Chapter 3

Research Methodology

3. Research Methodology 58-69

3.1 Objectives of the Study 58

3.2 Hypothesis for the study 59

3.3 Population and sample 61

3.4 Time Period 61

3.5 Data Variables & Data Sources 61

  3.5.1 Stock Market 61

  3.5.2 Macroeconomic Indicators 62

3.6 Statistical tools & Techniques 63

3.7 Limitations of the Study 68
3. Research Methodology

3.1 Objectives of the Study: Keeping into consideration the need of the study, various objectives of the study are:

1. To track the trends in the growth and volatility in Indian Stock markets.
2. To examine whether the rise in Sensex is supported by fundamentals (increasing operating profits) or is it just an asset price bubble?
3. To identify the macroeconomic factors those have a significant bearing in the stock market valuations.
4. To study the growth in the FII inflows in India and find the co-relation between these inflows and the stock market movements, so as to understand the benefits and detriments, the FII’s bring upon the Indian stock markets.
5. To investigate whether it is possible to determine the stock market by various macroeconomic factors cumulatively?
6. To investigate if there are any other factors which lead to fluctuations in the market?
7. To predict what lays ahead for the stock Market in India.
3.2 Hypothesis for the study:

Null hypothesis

1. $H_0$: There is absolutely no co-relation between the increasing profitability of the underlying BSE-30’s firms and the rise in Sensex and the present surge in the Sensex is a mere asset price bubble.

2. $H_0$: There is no significant bearing of the **Broad Money Supply** on the Sensex; and thus movements of the stock market Index are independent of the impact of the money supply.

3. $H_0$: There is no significant bearing of the **Interest Rates** on the P/E Valuations of the Sensex; and thus movements of the stock market Index are independent of the impact of interest rates.

4. $H_0$: There is no significant bearing of the **Inflation** on the P/E Valuations in the stock markets; and thus movements of the stock market Index are independent of the impact of rising prices.

5. $H_0$: There is no significant bearing of the **Exchange Rate** on the activities of the stock markets; and thus movements of the stock market Index are independent of the impact of the rupee dollar fluctuations.

6. $H_0$: There is no significant bearing of the **Oil Prices** on the activities of the stock markets; and thus movements of the stock market Index are independent of the impact of this variable.

7. $H_0$: There is no significant bearing of the **Index of Industrial Production** on the activities of the stock markets; and thus movements of the stock market Index are independent of the impact of this variable.

8. $H_0$: There is no significant bearing of the **Gross Domestic Product** on the activities of the stock markets; and thus movements of the stock market Index are independent of the impact of this variable.
9. $H_0$: There is no significant bearing of the **Foreign Institutional Investors** on the activities of the stock markets; and thus movements of the stock market are independent of the FII investments.

10. $H_0$: There is no significant bearing of these cumulative **Macroeconomic variables** on the activities of the stock markets; and thus it goes by Efficient Market Hypothesis.

**Alternate hypothesis:**

1. $H_a$: There is a very significant co-relation between operating profits of the BSE-Sensex firms and the rise in Sensex.

2. $H_a$: There is a significant bearing of the **Broad Money Supply** on the activities of the stock markets; and the movements of the Stock Market Index are very much dependent of the impact of money supply.

3. $H_a$: There is very significant bearing of the **Interest Rates** on the activities of the stock markets; and the stock market valuations are affected by interest rate changes.

4. $H_a$: There is a very significant relationship between inflation and P/E valuations and the later is effected by rising prices.

5. $H_a$: There is a very significant bearing of the **Exchange Rate** fluctuations on the activities of the stock markets.

6. $H_a$: There is a very significant effect of the **Oil Prices** on the activities of the stock markets.

7. $H_a$: There is a very significant effect of the **IIP Output results** on the activities of the stock markets and the later responds to it very vigorously.

8. $H_a$: There is a very significant bearing of the **Gross Domestic Product** on the activities of the stock markets.
9. \( H_a: \) There is a very significant bearing of the Foreign Institutional Investors on the behaviour of the Sensex.

10. \( H_a: \) There is a very significant bearing of the cumulative Macroeconomic variables on the Sensex.

3.3 Population and sample: The population for the study is the entire corporate sector in India. However, for the purpose of the study, the data has been collected for BSE-30 companies. The sample is so chosen because these companies’ accounts for a substantial share in corporate business sector in India in terms of market capitalization, turnover, growth, profitability etc. And besides this, Sensex is also looked upon as the barometer of the Indian economy by investors all over the world.

3.4 Time Period: Initially the time period was to be covered for ten years starting 2004 to 2013. But the changes and the developments has been so frequent in Indian stock market, that the time period has been revised to include 2014 in order to make the findings more contemporary and relevant to the present scenario.

