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The Role of Institutional Investors in The Indian Stock Markets During the Pandemic

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Abstract: Research Question: The study evaluates the behaviour of the FIIs and DIIs on the returns and volatility of the four major Indian stock indices namely, Nifty 50, Nifty Next 50, BSE Sensex, and BSE 100 before and during the pandemic of COVID-19. To capture the volatility, exogenous variable, India VIX has been used. **Motivation:** Due to the stringent measures taken by several countries in response to the COVID-19 pandemic, there was an initial downturn in the global economic prospects and a meltdown in the financial markets. **Idea:** It made the individual investors curious about the behaviour of institutional investors to take a position amidst the highly uncertain environment. **Data:** The daily data of buying and selling of FIIs and the DIIs and the four indices have been obtained from the period January 1, 2011, to April 3, 2020. Further, the study is divided into three sub-periods that is full, before COVID and during COVID. **Method/Tools:** Various analysis were performed using correlation, rolling correlation, Granger causality, GARCH, GJR-GARCH and EGARCH to gauge the relationship between activities of FIIs and DIIs and the market returns. **Findings:** The outcome of the analysis reveals that both the FIIs and DIIs play significant role in generating the returns and volatility in the Indian stock market. However, during the pandemic of COVID-19, the FIIs led the market returns and DIIs led the volatility. This is due to the fact that the DIIs were the net buyers during this period and the distribution of their net position was positively skewed. The leverage effect is also observed. The persistence of the volatility is highest during COVID-19. **Contributions:** The study is one of a kind adding to the existing body of knowledge related to the behaviour of FIIs and DIIs during the global epidemic. It is the most recent and closely related to the literature on capturing FII and DII investment patterns during a global pandemic.

Keywords: FIIs, DIIs, Indian stock markets, COVID-19, GARCH.
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1. Introduction

Indian economy is one of the best places to invest due to its demographic growth, expanding productivity, and long-term economic growth potential[1] (IBEF, 2019). It has been ranked as one of the world's top emerging economies due to its striking Gross Domestic Product (GDP) at around 6% during Fiscal Year (FY) 2019 among other emerging economies in the world[2]. It not only appeals to domestic investors (institutional as well as retail) to invest for lucrative returns but also fascinates foreign participants. The emerging Indian economy, which offers a relatively higher growth rate than many other developed economies[3], has been the focus of foreign investors since 1991 after the announcement of LPG as a part of the new economic policies. The Indian stock market was kept open for foreign investors in September 1992 and gained popularity as an attractive investment destination for Foreign Direct Investments (FDIs) and Foreign Institutional Investors (FIIs). Other than retail investors, institutional investors include asset management companies, banks, insurance companies, hedge funds, pension funds and portfolio management companies, to name a few. As investors, they generate more volatility in the stock market since they hold a substantial fraction of financial assets, huge trading volume, and larger investment funds (Baral and Patra, 2019; Roy and Deb, 2019; Reddy, 2017; Naik and Padhi, 2015). They are also considered to have better information access compared to retail investors (Ghosh and Srinivasan, 2014). They are the driving force for any economy as they inject global liquidity into the capital markets of the host country, increase the efficiency of these markets by raising the price-to-earnings ratios, and lower the cost of capital (Srikanth and Kishore, 2012). As a result, retail investors are more likely to follow institutional investment strategies and herd around foreign investors (Chong *et al.*, 2019).

Institutional investors are mostly classified into two broad categories: (a) Domestic Institutional Investor (DII) is defined as the institutional investors registered in the home country who are investing in the financial markets of the same country. The DIIs channel domestic savings into the financial markets (Naik and Padhi, 2015). b) Foreign Institutional Investor (FII) is defined as an entity incorporated outside India that proposes to invest in India and is registered as an FII under SEBI (Foreign Institutional Investors) Regulations, 1995. They include investment companies incorporated and registered outside India that make investments in a large pool of investments created by small investors (Goyal and Singh, 2013). Recent years have witnessed an increase in investments by FIIs and DIIs in the Indian stock market, which has resulted in an increase in the value of the Indian stock indices such as the BSE Sensex and Nifty (Roy and Deb, 2019). Some studies suggest that DIIs invest in the market when FIIs take an exit call and help stabilize the market (Baral and Patra, 2019; Murthy and Singh, 2013). However, according to a study conducted by moneycontrol.com[4], it has been observed that in the long run, there is no correlation between domestic and foreign institutional investments and market returns. With improvement in the economy's global linkages, foreign capital also makes the host country's markets more vulnerable to global shocks (Ghosh and Srinivasan, 2014). In 2019, the global economy was already going through turmoil and the outbreak of COVID-19[5] created a high risk of converting this slowdown into

[1] https://www.ibef.org/economy/foreign-institutional-investors.aspx Accessed on: March 20, 2020

[2]https://www.businessinsider.sg/oxford-economics-ranking-of-emerging-market-economies-2019-2 Accessed on: March 20, 2020

https://www.statista.com/statistics/741729/gross-domestic-product-gdp-growth-rate-in-the-bric-countries/ Accessed on: March 26, 2020

[3] https://www.karvy.com/growth-hub/personal-finance/fii-vs-dii Accessed on April 5, 2020

[4] https://www.moneycontrol.com/news/business/markets/do-fiis-and-diis-really-drive-the-markets-heres-what-correlations-say-2260223.html Assessed on April 5, 2020

[5] https://home.kpmg/content/dam/kpmg/in/pdf/2020/04/potential-impact-of-covid-19-on-the-Indian-economy.pdf Accessed on April 5, 2020

a crisis at the beginning of 2020. Many developed and developing economies are forced to go for a shutdown of economic activities to curtail the spread of the pandemic (Mishra *et al.*, 2022). It has shaken powerful economies like the United Kingdom, the United States, Japan and China to name a few. Indian economy is no exception to this. Indian real GDP has also gone down to the lowest in over 6 years in the third quarter of FY 2019-20. It has affected the three major contributors to GDP, i.e., private consumption, investments, and external trade[6].

In this backdrop, the objectives of the study are to (a) examine the investment patterns of FIIs and DIIs before and during the period of a pandemic, (b) appraise the influence of FIIs and DIIs activities on the returns and volatility of the Indian stock market using GARCH tests before and during the global crisis of COVID-19, and (c) get an answer to the question "who drives the market-FIIs or DIIs?" This article consists of five sections, starting from the introduction. The next section discusses a detailed review of related literature. It is followed by the third section on data and research methodology. The fourth section deals with data analysis and discussions. The concluding remarks of the study are provided in section five.

2. Literature Review

Substantial amounts of foreign capital have been attracted to India as a result of the opening of the Indian stock market to foreign investors in September 1992, the market's stellar performance since around 2001, an increase in the number of profitable corporate houses, and a gradual improvement in the rate of overall economic growth. (Poshakwale and Thapa, 2010). The two major factors attracting inflows of FIIs are (a) positive interest rates and (b) growth in the Index of Industrial Production (IIP). Ultimately, it leads to a surge in foreign exchange reserves of the country (Srikanth and Kishore, 2012). Mohanamani and Sivagnanasithi (2012) suggested that the FIIs positively affect the economic factors at a macro level and are likely to have an impact on the overall economic development of the country. On the contrary, Kaur and Dhillon (2010) observed that the flows of FIIs are greatly influenced by both macroeconomic factors and returns from the stock market. Based on the study, evaluating the relationship between FIIs and organisation-specific factors like shareholding pattern, financial performance, and returns from stock, it is observed that the companies operating in emerging economies generate huge profits and that attract institutional investment (Goyal and Singh, 2013). One study has also noted that FIIs prefer to invest in companies where the public holds a higher portion of shares. It suggests that there is a negative relationship between the promoters' holdings and foreign investments (Prasanna, 2008).

Mostly the studies referred to consider only FIIs as institutional investors and the literature targeting the impact of both the FIIs and the DIIs is scarce. Moreover, a limited number of studies have considered the overall DIIs category, while some have taken investments by mutual funds as a proxy of DIIs (Naik and Padhi, 2015; Murthy and Singh, 2013; Kumar, 2007). The FIIs also influence the actions of the DIIs (Gahlot, 2019). Many researchers have highlighted that institutional investors typically follow their past investment strategies. (Naik and Padhi, 2015). For example, they normally buy the added shares in the index and sell out the deleted shares within several days (Ng and Zhu, 2016). Shaharuddin *et al.* (2017) confirm that due to institutional investors' preference for growth stocks from blue-chip companies, the growth style is more sensitive to fresh information than the value style. Gupta and Gordon (2003) observed that the flows of the FIIs are resilient and it is positively influenced by the performance of the shares listed on the indices of the emerging markets. They found a surprising negative relationship between domestic market performance and FIIs flows. In emerging economies, FIIs play a more crucial role in setting the market trend and in

[6] https://home.kpmg/content/dam/kpmg/in/pdf/2020/04/potential-impact-of-covid-19-on-the-Indian-economy.pdf Accessed on April 5, 2020

generating liquidity and volatility in stock returns as compared to DIIs (Shukla *et al.*, 2011; Baral and Patra, 2019; Roy and Deb, 2019). The volatility in the stock market is the rate and magnitude at which the prices of securities, indices, and derivative products change. In finance, volatility has been referred to as risk (Ibrahim and Ahmad, 2008; Kuhe, 2018). In India, the index that measures expected volatility in the stock market over the near term based on the order book of the underlying index options i.e., Nifty Index Option prices is the India VIX Index[7]. French *et al.* (1987) observed that the expected excess return on a stock portfolio over the risk-free investment in a government treasury bill is positively related to the volatility of stock returns. The stock market volatility can be modelled using GARCH models proposed by Engle (1982), Bollerslev (1986), etc. Recently, it has gained the interest of researchers, academicians and financial analysts. The GARCH models have also been more successful in analysing statistical facts of financial time series such as volatility clustering, volatility shock persistence, volatility mean reversion, leverage effect and risk premium, etc. (Kuhe, 2018).

