CHAPTER - III

RESEARCH METHODOLOGY

The study is concerned with the analysis of risk and return of equities by using historical data. The main responsibility of the investigator is to form a research methodology for drawing out the sample of the study. So, this part of research describes

- Which devices have been employed?
- From where the data has been collected?
- How the data has been analyzed i.e., what techniques have been adopted?

So, in this chapter the methodology used in this study has been discussed.

3.1 Research Method

The study under consideration "Risk-Return Relationship and the Effect of Diversification" has been conducted to examine the risk and return of selected the listed securities of BSE-500 in the Indian stock market. This study is empirical and exploratory in nature. It is empirical in nature which aims to examine the risk and return of selected securities of BSE-500 and it is a data based research and used to derive meaningful conclusion. It is exploratory in the sense that it explores the evidences of the forecasting the relationship of macroeconomic variables and stock market returns.

3.2 Period of the Study

Keeping in view of present study, the main data used in the study is secondary in nature. The present study is for eleven years starting from 1 January, 2001 to 31 December 2011. As discussed in chapter I, this period has been chosen because of huge transition in economy. During this period many developments took place in the Indian Capital Market. So, a need has been felt to examine the risk and return of Indian equities. In the study also the eleven years data have been used to examine the effect of macroeconomic variables on stock market returns in India.

3.3 Sample of the Study

Before going on the sample of the study we should know about the population of the study. In this study, the population includes all the companies that were the part of Bombay Stock Exchange-500 at the time of data collection (May 2012) which was comprised of the different sectors.

The sample size includes a total number of 225 securities and sample population consists of all stocks listed on BSE-500. The study used daily adjusted closing prices of listed 225 securities (see appendix) of BSE-500. The selection of stock varies on the basis of the listing in BSE-500, market capitalization, trading volume and the availability of data. This provides us with a sample size of 225 securities. The securities were selected from different industry groups. The studies done in the past used monthly, weekly, quarterly, annual data for the analysis of risk and return. But this study used daily data for the analysis as suggested by Brown and Warner's (1985) who suggests that daily prices are better as compared to the quarterly, monthly and weekly prices. Another reason is that Barua, Raghunathan & Varma (1992) have also favoured the daily data and therefore daily prices data were used in the study. The study also used the monthly data to examine the risk and return of selected securities during the study period. The BSE Sensex is taken as the market proxy. The choice of BSE index securities for because it is a most popular stock exchange and widely used for participants. BSE represents nearly 93 percent of total of market capitalization. Some securities with missing data were also removed from the sample.

In the study, macroeconomic variables effect has also been checked. In order to check the effect of macroeconomic variables on stock market returns, the following variables have been used (Industrial Production, Consumer Price Index, Exchange Rate, Money Supply, Call Money Rates). For the purpose of checking the effect of macroeconomic variables on stock market returns, the monthly data has been used because there were some difficulties for undertaking the daily data and most of the studies used monthly data for the purpose of checking the effects of macroeconomic variables on stock market returns.

3.4 Data Collection Sources

The study is based on the secondary data and the data relevant for this study has been collected from various websites such as www.bseindia.com, www.yahoofinanceindia.com and the Centre for Monitoring of Indian Economy (CMIE) prowess database software. In this study, term deposit rates were used as risk-free rate.

The present study also checked the effect of macroeconomic variables on stock market return. In the study for the purpose of checking the effect of macroeconomic variables on stock market returns, the monthly closing prices of BSE-Sensex has been used. Data for macroeconomic variables has been collected from the website of Reserve Bank of India.

3.5 Measures of Risk and Return

3.5.1 Daily Return: Daily returns on securities are calculated by applying the following formula: -

$$R_{it} = \ln\left[\frac{P_t}{P_{t-1}}\right]*100$$

Where r_{it} is return on stock i in time period t, P_t is stock price at the time t, P_{t-1} is stock price at the time period t-1

3.5.2 Market Return: Market returns on securities are calculated by applying the following formula: -

$$X_{it} = \ln\left[\frac{I_t}{I_{t-1}}\right]*100$$

X_{it} is the return on index, I_t is the closing value and I_{t-1} is the opening value

