4

RESEARCH METHODOLOGY

4.1 Problem Declaration

In 1991, when the country is facing a problem related to the foreign reserve and at that time the economic condition of India was not so good. This was because of various Issues related to development in term of financial and Industrial Development aspect.

In 1992, India open door for foreign investors to invest in the countries stock market as Foreign Institutional Investors (FIIs). From the time they allowed they are increasing all the years and they show positive investment except the three years, 1998-99, 2008-09 and 2015-16 according to Alam et al. (2018); Jain, Vyas and Roy (2013); Bulsara et al. (2014); Mohananmani and Sivagnanasithi (2012); Mangala and Rani (2015); Tiwari and Mehrotra (2012); SEBI annual report 2015-16. At the time of starting the investment Govt. allow FIIs to invest in Mutual funds, Pension funds, Assets management companies, incorporate institutional portfolio and investment trust manager was permitted to invest in the stock market in India. After the positive flows of FIIs in 1996-97 Govt. included registered university funds, foundation, endowment and charitable trust to invest.

Mauritius route is a way by which foreign investors can invest in India. This was the popular way from 2001 to 2011 it was the main provider of Foreign Investors FDI and FIIs. In 1999-2000 Indian Govt. has comprehensive Double Taxation Avoidance Agreement (DTAA) this exempted the Mauritius Double Tax for the entries through this route. This decision encouraged an investor to invest the money in India by using Mauritius way.

In 2017 the yearly Net investment of FIIs was 194630.76 (र in crore) which was more than double from the year 2007. In the same period, the Net purchase in 2007 was 836378.15 (र in crore) which is just half of the year 2017 was 1697974.48 (र in crore). In the starting year of FIIs in India the total investment made in equity segment was
2595.2 (₹ In crore) and in the year 2017, it was 49880.89 (₹ In crore). Total investment in the year was in equity was 49880.89 (₹ In crore) and in the debt Market was 144749.87 (₹ In crore) which is 65 percent more than the equity market.

Further, the Number of FIIs registered in India with Security Exchange Board of India (SEBI) in 1998-99 was 450 in numbers and in present 2016-17 it is 8043 (including the FIIs and FPIs) which shows the increasing trend every year. Foreign investors are more attracted to the developing nation or emerging economies to invest their fund. India is having a more attractive country in the Asian because of its emerging economies and different economic policy, Macro and Micro factors Tripathi and Maggo (2015); Kumar et al. (2017); Garg et al. (2016); Srivastava Aman (2010); Gordan and Gupta (2003); Chousa et al. (2008); Jain et al. (2013); Kanojia and Arora (2016); Mohanasundaram and Karthikeya (2015). The FIIs are registered with the SEBI came from many countries, USA based institution are 34% of the total in numbers of FIIs registered with the SEBI and Luxembourg, Canada, Mauritius, UK, Ireland, Japan, Singapore are 12%, 8%, 7%, 6%, 6%, 4%, 3% respectability and other is 20%.

4.2 Objectives of the Study

- To access the determination of foreign institutional investors investment in India.
- To measure the impact of stock market volatility on the foreign institutional investors.
- To measure the relationship between foreign institutional investors and selected sectoral indices of NSE Nifty.
- To study the government policy influence on the foreign institutional investor's behavior

4.3 Hypothesis

- H₀: Different economic variables do not influence the decision making of foreign institutional investors
- H₀: There is no impact of stock market volatility on the decision-making behavior of foreign institutional investors
- H₀: Sectorial Indices of NSE Nifty do not have any relationship with the decision-making behavior of foreign institutional investors
- $H_0$: Government Policy has no influence on the decision-making behavior of foreign institutional investors

4.4 Scope of the Study

This study has significance for the institutional investors, financial advisors, companies, government etc.

For the investors, the factors that influence their decision making are crucial as this will influence their financial plans of the future.

For the company's identification of the most influencing factors that influence the behavior of their investor will affect their future strategies and plans.

For financial advisor’s identification of these factors will help them to suggest investments that best fits them.

And finally, for the government, identification of the most influencing factors will help it to modify required legislation and other procedures that are needed for satisfying the desires of investors and giving more support to the market efficiency.

4.5 Data and Sources

This study is based on secondary data which have been collected from different sources like websites such as www.nseindia.com, www.bseindia.com, www.stls.frb.org, www.rbi.org.in, www.moneycontrol.com, www.imf.org, www.mospi.govt.in, www.data.gov.in etc. and using published data source like Annual report published by SEBI, RBI Handbook, National Stock Exchange Publications, BSE Publications, PROWESS database which is maintained by CMIE (Centre for Monitoring Indian Economy), Publication by IMF have also been used to collect the data which is related to this study.

To identify the determinants of Foreign Institutional Investors (FIIs) in Indian Stock Market daily as well as monthly data have been used from January 1, 1999, to December 31, 2017. The daily data is not available before this date so this study is restricted to this period. The collected data are analyzed through the statistical and econometric software package E-views and Microsoft Excel.

**TABLE 4.1: THE DATA SERIES AND SOURCES**
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<td>Daily Basis return has been calculated by the closing price of the Index</td>
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<tr>
<td>Exchange_rate</td>
<td>Daily Exchange rate of Indian Rupees (₹) to US ($)</td>
<td><a href="http://www.rbi.org.in">www.rbi.org.in</a> <a href="http://www.stls.frb.org">www.stls.frb.org</a></td>
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4.6 Examination of Data

The research methods including the selection of variables and models used are objective specific. The research tools and various methodology applied under the study are explained as follows:

4.6.1 To access the determination of Foreign Institutional Investors investment in India

National stock exchange in India was established in 1993 which was open in 1994 for the trading. According to the data which is provided by SEBI that the National Stock Exchange has become the largest stock exchange in India in the context of daily turnover for equity shares from 1995. This is stock exchange is having the exchange listing trading services clearing settlement services and essays and Technology solution which also provide the financial education offerings. After the LPG policy, in 1991 India allowed the foreign institutional investor to invest in India in 1992 the data of FIIs investment data is not the available to date on daily basis from 1992 to 1998 so for this purpose of conducting this study data from 1st January 1999 to 31st December 2017 has been used. NSE is the largest stock exchange in India and its it is started at the time of 1992 at the time of FIIs are also invited in India for the investment in equity and debt market so for this present study National Stock Exchange (NSE) stock exchange is considered to find out the extra practice and decision making of foreign institutional investor with special reference to National Stock Exchange. In India, we have to measure stock exchange BSE and NSE. BSE is the oldest stock exchange in India and lots of study has been already conducted on behalf of BSE and lessor study conducted on NSE, so for this present study, NSE has been used.