Despite the associated volatility, the increase in foreign capital results in enhanced performance of the economy as a whole and the stock returns. On the other hand, improved stock returns and economic performance attract more foreign capital. The increase in the inflow of foreign capital due to an increase in stock returns is known as 'positive feedback' trading, while the increase in foreign capital inflow due to a decline in stock returns is termed 'negative feedback' trading (Inoue, 2009). The FIIs invest in the stock markets for opportunistic gain, as they involve more in trading activities and do not intend to cause a fundamental change in the market (Baral and Patra, 2019; Murthy and Singh, 2013) i.e., FIIs are considered as 'return chasers' or 'feedback traders'. They follow positive feedback trading while buying in the Indian stock market -cash and futures- whereas their sales are the outcome of negative feedback trading (Dhingra *et al.*, 2016). Samarakoon (2009) observed a similar outcome while evaluating the institutional investment flows and past returns. However, in times of crisis, he found a reversal trend. Examining the relationship between the returns and the past flows, it was observed that there is a significant positive correlation between purchases of the DIIs and future returns, while no significant correlation was observed between purchases of the FIIs and future returns. The sales by the DIIs have no correlation with future returns, while sales by the FIIs have a strong positive relationship with future returns. The impact of flows on future returns was found to be indifferent between stressed and normal periods.

During a time of crisis, in the home country or the host country, or at the world level, foreign investors are the first to leave. From the analysis of the worst twenty-five crashes at BSE, it was found that the FIIs have been highly bearish in all the cases (Loomba, 2012). Further, investigating the reason for the sudden fall in the Indian stock market during 2008-2009, it was understood the rapid fall was a drop in the investment of the FIIs and the DIIs (Roy and Deb, 2019). Other studies noted a negative correlation between the FIIs and the DIIs investment activities, i.e., the DIIs play a defending role by buying in a falling market when the FIIs withdraw, but their buying does not seem to be enough to restore the falling market (Jalota, 2017; Reddy, 2017). Kaur and Dhillon (2010) explored the determinants of FIIs in the Indian stock market. They observed that the inflows of the FIIs in India are dependent on both stock market movements and macroeconomic factors. Among the factors, returns on investment from the Indian stock market significantly influence the flows of FIIs in India, while returns on investment from the US stock market do not play any significant role. Apart from that risk factor associated with the stock market, the market capitalization of the Indian market has a substantial positive effect on the inflows of the FIIs to India, while market turnover has a considerable positive effect on the latter. However, this significance has been

[7] https://www1.nseindia.com/products/content/equities/indices/india_vix.htm Accessed on 18th March, 2020

found only in the short run. Among macroeconomic factors, the investments by the FIIs are positively related to the economic growth of the Indian economy in the long run as well as in the short run. The other macro-economic factors like inflation in the US, positively influence the investments of the FIIs in India only in the long run. While the inflation rate in India negatively affects the latter. Moreover, the interest rates in the US negatively affect the investments by the FIIs while the liberalization policy announcements in India encouraged more inflow of the FIIs.

Kotishwar and Alekhya (2015) undertook research to examine the correlation between Nifty returns and the FIIs and the DIIs and the mutual funds' inflows and outflows. The study was conducted for the period from 2006 to 2014. The outcome of the regression analysis indicates that Nifty is affected by the DIIs, not the FIIs. Moreover, it was also observed that mutual funds' inflows have a negative correlation with Nifty. However, Bansal and Rao (2018) observed a strong negative correlation between the DIIs and the Nifty returns, while Atif (2016) noted that there is a unidirectional relationship where Sensex movement drives the DIIs flows. Bose (2012) witnessed similar outcomes related to the negative correlation between the market returns and the investment flows by the DIIs. Loomba (2012), based on daily data for a period from January 2001 to December 2011, concluded that a significant positive correlation was observed between the activities of FIIs and the Indian stock market. Bohra and Dutt (2011) found a strange outcome that BSE Sensex is indifferent to the FIIs' inflows. Further, they probed the relationship between the flows of the FIIs and the turnover of different indices in BSE like small-cap and mid-cap indices. The analysis concluded that a positive correlation was observed between the investments by the FII and the stock market except in the years 2005 and 2008. They also observed that the FIIs' movement plays a major role in framing domestic investors' sentiments in the market. Moreover, the flow of the FIIs also significantly affects the share prices and the trading volume of the companies in mid-cap and small-cap indices. Ultimately, it results in an increase in volatility in the indices (Shukla *et al.*, 2011).

Studies have checked the causality between the investments by institutional investors and the stock market returns. The study conducted by Sonawane (2020) had an objective to analyse the long-term and short-term causality between the Indian stock market with the FIIs and DIIs. The period covered under the study was from April 2007 to December 2013 based on the monthly data of the two leading stock indices, namely, Sensex and Nifty. The study concluded that there is unidirectional causality from the FIIs to the Indian stock market both in the long run as well as short run. However, the DIIs have unidirectional long-run causality with the market. Gahlot (2019) examined the effect of FIIs and DIIs on the selected Indian stock indices. They used the Granger causality test and TGARCH model, and concluded that historical volatility is statistically significant, and it takes a long time to discover the same. As an outcome of Granger causality test, they found that the investment activities of the DIIs depend upon the investment activities of the FIIs. The results of ARCH and GARCH suggest that based on recent and historical news investors can make profitable investment strategies. The leverage coefficient indicates irregular movement between the return shock and volatility adjustment and due to that irregularity, it was suggested to the investors be more conscious of negative news in the market. However, according to the efficient market hypothesis, the news should quickly adapt to the entry of fresh information into the market Fama (1970). As a result, the active trader, such as institutional investors, takes a position utilising their knowledge and high-frequency data analysis (Danak and Patel, 2020).

Roy and Deb (2019) found as an outcome of the Granger causality test that the index value granger cause over the FIIs and the DIIs. Srikanth and Kishore (2012) observed a bidirectional causal relationship between the FIIs' inflows and BSE Sensex during their 8 yearlong study from April 2003 to March 2011. The results of Granger causality tests conducted by Murthy

and Singh (2013) suggest that the FIIs and the DIIs have a significant influence on the stock market, while the mutual funds are the passive players. Kumar (2007) investigated the combined impact of the FII and the mutual funds on the Indian stock market. The result of the Granger causality check shows that mutual funds are leading the movement of the market and that the FIIs are trailing them. Naik and Padhi (2015), with the help of the structural Vector Auto-Regression (VAR) framework, attempted to empirically check the relationship between institutional investment (both foreign and domestic) and the Indian stock market. On applying the causality test, it was found that there exists bidirectional causation between the net flows of the FIIs and market volatility, whereas flows of the mutual funds do not cause volatility. Bansal and Rao (2018) explored the relationship between investments by the DIIs and the FIIs with Nifty returns. They observed a strong negative correlation between the DIIs and Nifty returns, and the opposite for the FIIs and Nifty returns. The results of the Granger causality test revealed a unidirectional causality from the FIIs to Nifty returns and the DIIs to Nifty returns.

The current study is one of a kind adding to the existing body of knowledge related to behaviour of FIIs and DIIs during the global pandemic. As the pandemic of COVID-19 has resulted in a slowdown in the overall global economy, it has led individual investors curious about the behaviour of institutional investors to take a position amidst the highly uncertain environment. In such a scenario, the study evaluates the behaviour of the FIIs and DIIs on the returns and volatility of the four major Indian stock indices before and during the pandemic of COVID-19. It is the most recent and closely related to the literature on capturing FII and DII investment patterns and their impact on returns and volatility during the global pandemic. It attempts to examine the behaviour of the FIIs and the DIIs on the volatility of the stock market in India before and during the global crisis of COVID-19. We also check the causal relationship between the FIIs and the DIIs on the selected indices in India before and during the COVID-19 crisis. To achieve the objective, the study period was divided into three parts: the first (full) period: the entire period from January 1, 2011, to April 3, 2020; the second (pre-COVID) period: January 1, 2011, to December 31, 2019; and the third (during COVID) period: January 1, 2020, to April 3, 2020.

3. Data and Methodology

3.1 Objective of The Study

Through this research, we attempt to analyse the behaviour of the FIIs and the DIIs on the volatility of the Indian stock market before and during the global crisis of COVID-19. The study further tries to check the causal relationship between the FIIs, the DIIs, and the selected indices in the Indian stock market. The objectives of the study are to (a) examine the investment patterns of FIIs and DIIs before and during the period of an economic slowdown, (b) appraise the influence of FIIs and DIIs on the returns and volatility of the Indian stock market using GARCH tests before and during the global crisis of COVID-19, and (c) get an answer to the question "who drives the market-FIIs or DIIs?"

