CHAPTER-III

RESEARCH METHODOLOGY

Research methodology is a systematic method of solving the research problem. It deals with the research design used and methods adopted to present the study. A research process involves various stages or steps that guide the project from its commencement through the final analysis, recommendations and ultimate actions. The research process provides a planned, systematic approach to research project and guarantees that all aspects of research project are constant with each other. The research methodology explains the various steps that are generally adopted by a researcher in studying the research problem.

"Research is considered to be scientific, formal, intensive process of carrying on the systematic method of analysis. It consists of various systematic structure of investigation mainly resulting in some of formal record of procedures and report of result or specific conclusions." (J.W.Best, 1999).

3.1 STATEMENT OF THE PROBLEM

Emerging markets have recently been significant to the worldwide investment community. The market capitalisation, volatility and returns have increased dramatically in these markets. While emerging markets are more fluctuating than developed markets, they tend to be quite uncorrelated with each other and with developed markets. Global investors opt to diversify their capital across these markets to decrease their portfolio risk. Unfortunately financial crisis are characterized by dramatic fluctuations in foreign exchange markets and stock price which have been a common phenomenon in recent years in most of the emerging countries. The exchange rate has a great influence on stock market behaviour and vice versa. (Dhiraj Relli, 2017).

This fact reveals the need to investigate the impact of exchange rate fluctuations in stock market.

3.2 RESEARCH QUESTIONS

- What is the magnitude and trend of Foreign exchange market and stock market over the last decade?
- Does the exchange rate in this study have long-run equilibrium relationships with the stock market?
- Does the exchange rate have causal relationships during the sample period considered for the study? If so, what is the direction of the causality between the stock market and exchange rates?
- Does the exchange rate in this study have short-run equilibrium relationships with the stock market?
- Does the volatility of exchange rates influence the stock market return volatility?
- Does an exchange rate have any relationship with the sectoral indices in NSE?

3.3 OBJECTIVES OF THE STUDY

The main aim of the study was to find out the impact of exchange rate fluctuations on the share prices in the Indian Capital Market.

This involved

- To analyse the behavior of foreign exchange market and stock market during the study period.
- To examine the impact of exchange rates fluctuations on the share indices in the short run.
- To examine the impact of exchange rates fluctuations on the share indices in the long run.
- To determine the relationship between exchange rates and sectoral indices listed in NSE.
- To study the Volatility Spillover between stock market and foreign exchange market.

3.4 FRAMEWORK OF HYPOTHESIS

The objectives set forth are based on the following assumptions.

Jarque-Bera test

H_0 = The data series is not normally distributed

H_1 = The data series is normally distributed

Stationarity test

H_0 = There is no unit root in the time series data.

H_1 = There is unit root in the time series data.

Granger Causality test

H_0 = Stock exchange does not granger cause exchange rate.

H_1 = Exchange rate does not granger cause stock exchange..

Co-Integration test

H_0 = There is no co-intergration between exchange rates and stock index

H_1 = There is a co-intergration between exchange rates and stock index

Auto Correlation test

H_0 = There is no autocorrelation and partial autocorrelation in the time series data

H_1 = There is autocorrelation and partial autocorrelation in the time series data

Heteroskedasticity test

H_0 = There is no ARCH effect or Homoskedasticity in the residuals

H_1 = There is ARCH effect or Homoskedasticity in the residuals

ARCH/GARCH model

H_0 = There is no relationship between stock index and exchange rates

H_1 = There is a relationship between stock index and exchange rates

3.5 RESEARCH DESIGN

Research design is the basic plan which guides the researcher to collect relevant information economically for the objective framed for the study. The present study is descriptive and empirical in nature. The prime objective of the study is to investigate the impact if exchange rates fluctuation on share indices in Indian capital market.

3.6 SAMPLING DESIGN & DATA COLLECTION

The present study is directed towards studying the impact of exchange rate fluctuations on share indices in Indian capital market. For this purpose, the researcher focuses on Nifty 50 index, a well-diversified index of NSE. And for analyzing the sectoral relationship with exchange rate, all the 11 sectors listed on NSE are selected for the study i.e., Nifty Auto, Nifty Bank, Nifty Financial services, Nifty FMCG, Nifty IT, Nifty Media, Nifty Metal, Nifty Pharma, Nifty Private Bank, Nifty PSU and Nifty Realty Index. (Nifty Indices, 2017)

Four pairs of currencies are identified as key foreign exchange rates for analysis i.e., USD/INR, EURO/INR, GBP/INR and YEN/INR. Only these four currency pairs are legally traded in India as per RBI and SEBI norms. (www.rbi.org.in)

Thus, census method has been applied in this study.