3.5.3 Capital Asset Pricing Model (CAPM): Expected return is calculated by using this equation:

$$E(R_i) = R_f + \beta_i\left[E(R_m) - R_f\right]$$

Where $E[R_i]$ = expected return

R_f = Risk free rate

β_i = beta of the security i as $\frac{Cov(R_i, R_m)}{VAR(R_m)}$

$E(R_m)$ = expected return on the market

$[E(R_m) - R_f]$ = Market Premium

3.5.4 Time Series (First-pass regression) and Cross-sectional Regression (Second-pass regression):

Capital Asset Pricing Model (CAPM) says that each security's expected return is linear to its beta. So CAPM model generates expected return but the test of model use realized returns. For the purpose of checking the relationship between systematic risk and return in the study, the beta for each security was calculated by regressing individually the daily return and monthly return of these securities on the corresponding returns of market index (first-pass regression) during the eleven years period. Using the market model regression for each asset, the following regression model employed called first-pass regression (Celik et al. 2009).

$$E(R_{it}) - R_f = \alpha_i + \beta_i \left(E(R_{mt}) - R_f \right) + \varepsilon_{it}$$

The equation can also be written by:

$$r_{it} = \alpha_{it} + \beta_{it}(r_{mt}) + \varepsilon_{it}$$ … (first-pass regression)

Where, r_{it} is the return on security i over a period of time t,

r_{mt} is return on the market index,

β_i is slope coefficient, and α_i is the intercept and

ε_{it} is the error term.

The significance of beta is tested through t-statistics at 1 percent and 5 percent level of significance. Thus, 225 regressions equations i.e., one for each security were run for daily data and monthly data.

On the second stage tried to investigate the linear relationship between risk and return by applying the cross-sectional (second-pass) regression of individual security returns of its beta estimates calculated as of the first pass regression. Following is employed for cross-sectional regression equation:

$$R_{it} = \gamma_{0t} + \gamma_{1t}\beta_{it-1} + n_t \text{ … (Cross-sectional regression)}$$

For this cross-sectional regression, the number of observations is equal to the number of securities (or portfolios), and this regression is frequently referred to as the "second-pass regression". (Fuller & Farrell, 1987)

After that, in the study 15 portfolios of 15 securities each are made after arranging the securities in ascending order of their beta values during the study period and portfolios beta calculated by using the following equation:

$$r_{pt} = \alpha_p + \beta_p r_{mt} + \varepsilon_{pt}$$

After that the test of risk-return relationship is checked by employing the cross-sectional regression equation by using portfolio return as dependent variable and portfolio betas as independent variable.

Portfolios expected return is linear to its beta that implies by the Capital Asset Pricing Model (CAPM). So, Capital Asset Pricing Model (CAPM) generates expected return, but test of the model use realized returns. Following is employed for cross-sectional regression equation:

$$r_p = \gamma_0 + \gamma_1\beta_p + \varepsilon_p$$

Where

γ_0 is the estimate for intercept, γ_1 is the estimate for slope.

In the study for the purpose of checking the statistical trustworthiness of portfolios, the present study used the 'Z' test and't' test at the five percent level of significance.

3.5.5 Portfolio Return: Portfolio return has been calculated by using this formula:

$$R_P = \sum_{i=1}^{N} w_i(\alpha_i + \beta_i R_m)$$

Where R_p is the portfolio return and w_i is the weight give to security i.

3.5.6 Portfolio Variance: Portfolio variance has been calculated by using this formula:

$$\sigma_P^2 = \left[\sum_{i=1}^{N} (w_i \beta_i)^2 \sigma_m^2 \right] + \left[\sum_{i=1}^{N} w_i^2 e_i^2 \right]$$

Where σ_P^2 is variance of the portfolio, σ_m^2 is the expected variance of the index, $w_i^2 e_i^2$ is the weighted average of error term of each security in the portfolio.

3.5.7 Portfolio Standard Deviation: Symbolically, portfolio standard deviation can be obtained as:

$$\sigma_P = \sqrt{\sum_{i=1}^{n} \sum_{j=1}^{n} w_i w_j \operatorname{cov}(R_i, R_j)}$$

Where $Cov(R_i R_j)$ is the covariance between the rate of return of the *i* and the *j* security.