3.2 The Data

For capturing the behaviour of the investment pattern of the FIIs and the DIIs, we have taken four broad indices, namely, Nifty 50, Nifty Next 50, BSE Sensex, and BSE 100 because most of the investment of the FII and the DII lies with companies listed on these four indices (Gahlot, 2019). Broadly, these indices are considered the yardstick of the Indian economy and rightly explain the economic performance. The daily data of the FIIs purchases, the FIIs sales, the DIIs purchases, the DIIs sales, and the four indices have been obtained. In order to capture the volatility aspect, we have also taken the India VIX index as an exogenous variable.

3.3 Period of Study

The overall period of the study is from January 1, 2011, to April 3, 2020. We try to check the long-term pattern of investment by the FIIs and the DIIs as well as the effect of COVID-19 on the investment behaviour of the FIIs and the DIIs. Hence, the short-term period captures the COVID-19 effect, which allows investigation of the behavioural aspects of the institutional investors in the financial markets. The study covers the following three sub-periods:

(I) First (full) period: the entire period from January 1, 2011, to April 3, 2020.
(II) Second (pre-COVID) period: January 1, 2011, to December 31, 2019.
(III) Third (during COVID) period: January 1, 2020, to April 3, 2020.

The specific reason behind dividing the study period into three is to capture the effect of COVID-19 on the investment patterns of institutional investors. The first period investigates the overall behaviour and its impact on the volatility of the market. The second period is a normal period, which captures the behaviour before the COVID-19 outbreak. The third period was intentionally broken from January 1, 2020, because the national authorities in China informed the World Health Organization on December 31, 2019, regarding pneumonia of unknown etiology in Wuhan[8].

3.4 Data Source

The indices data are obtained from ProwessIQ, whereas the investment data of the FIIs and the DIIs are sourced through the two depository services in India, namely, the NSDL and CDSL and from the NSE website.

3.5 Returns Convertibility

It is essential to convert the price series into the returns series to take care of the unit root. Therefore, all the index series have been converted into the returns series by taking the first difference to their logarithmic value. We employed the following formula to convert the daily prices to the continuously compounded daily returns:

$$r_{A,t} = ln\left(\frac{P_{A,t}}{P_{A,t-1}}\right) \times 100 \quad (1)$$

where $r_{A,t}$ is the continuously compounded daily returns in percentage.$P_{A,t}$ and $P_{A,t-1}$are the price series of an asset for the period of t and $t-1$, respectively.

3.6 Econometric Methodology

3.6.1 GARCH Model

The GARCH (p, q) model, the most widely used tool to estimate volatility in financial markets, was originally proposed by Bollerslev (1986). He proposed this model by adding lags of the variance terms in the variance equation in addition to the ARCH term. In simple words, GARCH (p, q) refers to the p ARCH term and q GARCH term. The ARCH term refers to the lag on the squared error term and the GARCH term refers to lagged variance. The mean equation for all GARCH models is the same; however, the dummy variable is removed when it is not applicable, i.e., more precisely, the dummy is only possible for the full sample period to be broken into before and during the COVID-19 outbreak. The dummy variable was

[8] https://www.who.int/csr/don/05-january-2020-pneumonia-of-unkown-cause-china/en/ Accessed on February 18, 2020

introduced in the mean as well as the variance equation. The net FII and net DII investments are added to the variance equation to check the impact of the net position of the institutional investors on the volatility as proposed in objective (b).

$$R_i|I_{t-1} = \alpha + \beta_1 R_{i-1} + \beta_2 GP_{FII} + \beta_3 GS_{FII} + \beta_4 GP_{DII} + \beta_5 GS_{DII} + \beta_6 IND_{VIX} + \beta_7 D_{Covid} + \varepsilon_t \quad (2)$$

where α represents the intercept, R_{i-1} represents the lagged returns of different indices, GP_{FII} represents the gross purchase of FIIs, GS_{FII} represents gross sales of FIIs, GP_{DII} represents the gross purchase of DIIs, GS_{DII} represents gross sales of DIIs, IND_{VIX} represent the returns of the India VIX Index, D_{Covid} represents the dummy variable (0 before the COVID-19 outbreak and 1 during the COVID-19 outbreak), and ε_t represents error term.

Variance equation:

$$\sigma_t^2 = \omega + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 + \beta_2 FII + \beta_3 DII + \phi D_{Covid} \quad (3)$$

where ε_{t-1}^2represents ARCH term (lagged squared error of mean equation), σ_{t-1}^2represents the GARCH term (lagged variance), FII represents the net position of foreign institutional investors, DII represents the net position of domestic institutional investors, and D_{Covid} represents the dummy variable.

3.6.2 Threshold GARCH (GJR-GARCH) Model

The above GARCH specifications are symmetric, which is a major restriction. It indicates that the GARCH term must have the absolute value of the innovation because it considers the squared residuals and variance. The GJR-GARCH model was proposed by Glosten *et al.*, (1993). This model postulates the effect of negative and positive shocks on volatility. This model helps us to find the leverage effect which means that negative shocks (or 'bad news') in the market have a larger impact on volatility than positive shocks (or 'good news') of the same magnitude.

We specify the GJR-GARCH (1, 1) model for the conditional variance as shown below:

$$\sigma_t^2 = \omega + \alpha_1 \varepsilon_{t-1}^2 + \gamma \varepsilon_{t-1}^2 d_{t-1} + \beta_1 \sigma_{t-1}^2 + \beta_2 FII + \beta_3 DII + \phi D_{Covid} \quad (4)$$

where d_t= 1 if ε_t< 0 and d_t= 0 otherwise.

In this model, the good news (when $\varepsilon_t > 0$) and the bad news ($\varepsilon_t < 0$) have differential effects on the conditional variance. Hence, if there is good news, it has an impact on α_1, while the bad news has an impact on α_1 and γ. If $\gamma > 0$, it implies that the bad news increases the volatility and creates the leverage effect. Hence, we conclude that there is asymmetry, while if γ = 0, the news impact is symmetry.

3.6.3 Exponential GARCH

Nelson (1991) proposed the exponential GARCH (EGARCH) model by converting variance into the natural log variance that makes the leverage effect exponential and conditional variance nonnegative. The EGARCH captures the asymmetric effect between the positive and the negative returns.

$$ln(\sigma_t^2) = \omega + \alpha_1 \left|\frac{\varepsilon_{t-1}}{\sigma_{t-1}^2}\right| + \gamma \left[\frac{\varepsilon_{t-1}}{\sigma_{t-1}^2}\right] + \beta_1 ln(\sigma_{t-1}^2) + \beta_2 FII + \beta_3 DII + \phi D_{Covid} \quad (5)$$

where γ represents the asymmetric coefficient in the model and β_1 coefficient represents the measure of shock persistence. If $\gamma = 0$, symmetry exists and if $\gamma < 1$, the leverage effect exists.

4. Results and Discussions

4.1 Descriptive Statistics

Figure 1 depicts the price and returns series of four indices along with FII and DII purchases and sales during the sample period. It can be seen that all the price series of the indices follow a trend. However, after January 2020, the trend of all indices suddenly started falling when the first case of COVID-19 was reported in Kerala, India, on January 30, 2020[9]. It should be noted that the volatility in the returns during the COVID-19 outbreak is tremendous in all indices. The FIIs' purchases and sales are smoother than those of DIIs'. During the COVID-19 period, the FIIs' sales are higher than purchases; whereas, in the case of DIIs, the situation seems reversed. The sales of DII after 2017 seem more volatile. The descriptive statistics are computed based on the returns series and are reported in Table 1.

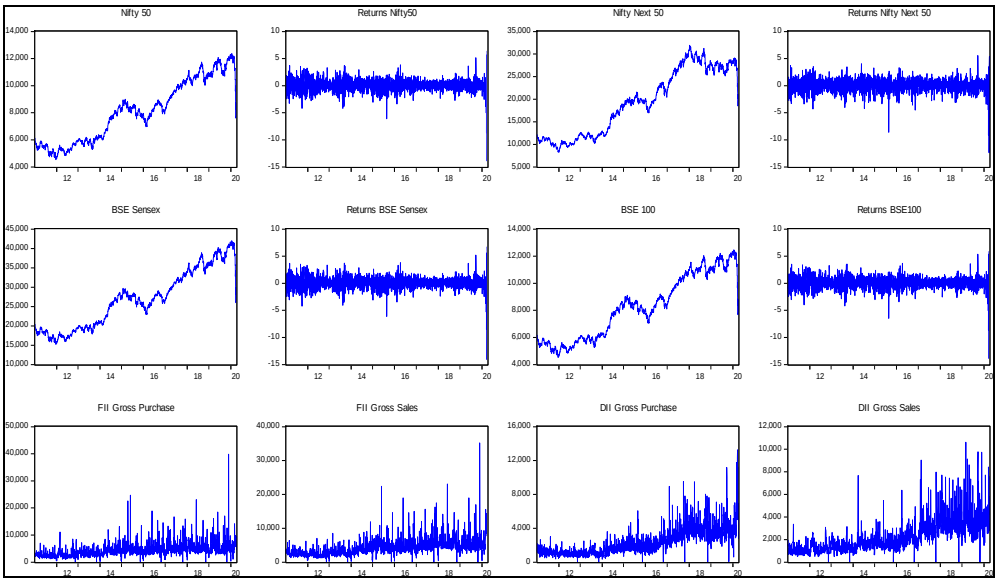

Figure 1: Price & return series of four indices along with FII and DII Purchases and Sales

Table 1 shows descriptive statistics of the different indices for three different periods. It is generally believed that the stock market offers the highest returns. During the full period, which also covers the turbulent period due to the COVID-19 outbreak, Nifty Next 50 offered the highest returns (0.0226%) with the highest standard deviation (1.167%), which was also consistent with the pre-COVID period. It offered the highest returns (0.0383%) with the highest standard deviation (1.087%). In all the returns series, the null hypothesis of normal distribution was rejected at a 1% level of significance based on the Jarque-Berra test. The series was also tested for autocorrelations. Not all the returns series demonstrate the autocorrelations before and during the COVID-19 period. The Ljung-Box Q statistic for autocorrelation is reported up to lag 6 in Table 1. The ordinary regression model presumes that the variance of the residual remains constant. This assumption is called homoskedasticity.