3.6.1 Data collection

The study is based on the secondary data and it has been collected from various secondary sources such as publications of National Stock Exchange(NSE), Reserve Bank of India(RBI) and Securities Exchange Board of India (SEBI), Journals such as Journal of Financial Economics, Economic and Political review, Company reports, database such as Prowess, Cline and websites such as www.rbi.org.in, www.nseindia.com, www.sebi.gov.in , www.indiainfoline.com and. www.econstats.com.

3.6.2 Data Used

The data used in this study consists of weekly time series observations covering the period of January -2007 to December 2017.

- **Exchange rate:** Weekly spot rates i.e. exchange rates of USD, EURO, GBP and YEN to Rupee as per RBI reference rate from January 2007 – December 2017, covering 10 years, were considered in the time series for exchange rate.

- **Share Index:** The monthly prices of the Indian stock market indicator, NIFTY 50 from January 2007 –December 2017 was mainly considered to study the existence of any relationship between exchange rate and share indices in the Indian capital

market. Sectoral indices such as Nifty Auto, Nifty Bank, Nifty Financial services, Nifty FMCG, Nifty IT, Nifty Media, Nifty Pharma, Nifty Private Bank, Nifty PSU and Nifty Realty Index from January 2007 – December 2017, were considered for the study. With respect to Nifty Metal the study period was from July 2011 – December 2017 were considered since Nifty Metal was launched in July 2011.

3.7 FRAMEWORK OF ANALYSIS

Data thus obtained have been analyzed in tune with the framed objectives of the study bringing out impact of exchange rates fluctuation on share indices in Indian capital market. The analysis has been conducted with the help of software packages like MS Excel and EViews. The statistical tools used for analyzing the data include

- Summary statistics which include mean, standard deviation, co-efficient of variation, Compound Annual Growth Rate (CAGR), skewness, kurtosis and Jarque-Bera test.
- Unit Root test
- Granger Causality test
- Block Exogeneity test
- Johansen Juselius Cointergration test
- Vector Error Correction Model
- Regression Analysis
- Ljung Box Auto Correlation test
- Lagrange Multiplier Test-Hetroskedasticity test
- GARCH & EGARCH

3.7.1 STATISTICAL MEASURES

3.7.1.1Descriptive Statistics:

The descriptive statistics is used in this study to study the behaviour of stock market and foreign exchange market for the past decade. It includes the basic statistical tools such as mean, the minimum and the maximum values, standard deviation, kurtosis, skewness and the Jarque-Bera test. These tests are applied for the data in their levels of

the stock market index and exchange rates during the period from January 2007 – December 2017. Jarque bera test helps to find out whether the stock indices and exchange rates are normally distributed or not.

The formula to find out Jarque bera test is calculated as given below.

$$\mathbf{JB} = \boldsymbol{n}\left[\frac{\boldsymbol{S}}{\mathbf{3}} + \left(\frac{\boldsymbol{K-3}}{\mathbf{12}}\right)\right]$$

Where, JB denoted Jarque Bera test statistic

N denotes the sample size taken for the study

S denotes the skewness co-efficient

K denotes the Kurtosis co-efficient.

3.7.1.2 Unit Root Analysis of data

It is a pre-condition for data to be stationary for econometric modeling. Augmented Dickey-Fuller (ADF) test and Phillip-Perron (PP) test were used for testing unit root in the data series.

- **Augmented Dickey Fuller Test**

The Augmented Dickey fuller test is applied on the level data to transform the non-stationary into stationary data. This is the most popular and accepted model of stationary analysis.

- **Phillip Perron Test**

In the ADF test, it is assumed that the error terms (u_t) are independent and have constant variances. To overcome this problem, Phillips-Perron has been applied to transform the non-stationary series to stationary series.

3.7.1.3 Granger Causality Test

The application of causality was developed by Granger(1969) and Slim (1972). In order to determine the influence of one market in forecasting another market in short run, Granger rest was applied. The following formula is used to find out if variable X or Y is granger caused by one another. It is calculated by applying the following ordinary least square method of regression equation.

$$s_t = \beta_1 + \sum_{i=1}^{k} a_i f_{t-j} + \sum_{t=1}^{m} b_j s_{t-j} + \varepsilon_t \ldots\ldots\ldots (1)$$

$$f_t = \beta_1 + \sum_{i=1}^{k} a_i s_{t-j} + \sum_{t=1}^{m} b_j f_{t-j} + \varepsilon_t \ldots\ldots\ldots (2)$$

Where,

S_t= Stock market

$\beta_{1=}$ Constant

K= number of lags

a_ib_j= the coefficients

f_{t-i}=exchange rates at lag j

ε_t=Error terms

3.7.1.4 Block Exogeneity Wald Test

To check the short run causality between exchange rates and stock indices, Block Exogeneity Wald test were also used.

