Chapter 1

INTRODUCTION

1.1 Introduction

The fixed income securities offer one of the most attractive investment opportunities with regard to safety of investments, adequate quality, flexibility in structuring a portfolio, easy monitoring, long-term reliability and decent returns. The debt market is critical to the development of any economy, and more so in the case of developing countries like India, which need to employ a large amount of capital and resources for achieving industrial and financial growth. The debt markets in most of the developed countries are often many times bigger than the other financial markets including the equities market. The Indian debt market is facing an era of unprecedented transition with strong forces of change, which would prepare it to a leading position among the Asian financial markets.

A liquid and active corporate debt market can assist the industrial growth of the nation and remove the pressure on institutional financing. The Indian debt market is growing in leaps and bounds for attaining global stands of safety, efficiency and transparency. The growth and size of debt market is complementary to an equity market development. The debt capital cannot grow beyond a limit without the support of equity capital, due to constraints on leverage. The equity alone cannot meet the demands of investor preferences. Debt is a contractual obligation, which requires to be met irrespective of the performance of the entity or borrower, who is using the fund. This feature of the debt causes a vulnerable impact on the instrument informing a risk called 'credit risk'. It is the oldest form of risk in the financial market. It is also called default risk. This risk refers to the risk that the issuer of a fixed income security will be unable to make timely principal and/or interest payment on the instrument. The credit risk is a low probability-high impact risk. The credit rating is the most widespread indicator of credit risk.
Since financial liberalisation, the Indian economy is heading towards a market economy in which market forces play a dominant role. The serious balance of payment crisis resulting in downgrading of the Indian economy below the investment grade in the international market prompted the government to lure the Non Resident Indians (NRI) to invest in India. As more and more NRIs and foreign companies have investments in India, they seek more information about the corporate sector. This situation offered enough opportunities in setting up of credit rating agencies and widened the scope of existing credit rating agencies in India. The rating has not been made compulsory in India for companies going public. It is only for debt instruments i.e., debentures, certificate of deposits and money market instruments like commercial paper for which rating is obligatory under the recent guidelines issued in this regard. Ravi Mohan (2000) states that the consistent deterioration of the quality of earnings of corporate, and shift in benchmarks and criteria of credit rating agencies also contributed to the increased activity of credit rating in India. Credit rating, by making information widely available at a low cost, have radically increased the Indian market's efficiency.

Indian credit rating agencies have, within a short period of time, established a high degree of credibility, unmatched in any other developing economy. The rating business has received a new lease of life lately because of (i) continuing soft interest rate regime which has spurred debt market issues, (ii) growing merger and acquisition activity, (iii) picking up of dis-investments, and (iv) the growing capital market and move of corporate sector from debt-age to free-market-finance age. The credit rating agencies produce expertise that allows investors to better estimate the risk involved in their investment decision. Any study on credit rating is a promising area of research as its influence has increased in the governance of financial markets.
1.2 Problem Overview

The borrowing company issues the freely tradeable debt instruments. The buyer of the debt instrument has to make an assessment on credit worthiness of the issuing company, based on its financial statements (balance sheet and income statement) and on expectations of future business performance for investment decisions. Most buyers of debt instruments do not have the resources to perform this type of difficult and time-consuming research. Fortunately, so-called credit rating agencies exist who specialize in assessing the credit worthiness of a company. The resulting credit rating is a measure for the risk of the company not being able to pay an interest payment or redemption of its issued debt instrument. The rating agencies claim that the issued ratings are based on (i) a quantitative analysis of the financial statements of a company and (ii) a qualitative analysis of the company and its operational environment. The quantitative factors include the profitability, liquidity and outstanding debt of the company. The skill of management and economic expectations of the company are the qualitative factors.

The credit rating process is said to be a black box. The rating agencies closely guard their rating process, they merely state that financial and qualitative factors are taken into account when assigning ratings to companies. This study tries to open this black box by exploring the relationship between the financial variables (variables from financial statements) of a company and its assigned rating. This study might enable to say how much of a company's rating is affected by the analysis performed by the rating agencies using financial statements. The default prediction has been a subject of study for a long period. The accurate prediction of default is important to investors and creditors. The credit rating agencies, which rate the default probability, explain that the data from corporate financial reports are evaluated for rating assignments. This study examines the relationship.

