CHAPTER 3. RESEARCH METHODOLOGY

3.1 Introduction

The main objective of this study is to develop a distress prediction model for listed manufacturing companies in India by identifying the financial ratios which are significant in predicting distress. Hence it is very important to use data from reliable sources and apply appropriate methods to develop the model. This Chapter discusses sample selection procedure, financial and macro-economic factors used as variables, sources of data, the definition of financial distress and the statistical techniques employed in the study.

3.2 Sample Selection

3.2.1 Definition of a financially distressed company

This study involves review of financial ratios of distressed and non-distressed manufacturing companies in India. Hence the first step in sample selection is to define financial distress so that the companies exhibiting the defined behavior can be classified as distressed companies. Financial distress in a company is a phenomenon exhibited through various signals. It has been defined by different researchers from different perspectives. Early studies have defined a financially distressed company as one which has filed for bankruptcy. [Beaver, (1966), Altman, (1968), Ohlson, (1980), Papoulias and Theodossiou, (1992), Coyne et al, (2008), Abad, (2007), Ganeshlingam and Kumar (2001), Pompe and Bilderbeek, (2005)]. Subsequent studies have included other factors along with bankruptcy to define financial distress. Jones and Hensher, (2004) have used failure to pay listing fees, loan default and bankruptcy as the determinants of financial distress. Grice and Dugan, (2001) have selected companies with ‘ccc’ bond rating and ‘lower b’ stock rating as financially distressed companies along with bankrupt companies. Li – Jen Ko et al, (2001) has used default rating along with bankruptcy as
criteria to select bankrupt companies. Mine et al, (2006) have selected bankrupt and default companies for their study. Companies with losses for 2 or more years and negative retained earnings have been identified by Poston Kay et al, (1994) as distressed companies. Various studies have also used continuous losses and negative cash flows as definition of financial distress. [Turetsky and McEwen, (2001), Xie et al, (2011), Mondal and Roy, (2013), Hui and Jing Jing, (2008), Lakshan and Wijekoon, (2013) , Whitaker Richard, (1999) , Murugan et al, (2001)]. Beneda Nancy, (2007) have selected companies whose market price has eroded by 95% within two years of IPO as distressed companies in her study.

Summarising, the following are the most commonly used definition of financial distress:

1. Bankrupt companies
2. Delisted companies
3. Companies defaulting on debt
4. Companies incurring continuous losses
5. Companies with negative or poor cash flows
6. Companies with low credit rating
7. Companies with negative net worth
8. Liquidated companies
9. Companies with debt restructuring
10. Companies consulting for turnaround

Equity investors are concerned with the company’s ability to generate, sustain and increase profitability, (Gerald et al, 2004). Profitability is the ability of a company to generate earnings. Net profits are an important measure of company’s performance. It is the ultimate test of efficiency of its operations and prudent management. It is a reflection of company’s response to business risks and financial risks. A company which reports net profits is able to generate revenue which can cover its operational and financial costs. Profitable companies have always been appreciated by capital markets and investors alike. A company’s inability to generate net profits signals that the company is not able to meet contractual obligations to its creditors and lenders. Continuous losses indicates company’s poor state of financial affairs and consequent
financial distress. A company reporting net losses will not be able to add value to their investor’s fund. Hence for this study, a company incurring net losses for 3 consecutive years have been defined as a financially distressed company. A non-distressed company is a company reporting profits for three consecutive years.

3.2.2 Selection of distressed companies

The study uses Capitaline Plus Database for selecting the distressed and non-distressed companies. This database is a Digital Corporate Database with financial information of more than 35000 listed, unlisted and subsidiary companies. The source data for this database is Annual reports / quarterly reports of companies. It provides information about the following aspects of a company:

General: History of the company, nature of its business, management team, promoters, stock exchange listing details etc.

Financial: Financial overview, Balance Sheet, Profit and Loss A/c, Cash flow statement, six monthly reports, quarterly reports etc.

Other information: Share prices, important announcements and news etc.