3.7.1.5 Johansen - Juselius Cointegration test

Johansen‘s Cointegration test is a procedure for testing co-integration i.e., long run relationship between stock market and foreign exchange market during the study period.. The appropriate lag length selection must be set for the model before performing the Johansen‘s cointegration test,. The lag length determines the number of lags to be included in the Vector Auto Regression (VAR) system before examining the cointegration test and constructing the Vector Error Correction Model (VECM). The lag length is determined by constructing an unrestricted VAR. VAR lag selection tests is based on the Likelihood Ratio (LR), Final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SIC), Hannan-Quinn information criterion (HQ).

After the lag selection, the Johansen‘s test was performed to test the long run relationship between stock market and foreign exchange market. A significant negative error term correction indicates that there exists long run causality between dependent and

independent variables. The two statistics proposed by Johansen (1988) for testing the presence of cointegration are the trace test and the maximum eigenvalues test

$$\lambda \, \mathbf{trace}(r) = -T \sum_{i=r+1}^{n} \ln\left(1 - \hat{\lambda}_i\right)$$

$$\lambda \mathbf{max}(r, r+1) = -T \, \mathbf{Ln}\left(1 - \hat{\lambda}_{r+1}\right)$$

For a sample size of T, each test is a likelihood ratio test based on the eigen values ( ) from the estimation of the matrix. The trace test states the null hypothesis that the number of cointegrating vectors is less or equal to r against the alternative hypothesis that there are more than cointegrating vectors and therefore more than r cointegrating relationships. The maximum eigenvalue test, orders the eigenvalues in descending order, and considers if they are different from zero. If none of the 1> 2>…> n are different from zero there is no cointegration among the variables. The null hypothesis is that the number of cointegrating vectors equals to r, which is tested against the alternative hypothesis that the number of cointegrating vectors equals to r+1. Both statistics follow non-normal distributions, which are specified in Johansen and Juselius (1990).

3.7.1.6 Vector Error Correction Model

The Vector Error Correction Model was applied to data to test the speed of adjustment towards equilibrium i.e. long run causality between stock market and foreign exchange market. In the short run, there may be disequilibrium between variables, but the proportion of the disequilibrium in the short run is corrected in the long run. The vector error correction model helps to find out the rate at which the disequilibrium between the variables is getting corrected. The formula that is used for VECM model is described below.

$$\Delta X_t = \delta + \sum_{i=1}^{P} \Gamma \Delta \, \mathbf{X_{t-i}} + \Pi \mathbf{X}_{t-i} + \vartheta$$

3.7.1.7 Regression Analysis

Regression is used to analyse the association between dependent and one or more independent variables. In this analysis, the linear regression model has been applied to find out the linkage between stock market returns and exchange rates return.

3.7.1.8 Ljung Box Q Statistics

Residuals are extracted by applying the regression model on the differenced data of stock market returns and foreign exchange returns. The extracted residuals were rotated to find out the effect of auto correlation using Ljung-Box Q statistics. The Ljung Box Q statistics is calculated using the following equation.

$$Q = n(n+2)\sum_{k=1}^{h}\frac{\hat{\rho}_k^2}{n-k}$$

Where, n is the sample size. P_k is the sample autocorrelation at lag k. and h is the no of lags.

3.7.1.9 ARCH – Lagrange Multiplier Test – Heteroskedasticity Test

The ordinary least square method assumes homoscedasticity or equal error variance. If the assumptions go wrong, it is not wise to apply regression method to investigate the relationship among variables. Therefore, it is highly important to detect if the stock returns and exchange rates employed in the study are suffering from the issue of heteroscedasticity. In order to detect heteroscedasticity, ARCH Langran ge Multiplier test is utilized.

3.7.1.10 Analysis of data using ARCH family of models

In order to analyze the transmission of volatility or volatility spillover effects between the stock and foreign exchange markets, both Generalised Autoregressive Conditionally Heteroscedastic model (GARCH) and Exponential Generalised Autoregressive Conditionally Heteroscedastic model (EGARCH) are taken into consideration. The GARCH model allows the conditional variance to be dependent upon previous own lags apart from the past innovation. Through GARCH model, it is possible

to interpret the current fitted variance as a weighted function of long-term average value information about volatility during the previous period as well as the fitted variance from the model during the previous period.