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1Credit ratings are letter values on an ordinal scale, giving an opinion of credit worthiness of the issuer of a debt instrument
between financial variables and credit ratings using univariate and multivariate quantitative techniques. The study of relationship between financial variables and credit rating, in other words, means a measure for financial information content in credit rating. The study also tries to assess the feasibility of classifying companies in rating classes using only financial statement data. The study is carried out with the expectation that the credit rating, which is a partial outcome of the financial statement of the corporate, should show a response for the negative bottom lines, poor liquidity, and negative net parsimony. The financial statements of a company are an important source of information that is available to the public. If it can be proved that the ratings given by the rating agencies and certain financial ratios are closely associated, then these ratios can be used in predicting rating and to build a credit rating model.

1.3 Debenture

Debenture is a long term instrument. It is a loan from one entity to the other. The entity that receives the loan is called the obligor or issuer. The loan itself is called a debenture obligation or issue. Debentures belong to the group of fixed-income instruments, because the issuer periodically pays a fixed amount to the buyer of the debenture. Debentures differ from equity in which buyers of debenture do not become owners of the company. When a company goes into bankruptcy, the owner of the debenture is in a better position than the shareholder because first all the loans are redeemed, and from which is left the owners are paid. Each debenture has certain characteristics which fully describe the debenture. The debenture has to be redeemed on a fixed date called the maturity date. Each period (annually) a certain amount of interest has to be paid. The value of a debenture depends largely on the interest percentage and current market interest rate. If the market interest rate rises, then the value of the debenture lowers. The interest percentage is fixed, and investors would rather buy a new debenture with current market interest rate. If the market interest rate declines, then the value of the debenture rises. Another factor influencing the value of the
debenture is the default risk associated with the debenture. When an issuer is unable to pay back a debenture, it is said that the issuer has 'defaulted' on the debenture. This does not necessarily mean that the issuer has gone bankrupt. A missed or delayed interest payment also counts as a default, on settling the payment he is said to be 'recovered'.

1.4 Debenture Ratings

The debenture ratings are letter values on an ordinal scale, giving an opinion of credit worthiness of the issuer of a debenture. The Indian rating agencies rate the debenture under the long term segment. This study focuses only CRISIL's debenture rating. A low rating corresponds to high default risk and a high rating corresponds to a low default risk. The rating 'D' indicates an actual default on the debenture. The scale is more refined by appending '+' or '-' to the letter ratings, indicating a slightly better or slightly worse rating respectively. The debenture ratings are frequently reviewed depending on the actual performance of the company and particularly on the performance of the programme on which the ratings are issued. The changed ratings are periodically published to the market participants through the press releases.

1.5 Investment Grade and Speculative Grade Ratings

Credits with an assigned rating from AAA to BBB- are known as investment grade credits and credits rated below BBB- are called speculative grade credits or high yield issues. The speculative grade credits provide interesting investment opportunities. In certain occasions the fund managers are restricted to purchase investment grade issues, to avoid speculative investments. However, the absolute default rates do not remain stable over a long period.
1.6 Objectives of the Study

The study is carried out with the following specific objectives

(i) To evaluate the financial information content in credit rating by investigating the existing relationship between the credit rating and financial variables

(ii) To identify and examine the fact that the past and present financial performance of the firms are considered in credit rating assignments

(iii) To study the quality of credit rating by testing whether ratings incorporate efficiently the publicly available information at the time of rating

(iv) To explore the important financial variables that forms the basis for rating classification

(v) To measure the industrial effect on credit rating classification

(vi) To test whether credit rating agency is effectively exercising its due diligence in properly checking relevant information before assigning a credit rating

1.7 Scope of the Study

The study highlights the importance of financial statements in credit rating assignments by examining the relationship between credit rating and financial variables. The outcome of the study might be used for credit score modeling as a proxy to credit rating agencies' ratings. This study can provide a base for similar studies with reference to other agencies in the Indian and international market. As the credit rating sector in India is in infancy, any study in this area could provide valuable information to the market. The identified key financial variables could provide knowledge to the issuer for preparing himself for a better rating. The results of this study would improve the confidence of the investors towards the credit rating agencies.
1.8 Study Period

The study covers a period of 6 years\(^2\) starting from 1996-97 to 2001-02. This moderate period is selected for the study as (i) the credit rating is hardly a decade old in India, (ii) the credit rating was most actively known and used in the market only since 1995, and (iii) this period is normal without any serious (systematic) economic events.