Hence comprehensive information about the company is available in this database. The procedure adopted for selection of distressed companies is explained in the following paragraphs:

(i) List of all manufacturing companies (‘Listed Manufacturing’ tag) reporting net losses for three consecutive years for the period 2005-06 to 2014-15 was obtained. The time period of 2005-06 to 2014-15 was divided into blocks of 3 years each. Thus 2006-2008 forms the first block of three years, 2007-2009 This list comprised of 2791 companies. Table 3.1 gives the number of distressed companies in each block of three years.

<table>
<thead>
<tr>
<th>TABLE 3.1 NUMBER OF DISTRESSED COMPANIES</th>
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<tbody>
<tr>
<td>(i) List of all manufacturing companies</td>
</tr>
<tr>
<td>‘Listed Manufacturing’ tag reporting net</td>
</tr>
<tr>
<td>losses for three consecutive years for</td>
</tr>
<tr>
<td>the period 2005-06 to 2014-15 was</td>
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<tr>
<td>obtained. The time period of 2005-06</td>
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<tr>
<td>to 2014-15 was divided into blocks of 3</td>
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<tr>
<td>years each. Thus 2006-2008 forms the</td>
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<tr>
<td>first block of three years, 2007-2009</td>
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<tr>
<td>This list comprised of 2791 companies.</td>
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<tr>
<td>Table 3.1 gives the number of distressed</td>
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<tr>
<td>companies in each block of three years.</td>
</tr>
</tbody>
</table>
Block of 3 years | Number of companies with reported net losses
---|---
2006-08 | 293
2007-09 | 301
2008-10 | 296
2009-11 | 301
2010-12 | 324
2011-13 | 382
2012-14 | 477
2013-15 | 417

*source: calculated by author*

(ii) From the initial list of 2791 companies, companies appearing in multiple blocks of three years were eliminated. These companies had incurred net losses in more than one block of three years. Such companies were retained in the most recent block of 3 years. Thus if a company has reported net losses block 2009-11 as well as block 2010-13, the company is grouped in block 2010-13. The revised list comprised of 795 companies.

(iii) Based on the nature of the business, these companies were classified into different sectors within manufacturing like automobiles, paper, textiles, fertilisers, pharmaceuticals etc. Thus 795 distressed companies identified belonged to 35 different sectors.

(iv) Each of these 795 companies were scrutinised and reviewed individually for nature of business, listing in stock exchanges, completeness of financial data. Based on detailed examination, the following companies were excluded:

a) Companies with a turnover of less than 10 crores. Such companies have negligible level of activity inadequate for detailed analysis.

b) Companies not having manufacturing as their core operating activity. Since study purports to review manufacturing companies, it is very important to correctly select only those companies whose main operating business is
manufacturing and selling. In Capitaline Database, companies in construction, telecommunication, media and advertising, retail are also classified under ‘Manufacturing’. Each company’s main business activity was thoroughly examined to obtain the appropriate sample.

c) Companies with incomplete data.

(v) The final list comprised of 288 listed manufacturing companies reporting net losses for 3 consecutive years during the period 2005-2015. These companies were categorised as ‘Distressed Companies’.

(vi) The distressed companies so selected is matched with a non-distressed company (company reporting net profits for the same three years). There are three matching techniques adopted in prior studies on financial distress:

a) For every distressed company, a matching non-distressed company is selected. The company so selected matches with the distressed company w.r.t nature of business and period of distress. (Altman 1968, Wang and Li, 2007, Bhunia and Sarkar, 2011).

b) The second technique is to ensure that ratio of distressed to non- distressed firms in the sample matches with that of the total firms. [Ganeshlingam and Kumar, (2001), Mondal and Roy, (2013)]. The first technique was criticized for overestimation of distressed firms. Zmijewski, 1984 argued that if each failed firm is matched with a non-failed firm, there is a probability of overestimation of failed firms. He suggested that the ratio of failed to non- failed firms in the sample should match with the ratio of failed to non- failed in the population.

c) The third type of sampling used is to select a greater number of non- distressed firms to match distressed firms i.e. number of non- failed companies is greater than the number of failed companies. It was argued that the number of non-
distressed companies matched with distressed companies does not affect the result of the analysis.

Since the initial sample of 2791 distressed companies includes all the companies meeting the criteria laid down, the first technique i.e every distressed company is matched with a non-distressed company in this study.