In GARCH models, restrictions are to be placed on the parameters to keep the conditional volatility positive. This could create problems from the estimation point of view. One of the primary restrictions of GARCH model is that they enforce a symmetric response of volatility to positive and negative shocks. This arises due to the conditional variance being a function of the magnitudes of the lagged residuals and not their signs. However; it has been argued that a negative shock to financial time series is likely to cause volatility to rise by more than a positive shock of the same magnitude. The EGARCH or Exponential GARCH model was proposed by Nelson (1991) and uses natural log of the conditional variance to address this drawback of GARCH model. Nelson and Cao (1992) argue that the nonnegativity constraints in the linear GARCH model are too restrictive. The GARCH model imposes the nonnegative constraints on the parameters, while there are no restrictions on these parameters in the EGARCH model. EGARCH allows for an explicit testing of volatility spillover without imposing additional restrictions.

The price and volatility spillover effect between the stock and foreign exchange markets and the degree of integration as well as significant interrelationships can be interpreted in at least two ways. First, a causal relationship may exist such that the volatility in one market induces volatility in the other through a lead-lag relationship. This is possible because the trading hours of the two markets are not common. Second, common international factors could influence the volatility in both the markets, thereby giving rise to an apparent causal relationship between the markets.

GARCH (1, 1) Spillover Equation

$$h_{t(\text{Stock Indices})} = \omega_0 + \beta_1 \varepsilon_{t-1}^2 + \alpha_1 h_{t-1} + \psi(\text{sqresid}_{\text{erate}})$$

$$h_{t(\text{Erate})} = \omega_0 + \beta_1 \varepsilon_{t-1}^2 + \alpha_1 h_{t-1} + \psi(\text{sqresid}_{\text{stock indices}})$$

where $\omega_0 > 0$, $\beta_1 \geq 0$, $\alpha_1 \geq 0$. In both the equation h_t is the conditional variance of both stock indices and exchange rates respectively, which is a function of mean ω_0. News about volatility from the previous period is measured as the lag of the squared residual from the mean equation (ε_{t-1}^2), last period's forecast variance (h_{t-1}) and the squared residual of exchange rate and stock indices, respectively in both the above equations.

In the GARCH (1,1) spillover equation, we use the squared residual of another market (ψ) instead of residual on their level, which is used as a proxy for shock in other markets, because in case of GARCH, we make sure that volatility is positive.

EGARCH (1, 1) Spillover Equation

$$\ln h_{t(\text{Stock Indices})} = \omega_0 + \beta_1 \ln h_{t-1} + \alpha_1 \left| \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} \right| + \phi \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} + \psi(\text{resid}_{\text{erate}})$$

$$\ln h_{t(\text{Erate})} = \omega_0 + \beta_1 \ln h_{t-1} + \alpha_1 \left| \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} \right| + \phi \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} + \psi(\text{resid}_{\text{stock indices}})$$

The above equations represent the EGARCH (1, 1) model. In these equations, log h_t is the log of variance, which automatically restricts the volatility to be positive. ω_0 is the constant level of volatility. B_1 In h_{t-1} explains the consistence, because this is a function of volatility. The coefficient α_1 measures reaction of volatility to change in news. The residual modulus that measures the relation with respect to positive news were considered. The coefficient φ_1 explains the relationship of volatility to both positive and negative news, because we are not taking modulus. The coefficient ψ represents the volatility spillover coefficient. In the first equation, residuals are generated from the EGARCH model of exchange rate, whereas in second equation, residuals are generated from the EGARCH model of stock indices. In the above EGARCH (1, 1) model, only residuals of other markets have been taken into consideration instead of squared residual, since EGARCH, by definition, ensures that volatility is positive.

3.8 SIGNIFICANCE OF THE STUDY

In the present context, this study is highly significant as there are lot of uncertainties in the stock market operations and this study will help the investors to understand the exchange rate fluctuations that influence the stock index returns and also the nature of relationships which would be useful to predict stock market behavior. It also provides a platform for participants to enhance their views about the relationship between the two markets. This study is useful for the policy makers to influence the investors and help them to make appropriate investments and help them in better portfolio management.

3.9 LIMITATIONS OF THE STUDY

Some of the practical limitations of the study are as follows:

- This study is primarily based on the secondary data, it has its own limitations and it may influence the findings of the study.
- In this study, Nifty has been used as benchmark of returns; other indices are not covered in this study.
- The study is confined to currencies against Rupee and cross currency pairs are not covered in the study.
- Since the study is conducted for a period of ten years from 2007 - 2017, the global and Indian economic and financial market happenings may have influenced the findings of the study. So, the findings cannot be generalized with other years that are not considered for analyzing in this study.

3.10 SCOPE OF THE STUDY

The scope of the study is limited to the exchange rate of Indian rupee against USD, Euro, GBP, Yen and equity prices in the secondary market exchanges of National Stock Exchange(NSE). Also the study covers all the sectoral indices and the period of study is 10 years i.e., January 2007- December 2017.