1.9 Sample Selection

The common problem faced in sample selection is the complex nature of large amount of data. The universe contains a large number of companies, and for each company many financial characteristics are available. As a solution to this complexity, the population for the study is defined to be the group of firms which had at least a CRISIL’s debenture rating (long term rating) during the study period and a specified asset size. The sample is a group of manufacturing firms chosen on a stratified random basis from the defined population. The firms were stratified by industry (as per CRISIL’s industry wise classification of firms). Under stratified random sampling the population is divided into several sub-populations that are individually more homogeneous than the total population (different sub-populations are called strata). The items from each stratum are randomly selected to constitute a sample. The degree of homogeneity in terms of sectoral differences and scale size was given importance by selecting only manufacturing firms for the study. This type of sample selection would avoid major differences in financial statement structure of the firms from different industries.

The asset size range of the selected sample was restricted between Rs 100 crores and Rs. 2000 crores. The asset size was defined to be the average asset size for the study period. The asset size of certain selected

\(^2\)A longer study period means a larger sample and a sound model but a too long study period could also obscure some relationship in the data because of changed environment for companies and changed measure for extending ratings to companies.
firms were slightly greater/lower than that of specified limit, as it was felt that matching of exact size of the firm was unnecessary. The asset size group of sampling was used to eliminate size effect and to provide a fair comparison across the firms. The proportional selection of sample companies under each industry was followed with the population proportionality. The study covers a sample of 103 companies dispersed into different industries with a total of 600 observations (firm years) for the study period. Table 1.1 exhibits the structure of population and samples used in this study. The certain closely related industries were merged together to be called as one industry (eg, the automobiles and auto ancillaries are collectively called as automobiles), for the purpose of avoiding confused groupings and to have a simplified stratum.

Each observation consists of the rating, 39 explanatory variables, and sector details. Except few companies almost all the companies had observation for almost all the years. The almost all the companies with many debenture issues had same rating for all its issues. Only a single observation was taken for the companies for every year irrespective of the number of issues made by the company. For example, if company 'X' had four debenture issues, and if all these four issues had an outstanding rating of 'AA' as on 31st March 2002, then, only one observation of credit rating is taken for rating of the company 'X' as 'AA' representing the company for the year 2002. The same company may have few more observations to represent different years. Since there was no difference in the ratings for the debenture issues made by the same company, selecting each issue to be an observation for a company would cause autocorrelation disturbances within the data.

1.10 Data Collection

The study has taken a dataset consisting of information on ratings as well as a set of financial variables (financial performance indicators) from 1995-2002. The study considers the data selected from various published
Table 1.1
Details of Defined Population and Selected Sample

<table>
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<th>Defined Population**</th>
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<th>Selected Sample</th>
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<td>No. of Firms</td>
<td>%</td>
<td>No. of Firms</td>
<td>%</td>
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<td>2</td>
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</table>

** The units in the population are subject to debenture rating availability during the study period and having asset size within the specified limit.
secondary sources. The two types of data used are financial data and credit ratings data. The study uses a major group of financial ratios computed from the financial statements along with few absolute variables. The financial ratios and absolute variables are collectively referred as, 'financial variables' throughout this report.