[9] https://economictimes.indiatimes.com/news/politics-and-nation/coronavirus-crisis-heres-total-number-of-confirmed-cases-in-india-as-per-health-ministry/articleshow/74589499.cms?from=mdr Accessed on April 16, 2020

In the case where the null hypothesis of homoskedasticity is rejected, the series is called heteroskedastic, and hence ordinary regression does not offer the best linear unbiased estimator (BLUE). In order to check this assumption, we performed the ARCH-LM test at lag 1 on the residuals. The null hypothesis of no heteroskedasticity in the residuals was rejected in most of the variables, except BSE100 in the full sample period and Nifty Next 50 and BSE 100 in the third period.

Table 1: Descriptive statistics for indices

Descriptive	NIFTY50	NNEXT50	SENSEX	BSE100
Panel-1: Full period sample Jan 1, 2011 to April 3, 2020				
Mean	0.0121	0.0226	0.0131	0.0122
Median	0.0303	0.1013	0.0394	0.0447
Maximum	6.41	5.57	6.75	5.89
Minimum	-13.90	-12.37	-14.10	-13.88
Std. Dev.	1.093	1.167	1.085	1.085
Skewness	-1.290	-1.096	-1.346	-1.354
Kurtosis	19.750	12.441	21.291	19.799
Jarque-Bera	26962.9*	8818.7*	32087.3*	27180.3*
Q(6)	35.085*	40.376*	34.992*	32.647*
ARCH-LM	78.40*	15.76*	83.20*	68.99
Observations	2253	2253	2253	2253
Panel-2: Pre-COVID period Jan 1, 2011 to December 31, 2019				
Mean	0.0311	0.0383	0.0318	0.0310
Median	0.0335	0.1064	0.0492	0.0546
Maximum	5.18	5.57	5.19	5.38
Minimum	-6.10	-8.59	-6.12	-6.49
Std. Dev.	0.972	1.087	0.957	0.967
Skewness	-0.040	-0.418	-0.028	-0.120
Kurtosis	5.189	5.701	5.232	5.263
Jarque-Bera	437.1*	728.4*	454.3*	471.9*
Q(6)	19.245*	48.575*	17.790*	22.365
ARCH-LM	10.69*	11.96*	11.00*	9.77*
Observations	2187	2187	2187	2187
Panel-3: During-COVID period Jan 1, 2020 to April 3, 2020				
Mean	-0.6197	-0.4964	-0.6095	-0.6102
Median	-0.2967	-0.1818	-0.3653	-0.2902
Maximum	6.41	5.36	6.75	5.89
Minimum	-13.90	-12.37	-14.10	-13.88
Std. Dev.	3.033	2.678	3.097	2.993
Skewness	-1.491	-1.723	-1.438	-1.544
Kurtosis	8.333	8.938	8.254	8.517
Jarque-Bera	175.0*	171.4*	184.6*	181.1*
Q(6)	23.811*	16.910*	22.059*	22.538*
ARCH-LM	3.73***	0.20	2.82***	2.36
Observations	66	66	66	66

Notes: (a) Q(6) are Ljung-Box Q statistics for return series for six lags. (b) ARCH-LM test shows Engle (1982) test for conditional heteroskedasticity calculated for the first lag only. (c) * implies significance at 1% level, ** implies significance at 5% and *** implies significance at 10% level.

During the full sample period, the least returns were observed in Nifty 50 (0.0121%) with a moderate standard deviation of 1.093%. It should be observed that the median return for Nifty Next 50 is 0.1013%. It is noteworthy that during this period, the returns of all the assets are negatively skewed with the highest kurtosis in Sensex (21.291), followed by BSE100 (19.799). The higher kurtosis implies a greater likelihood of abnormal gains or losses. During the pre-COVID period, the average returns are positive in all the indices and even much higher than the full period, which is mainly because the full period includes the COVID-19 outbreak. The highest returns are observed in Nifty Next 50 (0.0383%) with a 1.087% standard deviation, which implies good returns as compared to the risk in other assets. The least returns

are observed in BSE100 (0.0310%) with a standard deviation of 0.967%. It must be noted that as compared to the full period, in this period the skewness is relatively near zero and the kurtosis are slightly higher than the expected normal distribution. This clearly implies that the COVID-19 outbreak has really distorted the returns and the volatility of the returns during this period. The third period starts with the outbreak of COVID-19, which is prevalent in asset returns. The average returns in this period are negative in all the indices. The least returns are observed in Nifty 50 (-0.6197%) with a standard deviation of 3.033%. This was primarily because institutional investors invest more in these stocks. The volatility was highest as compared to the rest of the period. The skewness of all the asset returns is very negative, suggesting a negatively skewed distribution having abnormal negative returns and the kurtosis was relatively higher than prior to COVID-19.

Table 2: Descriptive statistics for FII and DII net investments

Descriptive	Panel-1: Full period sample Jan 1, 2011 to April 3, 2020		Panel-2: Pre-COVID period Jan 1, 2011 to December 31, 2019		Panel-3: During-COVID period Jan 1, 2020 to April 3, 2020	
	FIINET	DIINET	FIINET	DIINET	FIINET	DIINET
Mean	14.83	129.12	55.03	99.46	-1317.25	1111.79
Median	24.14	47.98	35.78	39.33	-693.58	418.59
Maximum	17488.73	7621.16	17488.73	5196.60	1495.25	7621.16
Minimum	-9690.84	-5631.99	-9690.84	-5631.99	-6595.56	-1419.85
Std. Dev.	1132.61	794.78	1079.23	719.12	1848.59	1866.47
Skewness	1.96	0.96	2.73	-0.05	-0.86	1.18
Kurtosis	37.68	13.79	44.40	10.00	3.05	4.13
Jarque-Bera	114319.7*	11279.01*	158886.7*	4467.93*	8.19**	18.91*
Observations	2253	2253	2187	2187	66	66

Notes: * implies significance at 1% level and ** implies significance at 5%.

Table 2 describes the statistics of the FIIs and the DIIs investments for three periods. In the full sample period, the average and median net investment by the DIIs is higher than the FIIs, which suggests that the scale of investment by the DIIs is larger than that of the FIIs; hence, the impact of investment of the DIIs may be higher in the stock market than the FIIs. However, the distribution of net investment by the FIIs was wider as compared to the DIIs. The maximum and minimum net investments of the FIIs are extreme as a result the standard deviation of the FIIs is higher than that of the DIIs. These observations are similar to the full sample period as well as the sample period before the COVID-19 outbreak. However, during the COVID-19 outbreak, the pattern of investments of the FIIs and the DIIs changed a lot. The average daily net investment during this period by the FIIs and the DIIs is -1317.25 crores[10] and 1111.79 crores, which indicates that during this period, the FIIs sold and the DIIs bought significant portions in the marketplace. This implies that the DIIs played an instrumental role in order to make the market less exposed to the COVID-19 outbreak. Moreover, it should be noted that the minimum net investment of the FIIs was -6595 crores as compared to -1419.85 crores, whereas the maximum net investment of the DIIs was 7621 crores as compared to 1495.25 crores of the FIIs. This further implies the instrumental role of the DIIs. The null hypothesis of a normal distribution is also rejected as per the Jarque-Berra test in all the periods. The skewness of the FIIs and the DIIs in the third period is negative and positive, respectively.

4.2 Regression Results

Generally, financial time series exhibit the trending behaviour in the price series, because their mean and standard deviation will not remain constant over the period. Unit root test is

[10] In India, 1 crore = 10 million

conducted to assess if the time series data are stationary or not. A time series is stationary if a change in time doesn't result in a change in the shape of the distribution. The existence of unit roots is a cause for non-stationarity. Hence, we checked the presence of the unit root using the Augmented Dicky-Fuller (ADF) unit root test.

Table 3: Unit Root Test

Sr. No.	Indices / Variables	Level		First difference	
		Intercept	Intercept and trend	Intercept	Intercept and trend
1	NIFTY 50	-1.108	-1.619	-17.00*	-17.02*
2	NIFTY NEXT 50	-1.051	-1.058	-42.73*	-42.73*
3	BSE Sensex	-1.084	-1.976	-17.14*	-17.15*
4	BSE 100	-1.082	-1.38	-16.87*	-16.89*
5	India VIX	-3.163**	-2.98	-43.77*	-43.78*
6	FII Purchase	-7.96*	-17.13*	-----	-----
7	FII Sales	-6.44*	-13.99*	-----	-----
8	FII Net	-11.20*	-11.62*	-----	-----
9	DII Purchase	-4.26*	-11.66*	-----	-----
10	DII Sales	-6.31*	-12.84*	-----	-----
11	DII Net	-11.05*	13.02*	-----	-----

Notes: * implies significance at 1% level and ** implies significance at 5% level.