4.6.2 Discussion of Macroeconomic factors:

Various research was already conducted and they have considered different macroeconomic factors which influence the FIIs Flows in India According to Darrat and Mukharjee (1987); Mukharjee and Naka (1995); Koutoulas and Kryzanowski (1996); Panda and Kamaiah (2001); Sadorsky (2003); Paye (2006); Ratanapakorn and Sharma, 2007; Kim and Yang (2008); Rahman et al. (2009); Srivastava Aman (2010); Pal and Mittal (2011); Lakshmi K. (2011); Prince Famous Izedonmi and Ibrahim Bello Abdullahi, (2011); Mandal et al. (2011); Makan et al. (2012); Teodoros Spyridis, (2012); JinhonJeong (2013); Jain et al. (2013); Kuamr Ramesh (2013); Suganthy and
Dharshanaa (2014); Kumari Jyoti and Mahakud Jitendra (2014); Joshi and Giri (2015); Mangala and Rani (2015); Baranidharan and Vanitha (2015); Poshakwale and Mandal (2016); Jareno and Negrut (2016); Ramadan et al. (2016); Kumar et al. (2017); Fernandes Karen (2017); Aggarwal and Saqib (2017); Sultana and Reddy (2017); in these study researcher discuss about the macroeconomic factors such as interest rate of India and Interest rate of USA, Exchange rate, IIP, CRR, SLR, Inflation, Crude Oil, Host Country Index, Index return of host and home country etc.

After considering their suggestion and Finding for this study Interest rate of 91-Days Treasury Bill is consider as the investment return rate, Interest rate of US 91-Days Treasury Bill consider as the option available for the Investors, FIIs may be considered the long-term effect of interest rate so for this purpose 10 years US Govt. Bond yield interest rate is taken, 10 year Indian Govt. bond interest rate is also considered for this study, Exchange rate data US ($) to Indian Rupees (₹) on the basis of real effective measures, India Index of Industrial Production consider as the economic growth of manufacturing factors and consider the factor in comparison of GDP because of the GDP Monthly data is not available, inflation rate in Indian shows the growth rate of Country, Money supply (M3) is an important part in the economic variable, Monthly Foreign Exchange Reserve data is considered as the investment decision and other policy related to the foreign investment is considered for this study, monthly data of Weighted call money rates (interest rate on a type of short-term on which the bank gives to the broker who in turn lend the money to investors to fund margin accounts) is considered an economic variable in this study, Host Country Index are considered on the basis of top most Index as well as the mostly investors are belongs to these country as Standard and Poor 500 taken USA Stock Exchange Index and FTSE 100 taken as the Index of London Stock Exchange, Risk and return of these Index is calculated by using the Standard Deviation of 15 days return of these indexes.

The main objective of this study is to find out the Factors which affecting the decision making of FIIs on the stock exchange the Monthly data from January 1, 1993 to December 31, 2017 was taken. Prior to this period daily data of FIIs are not available so this time period has been considering.

In this data collection problem is that the data is not available in some days because of the Holidays which is differ from India, US and UK. So, to fill the data which was not available, so to fill the data which is not available due the above
condition last date closing date of that month is taken because the closing price of the 
Index is available of the market is closed due to Holidays by Baroo et al. (1993); 
Dempster et al. (1977); King et al. (2001); Raghunathan TE (2004); Acar et al. (2011); 
Tran et al. (2017) etc.

In the previous studies Aggarwal (1997); Mohanty (1998); Morley and 
Pentecost (2000); Bartam and Dufry (2001); Griffin et al. (2002); Venkateshwarlu and 
Tiwari (2005) ; Narayan and Smith (2005); Panda et al. (2005); Banerjee and Sarkar 
(2006); Bhattacharya and Mukherjee (2006); Kumar(2007); Prasanna Krishna (2008); 
Mishra(2009); Suchismita Bose (2012); Jalota Shikha (2015); Nisha Nabila (2016); 
Ibidapo et al. (2017); Joshi Priyanshi (2018) concluded that there is significant impact 
of return in the host country in the foreign institutional investors. Return on the stock 
exchange of US and UK which are the major stock exchange in the world according to 
the world bank Index and a number of Foreign investors are more from these countries. 
and Bombay Stock Exchange is also considering for this study because of the larger 
area cover by these stock exchange and there are two major indexes available in India. 
The return on these stock exchanges is considering as an Independent variable.

To calculate the return on stock indexes the following equation is used:

\[ R_{tt} = \ln \left( \frac{P_{tt}}{P_{tt-1}} \right) \] ..................(1)

Where

\( R_{tt} \) = Market return for the t time period 
\( \ln \) = Natural Logarithm 
\( P_{tt} \) = Price for the current time period t 
\( P_{tt-1} \) = Price for the Preceding time period 

In this equation, I represent the market return of the data and t is the day would be given 
time period.

The following OLS regression equation is used:

\[ y = a + bx \] ..................(2)

Where y is the dependent variable, a is the y-intercept and b is the slope of line x and x 
is the independent variable.
Equation 3 is used where there is bi-variate analysis i.e. one dependent and one independent variable. But in this present study, the various variable has been used as an independent variable. To analysis this following equation is used:

\[ y = b_0 + b_1 x_1 + b_2 x_2 + b_3 x_3 + \ldots + b_p x_p \]  

\[ \ldots \ldots \ldots \]  

(3)

Where,
\[ y \] is the dependent variable;
\[ b_0 \] is the value of \( y \) when all the independent variable become zero;
\[ b_1, b_2, b_3, \ldots, b_p \] are the estimated regression coefficient;
\[ x_1, x_2, x_3, \ldots, x_p \] are the different \( p \) independent variables.

In the multiple regression for ex. \( b_1 \), show the change in \( y \) relative to one unit change in the \( x_1 \).

4.6.3 Dependent Variable:

Trading on Investment can be categorized into two parts one is Momentum or feedback trading and another is Herding strategy. At first, an investor tends to buy securities when they consider the current winner generating a positive return and sell the securities when they consider the current winner generating a negative return. In another way of trading behavior, they first find the behavior of others and then behave accordingly. So to capture all the behavior data of purchase and sale has been taken. Total six variables are considering as dependent variable which includes Net FIIs purchase, Net FIIs Sale, FIIs Net, gross purchase and Gross Sale are also been considered for this study and to find the more variability between the decision making of investors market of Debt and Equity care to be considered for the study.

4.6.4 Explanatory Variable:

The market is volatile in various situation and has an impact on the decision making of investment. So in this study, explanatory variables are classified into three parts: -

The first part of the OLS model included dependent variable as FIIs Purchase and Sales and Independent variable consider for this study are discussed as follows:

a) Stock return of the host country i.e. NSE_Nifty50_Return;
b) Stock return of the top three global index countries i.e. US and London as S&P_500_Return and FTSE_100_Return respectively;

c) The one-day lag of return of the host country as well as the global country index as L_NSE, L_S&P, and L_FTSE;

d) Risk of the host country as well as the global country index as NSE_Nifty50_Risk, S&P_500_Risk, and FTSE_100_Risk.