The financial data for the study were derived from financial statements of the year ending annual reports. The financial statement data used for analysis were drawn from CMIE (Centre for Monitoring Indian Economy) electronic database (prowess) and also form select published annual reports. The study considers only yearly data because (i) the customers in India are more aware to the annual reports of the firms than the interim reports of the firms, (ii) non availability of interim reports for the historical period of the study, and (iii) to avoid autocorrelation disturbances caused by using quarterly or half yearly data in the application of statistical models. The certain firms showed financial statements on the date other than 31st March. Such firms’ financial statements details were adjusted to form a fair position as on 31st March. The relevant credit ratings data were collected from the CRISIL's Rating Scans (a published source of credit rating information) from March 1997 to March 2002. The debenture rating outstanding as on 31st March of every year during the study period was considered for the study. This rating as on 31st March can provide a genuine comparison with that of financial statements data outstanding as on 31st March.

There are three major credit ratings agencies (i) CRISIL (Credit Rating and Investment Services of India Limited), (ii) ICRA (formerly called Investment Information and Credit Rating Agency of India Ltd), and (iii) CARE (Credit Analysis & Research Ltd) in the Indian credit rating sector. These three agencies account for more than 90% of the business. Among these three agencies CRISIL (incorporated in 1987) is the oldest rating agency covering a wider market. The credit rating of CRISIL which act as a benchmark for major analysis in the Indian market is taken for this study.
This study uses CRISIL ratings than any other agency's rating because the studies by Raghunathan and Varma (1992) and Chaudhury (1999) explains that CRISIL ratings are better compared to the ratings given by ICRA and CARE as per the two criteria of evaluation namely, international comparability and internal consistency. The study uses only debenture ratings (all types of debentures) to avoid inconsistency arising from different types of issues. Though this study considers only debenture rating, in this report it's generally referred as 'credit rating', instead of debenture rating.

1.11 Statistical Models
1.11.1 Two Sample t Test

The two sample t test is the technique of comparing the frequency distributions of a variable for two samples based on samples from two groups. The variable will be of measurement type. It requires a normal frequency distribution. It also assumes that the population standard deviations are equal. It is computed using the equation,

\[ t = (\bar{X}_1 - \bar{X}_2) / (S_p \sqrt{(1/n_1 + 1/n_2)}) \]

where \(\bar{X}_1\) and \(\bar{X}_2\) are the sample means, \(S_p\) is the pooled standard deviation, and \(n_1\) and \(n_2\) are the number of items in the samples.

1.11.2 Kruskal-Wallis Test

This test is used to test the null hypothesis that \(k\) independent random samples come from identical universes against the alternative hypothesis that the means of these universes are not equal. This test is analogous to the one-way analysis of variance, but unlike the latter, it does not require the assumption that the samples come from approximately normal populations or the universes having the same standard deviation. In this test, the data are ranked jointly from low to high or high to low as if they constituted a single sample. The test statistics is \(H\) for this test which is worked out as under.
where \( n = n_1 + n_2 + \ldots + n_k \) and \( R_i \), being the sum of the ranks assigned to the \( i^{th} \) sample, The sample distribution of \( H \) can be approximated with a chi-square distribution with \((k-1)\) degrees of freedom.

### 1.1.1.3 ANOVA

It is an essential technique for testing the difference among different groups of data for homogeneity. It is a method of analysing the variance to which a response is subject to its various components corresponding to various sources of variation. Through this technique one can, in general, investigate any number of factors, which are hypothesized or said to influence the dependent variable. The basic principle of ANOVA is to test for differences among the means of the populations by examining the amount of variation within each of these samples, relative to the amount of variation between samples. The ANOVA technique assumes a normally distributed observation. When the observation is not normally distributed, the observations are transformed and ANOVA is applied on this transformed data.

In one-way ANOVA, only one factor is considered and several possible types of samples (group) can occur within that factor. The differences within that factor are determined. The computation involves the following steps:

- Obtaining mean of each sample (group): \( \bar{x}_1, \bar{x}_2, \ldots, \bar{x}_k \)

where \( k \) is the number of samples.