Table 3 reports the results of the ADF tests. All the indices suffer from the problem of unit root in the log price series. Therefore, all the index series have been converted into the returns series by taking the first difference to their logarithmic value. The null hypothesis of the presence of unit root was rejected at a 1% level of significance using intercept and intercept and trend in all indices returns in all periods. Whereas purchases, sales, and net investments by the FIIs and the DIIs are stationary at the level.

4.3 Correlation Analysis

Correlation analysis is used to evaluate the strength of the relationship between variables under the study (Roy and Deb, 2019). Here, they are stock market return, the flow of FIIs and DIIs. The return series appears to have anomalous asymmetry during these three periods. The effect of diversification in an international portfolio investment can be explored using correlation, rolling correlation and cointegration (Joshi *et al.*, 2021; Modi *et al.*, 2010; Patel and Patel, 2022). As a result, correlation and rolling correlation were used to analyse the pattern of both institutional investors with regard to market and volatility index in order to identify the dynamic relationship of the FIIs and DIIs over time.

Table 4: Correlation analysis

		RNIFTY50	FIINET	DIINET
FIINET	Before	0.2702*	----	----
	During	0.3138*	----	----
DIINET	Before	-0.0816*	-0.6177*	----
	During	-0.221****	-0.8266*	----
INDIA VIX	Before	-0.5540*	-0.1090*	0.0491**
	During	-0.4754*	-0.3658*	0.4505*

Notes: (a) 'Before' includes the pre-COVID period from Jan. 1, 2011 to Dec. 31, 2019: n = 2187. (b) 'During' captures during the COVID from Jan 1, 2020 to Apr 3, 2020: n = 66. (c) * implies significance at 1% level, ** implies significance at 5% and *** implies significance at 10% level.

Table 4 discusses the pre-COVID and during COVID correlation of the net investment by the FIIs and the DIIs with the broad market index Nifty as well as the volatility index-India VIX in pre-COVID and during the COVID periods. The effect of the FIIs on the Indian stock market can be understood from the correlation analysis before and during the COVID-19 outbreak. The correlation of net investments by the FIIs with the Nifty 50 was positive and

significant at a 1% level before and during COVID-19. However, the DIIs besides the bigger investment pools have negative and significant correlations at 1% and 10% with the market in pre and during COVID periods, respectively (Bansal and Rao, 2018). The market generally has a negative relationship with volatility, which implies higher volatility follows lower returns and vice versa (Cox and Ross, 1976; French *et al.*, 1987; Bekaert and Wu, 2000; Boyer *et al.*, 2010; Qadan *et al.*, 2019). This can be evident from the significant negative correlation between market returns and the volatility index at 1%. It should be important to note that the correlation between the net investment by the FIIs and the DIIs in the pre-COVID period is -0.6177 and significant at 1%; furthermore, this correlation even became stronger during the COVID period at -0.8266. This clearly implies that this is the period when the FIIs kept on selling and the DIIs kept on buying. The FIIs have a significant negative correlation with the India VIX index, which implies a decrease in volatility when the FIIs buy more than they sell and vice versa. The DIIs in the pre-COVID period have a positive correlation with the volatility index at 0.0491, which is significant at 5%; however, during COVID, the correlation became strongly positive with 1% significance. This clearly shows the opposite behaviour as compared to the FIIs net investment. However, it should be noted that when the FIIs sell, DIIs start purchasing and the market volatility starts increasing.

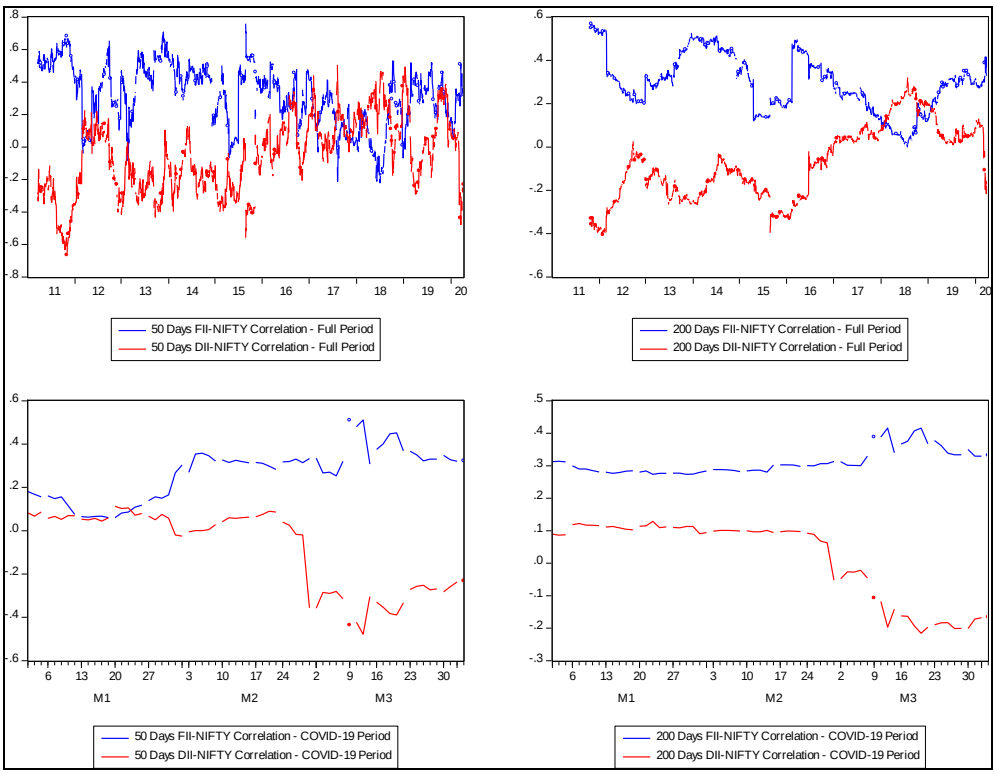

Figure 2: 50 Days and 200 Days Rolling correlations for full period and third period

Figure 2 portrays the rolling correlation of the FIIs and the DIIs with Nifty 50. Long-term investors rely more on longer day averages than day traders and swing traders, who typically use the shorter moving averages. In light of this, rolling correlations allow to comprehend the relationship's trend through time and eliminate the impact of temporal change on the relationship. To examine the short- and long-term evolution of the relationships, we have taken rolling correlations over 50 and 200 days. We have captured this correlation with only

Nifty 50 because of its high liquidity and well diversity. The top two figures are 50 days and 200 days rolling correlations for the full sample period and the bottom two figures capture the rolling correlations during the COVID-19 outbreak. The benefit of rolling correlation is that it removes the abnormal correlations. From figure 1, it seems that the behaviour of the net investments by the FIIs and the DIIs is negative in the long-term as well as short-term. This is obvious when comparing their 200 days rolling correlations. During the outbreak of COVID-19, this negative correlation became stronger, which is apparent in the bottom two figures, especially after February 2020.

Further, to investigate the relationship of the net investments by the FIIs and the DIIs with the market, we converted the time series into the ratio of purchase to sales. When the ratio is greater than one, it implies that the institution is buying more than selling and vice versa. The series of this ratio is then compared with the returns series of Nifty 50. This relationship was documented in the form of alpha and beta to understand the behaviour with the market index.

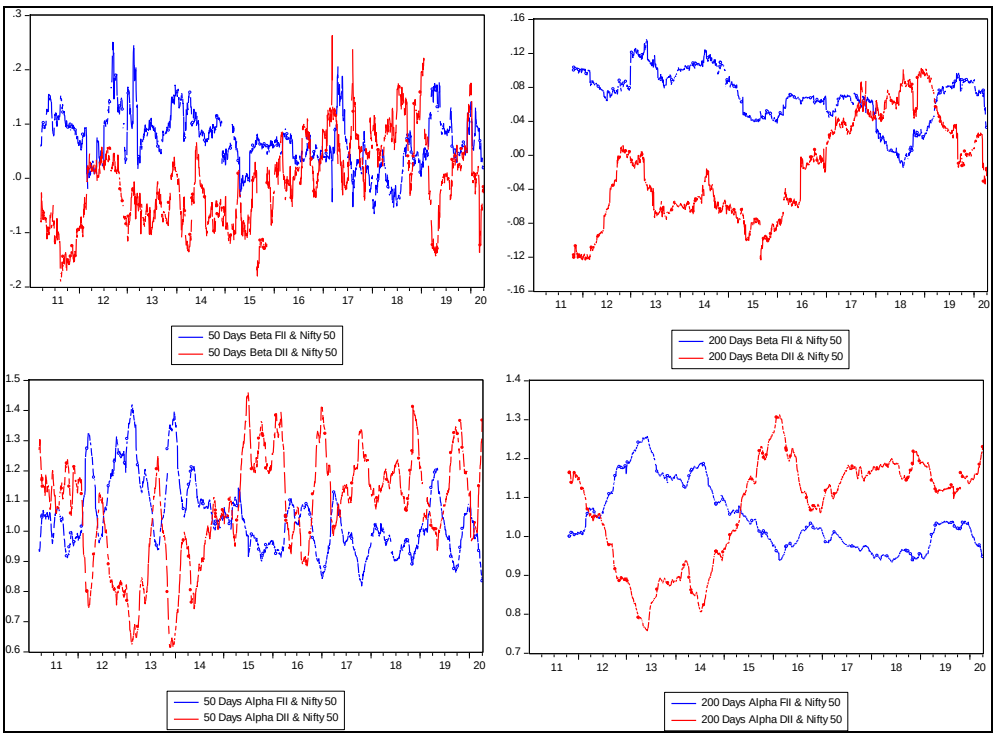

Figure 3: 50 Days and 200 Days Rolling alpha and beta for full period

From figure 3, it is quite apparent that the movement of the net investments by the FIIs and the DIIs seems the opposite. From the 50 days and 200 days rolling beta and alpha, it can be seen that the sensitivity of these institutions is opposite to each other with respect to Nifty 50, which looks candid in the 200 days rolling period.