3.5.8 Portfolio Beta: Portfolio beta has been calculated by using this formula:

$$\beta_P = \sum_{i=1}^{N} w_i \beta_i$$

Where β_P is the portfolio beta and β_i is the beta of individual stocks

3.5.9 Total Risk: Total risk of a security is the sum of systematic or unsystematic risk. Symbolically it can be written as:

$$TotalRisk = \beta_i^2 \sigma_m^2 + e_i^2$$

Total Risk = systematic risk (explained) + unsystematic risk (unexplained)

3.5.10 Relationship between Portfolio Size and Portfolio risk.

In the study the following regression equation are estimated to test the relationship between portfolio size and portfolio risk as suggested by Al Suqaier and Al Ziyud (2011).

$$Y_i = \beta_i \left(\frac{1}{X_i}\right) + A$$

Where, X_i is the size of portfolio i

β_i is the parameter of the model

Y_i Computed mean portfolio standard deviation.

A is constant

3.6 Risk-Free Rates

In the present study term deposit rates has been used as risk free rate.

TABLE 3.1

RATE OF INTEREST ON TERM DEPOSITS

Year	Rate of Interest (per annum)
2001	8.5%
2002	7.0%
2003	5.25%
2004	5%
2005	10.25%
2006	6%
2007	7.5%
2008	7.5%
2009	7%
2010	6%
2011	7.75%
Average (Interest)	**7.07%**

Source: www.rbi.org. com

Table 3.1 shows the average interest during the study period. Therefore, in the present study risk free return is 7.07 percent annually.

3.7 Econometric Models and Techniques

3.7.1 Description of Variables

The description of selected macroeconomic variables in the present research study was given by:

LBSE = Log of Bombay Stock Exchange

LIPR = Log of Industrial Production

LCPI = Log of Consumer Price Index

LEXR = Log of Exchange Rate

LMYSY = Log of Money Supply

LCMR = Log of Call Money Rate

On the basis of the literature reviewed, the study hypothesized the model between BSE-Sensex Index and the five macroeconomic variables, namely Industrial Production (IPR), Consumer Price Index (CPI), Exchange Rate (EXR), Money Supply (MYSY), Call Money Rates (CMR). The hypothesized model is as follows:

BSE = f (IPR, CPI, EXR, MYSY, CMR)

Macroeconomic Variables Testing Models

For the purpose of testing the effect of macroeconomic variables on stock market return, the monthly data series for all the selected variables have been used. The purpose of studying the effect of economic variables on stock market return, the following models has been applied:

TABLE 3.2

MACROECONOMIC VARIABLES TESTING MODELS

Models	
Model	**Equations**
Model 1	$(SMI)_{it} = \alpha_i + \beta_1 (IPR) + u_{it}$
Model 2	$(SMI)_{it} = \alpha_i + \beta_2 (CPI) + u_{it}$
Model 3	$(SMI)_{it} = \alpha_i + \beta_3 (EXR) + u_{it}$
Model 4	$(SMI)_{it} = \alpha_i + \beta_4 (MYSY) + u_{it}$
Model 5	$(SMI)_{it} = \alpha_i + \beta_5 (CMR) + u_{it}$
Model 6	$(SMI)_{it} = \alpha_i + \beta_1 (IPR) + \beta_2 (CPI) + \beta_3 (EXR) + \beta_4 (MYSY) + \beta_5 (CMR) + u_{it}$

Where SMI = Stock Market Return

IPR = Industrial Production

CPI = Consumer Price Index

EXR = Exchange Rate

MYSY = Money Supply

CMR = Call Money Rates

U_{it} = Error Term

α_i = Constant

β = Coefficient of Variables

In all these equations, α_i and β are the unknown constants in a model called parameters.

In these equations, the dependent variable is stock market return (BSE-Sensex). Return is calculated by using the following equation:

$$R_t = \ln\left[\frac{P_t}{P_{t-1}}\right]*100$$

3.7.2 Econometric Techniques

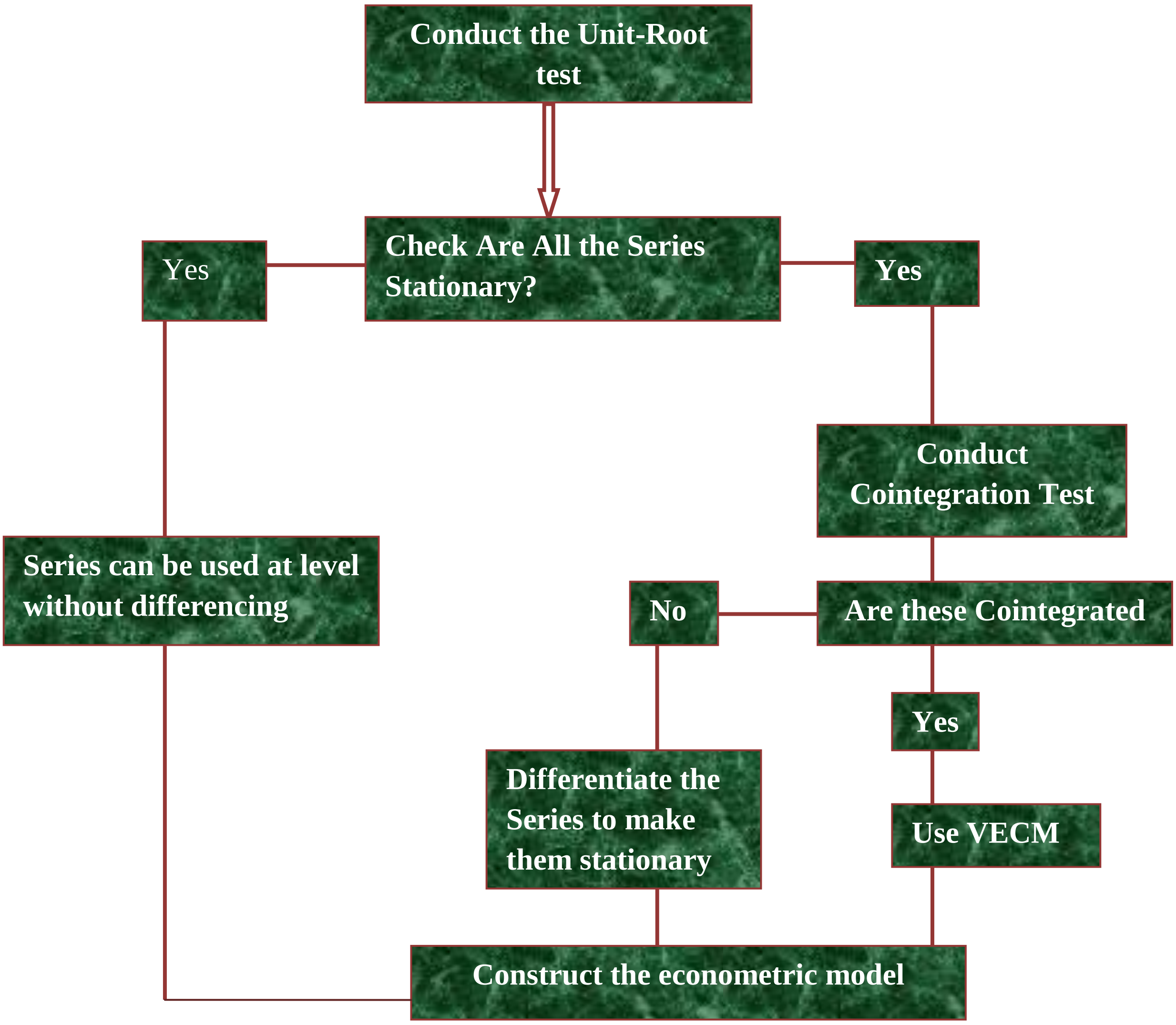
For the purpose of testing the effect of economic variables on stock market return, the following techniques have been used:

- Unit Root Test
- Cointegration Test
- Vector Error Correction Model

In order to take the better understanding of econometric techniques, the following flow chart has been mentioned:

FLOW CHART 3.1

ECONOMETRIC STEPS



3.7.2.1 Unit Root Test:

The analysis of the relationship between macroeconomic variables and stock market return in this study was based on the time series data for the period 1 January 2001 to 31 December 2011. But the time series data have the problem that may not be stationary at level and non-stationary variable may give spurious results. In order to avoid that problem, first of all, stationary test of these variables have been conducted. For that purpose, Augmented Dickey- Fuller test (ADF-test) and Philips-Perron test (PP test) have been applied. The Augmented Dickey- Fuller test (ADF-test) is based on the assumption that the error term is statistically independent and have a constant variance. Due to the structural changes, there is a cause of non-stationary. From this test the existence of unit root among both of the variables can be checked. If the series are non-stationary, we will go for Unit-Root Testing. The simple process for testing by applying the Augmented Dickey-Fuller test is

$$y_t = \rho y_{t-1} + \varepsilon_t$$

$$\Longrightarrow y_t - y_{t-1} = \rho y_{t-1} - y_{t-1} + \varepsilon_t$$

$$\Longrightarrow \Delta y_t = (1-\rho) y_{t-1} + \varepsilon_t$$

$$\Longrightarrow \Delta y_t = \delta y_{t-1} + \varepsilon_t$$

In this we have to test if p is 1 or not

$$H_0 : \rho = 1$$
$$H_1 : \rho < 1$$

This process will be stationary if

$$\rho < 1$$

Moreover, this test in conducted by "augmenting" the preceding three equations by adding the lagged values of the dependent variable ΔY_t. The ADF test here consists of estimating the following regression: (Gujarati, porter & Gunasekar, p.800)