- Obtaining mean of sample means: \( \bar{\bar{x}} = (\bar{x}_1 + \bar{x}_2 + \ldots + \bar{x}_k) / k \)

- Calculating sum of squares for variance between the samples (SS) between...
\[ SS \text{ between} = n_1 (\bar{X}_1 - \bar{X})^2 + n_2 (\bar{X}_2 - \bar{X})^2 + \ldots + n_k (\bar{X}_k - \bar{X})^2 \]

The mean square (MS) between samples are obtained
\[ MS \text{ between} = SS \text{ between} / (k-1) \]

obtaining the deviations of the values of the sample items for all the samples from corresponding means of the samples and computing the squares of such deviations and obtaining their total. This total is known as the sum of squares for variance within samples, (SS within) symbolically this can be as
\[ SS \text{ within} = \sum (X_1 - \bar{X})^2 + \sum (X_2 - \bar{X})^2 + \ldots + \sum (X_k - \bar{X})^2 \]

obtaining the variance or mean square (MS) within the samples
\[ MS \text{ within} = SS \text{ within} / (n-k) \]

where \((n-k)\) represents degree of freedom within samples,
\(F\) ratio is computed, \(F = MS \text{ between} / MS \text{ within}\)

1.11.4 Spearman’s Rank Correlation

The Spearman’s rank correlation is a non-parametric technique used for determining the degree of correlation between two variables in case of ordinal data, where ranks are given to the different values of the variables. The main objective of this coefficient is to determine the extent to which the two sets of ranking are similar or dissimilar. For computing rank correlation coefficient, all the actual observations are replaced by their ranks, giving rank 1 to the highest value, rank 2 to the next highest value and following this every order ranks are assigned for all values. If two or more values happen to be equal, then the average of the ranks which should have been assigned to such values had they been all different, is taken and the same rank (equal to the said average) is given to the concerned values. This coefficient is determined using the following equation
\[ r_s = 1 - \frac{6 \sum d_i^2}{n (n^2 - 1)} \]

Where \(d\) is the difference between ranks of \(i^{th}\) pair of the two variables and \(n\) is the number of pairs of observations. The value of Spearman’s rank correlation coefficient will always vary between ±1, +1 indicating a perfect
positive correlation and -1 indicating perfect negative correlation between two variables. All other values of correlation coefficient will show different degrees of correlation.

1.11.5 Factor Analysis

Factor Analysis is a diagnostic, interdependence statistical technique used for the purpose of data reduction and summarization. It involves a set of techniques designed to identify order and structure in such data by providing a parsimonious and meaningful explanation for the observed variation and co-variation in surface attributes. As a statistical technique it explores the common variation of a large number of variables, and from this variation creates a small set of new variables called factors\(^3\) or latent variables. This shared variation among variables arises when different variables respond similarly to the same phenomena, or when different variables constitute different aspects of the same phenomenon. The two principal techniques employed by factor analysis to obtain factor solutions are Common Factor Analysis (CFA) and Principal Component Analysis (PCA). The CFA uses only that variance which is shared among variables to determine a solution but where as PCA uses all available variance to calculate a factor solution.

Principal component method is employed to determine the minimum number of factors needed to account for the maximum amount of information. As variable independence is a requisite assumption for many predictive statistical techniques. It can be particularly valuable as a preliminary step to further analysis. It re-constitutes the auto correlated independent variable set into a set of truly independent new latent factors. The number of observations should be four to five times greater than the number of variables. Principal component method is also used for the identification of surrogate variables that loaded heavily on independent factors. These variables can be used as

\(^3\)Factor is a variable that appropriates the regression line between the variables.
proxy variables to measure same phenomena for further analysis. The further analysis using different statistical test can be done by employing the factor scores\(^4\) associated with each factor or by selecting a surrogate variable for each of the factor.

The orthogonal and oblique factor extraction are the two method of factor extraction used in a factor model. The orthogonal extraction is the appropriate method to obtain independent factors to be used in the statistical technique that requires high degrees of independence among the explanatory variables. Oblique extractions assume that the factors are correlated. The rotation in factor analysis is used to simplify the factor solution by increasing the independent variables on particular factors and reducing the number of factors on which each variable loads. Rotating the factor solution redistributes the variance from the first factor to subsequent factors to identify each of the factors more easily. The most popular rotational strategies are varimax, quartimax, and equimax. The varimax (variance maximizing) rotation maximizes the variance of the new latent variable, while minimizing the variance around the new latent variable. The factor loadings are correlation of variables with the factors on which they load. A factor must account for at least 10 percent of variables' variations before that variable can be used to interpret the factor. Thus factor loadings plus or minus 0.30 is considered weak and any loading equal to or above the absolute value of plus or minus 0.50 is considered strong. The lower factor loadings are permissible for larger sample sizes. The proportion of variance of particular item that is due to common factor is called communality.