**OLS Equation for the First Part:**

\[
FIIs_{Sale_t} = \alpha_0 + \beta_1 NSE_{Return_t} + \beta_2 NSE_{Risk_t} + \beta_3 S&P_{Return_t} + \beta_4 \text{L}_\text{S&P}_{Risk_t} + \beta_5 S&P_{Risk_t} + \epsilon_t \quad \ldots \ldots \ldots \ldots \ldots (4)
\]

\[
FIIs_{Purchase_t} = \alpha_0 + \beta_1 NSE_{Return_t} + \beta_2 NSE_{Risk_t} + \beta_3 S&P_{Return_t} + \beta_4 \text{L}_\text{S&P}_{Risk_t} + \beta_5 S&P_{Risk_t} + \epsilon_t \quad \ldots \ldots \ldots \ldots \ldots (5)
\]

The second part of OLS Model where the dependent variable is considered as Debt and Equity Market investment by FIIs Independent variable is considered for this study are discussed as follows:

a) Interest rate of US market;

b) The difference of Indian and US Market 91-days Treasury Bill interest rate consider as the spread as SPREAD_91_DAYS;

c) The difference of Indian and US Market 10-year long-term treasury Bill interest rate consider as the spread as SPREAD_10_YEARS.

**OLS Equation for the Second Part:**

\[
FIIs_{Debt_{Purchase_t}} = \alpha_0 + \beta_1 US\_{Interest\_Rate_t} + \beta_2 \text{Spred}_{91\_Days_t} + \beta_3 10\_Years\_Govt\_Bond\_US_t + \beta_4 \text{Spread}_{10\_Years_t} + \epsilon_t \quad \ldots \ldots \ldots \ldots \ldots (6)
\]

\[
FIIs_{Debt_{Sale_t}} = \alpha_0 + \beta_1 US\_{Interest\_Rate_t} + \beta_2 10\_Years\_Govt\_Bond\_US_t + \beta_3 \text{Spred}_{91\_Days_t} + \beta_4 \text{Spread}_{10\_Years_t} + \epsilon_t \quad \ldots \ldots \ldots \ldots \ldots (7)
\]

\[
FIIs_{Equity_{Purchase_t}} = \alpha_0 + \beta_1 US\_{Interest\_Rate_t} + \beta_2 \text{Spred}_{91\_Days_t} + \beta_3 10\_Years\_Govt\_Bond\_US_t + \beta_4 \text{Spread}_{10\_Years_t} + \epsilon_t \quad \ldots \ldots \ldots \ldots \ldots (8)
\]
\[ FIIs_{Equity\_Sale_t} = \alpha_0 + \beta_1 \text{US\_Interest\_Rate}_t + \beta_2 \text{Spred\_91\_Days}_t + \beta_3 10\_Years\_Govt\_Bond\_US_t + \beta_4 \text{Spread\_10\_Years}_t + \varepsilon_t \] .........................(9)

The third part of the OLS model where the dependent variable is FIIs Purchase and Sales and Independent variable consider for this study are discussed as follows:

a) Crude Oil Price;
b) Exchange Rate;
c) Index of Industrial Production;
d) Inflation Rate as CPI (Consumer Price Index);
e) Money Supply (M3);
f) Forex Reserve;
g) Weighted Call Money Rates.

**OLS Equation for the Third Part:**

\[ FIIs_{Purchase_t} = \alpha_0 + \beta_1 \text{Crud\_Oil}_t + \beta_2 \text{Exchange\_Rate}_t + \beta_3 \text{Forex\_Reserve}_t + \beta_4 \text{M\_On\_Supply\_M3}_t + \beta_5 \text{Weighted\_Call}_t + \beta_6 \text{Interest\_Rate\_India}_t + \beta_7 \text{Inflation\_Rate\_CPI}_t + \varepsilon_t \] .........................(10)

\[ FIIs_{Sale_t} = \alpha_0 + \beta_1 \text{Crud\_Oil}_t + \beta_2 \text{Exchange\_Rate}_t + \beta_3 \text{Forex\_Reserve}_t + \beta_4 \text{M\_On\_Supply\_M3}_t + \beta_5 \text{Weighted\_Call}_t + \beta_6 \text{Interest\_Rate\_India}_t + \beta_7 \text{Inflation\_Rate\_CPI}_t + \varepsilon_t \] .........................(11)

4.7 To measure the impact of stock market volatility on the Foreign Institutional Investors.

4.7.1 Dickey-Fuller Test and Augmented Dickey-Fuller Test (Unit Root Test):

Time series data required to be stationary before it been used for the analysis purpose otherwise it may lead to the spurious results of the study. As this study is based on time series data, so to check whether the data is fulfilling the properties of stationery this research used Augmented Dickey-Fuller test (ADF) and Phillips Perron (PP) test.
4.7.2 Augmented Dickey-Fuller (ADF) test:

Estimating error is to be statistically independent and homoscedastic which are implicitly presumed by the Augmented Dickey-Fuller (1979) and there is no heteroscedasticity effect in the unit root test results. It may happen that the autocorrelation is present in the estimated error term ($\varepsilon_t$) which can cause the problem in the study and in the results. For the Non-Stationarity random walk, the model is a suitable illustration. In given time series data there can be three types of possibility or circumstances of a unit root. First, it is like as of random walk, secondly random walk with drift in the data series and at last random walk with the time trend and drifts both in the time series data.

All three situations are explained through the following equation.

$$\Delta Y_t = \alpha_1 Y_{t-1} + \sum_{j=1}^{p} \beta_j \Delta Y_{t-j} + \varepsilon_t \quad \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (12)$$

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \sum_{j=1}^{p} \beta_j \Delta Y_{t-j} + \varepsilon_t \quad \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (13)$$

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 t + \sum_{j=1}^{p} \beta_j \Delta Y_{t-j} + \varepsilon_t \quad \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (14)$$

In the above equation, $\varepsilon_t$ represented the residuals in the series and called as white noise term.

The $\varepsilon_t$ must be free from the autocorrelation which ascertains the extra lagged difference term. In econometric terminology, there is some test which ascertains the extra lagged difference terms to determine the leg of the white noise term in the econometrics are called as ‘lag length criteria’ which contains the various forms such as AIC (Akaike Information Criterion) or SIC (Schwartz Bayesian Criterion). In these tests the null hypothesis: i.e. ($H_0$): $Y_t$ is not I (0) is considered and if the results of ADF statistic shows the less than their respective critical values given in the table then we accept the "null hypothesis ($H_0$)" and the series are called as non-stationary.

4.7.3 Phillips-Peron (PP) test:

Dickey-fuller tests assumption is that the distribution theory which is based on some conditions that the error term and the existence of the constant variance i.e. it is to be assured that the error term is not autocorrelated and the constant variances should
remain constant with respect to the time when the ADF test has to be applied. So to check the stationarity in the data researcher has another test called Phillips-Peron (PP) test. This test is further development of the ADF test by the Phillips and Perron (1988) by generalizing the procedures of ADF test and this test allowed some lower assumptions which are related to the distribution of errors.

