of Indices

In the fiqure 2 of Impulse Response Function (IRF), there is one solid line between two dotted line. Former line shows coefficient of the impulse response while the dotted line shows bootsratpped confidence band at 90% level (Dhingra et al., 2016). The shock at one S.D. to AC and DD was observed for response on different maket indices (see *figure 2*). Response of SENSEX, BANK and IN to AC shows sharp decline initially but from 2nd period, it increases and remains negative throughout. For FMCG and SPICBI to AC, response abruptly increases to 2nd period and gradually dies out. The response of four indices (SENSEX, FMCG, BANK and IN) to DD shows sharp fall till 2nd period and similarly sharp rise in 3rd period, after which fluctuating response is seen throughout the periods. Considering response of SPICBI to DD, it shows decline till 3rd period and slight fluctuation during rest of the periods.

DISCUSSION

The econometric models analyzed the impact of COVID-19 on Indian stock market, which reflects the condition of Indian economy in short run. Overall results reveal negative impact on all the market indices influenced by COVID-19. SENSEX Index has been found to have negative and significant relationship with active cases of COVID-19 while applying all the four methods and insignificant considering daily death counts except with the results of IRF. The impact of AC on FMCG has evidence of significantly negative affect while observed from three methods except for IRF. Similarly, BANK has been negatively affected by AC shown in all the methods although GARCH predicts marginally insignificant relationship (*P*-value = 0.106).The IN index shows negative and significant relationship with COVID-19 in regression, GARCH, S-VAR and IRF.

Interestingly, SPICBI is showing positive relationship influenced by COVID-19. Yet only regression concludes on significant coefficients while GARCH and S-VAR show insignificant but positive relationships. Positive influence can also be seen in IRF graph.

CONCLUSIONS

As the COVID-19 pandemic is causing significant disruption in the World economy (Shehzad et al., 2020), it is also highly likely for the Indian economy to enter into phase of "economic shock" (Baldwin and di Mauro, 2020). The econometric models analyzed the impact of COVID-19 on Indian stock market, which reflects the condition of Indian economy in the short run. GARCH (1,1); Standard Vector Auto-regression and IRF was applied to further investigate the hypotheses.

The result for SENSEX and COVID-19 is in line with the recent plunge of SENSEX in end week of March 2020 (Business Reporter, 23 March 2020). The negative relationship may have been caused due to withdrawal of investment from the market by both domestic and foreign investors; this is evident by Foreign portfolio investors (FPI) pulling INR 1 Lakh crore from Indian market (Sharma, March 2020).

The negative impact of COVID-19 on Index of FMCG, Banking and Industrial sectors may have been due to the investor's fear and loss of trust in these sectors, which corroborates with recent survey by Babar (The Economic Times, 16 April 2020). Although, the healthcare and IT sector, are predicted to have positive relation in near future (Khanna, 15 April 2020; The Hindu Business Line, 10 April 2020), the result depicts otherwise.

COVID-19 and S&P BSE India Corporate Bond Index is positive due to the fact that corporate bonds are fixed income securities which are less volatile as compared to equities. This may have caused investors of corporate bonds not withdrawing their investment to that scale in contrast to other indices. Additionally due to less volatility, this causality can be attributed to the possible influx of more investment in corporate bonds, when it is considered the government should channelize investment which will help in reviving the real economy (Sen, 2019).

Overall, based on this study, the effect of pandemic with other indices suggests many insights and implications. First, investors can diversify portfolio to mitigate the risk caused by the ongoing pandemic. This can be achieved by consciously including corporate bond in their investment portfolio. Second, the policy makers of secondary market should emphasize development of debt based securities. Third, the study implies that government should facilitate the investors to put money into bond and related stocks.

This shall help the stock market to revive by the influx of investment and in the time of pandemic, this strategy can act as a buffer to the forecasted economic shock. Fourth, the bond market which has been a concern for the government, being sluggish for a long time will also be boosted. Fifth, this study will not only add knowledge to the existing literature but also will facilitate the academician and researchers to comprehend the impact of pandemics on Indian economy. Lastly, this study suggests that the government should take preventive measures against devastating effect of COVID-19.