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-1} + \varepsilon_t$$

Where Y is the variable whose time series properties are examined, $\beta, \delta and \alpha$ are the coefficients to be estimated, and ε is the white-noise error term. The null hypothesis is $\delta = 0$, that is there is a unit root and the alternative hypothesis is that $\delta \prec 0$ that means the time series is stationary.

Dickey and Fuller presented three different equations. These are:

Y_t is random walk

$$\Delta Y_t = \delta Y_{t-1} + u_t$$

Y_t is random walk with drift

$$\Delta Y_t = \beta_1 + \delta Y_{t-1} + u_t$$

Y_t is random walk with drift around a stochastic trend

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + u_t$$

Phillips-Perron (PP) Test: The Phillips-Perron (PP) unit deals with serial correlation and heteroskedasticity in the errors. PP test is that it is free from parametric errors. Philips-Perron (PP) test allow the disturbance to be weakly dependent and heterogeneously distributed (Ahmed, 2008).

3.7.2.2 Cointegration Test: When we comprise the first difference of variable it is required to check the cointegration between dependent and independent variable to ascertain the true relationship. If both of the variables are stationary at same order, then cointegration test can be applied. Moreover, it is necessary for cointegration test that our variables should be non-stationary. The number of lag in the cointegration analysis was selected on the basis of the Akaike Information Criteria.

Johansen(1988) suggested two statistics for testing expression viz. the trace statistic J_T and maximum eigen value statistic $\lambda_{\max}$ (Nachane 2006, pp. 795) .

$$J_T = -T \sum_{i=r+1}^{N} In\left(1 - \hat{\lambda}\right)$$

$$\lambda_{\max} = -TIn\left(1 - \hat{\lambda}_{r+1}\right)$$

Where T is the effective number of observations

The two statistics are designed to cover two distinct hypothesis testing scenarios. For the trace statistics J_T the null hypothesis is:

H_0: at most r cointegrating vectors

against the alternative hypothesis

H_1: more than r cointegrating vectors.

For the maximal eigen value statistics $\lambda_{\max}$ the null hypothesis is

H_0: exactly r cointegrating vectors

and the alternative hypothesis is

H_1: exactly (r+1) cointegrating vectors

One of the important thing is that to maintain cointegration, ECM (Error Correction Model) is must. This is a theoretical Model. Error Correction Mechanism is responsive for

$$X = I(1)$$
$$Y = I(1)$$

If X and Y are not stationary, they integrated in the same order. Moreover,

$$y = \alpha + \beta x_t + \mu_t$$

Cointegration Equation and Spurious Equation Conditions:

μ_t If this has residuals so the equation would be cointegrated.

μ_t If this is non-stationary so the equation would be spurious.

Equation is spurious or cointegrated, it depends upon μ_t

$$\Delta y_t = \theta_1 \mu_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \Delta x$$
$$\Delta x_t = \theta_2 \mu_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \Delta y$$

There is a need of one response. It is key concept in this model.

3.7.2.3 Vector Error Correction Model (VECM): In the study Error correction Model is useful for explaining the short run relationships between both of the variables. Vector Error Correction Model was used in this study to verify the short run relationship. The Error Correction Model equations as follows:

$$\Delta Y_t = \delta + \prod Y_{t-1} + \sum_{i=1}^{p-1} \phi_i^* \Delta Y_{t-1} + \varepsilon_t$$

$\prod Y_{t-1}$ is called the error correction term.

The ECM provides a short term analysis of dynamic correlations, quite distinct from the first stage of cointegration analysis, where we seek cointegrating relationships between integrated variables, each one corresponding to different long term equilibrium (Alexander, 2008)

3.8 Software Used for Data Analysis: The Microsoft Office Excel, SPSS 17 version, E-VIEWS, STATA is used as a software program for the analysis of the data.

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