The regression equation of the Phillips and Perron test's is as below:

\[ \Delta Y_{t-1} = \alpha_0 + \alpha_1 Y_{yt-1} + \varepsilon_t \]  

ADF test rectifies the high order autocorrelation by adjoining differencing terms on the right-hand side in the other side Phillips and Perron (PP) test does rectifications to the coefficient ‘Y’ t-statistic from AR (1) regression to consider for the serial-correlation in error term (\( \varepsilon_t \)). In that test the hypothesis \((H_0) = 0\)}\), i.e. there are existence of unit root. So overall it can be said that PP test is noting as it is just reforms of the ADF t-statistics that brings “the less restrictive nature of the error process” into consideration.

4.7.4 The ARCH Model:

Generally, the ordinary least square (OLS) regression assumed the constant error variance but on the other way, if in the data series presence of heteroscedasticity found than the OLS not give proper results. Specially in the time series financial data which are considered in the present study comprises volatility clustering behavior. It is to be found that high returns followed by the high return and low returns followed by the low return generally in the given financial time series data used in the present study. That same concept is followed in the volatility clustering concept where there is a large fluctuation followed by large one and Small fluctuation followed by the small fluctuation. So in that situation, the existence of the OLS model become inadequate and totally useless for the calculation of the volatility. Mandelbrot (1963), Fama (1965), and Bollerslev (1986) studied and found that the significant presence of heteroscedasticity in the stock return. if in the data series heteroscedasticity is presence than now it become important that for the analysis of dataset consider the appropriate methodology so that the issue related to heteroscedasticity can be considered and proper results can be calculated so that in the present research the ARCH and GARCH family models have also been employed to study the volatilities in currency spot prices.
Statistical Model which considers the heteroscedasticity in the data is the Autoregressive Conditional heteroscedasticity-ARCH model, which was first proposed by the Engel (1982). This model considers the volatility and considers letting the error term lagged value. This model of variances as a linear arrangement consider the past squared error of particular lag.

In 1986 Bollerslev generalized the ARCH model and this model describes the variance with two distributed lags than after it is called as Generalized Autoregressive Conditional Heteroscedasticity (GARCH). This model works on two distributed lags as first, this model squared the past error values so that it can arrest the news and high-frequency effect related to the volatility of the previous date and is estimated as squared residual's lag from the mean equation. Secondly, its own variance's lagged values to capture long-run effects.

A ‘GARCH (p, q) model’ estimated through the equation given below.

\[ Y_t = \beta_0 + \beta_0 X_t + \varepsilon_t \] ..............................(16)

\[ \varepsilon_t / \Psi_{t-1} \sim (0, hi) \] ..............................(17)

In the above-explained equation

\( Y_t \) stands for the conditional mean with the function of constant \( \beta_0 \), \( X_t \) exogenous variable, and the \( \varepsilon_t \) error term

\( H_t = \alpha_0 + \sum_{i=1}^{p} \alpha_1 \varepsilon_{t-i}^2 + \sum_{j=1}^{q} \alpha_2 h_{t-j} + v_t \) ..............................(18)

\( H_t \) represents the conditional variance in the above equation this also represents the equation for the forecasted variance for one period ahead. \( H_t \) equation discuss the ARCH and GARCH term so that the conditional variance of one period forward can be found out. Here is the equation of \( H_t \) the ARCH term is represented by the \( \varepsilon_{t-1}^2 \) which simply means that the ‘lagged squared residual derived from the mean equation’.

In another way when this \( H_t \) equation used in GARCH term than \( h_{t-1} \) known as the owned lagged. \( v_t \) represent the white noise residual. So it can be said that this \( H_t \) conditional variance equation becomes the function of \( \alpha_0 \) which means constant.

Now \( \varepsilon_{t-1}^2 \) for the ARCH
\( h_{t-1} \) for the GARCH
\( v_t \) white noise residual.
p represent the degree of the ARCH means $\varepsilon_{t-1}^2$

q represent the degree of the GARCH means $h_{t-1}$

$\alpha_1$ and $\alpha_2$ represent the dynamics of short-term volatility.

If $\alpha_2$ have a higher degree of the coefficient, it indicates that the level of shocks happens to conditional variables. After introducing the currency future in India GARCH (1,1) technique has been employed to analyze the volatility repercussion of the spot market.

In this chapter this methodology used that comprises the econometrics models are based on the Literature Review and in-depth study by the various scholars.

Engle (1982) proposed the ARCH model (Auto-regressive Conditional Heteroscedastic) with the purpose of modeling the volatility clustering in financial variables.

An ARCH method equation with order q is as follows:

$$\varepsilon_t = Z_t \sigma_t$$(19)

$$\sigma_t^2 = \omega + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-1}^2$$(20)

In the above-explained equation $Z_t$ represent the process of independently and identically distributed along with the means of $E(Z_t) = 0$ and the variance “$\text{Var}(Z_t) = 1$”, the assumption of this model is that the error term $\varepsilon_t$ should not auto-correlated and the mean and the variances remain zero with the time-varying conditional variance $\sigma_t^2$. It is adequate to enforce $\omega > 0$ and $\alpha_i \geq 0$ to confirm that $\sigma_t^2$ remain positive during all the ‘t’ which explain time duration. As the conditional variance of $\varepsilon_t$ is an upward function of ‘$\varepsilon_{t-1}^2$’, the ARCH model would explain the volatility clustering. Subsequently, if $\varepsilon_{t-1}$ is big in total value, $\sigma_t^2$ and thus $\varepsilon_t$ is also anticipated to be big in total value too. The unconditional variance of ‘$\varepsilon_t$’ occurs when $\omega > 0$ and $\sum_{i=1}^{q} \alpha_i < 1$, and is specified through “$\sigma^2 = E \left[ E \left( \frac{\varepsilon_t^2}{\delta_{t-1}} \right) \right] = \frac{\omega}{1 - \sum_{i=1}^{q} \alpha_i}$. Explanatory variables (e.g. central bank interferences and policies related news declarations etc.) may be added in the conditional variance equation.
4.7.5 Generalized Autoregressive Conditional Heteroscedasticity (GARCH) Model:

Engle (1982) proposed the ARCH (autoregressive conditional heteroscedasticity) model which is one of the important techniques used widely in the analysis of the time series data which mostly the part of the financial character. This technique explained the value of residual variances is dependent upon the past period's squared error term. In this technique, the error term $\varepsilon_t$ should be based on the conditional normal distribution and free from auto-correlation. There is two central condition for the financial variable in the ARCH model that the model must have some specified procedure to follow such as the ‘Conditional mean and conditional variance’.

4.7.6 GARCH (1, 1):

As earlier Engle's ARCH (1982) model was updated to GARCH Model by Bollerslev (1986), the GARCH model totally based on the assumption that the time-varying variance is subject to the assets lagged variance.

The GARCH model specification is more persistent with return distribution that remains leptokurtic and this induces the long-term memory into the ‘conditional return distributions variance’. Thus, the GARCH technique specifications become more fitting than the traditional standard statistical models. Consequently, the unforeseen growth or decline in returns series at time ‘t’ will create an upsurge in the anticipated inconsistency in the succeeding period. The GARCH (1,1) model perform well in most of the applied conditions, as evidenced by Najand and Yung (1991) and Bollerslev (1992).