Author Contributions: Conceptualization, M.A.A., N.K., A.S.M., and M.T.; Data Curation, M.A.A., N.K., A.S.M., and M.T.; Methodology, M.A.A.; Validation, M.A.A.; Visualization, M.A.A.; Formal Analysis, M.A.A., N.K., A.S.M., and M.T.; Investigation, M.A.A., N.K., A.S.M., and M.T.; Resources, M.A.A., N.K., A.S.M., and M.T.; Writing – Original Draft, M.A.A.; Writing – Review & Editing, M.A.A., N.K., A.S.M., and M.T.; Supervision, M.A.A.; Software, M.A.A.; Project Administration, M.A.A.; Funding Acquisition, M.A.A., N.K., A.S.M., and M.T. Authors have read and agreed to the published version of the manuscript.

Institutional Review Board Statement: Ethical review and approval were waived for this study, due to that the research does not deal with vulnerable groups or sensitive issues.

Funding: The authors received no direct funding for this research.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to restrictions.

Conflicts of Interest: The authors declare no conflict of interest.

REFERENCES

Amarendra, A. (2011). Corporate Bond Market in India: Issues and Challenges. *Reserve Bank of India Occasional Papers*, *32*(3), Winter 2011. Retrieved from https://rbidocs.rbi.org.in/rdocs/Content/PDFs/3ARCO100114.pdf

Al Jazeera. (2020, April 14). India extends world's biggest coronavirus lockdown till May 3. Retrieved from https://www.aljazeera.com/news/2020/04/india-nationwide-coronavirus-lockdown-extended-3-modi-200414045543730.html

Agencies. (2020, March 14). India declares Covid-19 a 'Notified Disaster' The Economic Times. Retrieved from https://economictimes.indiatimes.com/news/politics-and-nation/india-declares-covid-19-a-notified-disaster/articleshow/74631611.cms?from=mdr

Anselin, L. (2013). *Spatial econometrics: methods and models* (Vol. 4). Springer

Armien, B., Suaya, J. A., Quiroz, E., Sah, B. K., Bayard, V., Marchena, L., & Shepard, D. S. (2008). Clinical characteristics and national economic cost of the 2005 dengue epidemic in Panama. *The American journal of tropical medicine and hygiene*, *79*(3), 364-371.

Ayittey, F. K., Ayittey, M. K., Chiwero, N. B., Kamasah, J. S., & Dzuvor, C. (2020). Economic impacts of Wuhan 2019-nCoV on China and the world. *Journal of medical virology*, *92*(5), 473. https://doi.org/10.1002/jmv.25706

Arun, T. K. (2020, January 14). View: What India needs is a corporate bond market, not a new DFI. *The Economic Times.* Retrieved from https://economictimes.indiatimes.com/markets/stocks/news/view-what-india-needs-is-a-corporate-bond-market-not-a-new-dfi/articleshow/73238824.cms?from=mdr

Business Today. (2020, January 15). Share Market Update: Sensex ends highest ever at 41,952.63, Nifty at 12,362.30; media stocks lead gains. Retrieved from https://www.businesstoday.in/markets/stocks/share-market-live-sensex-nifty-trading-on-jan-14-2020-edelweisis-cipla-mindtree-wipro-irctc-indusind-bank/story/393749.html

Baldwin, R., & Di Mauro, B. W. (2020). Economics in the time of COVID-19: A new eBook. *VOX CEPR Policy Portal*, 2-3.

Barnett, T., Whiteside, A., Khodakevich, L., Kruglov, Y., & Steshenko, V. (2000). The HIV/AIDS epidemic in Ukraine: its potential social and economic impact. *Social science & medicine*, *51*(9), 1387-1403. https://doi.org/10.1016/S0277-9536(00)00104-0

Beutels, P., Jia, N., Zhou, Q. Y., Smith, R., Cao, W. C., & De Vlas, S. J. (2009). The economic impact of SARS in Beijing, China. *Tropical Medicine & International Health*, *14*, 85-91. https://doi.org/10.1111/j.1365-3156.2008.02210.x

Bloom, D. E., & Mahal, A. S. (1997). Does the AIDS epidemic threaten economic growth?. *Journal of Econometrics*, *77*(1), 105-124. https://doi.org/10.1016/S0304-4076(96)01808-8

Bollerslev, T. (1986). Generalized autoregressive conditional heteroskedasticity. *Journal of econometrics*, *31*(3), 307-327. https://doi.org/10.1016/0304-4076(86)90063-1

Bollerslev, T., Chou, R. Y., & Kroner, K. F. (1992). ARCH modeling in finance: A review of the theory and empirical evidence. *Journal of econometrics*, *52*(1-2), 5-59. https://doi.org/10.1016/0304-4076(92)90064-X

Bollerslev, T., Engle, R. F., & Nelson, D. B. (1994). ARCH models. *Handbook of econometrics*, *4*, 2959-3038. https://doi.org/10.1016/S1573-4412(05)80018-2

Brooks, C. (2008). *Introductory Econometrics for Finance* (2nd Eds.). UK: Cambridge University Press.