The non-distressed company is selected from the same sector as the distressed company. e.g Company ABC Ltd from Auto Ancillaries industry reporting net losses for the year 2007-09 is matched with Company PQR Ltd. from Auto Ancillaries industry reporting net profits for the period 2007-09.

Thus 288 Distressed Companies were matched with 288 Non-Distressed Companies to form the final sample of 576 companies for review. Table 3.2 gives sector wise distribution of selected companies. List of 576 companies is given in Annexure 1.

### TABLE 3.2 SECTOR WISE DISTRIBUTION OF COMPANIES

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Nature of Business</th>
<th>Number of companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Agro Chemicals</td>
<td>02</td>
</tr>
<tr>
<td>2</td>
<td>Alchoholic Beverages</td>
<td>08</td>
</tr>
<tr>
<td>3</td>
<td>Auto Ancillaries</td>
<td>26</td>
</tr>
<tr>
<td>4</td>
<td>Automobiles</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>Cables</td>
<td>12</td>
</tr>
<tr>
<td>6</td>
<td>Capital Goods- Electrical Equipments</td>
<td>38</td>
</tr>
<tr>
<td>7</td>
<td>Capital Goods – Non Electrical Equipments</td>
<td>30</td>
</tr>
<tr>
<td>8</td>
<td>Castings , Forgings and Fasteners</td>
<td>24</td>
</tr>
<tr>
<td>9</td>
<td>Cement</td>
<td>12</td>
</tr>
<tr>
<td>10</td>
<td>Ceramic Products</td>
<td>10</td>
</tr>
<tr>
<td>11</td>
<td>Chemicals</td>
<td>32</td>
</tr>
<tr>
<td>12</td>
<td>Consumer Durables</td>
<td>34</td>
</tr>
</tbody>
</table>
### 3.3 Variable Selection

Financial ratios, macroeconomic variables, stock market returns have been extensively used as predictors of financial distress in research. The present study uses financial ratios and macroeconomic indicators as variables to predict financial distress in listed manufacturing companies in India. Selection of the ratios is based on literature review and general consensus.

#### 3.3.1 Financial Ratios

Past studies have used different ratios reflecting profitability, liquidity, efficiency in operations, leverage, valuation, cash flows in a quest to identify the most important ratios which can signal distress. Though there is no consensus as to the most important ratios, some ratios have frequently appeared in these studies. For this study, 18 financial
ratios representing different aspects of company’s performance have been selected. Table 3.3 groups the ratios used as per the performance parameters.

TABLE 3.3 FINANCIAL RATIOS USED IN THE STUDY

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Parameters of company performance</th>
<th>Ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Profitability</td>
<td>1. Gross Profit Margin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. EBIT Margin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Net Profit to Net Worth</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Net Profit to Total Assets</td>
</tr>
<tr>
<td>2</td>
<td>Solvency</td>
<td>5. Debt Equity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6. Interest Coverage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7. Debt to Total Assets</td>
</tr>
<tr>
<td>3</td>
<td>Efficiency</td>
<td>8. Fixed Assets Turnover</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9. Capital Turnover</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10. Inventories Turnover</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11. Debtors Turnover</td>
</tr>
</tbody>
</table>
### 3.3.1.1 Profitability

Profitability implies the company’s efficiency in generating profits. It is an important indicator of company’s performance. Profitability reflects the final results of the business operations, (Chandra, 2008). Analysis of profit is of vital importance to stockholders and creditors as they are source of funds for debt coverage, (Gibson, 2013). Profitability and retention of profits affects the growth of the company. Ratios selected to measure profitability are:

1. **Gross Profit Margin (GPM):** \[
\frac{\text{Gross Profit} \times 100}{\text{Net Sales}}
\]

Gross Profit is the difference between Sales and Cost of Goods sold. It indicates the efficiency of production as well as pricing. It is a measure of profits left after meeting manufacturing costs. Gross Profit is influenced by direct costs viz materials, labour and overheads as well as fixed component of these costs. A high GPM indicates efficient Pricing and Sales strategy as well as cost control.