4.4 Granger Causality Test

This test scrutinizes the direction of causality between the variables of the time series. After examining the unit root and correlation analysis, the next step is to know the direction of the causality. The test represents that for two variables (for example, X and Y); if X is influenced by its delayed values and/or the delayed values of Y, then we can say Y Granger cause of X and vice versa in case X Granger cause of Y. When both X and Y Granger cause each other,

it is the case of bidirectional causality. When only one exists, then it is unidirectional causality. There may be cases of the existence of no causality between variables (Roy and Deb, 2019). The Granger causality test for each of the three periods is listed in Table 5. The lag length of two was identified based on the VAR unrestricted model with regard to the Schwarz information criterion (SIC) and the Hannan-Quinn Information Criterion (HQIC).

Table 5: Analysis of Granger Causality Test

Caused by ↓	Granger caused to ↓						
	NIFTY 50	Nifty Next 50	Sensex	BSE 100	India VIX	FII Net	DII Net
Panel 1: Jan 1, 2011 to Apr 3, 2020							
NIFTY 50	-----	1.526	5.602*	1.515	2.377***	47.351*	70.951*
Nifty Next 50	0.244	-----	0.198	0.161	5.047*	37.003*	72.312*
Sensex	5.587*	0.922	-----	0.782	2.260	47.069*	69.558*
BSE 100	1.175	1.261	1.137	-----	3.022**	48.243*	75.574*
India VIX	4.104**	4.509**	4.296**	4.042**	-----	21.882*	12.63*
FII Net	5.66*	6.586*	5.71*	6.338*	0.296	-----	30.05*
DII Net	3.69**	2.590***	3.621**	3.489**	2.303	50.989*	-----
Panel 2: Jan 1, 2011 to Dec 31, 2019							
NIFTY 50	-----	1.678	2.271	0.794	8.916*	39.059*	61.127*
Nifty Next 50	0.070	-----	0.137	0.079	12.863*	29.167*	64.397*
Sensex	2.44***	1.754	-----	0.584	8.481*	38.605*	60.465*
BSE 100	0.302	1.491	0.370	-----	10.495*	39.591*	66.111*
India VIX	0.963	2.421***	1.068	0.978	-----	14.812*	10.059*
FII Net	0.115	0.930	0.222	0.152	1.486	-----	25.795*
DII Net	0.738	0.155	0.901	0.689	1.707	39.808*	-----
Panel 3: Jan 1, 2020 to Apr 3, 2020							
NIFTY 50	-----	0.329	3.539**	0.577	1.637	2.978***	3.235**
Nifty Next 50	0.451	-----	0.519	0.309	2.202	4.044	3.192**
Sensex	3.434**	0.106	-----	1.715	1.652	3.082***	3.087***
BSE 100	0.683	0.326	2.151	-----	1.732	3.248**	3.218**
India VIX	1.988	1.125	1.973	1.759	-----	3.804**	0.563
FII Net	6.69*	5.959*	6.191*	6.836*	1.517	-----	2.263
DII Net	5.793*	3.66**	5.594*	5.612*	0.575	1.350	-----

Notes: * implies significance at 1% level, ** implies significance at 5% and *** implies significance at 10% level.

Panel 1 explores the Granger causality for the full sample period. It can be observed that Nifty 50 is (Granger) caused by Sensex, the net investment of the FIIs and the DIIs at 1% level of significance which is consistent with Roy and Deb (2019). Whereas, India VIX granger cause Nifty 50 at 5% level. Nifty Next 50 is caused by the net investment by the FIIs at 1% level; however, India VIX causes at 5%, whereas the net investment by the DIIs causes at 10% level of significance. Sensex is caused by the Nifty 50 as well as the net investment by the FIIs at 1%, which indicates a bidirectional relationship. The BSE 100 is caused by the net investment by the FIIs at 1%. India VIX is significantly caused by Nifty Next 50 at 1%. It should be noted that the net investments by the FIIs and the DIIs are caused by all the variables at 1%. Bhargava and Malhotra (2015) also observed that the activities of FIIs have a direct and positive impact on the Indian stock market. Moreover, it should be noted that India VIX causes both the net investment by the FIIs and the DIIs, whereas none of the institutions cause India VIX. This signifies the dependency of the returns and the volatility of the indices on the investment patterns of the FIIs and the DIIs.

Panel 2 summarizes the Granger causality for the second period, which is quite a normal period before COVID-19. In this period, the Nifty 50 is hardly caused by any variable except Sensex at a 10% level of significance. Moreover, the Nifty 50 causes India VIX as well as the net investments by the FIIs and the DIIs. This is similar to all the indices. India VIX is caused by all the other indices. The relationship between the net investments by the FIIs and the DIIs

is consistent with the full sample period and they are caused by the returns and the volatility in the market.

Panel 3 discusses the sample period during the COVID-19 outbreak. It is worth noting that the India VIX is not caused by any of the variables. All the indices except the India VIX are caused by the net investments of the FIIs and the DIIs at a 1% level of significance. However, the indices, except Nifty Next 50, are also causing the net investments by the FIIs and the DIIs, but the magnitude of this cause was not significant at 1% level. They are significant either at 5% or at 10%. It is surprising to observe that during this period none of the institutional investors caused each other, which implies that the investment patterns of the FIIs and the DIIs are different. However, looking at the correlations during the pandemic, both institutions have significant and negative correlations and there is substantial evidence from Table 2 during this period.

4.5 GARCH (1,1)

The results of Table 6 report the parameter estimates of the symmetric GARCH (1,1) model with normal Gaussian distribution for Nifty 50 as a dependent variable in the three periods. We found similar results in the other three indices (results are available on request). In the symmetric GARCH (1, 1) model, all the parameters of the model are statistically significant at a 1% level of significance. In each of the models, R^2 is meaningful because of the regressors in the mean equation. The upper part of the model provides the output for the mean equation, the middle part provides the output for the variance equation, and the lower part provides the model diagnostics.

From the mean equation of GARCH (1, 1), it can be observed that the coefficients of gross purchases of the FIIs and the DIIs are positive and significant, while at the same time, the coefficients of gross sales of the FIIs and the DIIs are negative and significant. This implies that the purchases of institutional investors have a positive impact and sales have a negative impact on the market returns. Moreover, the India VIX has a significant negative relationship with the market returns, which implies that the volatility has a negative impact on the market returns. This can be the first evidence of the leverage effect. The COVID-19 dummy is not statistically significant in the return equation. In the variance equation, the α coefficient reflects the weight attached to the news assessed as the shock of the lagged period hence, a larger α indicates market reaction to the news. The β coefficient is the weight applied to the previous volatility forecast. The equation of GARCH (1, 1) in Table 6 clearly indicates that the current volatility is explained by the reaction of news as well as past volatility and as a result, this model showed evidence of the volatility clustering in full and sub-period. The sum of ARCH and GARCH terms is close to unity in GARCH and GJR-GARCH in all periods, which indicates a high degree of volatility persistence. This observation is common in all the indices under the study. Hence, we have not reported the results of all the indices; however, results are available on request. The higher value of $\alpha + \beta$ indicates that the shocks in the Indian market tend to have longer durations. The more important variable in the variance equation is the COVID-19 dummy variable applicable in the first period which breaks the two sub-periods. It can be observed that the coefficient of a dummy is positive (0.0622) and significant, which implies that the volatility has increased after this period. The net position of FIIs is statistically significant which indicates that the volatility is driven by the net position of FIIs. During the COVID period, the net position of DIIs drove the volatility. In the pre-COVID period, the results are quite similar. However, the β coefficient is higher than the full period and the α coefficient is lower than the first period. This clearly implies the COVID-19 effect in the first period has distorted the volatility in the market.