1.11.6 Rank Transformed Regression

Rank transformed regression is the technique in which the values of each variable of a multivariate sample (independent & dependent variables) is replaced by its rank from 1 to n for all the observations. Conventional

\(^4\)Factor scorng is a estimated actual values of individual cases (observations) for the latent variables.
regression analysis is then performed on the ranks Independent rank transformed regression models and coefficients are developed as in the ordinary regression model. The multiple linear regression model is used to study the relationship between a dependent variable and several independent variables. The regression equation,

\[ y_i = \beta_1 x_{i1} + \beta_2 x_{i2} + \ldots + \beta_k x_{ik} + e_i \]

Where \( y \) is the dependent or explained variable, \( x_1, x_2, \ldots, x_k \) are the independent or explanatory variables (also known as regressors), and \( i \) indexes the \( n \) sample observations. The disturbance \( e \) is used to model external random influences that cannot be captured by the model. The coefficients of the independent variables (\( \beta_1, \beta_k \)) and the disturbance are most often estimated using the ordinary least square technique. The predictive adequacy of a set of beta weight is indicated by the size of the correlation coefficient between the predicted score and actual score. This special correlation coefficient is termed as multiple correlation coefficients (\( R \)). The squared multiple correlations (\( R^2 \)) represent the proportion of criterion variance accounted for by the explanatory variables.

1.11.7 Discriminant Analysis

This technique is used to classify the objects into one of two or more mutually exclusive and exhaustive group on the basis of a set of independent variables. Discriminant analysis requires interval (non-metric) independent variables and nominal dependent variable. The objective of discriminant analysis is to predict an object's likelihood of belonging to a particular group based on several independent variables. The discriminant analysis reveals which specific variables in the profile account for the largest proportion of inter-group differences. It is a simple scoring system that assigns a score to each individual or object. This score is a weighted average of the individual's numerical value of the independent variables. On the basis of this score the individual is assigned to the 'most likely' category. The model is represented as,

\[ z_i = \beta_0 + \beta_1 x_{i1} + \ldots + \beta_n x_{in} \]
Where \( x_i \) is the \( i^{th} \) individual's value of the \( j^{th} \) independent variable \( \beta_j \) is the discriminant coefficient of the \( j^{th} \) variable \( z_i \) is the \( i^{th} \) individual's discriminant score. The classification procedure in such case would be,

- If \( z_i > z_{cnt} \) classified as belonging to group I
- If \( z_i < z_{cnt} \) classified as belonging to group II

Where \( z_{cnt} \) is the critical value for the discriminant score

### 1.11.8 Binary Logistic Regression

The binary logistic regression is a method used to obtain a functional relationship between a transformation form of a qualitative variable called logit and \( p \) predictor variable, which can be either quantitative or qualitative (Hosmer and Lemeshow, 1989). It is used to develop a model which attempts to adjust the best and to be sufficiently reasonable to describe the relation between the result and the set of independent (explanatory) variables. The fundamental characteristics of this regression are that the dependent variable is dichotomous. Mathematically, the function used in logistic distribution is extremely flexible and easy to use.

Indicating the dichotomous variable to predict \( y \) and the \( p \) predictor variables by \( x_1, x_2, ..., x_p \). The objective is to determine the coefficients \( \beta_0, \beta_1, ..., \beta_p \) in order to satisfy the logit transformation formula,

\[
g(x) = \ln \left[ \frac{p(y=1)}{p(y=0)} \right] = \beta_0 + \beta_1 x_1 + \cdots + \beta_p x_p
\]

where \( \beta_0 \) is the intercept and \( \beta_1, \beta_2, ..., \beta_p \) are the parameters.