Brooks, C. (2014). *Introductory Econometrics in Finance* (3rd ed.). New York, NY. Cambridge University Press.

BSE (n.d.) Introduction. Retrieved from https://web.archive.org/web/20180131201340/http://www.bseindia.com/static/about/introduction.aspx?expandable=0

Business Reporter. (2020, March 23). Sensex plunges 3,935 pts in biggest 1-day fall; investors lose Rs 13.88 trn. Retrieved from https://www.business-standard.com/article/markets/market-live-markets-sensex-nifty-bse-nse-coronavirus-hdfc-ril-120032300127_1.html

Carpenter, T. E., O'Brien, J. M., Hagerman, A. D., & Mc Carl, B. A. (2011). Epidemic and economic impacts of delayed detection of foot-and-mouth disease: a case study of a simulated outbreak in California. *Journal of Veterinary Diagnostic Investigation*, *23*(1), 26-33. https://doi.org/10.1177/104063871102300104

Chen, M. H., Jang, S. S., & Kim, W. G. (2007). The impact of the SARS outbreak on Taiwanese hotel stock performance: an event-study approach. *International Journal of Hospitality Management*, *26*(1), 200-212. https://doi.org/10.1016/j.ijhm.2005.11.004

Clear Tax. (2018, August 20). Stock Market Index: Meaning, Importance, NSE & BSE and more. Retrieved from https://cleartax.in/s/stock-market-index

Clark, G. (2007). The long march of history: Farm wages, population, and economic growth, England 1209–1869 1. *The Economic History Review*, *60*(1), 97-135. https://doi.org/10.1111/j.1468-0289.2006.00358.x

Clark, G. (2010). The macroeconomic aggregates for England, 1209–2008. In *Research in economic history*, pp. 51-140. https://doi.org/10.1108/S0363-3268(2010)0000027004

Engle, R. F. (1982). Autoregressive conditional heteroscedasticity with estimates of the variance of United Kingdom inflation. *Econometrica: Journal of the econometric society*, 987-1007. https://doi.org/10.2307/1912773

Ellis-Peterson, Hannah (2020, March 24). India's 1.3 bn population locked down to beat coronavirus. The Guardian. Retrieved from https://www.theguardian.com/world/2020/mar/24/indias-13bn-population-locked-down-to-beat-coronavirus

Gangadharan, S. R., & Yoonus, C. A. (2012). Global financial crisis and stock market integration: A study on the impact of global financial crisis on the level of financial integration between the US and Indian stock markets. *Asia-Pacific Journal of Management Research and Innovation*, *8*(2), 101-110.