The GARCH (1, 1) technique, one of the basic and best extensive models can be explained as following:

$$R_t = \alpha + bR_{t-1} + \varepsilon_t \quad \dot{\ldots} \quad (21)$$

$$\varepsilon_t / \mu_{t-1}N(0, h_t),$$

$$h_{tt} = \alpha_0 + \sum_{i=0}^{p} \beta_i h_{t-1} + \sum_{j=1}^{q} \lambda_j \mu^2_{t-j} \quad \dot{\ldots} \quad (22)$$

In the above equation

$R_t$ represent Realized return

$h_{tt}$ represents the conditional Variance which is provided by $R_{t-1}$
\( \alpha, \beta \) and \( \lambda \) represent the coefficient which is needed to be estimated.

The degree of coefficient \( \beta \) and \( \lambda \) estimate the short term dynamic forces resulting in the volatility in the series. In the equation, \( \lambda \) measure the \( h_t \) parameter which determines by both on the previous value of itself as it collected using the lagged \( h_t \) terms and past value of the squared error terms. The larger value of GARCH term coefficients explains the conditional variance's informational effects.

4.7.7 T-GARCH Model:

There is a leverage effect of the positive and negative news coming to the market and that news impact the volatility of the market. The same magnitude of positive and negative news has a dissimilar effect on the market's volatility by Black (1976). As the above-explained then, in that case, the negative shocks of news causes greater volatility as compared to the positive one by Engle and Ng (1993). Another extension to threshold GARCH model from earlier GARCH model brought out by Glosten, Jaganathan, and Runkle (1993) and Zakoian (1994).

The main objective to apply T-GARCH technique is to capture the asymmetry behavior in respect of negative and positive shocks. This technique additionally created a dummy variable for the positive and negative news at the time of applying the regression on the selected model, so that statistically significant difference of positive and negative news can be checked.

The equation of threshold GARCH for conditional variance is as follows:

\[
R_t = \alpha + bR_{t-1} + \varepsilon_t \quad \text{..........................}(23)
\]

\[
\varepsilon_t / I_{t-1} N(0, h_t),
\]

\[
h_{tt} = \alpha_0 + \sum_{i=0}^{p} \beta_i h_{t-1} + \sum_{j=1}^{q} \lambda_j \mu^2_{t-j} + \delta_t \mu^2_{t-1} d_{t-1} \quad \text{..........................}(24)
\]

In the above equation if \( \varepsilon_t \) is negative then \( d_t \) consider the value 1 otherwise it considers as 0, to identify "good news" and "bad news" impact.
4.7.8 EGARCH Model:

The Exponential GARCH model is proposed by Nelson (1991). Under the GARCH model, the non-negative constraints become extremely restrictive described by Cao and Nelson (1992). In the GARCH model consider the non-negative constraints as the parameters of $\beta_j$ & $\lambda_j$, whereas compared to the EGARCH model which is free from any this type of restrictions. In this Model the conditional variance i.e. ‘$h_t$’ becomes an asymmetric function with regard to the lagged disturbances ‘$h_{t-1}$’. In this technique of EGARCH, it considers all the conditional variances in the form of logarithmic that means that it is not required to enforce the ‘estimation constraints’ with the purpose of avoiding 'negative variance' as explained by Nelson (1991).

The mean and variance equation of E-GARCH model are as follows:

$$R_t = \alpha + bR_{t-1} + \varepsilon_t \quad \varepsilon_t/l_{t-1} \approx N(0, h_t),$$

$$\text{Log}(h_t) = \alpha_0 + \sum_{j=1}^{q} \beta_j \frac{\varepsilon_{t-j}}{h_{t-j}} + \sum_{j=1}^{q} \lambda_j \frac{\mu_{t-j}}{h_{t-j}} + \delta_{t-1} h_{t-1} \quad \text{.........................(26)}$$

In the above-explained equation, the $\delta$ represents the asymmetric effects. it is to make sure that all the value of conditional variances must remain positive always in the EGARCH Model as even there are negative parameter values. Consequently, the parameter restrictions to impose non-negativity is not required.

4.8 To measure the relationship between Foreign Institutional Investors and Selected sectoral indices of NSE Nifty

In stage 1st the normality of data has been checked and the descriptive analysis has been done by using the econometrics software and calculated individual analysis of all the variables. This analysis included means, median, max and min value, Standard Deviation (S.D.). To check the series asymmetry or not and peak in the data series descriptive analysis also provided the value of Skewness and Kurtosis respectively and to check the data normal or not the value of Jarque-Bera and its probability value. In the second stage, correlation test has been applied to find out the statistical relationship among the variables. Correlation basic condition is that the value lies
between -1 to 1. As it less than 0 then shows the negative relationship with the variable and more than 0 shows the positive relationship. The value of correlation between the X and Y variable is calculated by using this formula

\[ r_{XY} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2} \sqrt{\sum_{i=1}^{n}(y_i - \bar{y})^2}} \] .................................(27)

After getting the results of correlation, to measure the association between the variable Granger Causality test has been applied. There is a certain condition which should be fulfilled before the test has to be applied.

So in the third stage of analysis, data has to be checked whether the data is stationary or not. So to check this Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test is applied.

Augmented Dickey-Fuller (ADF) test, The Null Hypothesis is that the series has a unit root. To check the ADF following equation has been used:

**4.8.1 ADF test equation**

\[ \Delta X_t = \alpha_1 + \alpha_2 t + \gamma X_{t-1} + \sum_{i=1}^{k} \Psi \Delta X_{t-i} + \epsilon_t \] .................................(28)

Here first difference operator is \( \Delta X_t \), Intercept is \( \alpha_1 \) and linear trend line is \( \alpha_2 t \), number of lagged terms represent by I and the white noise term is \( \epsilon_t \).

Phillips-Perron (PP) test is applied in the time series data to check the integrated order of the series and this depends on the hypothesis that series is having a unit root. PP test as compared to the ADF test makes and non-parametric correlation to the t-statistics.

To Apply this following equation has been used:

**4.8.2 PP test equation**

\[ \Delta X_t = \alpha_1 + \alpha_2 t + \gamma X_{t-1} + \epsilon_t \] .................................(29)

Here first difference operator is \( \Delta X_t \), Intercept is \( \alpha_1 \) and linear trend line is \( \alpha_2 t \), number of lagged terms represent by I and the white noise term is \( \epsilon_t \).

In the next stage, the objective is to find out the co-integration among the series. For this Johansen Cointegration test has to be applied. The process and requirement for this test are that data must be non-stationary at the level and is converted into stationary
after the first difference. After finding the results of unit root test using ADF and PP test it is found that it fulfills the criteria for Johansen cointegration test. Next important part for this test is to find out the leg selection i.e. the optimum leg that effects the decision making of the variable. So to find the optimum leg for this data, VAR Lag Order Selection Criteria has been used. To the proper result for the data and obtaining the unique solution in this study consider Akaike information (AIC) criterion and Final prediction error (FPE) criterion to select the optimum lag.