Table 6: GARCH (1, 1) estimates

	NIFTY 50					
	Panel-1: Full period sample Jan 1, 2011 to April 3, 2020		Panel-2: Pre-COVID period Jan 1, 2011 to December 31, 2019		Panel-3: During-COVID period Jan 1, 2020 to April 3, 2020	
Variable	Coefficient	z-Statistic	Coefficient	z-Statistic	Coefficient	z-Statistic
Mean equation						
Intercept	0.0485	1.521	0.0373	1.133	0.5758	0.897
Returns (-1)	0.0816*	4.357	0.0839*	4.563	-0.3928*	-2.947
FIIGP	0.0002*	25.292	0.0002*	24.762	0.0009*	4.687
FIIGS	-0.0002*	-24.318	-0.0002*	-22.768	-0.0007*	-2.844
DIIGP	0.0002*	8.894	0.0002*	8.626	0.0001	0.586
DIIGS	-0.0002*	-6.630	-0.0002*	-6.351	-0.0005**	-2.510
INDIA_VIX	-0.1005*	-39.525	-0.0983*	-38.845	-0.1199*	-4.420
COVID-19 Dummy	0.0068	0.036	-------	-------	-------	-------
Variance equation						
ω	0.0186*	4.164	0.0122*	3.790	0.2496**	2.414
α	0.0988*	11.235	0.0650*	8.730	0.4498***	1.909
β	0.8767*	71.245	0.9167*	94.712	0.4954*	2.972
FII	0.0347***	1.843	0.0088	0.549	0.1478	0.181
DII	0.0179	1.494	0.0028	0.276	0.8626**	2.436
COVID-19 Dummy	0.0622*	4.010	-------	-------	-------	-------
$(\alpha + \beta)$		0.9755		0.9818		0.9453
Model diagnostics						
R-squared		0.3237		0.3641		0.4563
Adj. R-squared		0.3216		0.3623		0.4019
Durbin-Watson stat		2.2056		2.0008		2.0984
Log likelihood		-2586.680		-2461.825		-106.989
AIC		2.3097		2.2633		3.5519
SIC		2.3452		2.2946		3.9468
Q(5) (P-value)		1.2681 (0.938)		0.3129 (0.997)		4.3473 (0.501)
Q^2(5) (P-value)		3.1649 (0.675)		3.7475 (0.586)		2.4024 (0.791)
ARCH-LM Test (P-value)		1.5499 (0.2133)		1.4997 (0.2208)		2.4213 (0.1246)

Notes: (a) Q and Q^2 are Ljung-Box Q statistics up to five lags of the residuals in GARCH (1, 1) Model. (b) The results of ARCH-LM test for conditional heteroskedasticity in GARCH (1, 1) Model using the first lag of the residuals. (c) * implies significance at 1% level, ** implies significance at 5%, and *** implies significance at 10% level.

In the COVID period, the purchases and sales of the FIIs play a very important role in the mean equation and they are significant at 1%. However, the purchases of the DIIs did not affect the mean returns. This primarily indicates that the returns are driven by the purchases and sales of the FIIs during the COVID-19 outbreak period. The α coefficient and the β coefficient in all the market indices are close to each other. This implies that the increase in volatility is due to news surprises as well as lagged volatility in the marketplace. The $\alpha + \beta$ value is close to unity in Nifty 50. Figure 4 shows the conditional variance of the model that is dynamic, volatile, and the entire process becomes nonstationary with highly persistent variance after March 11, 2020. This implies that the COVID-19 outbreak in this period made the Indian market over-persistence of shocks, which can eventually explode to infinity. Lamoureux and Lastrapes (1990) argued that the high persistence might reflect the event specific variance. This result is also consistent with Bala and Asemota (2013). Hence, during this period, explosive-shocked stock markets are not conducive to long-term investing because investors in these stocks may lose or benefit forever (Kuhe, 2018).

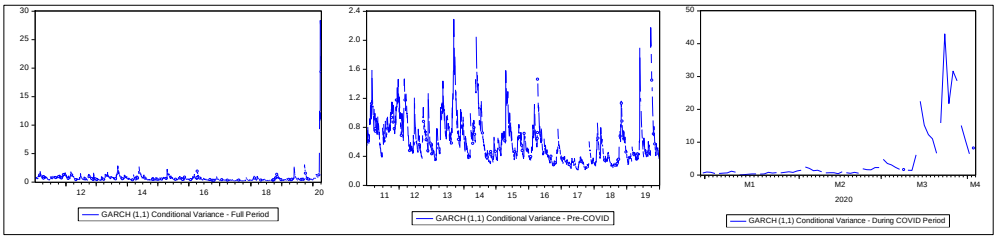

Figure 4: GARCH (1.1) Conditional variance

4.6 GJR-GARCH

Table 7 reports the parameter estimates of the asymmetric GJR-GARCH (1,1) model with normal Gaussian distribution for Nifty 50 as a dependent variable in the three periods. We found similar results in the other three indices (results are available on request). All the estimated parameters of the mean equation are significant, except COVID-19 dummy variables, which indicate that the market in normal conditions is driven by the activities of the FIIs and the DIIs. All the parameters in the variance equation are positive and statistically significant at 1%. The value of α coefficient (0.0667) is significant. It shows the effect of recent news on current market volatility. The significant and positive γcoefficient (0.1045) value shows a strong presence of the asymmetric effect of news that implies that the market is more sensitive toward negative shocks as compared to positive shocks in the returns. The historical volatility impact represented by the β coefficient (0.8454) is also significantly positive and much higher than the recent news impact. This means that in the Indian stock market, historical volatility takes a long time to wipe out (Gahlot, 2019). This is consistent with all the indices in the full period and sub-periods. The positive and significant γcoefficient (0.1045) indicates that the negative news (negative shocks) leads to increased volatility compared to the positive news (positive shocks) of the same magnitude. Thus, the study found empirical evidence for asymmetry with the leverage effect. These results are similar for the second period.

The third period is full of chaos due to the COVID-19 outbreak. It must be worth noting that the purchases and sales of the FIIs have a direct impact on the mean returns. However, purchases of the DIIs do not affect the returns in any of the market indices. The Indian VIX also has a negative impact on the mean returns and it is significant at 1%, this implies that the market returns decrease as volatility increases, which is prima facie evidence of the leverage effect.

The significant and negative γ coefficient (-0.0642) value shows the presence of the asymmetric effect of news which implies that the market is more sensitive toward positive shocks as compared to negative shocks in the returns. The historical volatility impact represented by the β coefficient (0.7083) is also significantly positive and much higher than the recent news impact. This means that in the Indian stock market, historical volatility takes a long time to wipe out (Gahlot, 2019). This is consistent with the empirical literature, which states that the lagged volatility influences the current volatility. Even the persistence of the volatility is highest in the third period, which indicates the explosion in the volatility to make abnormal gains and losses. Using the GJR-GARCH, it is also observed that during the COVID period, the net position of DIIs drove the volatility. This is consistent with the GARCH (1,1) model.

Table 7: GJR-GARCH (1, 1) estimates

	NIFTY 50					
	Panel-1: Full period sample Jan 1, 2011 to April 3, 2020		Panel-2: Pre-COVID period Jan 1, 2011 to December 31, 2019		Panel-3: During-COVID period Jan 1, 2020 to April 3, 2020	
Variable	Coefficient	z-Statistic	Coefficient	z-Statistic	Coefficient	z-Statistic
Mean equation						
Intercept	0.0586***	1.8346	0.0527	1.6173	0.8495**	2.3734
Returns (-1)	0.0817*	4.3309	0.0844*	4.5321	-0.1047	-0.7719
FIIGP	0.0002*	23.9409	0.0002*	23.4843	0.0005*	3.3140
FIIGS	-0.0002*	-23.4124	-0.0002*	-22.6092	-0.0005*	-2.8929
DIIGP	0.0002*	8.6468	0.0002*	8.2529	0.0001	1.2123
DIIGS	-0.0002*	-6.6030	-0.0002*	-6.0765	-0.0003*	-2.6614
INDIA_VIX	-0.0978*	-38.0174	-0.0960*	-37.8280	-0.1080*	-6.6502
COVID-19 Dummy	0.0288	0.1513	-------	-------	-------	-------
Variance equation						
ω	0.0276*	4.6475	0.0183*	4.2581	0.0635*	3.6649
α	0.0667*	6.4543	0.0491*	5.8117	0.3496	1.5934
γ	0.1045*	5.3524	0.0661*	4.2593	-0.0642	-0.1982
β	0.8454*	50.6013	0.8914*	70.4245	0.7083*	8.7257
FII	0.0522*	2.6258	0.0272	1.5499	-0.4684	-1.2150
DII	0.0104	0.7632	0.0017	0.1353	0.3654*	77.6947
COVID-19 Dummy	0.0595*	4.0787	-------	-------	-------	-------
$\alpha + \beta + \frac{\gamma}{2}$		0.9644		0.9736		1.0258
Model diagnostics						
R-squared		0.3218		0.3626		0.3320
Adj. R-squared		0.3197		0.3608		0.2641
Durbin-Watson stat		2.2046		2.0007		2.6126
Log likelihood		-2578.179		-2456.613		-95.1277
AIC		2.3030		2.2595		3.2766
SIC		2.3411		2.2933		3.7079
Q(5) (P-value)		0.8449 (0.974)		0.3115 (0.997)		4.8856 (0.43)
Q^2(5) (P-value)		2.1795 (0.824)		3.6339 (0.603)		2.2451 (0.814)
ARCH-LM Test (P-value)		0.5491 (0.4588)		1.1577 (0.2821)		2.2702 (0.1369)

Notes: (a) Q and Q^2 are Ljung-Box Q statistics up to five lags of the residuals in GARCH (1, 1) Model. (b) The results of ARCH-LM test for conditional heteroskedasticity in GARCH (1, 1) Model using the first lag of the residuals. (c) * implies significance at 1% level, ** implies significance at 5%, and *** implies significance at 10% level.

4.7 EGARCH

The results of Table 8 report the parameter estimates of the asymmetric EGARCH (1,1) model with normal Gaussian distribution for Nifty 50 in the three periods. The results of EGARCH (1, 1) are also consistent with GJR-GARCH (1, 1). The γcoefficient (-0.0358) indicates that the negative news leads to increased volatility compared to the positive news. This is consistent in the pre-COVID period. However, γcoefficient (0.3715) in the COVID period indicates positive news increases volatility. In the third period, it is observed that the ARCH term is positive and significant at a 1% level in all the indices, which indicates that the recent news creates volatility in the market. The Q^2 of residuals also indicates the serial autocorrelation in the squared residuals.