The logistic regression model is described by the following formula

\[
\Pi(x) = e^{g(x)} / 1 + e^{g(x)}
\]

The logistic regression model is a nonlinear model. It is more advantageous for statistical analysis as it is not affected by heteroskedasticity. It could yield values of 0 and 1, and it is consistent with random utility maximisation.

### 1.12 Limitations of the Study

This study is attempted extensively with utmost care, which resulted in very few limitations. In this study no step has been taken in incorporating the
quantitative variable in analysing the debenture ratings. The study has not made any difference between the type, maturity period and interest rate of the instrument. The study is limited to Indian manufacturing firms with CRISIL's debenture rating.

1.13 Scheme of the Report

The research report has been divided into six chapters including summary and findings. The first chapter gives an intense and clear picture about the need for the study, problem overview, importance of the study, limitations of the study, objectives of the study, methodology adopted indicating the sampling design, data source and statistical tools used for analysis, and the organization of the research report. The second chapter reviews the related past studies and presents a frame for this study. The third chapter focuses on the conceptual framework of credit rating, origin and growth of credit rating, role of international and Indian credit rating agencies, the challenges faced by this industry, and the opportunities for this in India. The fourth chapter theoretically explains the relationship between the financial variables and credit rating, which formed a basis for the empirical analysis of this study. The fifth chapter presents the procedure of empirical analysis, estimated results, explained interpretations, and the drawn inferences with a comparison to the designed objectives. The sixth chapter presents the summary of the report, findings and conclusion.

1.14 Chapter Summary

The rating agencies closely guard their rating process, they merely state that financial and qualitative factors are taken into account when assigning ratings to companies. This study tries to explore the relationship between the financial variables of a company and its assigned rating. The default prediction has been a subject of study for a long period. The accurate prediction of default is important to investors and creditors. The credit rating agencies, which rate the default probability explains that the data from corporate financial reports are evaluated for rating assignments. This study
examines the relationship between financial variables and credit ratings using univariate and multivariate quantitative techniques. The study also tries to assess the feasibility of classifying companies in rating classes using only financial statement data. The study is carried out with the expectation that the credit rating, which is a partial outcome of the financial statement of the corporate, should show a response for the negative bottom lines, poor liquidity, and negative net parsimony.

The study is carried out with the following specific objectives: (i) To evaluate the financial information content in credit rating by investigating the existing relationship between the credit rating and financial variables, (ii) To identify and examine the fact that the past and present financial performance of the firms are considered in credit rating assignments, (iii) To study the quality of credit rating by testing whether ratings incorporate efficiently the publicly available information at the time of rating, (iv) To explore the important financial variables that forms the basis for rating classification, (v) To measure the industrial effect on credit rating classification, and (vi) To test whether credit rating agency is effectively exercising its due diligence in properly checking relevant information before assigning a credit rating.

The study covers a period of 6 years starting from 1996-97 to 2001-02. The population for the study is defined to be the group of firms, which had at least a CRISIL's debenture rating (long term rating) during the study period. The sample is a group of manufacturing firms chosen on a stratified random basis from the defined population. The asset size range of the selected sample was restricted between Rs 100 crores and Rs 2000 crores. The study covers a sample of 103 companies dispersed into different industries with a total of 600 observations (firm years) for the study period. The financial data for the study were derived from financial statements of the year ending annual reports. The relevant credit ratings data were collected from the CRISIL's Rating Scans (a published source of credit rating information) from March 1997 to March 2002. The statistical model used in
the study includes (i) two sample t test, (ii) Kruskal-Wallis test, (iii) ANOVA, (iv) Spearman's rank correlation, (v) factor analysis, (vi) rank transformed regression, (vii) discriminant analysis, and (viii) binary logistic regression

References
Bailey, Kenneth D , 1978 Methods of social research New York
Hosmer, D W , Lemeshow, S , 1989 Applied logistic regression Willey Senes Probability and Mathematical statistics
Kothari, C R , 1990 Research methodology, methods & techniques Wishwa Prakashan, New Delhi
Raghunathan V Varma J R , 1992 “CRISIL rating when does AAA mean B?” Vikalpa, 17 (2), 35-45