The following equation and determinant are defining as follows:

\[ FPE_{(m)} = \left[ \frac{T + \sum_{m=1}^{\infty} \lambda}{T - \sum_{m=1}^{\infty} \lambda} \right] \det \Sigma_{\mu}(m) \] .................(30)

According to the FPE criterion, we choose the estimation \( \hat{p}(FPE) \) of the lag order \( p \) such that

\[ FPE[\hat{p}(FPE)] = \min\{FPE_{(m)}|m=0,1,\ldots,M\} \]

In this model \( m=0,1,\ldots,M \) are estimated and the corresponding value of FPE computed. The selection of lag depends on the minimum order of \( m \) which minimizing the FPE that is to be select an an estimate of the true underlying lag order \( p \).

AIC is defining as follows:

\[ AIC_{(m)} = \ln | \Sigma_{\mu}(m) | + \frac{2mK^2}{T} \] .................(31)

\( mK^2 \) is the number of freely estimated parameters in the VAR model. \( \frac{2mK^2}{T} \) is the penalty term that increases in \( m \) and converges to zero for \( T \to \infty \)

For the better results, the estimate \( \hat{p}(AIC) \) of \( p \) such that \( AIC_{(m)} \) is minimized.

4.8.3 Johansen Co-integration test

The Johansen and Juselius (1988) approach are used to assess the long-run relationship between the variables which is based on VAR (Vector autoregressions).

\[ X_t = \alpha_1 X_{t-1} + \alpha_2 X_{t-2} + \ldots + \alpha_k X_{t-k} + \varepsilon_t \] ..............(32)

\[ \Delta X_t = \pi X_{t-k} + \Gamma_1 \Delta X_{t-1} + \Gamma_2 \Delta X_{t-2} + \ldots + \Gamma_{k-1} \Delta X_{t-(k-1)} + \varepsilon_t \] ..............(33)

\[ \lambda_{trace} = -T \sum_{i=r+1}^{\infty} \ln (1 - \lambda_i) \] ..............(34)

\[ \lambda_{max} = -T \ln (1 - \lambda_{r+1}) \] ..............(35)
Here \( r \) is the number of cointegrating equations in the null hypothesis of cointegration tests and \( \lambda_i \) is the estimation of an \( i^{th} \) order of eigenvalues. A significant non-zero eigenvalue denotes a significant cointegrating vector.

In the time series if all the variables are I (1) then these variables are created a dynamic system and, in that condition, the cointegrating relationship exists \( n-1 \) between them. Each co-integration relationship exists between the variable are having a common trend which linking some of the all the series in the system (Stock and Watson).

Johansen test is based on the finding of the number which are having non-zero eigenvalues. As concerns the rank, which refers to the rank of the matrix that characterizing the dynamic system. In this regard as the dynamic system having the \( n \) variables that have \( r \) cointegrating relationship, then the rank of the matrix should be \( n-r \). that represents the matrix which has \( r \) eigenvalue that is 0 and that \( n-r \) are not.

To find out the rank of cointegrating i.e. the value of \( r \), we move to perform the sequence test. To perform this test first, we go through with the Null Hypothesis of \( r=0 \) against the value of \( r \geq 1 \) this test is to find out that there is an existence of at least one cointegrating relationship. If this test fails to find the any cointegrating that is when \( r = 0 \) rejects that it is concluded that there is no cointegration relationship exist or there is no common trend among the series.

In the first stage when the hypothesis \( r=0 \) are rejected at the initial stage then there is at least some of the series which are integrated and that relation has to be determined. After this further move to the next step to test the null hypothesis that \( r \leq 1 \) against \( r \geq 2 \). If this hypothesis can't reject then there is no more common trend, then after the VECM system can be estimated with one cointegrating relationship.

In the Johansen test, that proposed many tests which can be used at each stage. Commonly test results are trace statistic or, alternatively, the maximum eigenvalue statistics or the different information criteria. This procedure of Johansen in the trace statistics shows both the parameters of the adjustment process and the long-term relationship by the maximum likelihood.
4.8.4 Johansen’s Co-Integration Test and Johansen’s Vector Error Correction Model (VECM):

A series called to order I (1) if the series is at the level is non-stationary and when the series is to differentiate at first difference then it became stationary. Suppose we have two-time series variable that variable is called to be co-integrated if these variables are found to be integrated at the same order of differentiating and this variable must have the linear combination of those data series are to be stationary. If the series is the linear combination or having the linear relationship, then it would evidence the presence of long-term relationship among them. Granger in 1981 introduced the co-integration concept in the data analysis and then he again improved the analysis part in 1987. In the year 1987 Engle and Granger drive the concept of long-term and a short-term relationship between the time series variables.

Granger (1986) stated that "The concept of co-integration between the data are provided more efficient investigation and interpretation to the researcher so that they can be made the equilibrium relationship in the series as short run and long run". Error correction model plays an important role to test the co-integration in the short run or disequilibrium in the series, which would bring equilibrium in the long run by the adjustment process.

Soren Johansen in 1991 developed the Johansen cointegration test, this test is useful when more than one equation has a co-integrating relationship with two or more variable which is not covered by the Eagle Granger co-integration test (EGC). EGC was totally based on the Augmented dicky fuller test (ADF) for a unit root in the residual which applied for the single co-integrating relationship equation. The long-term relationship between the different stock market indices with the Foreign Institutional Investors (FIIs) is measured by the same test of Johansen co-integration test (1991). It is required to find out the appropriate number of Vectors in the co-integrating equation which is estimated by using the maximum likelihood which totally based upon the trace statistics ($\lambda_{\text{trace}}$) and Eigenvalue ($\lambda_{\text{max}}$) statistics developed and improved by the Johansen in the year 1991 and 1995 respectively. This can be explained as if there are ‘k’ number of endogenous variables and all the variables are integrated...
on first order then the number of co-integrating vectors with the linear independence may be between ‘0’ to ‘k-1’.

In the process of Johansen Technique, it segregates the rank (II) and convert it into the matrices form such as α and β and the matrices are in the order of k x r where r < k in the way that II= α × β and therefore rows for ‘β’ can be described in a way where r distinguishing the cointegration vectors. There rafter Eigenvalue (Johansen 1995) is provided by the appropriate co-integrating vector. This test also recommended for the "trace test", this test is for identifying the co-integrating rank ‘r’ so that the value become in the form of \( \lambda_{\text{trace}} = -T \sum_{i=r+1}^{k} \ln(1 - \lambda_i) \).

This test also suggests applying the additional likelihood ratio (LR) test to find the maximum number of co-integrating vectors exist against ‘r+1’ so that it can convert in the form of \( \lambda_{\text{max}}(r, r+1) = -T \ln (1 - \lambda_r) \) along with critical values in Johansen (1995).