<table>
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<tr>
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<tbody>
<tr>
<td>15. Working Capital to Total Assets</td>
<td>16. Net Block of Fixed Assets to Total Assets</td>
</tr>
<tr>
<td>5. Cash flows</td>
<td>17. Cash flows from Operations to Total Assets</td>
</tr>
<tr>
<td>18. Cash flow from Operations to Sales</td>
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</tbody>
</table>
2. **EBIT Margin (EBITM):**

\[
\text{Earnings before Interest and Taxes} \quad \frac{\text{Net Sales}}{} \\
\]

Operating Profit, also termed as Earnings before Interest and Taxes (EBIT), is a measure of operational profitability of the company. It is the profit available after meeting Administrative, Selling, Distribution and other sundry expenses incurred to operate the business. It is the profit available to all stakeholders after meeting all normal business expenses. It is a very good indicator of the expense management strategies adopted by the company. This profit is not influenced by the capital structure of the company.

3. **Net Profit to Net Worth (NPNW):**

\[
\frac{\text{Reported Net Profit}}{\text{Equity Shareholders Funds}} \\
\]

Net Profit to Net Worth measures the return to shareholders in relation to their investment. It is a very good indicator of profitability for the shareholders. It summarises the impact of all decisions taken in the business for the shareholders. Reported Net Profit is the residual profit after meeting all expenses including interest and taxes. This is the profit available for shareholders of the company. Equity Shareholders’ Funds includes equity capital and reserves. NPNW determines the profitability of shareholders investments.

4. **Net Profit to Total Assets (NPTA):**

\[
\frac{\text{Reported Net Profit} \times 100}{\text{Total Assets}} \\
\]

Net Profit to Total Assets measures the net profit available in relation to its total investment in fixed assets and current assets. It is a measure of capital productivity indicating the returns on its gross investments. Investment in Assets is funded by retained earnings and Capital. NPTA determines the profitability of total investments.
3.3.1.2 Solvency

Solvency means the ability of the company to meet its debts. The presence of long term debt in the capital indicates financial risks. Debt to Total Assets, Interest coverage ratios etc. helps to evaluate long term risks and return prospects. A company with long term debt can give excess returns to their shareholders by leveraging debt. However if the profits decline, the returns to shareholders are compromised. Moreover long term debt and interest have priority over other claims. The inability of a company to meet these obligations can lead to distress and bankruptcy.

Ratios used to measure solvency are:

5. Debt to Equity (D/E): \[ \frac{\text{Long Term Debts}}{\text{Equity Shareholders Funds}} \]

Debt to equity ratio is a measure of capital structure of a company. Here the long term debt includes long term loans, debentures and preference share capital and Equity Shareholders Funds refers to Equity Share Capital + Reserves and Surplus. A high D/E ratio indicates leverage as well as financial risks. It explains the level of risk borne by the company. Low D/E ratio implies greater protection for lenders and hence more solvency.

6. Interest Coverage (OPI): \[ \frac{\text{Earnings before Interest and Taxes}}{\text{Annual Interest}} \]

This ratio measures the coverage available for interest in terms of profits. This is a direct measure to examine a company’s ability to generate profits to meet its fixed obligations in terms of interest on long term debts. A high interest coverage means that the company has sufficient profits to meet its fixed interest obligations. A decline in the
profits may not affect interest payments whereas a low interest coverage can be an indicator of distress. This ratio is widely used by lenders to assess a company’s debt capacity, (Chandra, 2008).

7. Debt to Total Assets (DTA): \[
\frac{\text{Total Debt}}{\text{Total Assets}}
\]

This ratio is a very good indicator of long term solvency. It measures the extent to which the assets are financed by debt both long term and short term. A high DTA implies high financial risks. In the event of low profitability, this situation can mean financial distress.

3.3.1.3 Efficiency/ Activity

A company’s survival depends upon its efficiency in utilizing the assets employed in the business. Assets employed in the business can be classified into two groups – Fixed Assets and Current Assets. Investment in fixed assets ensures revenue generation for a business. The more efficiently and productively a company uses its assets, the more is the profitability and its long term survival. Efficient management of current assets ensures immediate capital to meet its short term needs. Efficiency ratios compares the level of activity represented by Sales with the amount of assets held. Fixed Asset Turnover ratio, Debtors Turnover ratio, Inventory Turnover ratio, Working Capital Turnover ratio are the ratios which can help determine the efficiency levels of the business.