https://doi.org/10.1177/2319510X1200800203
Garson, G. D. (2012). *Testing statistical assumptions.* Asheboro, NC: Statistical Associates Publishing.
Garg, A., & Bodla, B. S. (2011). Impact of the foreign institutional investments on stock market: Evidence from India. *Indian Economic Review*, 303-322. Retrieved from https://www.jstor.org/stable/23266433
Gujarati, D. N., Porter, D. C., & Gunasekar, S. (2012). *Basic Econometrics (5th ed.).* New Delhi, ND. McGraw Hill education.
Gupta, A. G., Moyer, C. A., & Stern, D. T. (2005). The economic impact of quarantine: SARS in Toronto as a case study. *Journal of Infection*, *50*(5), 386-393. https://doi.org/10.1016/j.jinf.2004.08.006
Hair, J. F., Jr., Anderson, R. E., Tatham, R. L. & Black, W. C. (1995). *Multivariate Data Analysis*, 3rd ed, Macmillan Publishing Company, New York
Hassan, E. U., Shahzeb, F., Shaheen, M., Abbas, Q., Hameed, Z., & Hunjra, A. I. (2013). Impact of affect heuristic, fear and anger on the decision making of individual investor: a conceptual study. *World Applied Sciences Journal*, *23*(4), 510-514. Retrieved from https://www.idosi.org/wasj/wasj23(4)13/11.pdf
IBEF. (2020, March). Indian FMCG Industry Analysis. Retrieved from https://www.ibef.org/industry/Fmcg-presentation
Iyer, A. (2020, April 09). Covid-19 may be lethal for India's economy but it ain't bad for rupee. Livemint. Retrieved from https://www.livemint.com/market/mark-to-market/covid-19-may-be-lethal-for-india-s-economy-but-it-ain-t-so-bad-for-rupee-11586407946514.html
Jorda, O., Singh, S. R., & Taylor, A. M. (2020). Longer-run economic consequences of pandemics (No. w26934). *National Bureau of Economic Research.* https://doi.org/10.1162/rest_a_01042
Khanna, S. (2020, April 15). Opinion | Can covid-19 be Indian pharma's Y2K moment? Livemint. Retrieved from https://www.livemint.com/opinion/columns/can-covid-19-be-indian-pharma-s-y2k-moment-11586966253864.html
Livemint. (2020, April 7). India biggest producer of 'game-changer' hydroxychloroquine drug; has enough capacity. Retrieved from https://www.livemint.com/science/health/india-biggest-producer-of-game-changer-hydroxychloroquine-drug-has-enough-capacity-11586266119087.html
Luo, S. & Tsang, K. P. (2020). How Much of China and World GDP Has The Coronavirus Reduced?, *Social Science Research Network Report*.
Maital, S. and Barzani, E. (2020). Abstract: The Global Economic Impact of COVID-19: A Summary of Research. *Samuel Neaman Institue for National Policy Research*. Retrieved from https://www.neaman.org.il/Files/Global%20Economic%20Impact%20of%20COVID-19.pdf
McKibbin, W. J., & Fernando, R. (2020). The global macroeconomic impacts of COVID-19: Seven scenarios. https://doi.org/10.1162/asep_a_00796
Mehta, R. (2020, March 16). Big Sensex falls in 20 years and market reaction to other viral outbreaks. The Economic Times. Retrieved from https://economictimes.indiatimes.com/wealth/personal-finance-news/biggest-sensex-falls-in-20-years-and-market-reaction-to-other-viral-outbreaks/articleshow/74624064.cms?from=mdr
Montgomery, D.C., E.A. Peck and G.G. Vining, 2001. *Introduction to Linear Regression Analysis.* 3rd Edn., John Wiley and Sons, New York, USA., ISBN-13: 978-0471315650, Pages: 672.
Mohanty, P. (2019, July 15). Labour reforms: No one knows the size of India's informal workforce, not even the govt. Business today. Retrieved from https://www.businesstoday.in/sectors/jobs/labour-law-reforms-no-one-knows-actual-size-india-informal-workforce-not-even-govt/story/364361.html
Mudgill, A. (2020, April 25). How will India lockdown play out for economy & markets: 4 scenarios. The Economic Times. Retrieved from https://economictimes.indiatimes.com/markets/stocks/news/how-will-india-lockdown-play-out-for-economy-markets-4-scenarios/articleshow/74804087.cms
Mehta, R. (2020, March 23). How the coronavirus has hit Indian and global markets. The Economic Times. Retrieved from https://economictimes.indiatimes.com/wealth/personal-finance-news/how-the-coronavirus-has-hit-indian-and-global-markets/articleshow/74745391.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst
Nagaraj, R. (2013). India's dream run, 2003-08: Understanding the boom and Its aftermath. *Economic and Political Weekly*, 39-51.
Patnaik, I., Shah, A., & Singh, N. (2013). Foreign investors under stress: Evidence from india. *International Finance, 16*(2), 213-244. https://doi.org/10.1111/j.1468-2362.2013.12032.x
Patil, D. (2020, January 20). Sluggish bond market is the latest headache for Indian borrowers. The Print, Retrieved from https://theprint.in/economy/sluggish-bond-market-is-the-latest-headache-for-indian-borrowers/351899/
Ruiz Estrada, M. A., Park, D., Koutronas, E., Khan, A., & Tahir, M. (2020). The impact of infectious and contagious diseases and its impact on the economic performance: The case of Wuhan, China. *China* (January 29, 2020). http://dx.doi.org/10.2139/ssrn.3527330
Riley, C. & Horowitz, J. (2020, February 10). The coronavirus is already hurting the world economy. Here's why it could get really scary. CNN Business. Retrieved from https://edition.cnn.com/2020/02/08/business/coronavirus-global-economy/index.html
Sahoo, J. (2020). Financial stress index, growth and price stability in India: Some recent evidence. *Transnational Corporations Review*, 1-15. https://doi.org/10.1080/19186444.2020.1768789
Sharma, S. (2020, March 25). FPI investors leave India with lifetime high withdrawal; pullout more in March than in full year 2018. Financial Express. Retrieved from https://www.financialexpress.com/market/fpi-investors-leave-india-with-lifetime-high-withdrawal-pullout-more-in-march-than-in-full-year-2018/1908404/

Salvatore, D., & Reagle, D. (2002). *Shaum's outline of statistics and econometrics* (2nd ed.). New York, N.Y.: Schaum McGraw-Hill

Sen, S. (2019). Official Reforms and India's Real Economy. *Economic & Political Weekly*, *54*(38), 17.