Granger in 1981 first time brought the concept of co-integration uses for the purpose of statistical analysis between two-time series. In 1987, Granger and Engle explained the specific area to test the co-integration hypothesis. In this first regression analysis is to perform so that the level of residual can be known in the original series, this can also be considered as the equilibrium pricing errors. At the time when the residual is found in the regression model then this leads to the co-integrating test and for this purpose ADF test was used. The co-integration regression equation is displayed hereunder based on the various time series variable which is represented by ‘Ft’ (Total Foreign Institutional Investors), ‘Bt’ (NSE Bank), ‘At’ (NSE Auto), ‘FMt’ (NSE FMCG), ‘FS’ (NSE FS), ‘IT’ (NSE IT), ‘Mt’ (NSE Media), ‘P’ (NSE Pharma), ‘PV’, (NSE Private Bank), ‘PS’ (NSE PSU), ‘Rt’ (NSE Reality) and all are having order of I (1).

\[
F_t = \alpha_0 + \alpha_1 B_1 + \alpha_2 A_1 + \alpha_3 F M_3 + \alpha_4 F S_4 + \alpha_5 I T_5 + \alpha_6 M_6 + \alpha_7 P_7 + \alpha_8 P V_8 + \alpha_9 P S_9 + \alpha_{10} R_{10} + \varepsilon_1
\]  

Where \( \alpha_0 \) to \( \alpha_{10} \) is the regressed on a constant for the respective error terms or residuals is represented by ‘\( \varepsilon_1 \)’.
If \( \varepsilon_1 \) is found stationary, there are cointegration between the dependent and independent variable exists.

The co-integration test which is explained by the Granger and Engle (1987) totally depends upon the first rate integration outcome and OLS Model estimation used to find the cointegrating vector with parameter estimates. For an autoregressive (AR) process Johansen (1988), and Juselius& Johansen (1990) developed the co-integrating vectors with estimators (maximum likelihood). In this test, they also applied the 'independent Gaussian errors' along with 'likelihood ratio test' for estimating the numbers of the cointegrating vector. This procedure has an advantage of considering the underlying process’ error structure.

If the model is providing better than this model provides various tools to find out the relationship in the short run as well as the long-run relationship in the system of the variable. This process empowers researcher to explore more and estimate the equilibrium point between two or more non-stationary data series at the time of computing deviations in short-run equilibrium. Consequently, it has provided better and more influential technique when the equation model is specified properly.

Johansen co-integration (1988, 1991) can be used to determine the long-term relationship between the variable if all the given series are I(1) order. This test provided information related to the co-integration between the series exists or not.

The Vector Error Correction Model (VECM) (Johansen, 1988) is estimated by the following equation: -

\[
\Delta X_t = +\Pi X_{t-1} + \varepsilon_t ; \varepsilon_t/\Omega_{t-1}(0,H_t) \quad \text{.........(37)}
\]

Here, \( X_t \) denote vector for all the dependent and independent variable in terms of ‘2 x 1’ respectively;

whereas ‘ \( \Delta \)’ indicates first order change operator.

Error term ( \( \varepsilon_t \) ) denote 2 x 1 residuals’ vector comprising dependent and independent variable both (\( \varepsilon_{st}, \varepsilon_{pt} \) ) which follow conditional distributed (unidentified) with ‘zero’ mean and covariance matrix ‘\( H_t \)' (time-varying).

The VECM measurement comprises evidence of adjustments for both the short run and long run to variations in ‘\( X_t \)’ through parameters measured of \( \Gamma \) and \( \Pi \), which
are defined as \(- (I - \Pi_1 - \Pi_2 - \cdots - \Pi_p)\) and \(- (I - \Pi_1 - \Pi_2 - \cdots - \Pi_{p+1})\), respectively. \(\Pi_1\) through \(\Pi_{p+1}\) are 2x2 matrices of the coefficient.

The co-integration in the system of the equation whether co-integrated and if yes then up to what extent is represented by the term "\(\Pi\)" and is recognized as "co-integrating constant" in the system of VAR model.

This test confirms that the coefficient matrix which is represent by \(\Pi\) has the vital information about the presence of long-run relationship between the dependent variable (\(F_t\)) and Independent variables (explained earlier) more precisely when rank \(\Pi\) is equal to zero (\(\Pi = 0\)), then \(\Pi\) becomes \(2 \times 2\) zero matrices indicating that there is no existence of cointegration between the dependent and independent variables.

This method is provided alternatively with the approach of maximum likelihood by the Johansen (1988) and later revised by Juselius and Johansen in 1990. This technique assumed to be very popular to find out the short run a long-term relationship among the different variables. This test is performed by considering the \(\Pi\) matrix through its eigenvalues method to test the cointegration between the two variables.

In Johansen's procedure follow the descending order for the arrangement of the eigenvalues.

\[ \lambda_1 \geq \lambda_2 \geq \lambda_3 \geq \cdots \geq \lambda_n \quad \cdots \cdots \tag{38} \]

Here, \(\lambda_1\) represents the highest value and \(\lambda_n\) the least one

There are two specified procedures to test the co-integration adopted by the Johansen’s approach considering the maximum likelihood approach.

### 4.8.5 The Lambda Max (\(\lambda_{\text{max}}\)) Test:

\(H_0\) (null hypothesis) for the Max Eigen technique tests is “whether co-integrating rank is same as ‘\(r\)’ in opposite of alternative hypothesis \((H_1)\): whether co-integrating rank becomes equal to ‘\(r+1\)’” The model is estimated as per following equation:

\[ \lambda_{\text{max}} \ (r, r+1) = -T \ln (1 - \lambda_{r+1}) \quad \cdots \quad \cdots \cdots \tag{39} \]

Here, \(\lambda\) represents eigenvalue

This tool is applied repeatedly up to \(r = 1, \ldots, k\), to the \(H_0\) is rejected.
4.8.6 The Lambda Trace ($\lambda_{trace}$) Test:

Trace statistics used to check the $H_0 = r$, i.e. (Null Hypothesis) whether co-integration rank is same as ‘r’ in opposition to the $H_1$ (alternative hypothesis) whether the co-integrating rank becomes ‘k’ or else more than ‘r’. This technique is performed in reverse order i.e. "$r = k, k-1, k-2...like that till ‘0’." The model statistic is estimated as per the following equation:

$$\lambda_{trace} = -T \sum_{i=r+1}^{k} \ln(1 - \lambda_i) \ldots \ldots$$

Small ‘r’ in Eq. number 8 and 9 represent the number of vectors of cointegration between the series and ‘$\lambda_i$’ indicate an estimated figure of $i^{th}$ organized Eigenvalue in an order derived from the $\Pi$ matrix.

Cointegration techniques investigate the presence of the stationary linear relationship with the non-stationary variables and if this test found any relationship then it is concluded that there is any equilibrium links is available among variables. If the association between them is found than this can be further used to make the Error Correction Model (ECM).