Table 8: EGARCH (1, 1) estimates

	NIFTY 50					
	Panel-1: Full period sample Jan 1, 2011 to April 3, 2020		Panel-2: Pre-COVID period Jan 1, 2011 to December 31, 2019		Panel-3: During-COVID period Jan 1, 2020 to April 3, 2020	
Variable	Coefficient	z-Statistic	Coefficient	z-Statistic	Coefficient	z-Statistic
Mean equation						
Intercept	0.04813	1.572	0.04369	1.393	-0.01114	-0.047
Returns (-1)	0.08032*	4.539	0.08014*	4.487	-0.35877*	-18.601
FIIGP	0.00022*	25.373	0.00022*	25.007	0.00096*	8.830
FIIGS	-0.00024*	-26.088	-0.00024*	-25.718	-0.00071*	-11.957
DIIGP	0.00020*	9.584	0.00020*	9.314	0.00015	2.069
DIIGS	-0.00018*	-7.366	-0.00018*	-6.973	-0.00045*	-4.034
INDIA_VIX	-0.09916*	-38.296	-0.09883*	-37.581	-0.11232*	-8.180
COVID-19 Dummy	0.07319	0.294	-------	-------	-------	-------
Variance equation						
ω	-0.16247*	-11.217	-0.15457*	-9.951	-0.99139	-1.532
α	0.18798*	11.901	0.17224*	10.253	1.70567*	4.966
γ	-0.03579*	-3.610	-0.03455*	-3.407	0.37152***	1.677
β	0.96866*	141.293	0.96272*	115.706	-0.59529*	-6.140
FII	0.07526**	2.162	0.09424*	2.587	-0.25493	-0.119
DII	0.03795***	1.747	0.03625	1.632	3.17478*	4.233
COVID-19 Dummy	0.12703*	8.049	-------	-------	-------	-------
$(\alpha + \beta)$		1.15664		1.13496		1.11038
Model diagnostics						
R-squared		0.3236		0.3654		0.4549
Adj. R-squared		0.3215		0.3637		0.4004
Durbin-Watson stat		2.2041		1.9973		2.1867
Log likelihood		-2565.945		-2445.814		-113.074
AIC		2.2921		2.2496		3.7634
SIC		2.3302		2.2834		4.1912
Q(5) (P-value)		0.7497 (0.98)		0.375 (0.996)		0.039 (0.858)
Q^2(5) (P-value)		5.3085 (0.379)		5.5423 (0.353)		0.197 (0.002*)
ARCH-LM Test (P-value)		3.0529 (0.081***)		2.4596 (0.1170)		0.053614 (0.8176)

Notes: (a) Q and Q^2 are Ljung-Box Q statistics up to five lags of the residuals in GARCH (1, 1) Model. (b) The results of ARCH-LM test for conditional heteroskedasticity in GARCH (1, 1) Model using the first lag of the residuals. (c) * implies significance at 1% level, ** implies significance at 5%, and *** implies significance at 10% level.

All GARCH models satisfy the assumptions in the first and second periods. Moreover, the null hypothesis of homoskedasticity in the residual is accepted using ARCH LM tests for ARCH effects of the estimated models. This shows that the conditional variance equations for GARCH (1, 1), GJR-GARCH (1, 1), and EGARCH (1, 1) models are well defined as the models captured all the ARCH effects and none was left in the innovation. In the first and the second periods, the sum of ARCH and GARCH terms and in GARCH and GJR-GARCH models is close to unity, which is required to have a mean-reverting process in the variance. However, this sum in the third period is more than unity, which indicates that the mean-reverting process in the variance is not taking place. This shows that the process of one-directional variance is still in the process and long-term investors may lose or gain in the market significantly.

5. Conclusion

The study examined the impact of activities of the FIIs and the DIIs on the returns and the volatility of the market indices in India prior to and during the COVID-19 outbreak using rolling correlation, Granger causality, GARCH, GJR-GARCH, and EGARCH. The current research divides the entire period into three sub-periods to capture the impact of activities of the institutional investors before and during the crisis due to the pandemic of COVID-19. The descriptive statistics suggest that COVID-19 skewed returns and volatility. The average and median net investment by the DIIs is higher than that of the FIIs, suggesting the scale of investment by the DIIs is greater than the FIIs. However, the pattern of the FIIs and the DIIs investments changed a great deal during the COVID-19 outbreak.

The average daily net investment during the COVID-19 period by the FIIs and the DIIs is -1,317.25 crores and 1,111.79 crores, respectively. It shows that during this period, the FIIs have sold and the DIIs have bought a significant portion in the marketplace. This implies that the DIIs played a very instrumental role to make the market less exposed to the COVID-19 outbreak, as referred to in various literature (Murthy and Singh, 2013; Baral and Patra, 2019). It was observed that the FIIs have been found to be net sellers during the time of crisis and DIIs have been defending players by buying in the falling market (Loomba, 2012; Murthy and Singh, 2013; Jalota, 2017; Reddy, 2017; Baral and Patra, 2019). The correlation of the net investments by the FIIs with the Nifty 50 was positive and significant at a 1% level before and during COVID-19. The DIIs, besides the bigger investment pools, have shown a negative and significant correlation at 1% before COVID-19. However, the correlation of the DIIs with the market was only significant at 10%. The correlation between the net investments by the FIIs and the DIIs in the long-term is -0.6177 in the normal course of action; however, during the outbreak of COVID-19, this correlation even reduced to -0.8266, which is significant at a 1% level, which implies this as a period when the FIIs kept on selling and the DIIs kept on buying. This finding is consistent with the rolling correlation analysis.

The result of Granger causality depicts that Sensex and the net investments by the FIIs and the DIIs cause Nifty 50 at a 1% level of significance. It should be noted that the net investments by the FIIs and the DIIs are influenced by all the variables at 1%. The results signify the dependency of the returns and the volatility of the indices on the investment pattern of the FIIs and the DIIs (Bansal and Rao, 2018; Roy and Deb, 2019). During the COVID-19 outbreak, the net investments by the FIIs and the DIIs caused all the indices except India VIX at a 1% level of significance. However, none of the indices causes the net investment by the FIIs and the DIIs at a 1% level. It is surprising to observe that during the pandemic period, none of the institutional investors caused each other, which implies that investment patterns of FIIs and DIIs are independent of each other.

The study modelled heteroskedasticity in the Indian stock market by employing three GARCH specifications, namely, symmetric GARCH (1,1), GJR-GARCH (1,1), and asymmetric EGARCH (1,1) models. The results of GARCH show that the current volatility is explained by the reaction to the news and the past volatility; and as a result, this model showed evidence of volatility clustering. The sum of ARCH and GARCH terms is less than one, which indicates high-volatility persistence. The more important variable in the variance equation is the COVID-19 dummy and the net position of institutional investors. It can be observed that the coefficient of the dummy is positive (0.0622) and significant, which implies that the volatility has exploded during the COVID-19 outbreak. Further, the volatility was due to the net position of FIIs. In the third period, the purchases and sales by the FIIs play a very crucial role in the mean equation and they are significant at 1%. However, during the COVID period, the net position of DIIs also drove the volatility. This largely shows that the returns are driven by the purchases and sales activities of the FIIs (Shukla *et al.*, 2011; Baral and Patra, 2019; Roy and Deb, 2019).

The α coefficient is lower than the β coefficient in all the market indices. This implies an increase in volatility due to lagged volatility in the marketplace. However, during the COVID period, these terms are close to each other which indicates that the volatility was due to news and previous volatility. This implies that the COVID-19 outbreak made the Indian market over-persistent to shocks, which can eventually explode to infinity. The GJR-GARCH reveals that negative news (negative shocks) leads to increased volatility compared to positive news (positive shocks) of the same magnitude. Thus, the study found empirical evidence for asymmetry with the leverage effect. However, during the COVID-19 outbreak, the volatility was mainly because of the negative news, which can be observed in γcoefficient in most of the indices. The results of EGARCH are consistent with GJR-GARCH. The asymmetric models showed evidence of asymmetry with leverage effect on the Indian stock market.

Our study is the most recent and is closely related to the literature on capturing FII and DII investment patterns and their impact on pandemic returns and volatility. None of the studies in the world examined how FIIs and DIIs acted during the global outbreak. As a result, our study is the first to look at this nexus, contributing to the body of knowledge. This research has policy implications for policymakers in terms of framing policies to decrease volatility that may develop as a result of unexpected pandemic news. Further, retail investors who become more sensitive during times of crisis should take cues from the activities of both FIIs and DIIs in taking their investment decisions. The leverage effect indicates an asymmetrical relationship between news and volatility in stock return, hence, investors are advised to play safe during such highly turbulent times especially when it is negative in nature. The increasing volume of institutional investment in the Indian capital market is a good signal for the growing economy. With many positive aspects, they also bring some risks for the markets and the overall economy. The outcomes of the Granger causality test for the period during the pandemic suggest that all the indices except the India VIX are caused by the net investments by the FIIs and the DIIs. Hence, the economy and the capital markets are highly dependent on the actions of institutional investors. However, as none of the institutional investors cause each other, indicating their independent investment patterns, they should be treated separately in such a way that it doesn't create a big impact on the capital markets of the economy. This research has a significant contribution to assessing how institutional investors react in the event of a pandemic. Future studies could look into the same relationship between developed and developing countries.

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