Shehzad, K., Xiaoxing, L., & Kazouz, H. (2020). COVID-19's disasters are perilous than Global Financial Crisis: A rumor or fact?. *Finance Research Letters*, 101669. https://doi.org/10.1016/j.frl.2020.101669

Sumantri, V. D. S. (2020). Analysis Factors Affecting Indonesia Stock Market (Case Studies on Consumer Goods Index). *Economic Studies & Analyses/Acta VSFS*, *5*(1).

Shukla, V. (2019, February 19). Top 10 Largest Stock Exchanges In The World By Market Capitalization. ValueWalk. Retrieved from https://www.valuewalk.com/2019/02/top-10-largest-stock-exchanges/

The Economic Times. (2018, August 18). India clocked 10.08 per cent growth under Manmohan Singh's tenure: Report. Retrieved from https://economictimes.indiatimes.com/news/economy/indicators/india-clocked-10-08-pc-growth-under-manmohan-singhs-tenure-shows-data/articleshow/65444247.cms?from=mdr

The Hindu Business Line. (2020, April 10). Covid-19 pandemic to hit Indian IT-BPO industry hard. Retrieved from https://www.thehindubusinessline.com/info-tech/covid-19-pandemic-to-hit-indian-it-bpo-industry-hard/article31305439.ece

Usmani, F. & Akhter, J. (2020). Dynamic Interaction Between Foreign Institutional Investors And Market Return In An Emerging Economy: Evidence From India. *International Journal of Scientific & Technology Research, 9*(4). Retrieved from https://www.ijstr.org/final-print/apr2020/Dynamic-Interaction-Between-Foreign-Institutional-Investors-And-Market-Return-In-An-Emerging-Economy-Evidence-From-India.pdf

Ülkü, N., & İkizlerli, D. (2012). The interaction between foreigners' trading and emerging stock returns: Evidence from Turkey. *Emerging Markets Review*, *13*(3), 381-409. https://doi.org/10.1016/j.ememar.2012.06.002

Vijayakumar, K., George, B., Anish, T. S. Rajasi, R. S., Teena, M. J., & Sujina, C. M. (2013). Economic Impact of Chikungunya Epidemic: Out-Of-Pocket Health Expenditures During The 2007 Outbreak In Kerala, India. *Southeast Asian J Trop Med Public Health, 44*(1), 54-61. Retrieved from https://www.tm.mahidol.ac.th/seameo/2013-44-1-full/8-5415-2.pdf

Vo, X. V. (2017). Trading of foreign investors and stock returns in an emerging market-Evidence from Vietnam. *International Review of Financial Analysis*, *52*, 88-93. https://doi.org/10.1016/j.irfa.2017.05.007

Worldometers. (n.d.). Countries where COVID-19 has spread. Retrieved from https://www.worldometers.info/coronavirus/countries-where-coronavirus-has-spread/

World Health Organisation [WHO]. (2020, March 12). WHO announces COVID-19 outbreak a pandemic. Retrieved from http://www.euro.who.int/en/health-topics/health-emergencies/coronavirus-covid-19/news/news/2020/3/who-announces-covid-19-outbreak-a-pandemic

Wick, B. (2020, April 17). IMF chief says its forecast that 170 global economies will shrink may be too optimistic. Business Insider. Retrieved from https://www.businessinsider.in/stock-market/news/imf-chief-says-its-forecast-that-170-global-economies-will-shrink-may-be-too-optimistic/articleshow/75207315.cms

World Health Organisation [WHO]. (2020, January 12). Novel Coronavirus – China. Retrieved from https://www.who.int/csr/don/12-january-2020-novel-coronavirus-china/en/

Yang, H. Y., & Chen, K. H. (2009). A general equilibrium analysis of the economic impact of a tourism crisis: A case study of the SARS epidemic in Taiwan. *Journal of Policy Research in Tourism, Leisure and Events*, *1*(1), 37-60. https://doi.org/10.1080/19407960902738313

Yang, P. C., Chu, R. M., Chung, W. B., & Sung, H. T. (1999). Costs of the 1997 Foot-and-Mouth Disease Epidemic in Taiwan. *Veterinary Record*, 145, 731-734. https://doi.org/10.1136/vr.145.25.731