An ECM is a statistical description in relation to financial dynamics in the variables that reinstate equilibrium position whenever disequilibrium happens to occur by its push or pull forces. Granger and Engle (1987) also identified that causality must exist in the series at least in one direction (unidirectional) if there are cointegration relationship found between the series i.e. dependent and independent variables and this causal relationship can be observed through VECM techniques based on the OLS regression in the equation:

$$\Delta S_t = \alpha_{S,0} + \sum_{i=1}^{p-1} \alpha_{S,i}\Delta S_{t-i} + \sum_{i=1}^{p-1} b_{S,i}\Delta F_{t-i} + \alpha_{S}Z_{t-1} + \varepsilon_{S,t} \ldots \ldots (41)$$

$$\Delta F_t = \alpha_{F,0} + \sum_{i=1}^{p-1} \alpha_{F,i}\Delta S_{t-i} + \sum_{i=1}^{p-1} b_{F,i}\Delta F_{t-i} + \alpha_{F}Z_{t-1} + \varepsilon_{F,t} \ldots \ldots (42)$$

Here, $\alpha_{S,0}$ and $\alpha_{F,0}$ represent the intercept point; $\alpha_{S,i}$, $\alpha_{F,i}$, $b_{S,i}$ and $b_{F,i}$ represent short-term coefficients and the error correction term is represented by the term ‘$Z_{t-1}$’ which is extracted from cointegration equation. The magnitude of the coefficients...
\( \alpha_s \) and \( \alpha_f \) determines the adjustment’s speed of returning back to the long-run equilibrium resulting in a market shock. Whenever the coefficient becomes bigger, adjustment time becomes speedier and consequently ‘z’ becomes much stationery and thereby speedy recovery back to the long-run equilibrium level.

Whenever the Total FIIs (\( F_t \)) and ‘Bt’ (NSE Bank), ‘At’ (NSE Auto), ‘FMt’ (NSE FMCG), ‘FS’ (NSE FS), ‘ITt’ (NSE IT), ‘Mt’ (NSE Media), ‘Pt’ (NSE Pharma), ‘PVt’ (NSE Private Bank), ‘PSt’ (NSE PSU), ‘Rt’ (NSE Reality) are found cointegrated, than ECM helps the dynamic correlations as well as causalities among their returns. It must be required that the causality between the variables must exist among the variables when they move together in a line and the spread between them is mean reverting but this causality may change its direction over the time. To examine the hypothesis relating to the significance of ECM coefficient T-Test is applied and to examine the collective significance of the estimated coefficient (lagged values) F-test is applied. To fix the number of required lags during the analysis through Cointegration and VECM model the AIC and SIC criterion has been used.

4.8.7 Granger Causality Test

At last stage we calculated the Granger Causality Test, this test is called as statistical hypothesis test to determine that one-time series can be used to analyze the other series or can predict the future value of the series by getting the value of one series.

Suppose we have two series X and Y, and when the time series X that Granger Cause to the other time series i.e. Y, that represents that the pattern of X and Y series are same and repeated approximately after some time lag, so we can say that the past values of X time series can be used to predict the future value of Y series.

In the Granger (1969) concept is that to know that the value of one series can affect another time series and the main cause is that the lag value of same dependent variable affects the decision making or the behavior of the variable. So for this question, Granger helps that the coefficient lagged value affect the decision making or not and it also provided the statistical value so that to know the significance value of the prediction. It also provided or find the value of cause in both the direction as one series are dependent and vice versa.
It is very important to select the lag value which applying this test, so to apply this test in this present study use the already discuss criterion using AIC that is 5 lag has to be taken and all other lags are also considered to find out the result that the lag value of the same variable causes or not. So in this study the lag value is considered from 5 lag to 1 lag and the value of significance and F-statistics are shown in the results.

In the E-views the Granger Causality test is run with this equation:

\[ y_t = \alpha_0 + \alpha_0 y_{t-1} + \cdots + \alpha_1 y_{t-1} + \beta_1 x_{t-1} + \cdots + \beta_1 x_{t-1} + \epsilon_t \quad \text{(43)} \]
\[ x_t = \alpha_0 + \alpha_0 x_{t-1} + \cdots + \alpha_1 x_{t-1} + \beta_1 y_{t-1} + \cdots + \beta_1 y_{t-1} + \epsilon_t \quad \text{(44)} \]

The above equation shows the different pair of two series x and y. where this equation consists the other series and lag value of own variable and also included the lag value of another variable. This test resulted in the F-statistics and probability value to check the hypothesis and the wald statistics for the different variables and hypothesis the following condition is used for this purpose:

\[ \beta_1 = \beta_2 = \cdots = \beta_1 = 0 \quad \text{(45)} \]

The hypothesis for this test taken as that x series does not Granger causes the other series y for the first equation and as same that y series does not Granger causes the other series x in the another equation.

4.9 To examine whether the factors to Government Policy have an influence on the behavior of the institutional investor

To examine the impact of Government (Govt.) policy on the decision making of Foreign Institutional Investors (FIIs) is an objective of the study. As mention in the previous chapters that how the different economic variable influences the decision making of FIIs, how the market risk and return influence the decision making of Foreign investors. in previous chapter we also studied about whether the volatility of the stock market influence the purchase and sale decision of FIIs and for the more understanding about the variables in the previous objective different stock indices have been considering for the study that which sector has influenced more to the FIIs. Now it is important to know that whether the policy prepared by the concern authorities i.e. SEBI, RBI, and other Custodian is impacting the decision making of Foreign investors. Are the foreign investors’ concern about the different policy prepared by the Govt., or they influence with the policy or they take decision while considering the Govt. policy.
So to know the various aspect related to govt. policy in this chapter all the govt. the policy has been considering, which are prepared in respect of foreign institutional investors.

To find out the impact of govt. policy regression analysis is used and as dependent variable FIIs purchase and FIIs sales has been considering, as the govt. the policy is not having any numeric value so to find out the impact of policy dummy variable has been used as an independent variable. The time gap for the policy is not always equal, so for the study, 30 days previous and after the date of the policy is consider and Dummy 0 is considering before the date of the policy and Dummy 1 is considered after the date of the policy.

The following equation has been used for the study:

\[ y = a + bx \] ..........(46)

Where \( y \) is the dependent variable, \( a \) is the \( y \)-intercept and \( b \) is the slope of line \( x \) and \( x \) is the independent variable.

A dummy variable is used where the data for the analysis is of qualitative rather than quantitative. To take the dummy variable dummy 1 is taken where the criterion is satisfied and dummy 0 if not satisfied.

In this study, FIIs Purchase and FIIs Sales are considered as the dependent variable and the policy dummy variable are considering an independent variable.

\[ FIIs\_Purchase = a + b (Polic\_D) \]
\[ FIIs\_Sale = a + b (Polic\_D) \]

Flows of FIIs (\( FIIs\_Purchase \) and \( FIIs\_Sale \)) are considered as dependent Variable because the main objective was to find the impact on the flows of FIIs and Govt. Policy (\( Policy\_D \)) are considered as Independent Variable.