8. Fixed Asset Turnover (FATO): \[
\frac{\text{Net Sales}}{\text{Net Block of Fixed Assets}}
\]

Fixed Assets form one of the largest investment in manufacturing business. Fixed Assets are acquired with an intention to generate revenues. Effective utilization of fixed assets leads to greater revenues thereby ensuring long term survival of the business. FATO compares revenues represented by Sales with the level of fixed assets invested
in the business. A high FATO means that the company is using fixed assets efficiently to generate Sales.

9. **Capital Turnover (CTO):** \[
\frac{\text{Net Sales}}{\text{Total Capital Employed}}
\]

Capital Turnover is a very good indicator of company’s efficiency. It measures the extent of sales generated in relation to total funding. Liabilities are company’s funding sources. A high CTO reflects efficiency in operations. Since total liabilities i.e. funding is invested in Fixed Assets and Current Assets, this ratio also indicates the revenue generated by the company by virtue of its total investments in assets.

11. **Working Capital Turnover (WCTO):** \[
\frac{\text{Net Sales}}{\text{Net Current Assets}}
\]

Working capital is the operating capital required to conduct the day to day operating activities. This ratio reflects the amount of operating capital needed to maintain a given level of Sales. Higher WCTO implies low amount of capital requirement for generating sales, i.e. lesser burden on business and higher chances of survival. A low WCTO means a larger amount of working capital required to maintain a given level of sales thereby indicating higher burden on business.

12. **Debtors Turnover (DTO):** \[
\frac{\text{Net Credit Sales}}{\text{Receivables}}
\]

Though Sales is the most important metric of a company’s success in its business activities, the ability to convert its sales into cash i.e. receivable management denotes survival. Since collections from customers provide the business with its working capital, the speed and regularity with which a company converts its sales into cash indicates the quality of its cash flow. DTO measures the effectiveness of its credit management. A high DTO means speedy collections from debtors. A low DTO means lag in collection from debtors leading to raising short term funds and long term funds.
to meet its liabilities. A consistently low DTO will lead to financial distress in companies.

13. Inventory turnover (INVTO): \[
\frac{\text{Inventory}}{\text{Cost of Goods Sold}}
\]

Inventory constitute the largest current assets in most manufacturing concerns. ITO reveals the speed with which inventories are converted into sales. Holding inventory for a longer period entails holding cost which affects profitability. A high ITO means that the inventories are moving very fast indicating efficient inventory management. Efficient inventory management releases working capital ensuring survival and sustainability of the business.

3.3.1.4 Liquidity

Liquidity in a business refers to short term solvency. Liquidity ratios checks the availability of funds to meet the short term obligations of the business like payment to suppliers, payment for short term loans, outstanding expenses, unexpected cash outlays etc. The ability of a company to meet its short term liabilities indicates good working capital management. Suppliers and short term lenders review liquidity ratios to get assurance about the repayment capacity of the company. Liquidity ratios compare the level of currents assets with current liabilities. Current Assets includes inventories, receivables, short term loans and advances given, marketable securities and cash and bank balances. Current liabilities refers to creditors, outstanding expenses, short term provisions. Current ratio, Quick ratio and Working capital to Total Asset ratio are the most popular ratios to evaluate liquidity.

13. Current Ratio (CR): \[
\frac{\text{Current Assets}}{\text{Current Liabilities}}
\]
Current ratio compares the level of current assets available to meet the current liabilities. It evaluates the capacity of the business in terms of assets to pay its immediate liabilities. Higher the ratio, stronger is the company’s short term liquidity or solvency. A company which can pay off its current liabilities with its current assets is financially healthy as it does not have to resort to long term debts to meet its short term obligations. A low current ratio may mean a weak liquidity position leading to financial distress.

14. **Quick ratio (QR):** \[ \frac{\text{Current Assets} - \text{Inventories}}{\text{Current Liabilities}} \]

A quick ratio complements the current ratio by providing a better metric of evaluating the short term solvency position. Current ratio provides an overall picture of a company’s liquidity. It does not, however, take into account the composition of current assets. A quick ratio is a more conservative test of a firm’s solvency. In calculating quick ratio, current assets which are quickly convertible into cash viz. cash and cash equivalents, marketable securities and receivables are compared with the amount of current liabilities held. A high quick ratio indicates a very good solvency position of the business.