3.5 Data Variables & Data Sources: Various data variables under study are:

3.5.1 Stock Market: Data variables considered for stock market valuations are index values for the BSE- Sensex, Sensex P/E, and Market Capatilization. The work studies the values of the scripts which were listed in both the exchanges representing BSE and NSE, since January 2004 to June 2014, which has been collected from Centre for Monitoring Indian Economy’s database, RBI database, www.worldbank.org.in, research journals and the BSE site.
3.5.2 **Macroeconomic Indicators:** Since our aim is to study the causal relationship between Stock market valuations and various macroeconomic variables, it was imperative to identify various factors for the analysis. After thorough review of literature and tracking the sensitivity of the Sensex to various news items, nine factors were considered for the research purpose, i.e. 1) Broad Money Supply, 2) Exchange rates, 3) Oil prices, 4) Inflation as a measure of WPI, 5) Inflation as a measure of CPI, 6) Gross Domestic Product, 7) Index of Industrial Production, 8) Interest rates and 9) Foreign Institutional Investments, for the time period i.e. January 2004 to June 2014, using the monthly time series data. So the monthly data of Sensex, P/E and market capitalization has been used as the dependent variable, as per the need of the study and various identified macroeconomic factors have been taken as independent variables.

In order to test the first hypothesis, the average annual Market Price of the BSE – 30 firms have been taken from database of CMIE – Prowess. To test the other nine hypothesis, data on the monthly statistics of Broad money supply (in Rs. Billion), exchange rates (Rs./$), oil prices (Crude oil (Dubai Fateh 32) $/Barrel), Foreign Institutional investors (Rs. Billion, net investment on BSE) has been extracted from the CMIE’s database on Indian Economy – Business Beacon. To account for Inflation, data has been collected using both, the wholesale price Index and consumer price Index with a base year of 2004-05 and 1984-85 respectively. The data on IIP has also been taken from Business Beacon with a base year of 2004-05. Since it’s difficult to find any benchmark interest rate for the entire time period under study, we have taken the monthly data for CRR for the reasons discussed later in the study. GDP which, reflects the industrial and services growth in India and is used as the proxy for national output, is taken at factor cost base year 2004-05 so as to make the figures comparable to that of the market capitalization.
3.6 **Statistical tools & Techniques:** During the review of literature it has been observed that the relationship between the variables can be studied by the regression analysis and thus based on the literature, data in this study is analysed with the help of Correlation, Regression tests. In order to analyse the data, MS-Excel and E-Views7 software package of statistical analysis have been used. For drawing line graph and running regression analysis for each macroeconomic factor with Sensex, Data analysis option in MS-Excel has been used.

**Standard deviation** is a measure of how widely values are dispersed from the average value (the mean). The formula used to calculate standard deviation is

\[ \sqrt{\frac{n}{n-1} \sum x^2 - \left( \frac{\sum x}{n} \right)^2} \]

**Skewness** characterizes the degree of asymmetry of a distribution around its mean. Positive skew ness indicates a distribution with an asymmetric tail extending toward more positive values. Negative skew ness indicates a distribution with an asymmetric tail extending toward more negative values.

The equation for skew ness is defined as:

\[ \frac{n}{(n-1)(n-2)} \sum \left( \frac{x_j - \bar{x}}{s} \right)^3 \]

**Kurtosis** characterizes the relative peaked ness or flatness of a distribution compared with the normal distribution. Positive kurtosis indicates a relatively peaked distribution. Negative kurtosis indicates a relatively flat distribution. Kurtosis is defined as :

\[ \left\{ \frac{n(n+1)}{(n-1)(n-2)(n-3)} \sum \left( \frac{x_j - \bar{x}}{s} \right)^4 \right\} - \frac{3(n-1)^2}{(n-2)(n-3)} \]

where: \( s \) is the sample standard deviation.
In order to run multiple regression for all the macroeconomic factors taken together, E-Views multiple backward regression approach has been used in which all variables are included on the first step and on following steps insignificant variables are removed one by one on the basis of least t-values. In order to test the hypothesis in the study, f-text has been used.

**Correlation** The correlation between the two variables can be calculated by using the following formulae

\[
\text{Correlation (r)} = \frac{\text{Cov (xy)}}{(\sigma_x \sigma_y)}
\]

Where : \(x=\) variable 1 and \(y=\) variable 2

\[
\begin{align*}
 r_{xy} &= \frac{\sum_{i=1}^{n} (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n} (x_i - \bar{x})^2} \sqrt{\sum_{i=1}^{n} (y_i - \bar{y})^2}} \\
\end{align*}
\]

Where : \(u=x-\bar{x}\) and \(y-\bar{y}\)

\(\bar{x}\) = mean of \(x\) series ; \(\bar{y}\) = mean of \(y\) series

**Regression Analysis** Regression analysis is concerned with the study of the dependent of one variable, the dependent variable, on one or more other variables, the explanatory variables, with a view to estimate or predicting the population mean or average value of the terms of known or fixed values of the latter. The simple form of regression model is two variable model but in this study we will also be using multiple regression analysis with one dependent variable and more than one explanatory variable. The regression analysis is used in Chapter IV for developing the model for determinants of Sensex. The model developed for the determinants of Sensex thus are selected on the basis of summery statistics mentioned above.
Summary Statistics R-square is known as the (sample) coefficient of determinant and the most commonly used measurement of goodness of fit. The R-square ($R^2$) statistic measures the success of the regression in predicting the values of the dependent variable within the sample. In standard setting, it may be interpreted as the fraction of the variance of the dependent variable explained by the independent variables. The statistics will be equal one if the regression fits perfectly, and zero if it fits no better than the simple mean of the dependent variable. It is a non-negative quantity. It can be noted that $R^2$ cannot fall when more variables are added to the model but adding more increases the variance of forecast error. It can be calculated by using the following formulae.

$$R^2 = 1 - \frac{RSS}{TSS}$$

Where RSS is residual sum of squares; TSS is total sum of squares

Adjusted R Square As a penalty for adding regressors to increase the $R^2$ value, Henery Tiel developed the adjusted $R^2$ denoted by adj $R^2$. It can be calculated as

$$\text{Adj}R^2 = 1-(1-R^2) \frac{n-1}{n-k}$$

Where n-no of observation and K is no of regression including intercept.

The adjusted $R^2$ is never larger than the $R^2$, can decrease as you add regressors, and for poorly fitting models, may be negative. For comparative purpose adjusted $R^2$ is better measure than $R^2$ but the regress and must be the same for the comparison to be valid. In Chapter IV the $R^2$ and adjusted $R^2$ is used to analyse the data.
**F-Statistics** The f-test is the measure of the overall significance of the estimated regression. The F-statistics reported in the regression output is from a test of the hypothesis that all of the slope coefficient (excluding the constant, or intercept) in a regression are zero. For ordinary least square models, the F-statistics is computed as: \( \frac{ESS/K-1}{ESS/n-k} \)

It follows the F-distribution with \( k-1 \) and \( n-k \) degrees of freedom. Under the null hypothesis with normally distributed errors, this statistics has an F-distribution with numerator degrees of freedom and denominator degrees of freedom. If the p value is less than the significant level you are testing say at 0.05, you reject the null hypothesis that all slope coefficient are equal to zero. Note that the F-test is a joint test so that even if all the t statistics are insignificant, the F-statistics can be highly significant. The F-value exceeds the critical F-value at the chosen level of significance, the null hypothesis is rejected, and the alternate hypothesis is accepted. T-test has been used and the p-values have been taken to support the conclusions drawn from the results of regression analysis.

![Diagram showing Rejection Region and Acceptance Region](image-url)
**Durbin Watson Test** The most celebrated test for detecting autocorrelation is the development by statistician Durbin and Watson. It is popularly known as the Durbin Watson d statistics, which is defined as

\[
d = \frac{\sum_{t=2}^{T} (e_t - e_{t-1})^2}{\sum_{t=1}^{T} e_t^2},
\]

We have the following criteria:

<table>
<thead>
<tr>
<th>DW</th>
<th>&lt;2</th>
<th>2</th>
<th>&gt;2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decision</td>
<td>Positive Serial Correlation</td>
<td>NO serial correlation</td>
<td>Negative Serial Correlation</td>
</tr>
</tbody>
</table>

This is simply the ratio of the sum of squared differences in successive residuals to the Residuals Sum of Squares. Note that in the numerator the d statistics the number of observations is n-1 because one observation is lost in taking successive difference.

A great advantage of the d statistics is that it is based on the estimated residual, which are routinely computed in the regression analysis. Because of their advantage it is now a common practice to report the Durbin Watson d statistics along with other summary measures, such as $R^2$, t, and F. The limits of d are 0 and 4. These are bound of d; any estimated value must lie within these limits. Therefore, as a rule of thumb, if d is found to be 2 in an application, one may assume that there is no first order autocorrelation, either positive or negative. If d is found to be zero in application it indicates perfect positive autocorrelation. Hence the closer d is to 4 the greater evidence of negative serial correlation. In Chapter IV Analysis and Discussion the Durbin-Watson for determinants has supportive value which is good for a no of autocorrelation point of view.
3.7 Limitations of the Study: Various limitations of the study can be enumerated in the following points:

1. Herd mentality, feel good factor and human emotions, in general affect the decisions pertaining to stock market investment, but are difficult to quantify. This study ignores the behavioural finance aspect of this decision-making and assumes that the investment decisions are made on the basis of either news pertaining to company, industry or economy.

2. Since 2002 especially, Indian stock market has come to characterise more of integration with the world markets and thus are affected by the global macroeconomic factors. This study does not track this association and depends upon purely the domestic macroeconomic indicators to determine the behaviour of the stock prices.

3. Entire financial market works in a system which has a networking within various sub-systems that exist. Practically, it is impossible to segregate the effect of one sub-system of others. This study makes an assumption that it is possible to study the effect of each variable by keeping the status paribus for the other factors.

4. Due to technological innovation and organized markets; such as BSE and NSE, information is now relatively cheap to obtain and process; and that too especially about the chosen macroeconomic variables. Because of this informational efficiency, no investor can reap abnormal profits, since the market prices reflect not only the presently available information, but it also discounts the future news.

And since the present study is using monthly time series data, it becomes all the more difficult for the market players to play on the
informational inefficiency or to forecast the stock market behaviour. Further the study assumes that it is not possible to make use of the historical data to ‘forecast’ stock market; so the chosen variables can, at the most act as coincidental indicators and cannot be leading the stock market behaviour.