15. **Working Capital to Total Assets (WCTA):** \[ \frac{\text{Net Current Assets}}{\text{Total Assets}} \]

WCTA is a very important ratio for investors and other stakeholders. This ratio shows the proportion of liquid assets held in total assets. A high WCTA means faster realisation of receivables and hence more liquidity. A low WCTA implies cash difficulties as the quantum of liquid assets in total assets is low.
16. Fixed Assets to Total Assets (FATA): \[
\frac{\text{Net Block of Fixed Assets}}{\text{Total Assets}}
\]
This ratio measures the quantum of fixed assets in total assets invested in a business. Fixed Assets are very critical to manufacturing activities. Large investments in fixed assets reflects company’s long term strategy for growth. This has to be supplemented by profitability. Large investment in fixed assets without adequate profitability can lead to distress.

3.3.1.5 Cash Flows

Cash is the life blood of any business. A profitable company can face financial distress if it is not able to generate cash from its operating activities. Long term survival of the business depends upon cash flow from its business activities. Literature review has increasingly shown the relevance and importance of cash flow ratios in distress prediction. For the current study, two ratios viz. Cash flows from Operations to Total Assets and Cash flow from Operations to Sales have been used.

17. Cash Flow to Total Assets (CFOTA): \[
\frac{\text{Cashflow from Operations}}{\text{Total Assets}}
\]
Cash Flow from Operations refers to net cash flows generated from its core operating activities viz. receipts from debtors, payment to suppliers and other expenses. CFOTA compares the cash flows from operations to the total assets held. It indicates the efficiency in utilization of assets of the business to generate cash. It reveals cash made per unit of asset employed in the business. A high CFOTA implies better efficiency and productivity of assets. A low CFOTA may mean less efficiency leading to distress over a period of time.

18. Cash Flows to Sales (CFOS): \[
\frac{\text{Cashflow from Operations}}{\text{Net Sales}}
\]
Cash flow to Sales compares the cash generated from its operating activities to Sales. It is test of efficiency of the business to generate cash from its Sales. A high CFOS indicates higher ability of the company to convert sales into cash implying better liquidity and long term survival. A low ratio can signal liquidity concerns and can impact long term survival.

Summarising, financial and cash flow ratios indicating profitability, solvency, efficiency and liquidity have been used in this study to identify the most important factors which would distinguish a distressed company from a non-distressed company.

3.3.1.6 Data Source for Financial Ratios

The financial ratios were manually computed using the financial statements – Statement of Profit and Loss A/c, Balance Sheet and Cash flow statement of selected distressed and non-distressed companies. The financial statements were obtained from Capitaline Database. 18 ratios were computed for 576 sample companies. Also for every company, ratios were computed for the three year period which was converted into a three year average. This set of average ratios for each of the sample companies is used as independent variables for the analysis.

3.3.2 Macroeconomic Indicators

Literature review has highlighted the impact of macroeconomic indicators on the performance of the company. A major factor affecting the company’s failure are the economic conditions in which a company operates, (Smith and Liou, 2007). The incidence of bankruptcy rises sharply during recession. Fluctuations in inflation, Interest rates, Gross National Product, Employment rates affects business. Tight monetary policy has increased the probability of failure. Rise in bankruptcies during recession is an important signal of the influence of external factors on survival and growth of business. The sensitivity of a company to economic conditions is expected to play an important role in distinguishing a distressed company from a non-distressed one, (Tirapat and Aekkachai, 1999)
This study purports to examine the influence of macroeconomic indicators in identifying a distressed company. Based on previous research and availability of indicators, Net National Income (NNI), Bank Rate (BR), Industrial Production Index for Manufacturing (IPIM), Inflation Rate (INFL) and Exchange Rate (EXR) have been used in this study. The following paragraphs discuss the meaning and relevance of these variables in the study.

### 3.3.2.1 Net National Income (NNI)

Net national income (NNI) is defined as Gross National Income / Product less depreciation. Gross National Income is Gross Domestic product plus net receipts of wages, salaries and property income from abroad, minus the depreciation of fixed assets (dwellings, buildings, machinery, transport equipment and physical infrastructure) through wear and tear and obsolescence. Thus

\[
\text{NNI factor cost} = \frac{GDP_{\text{market price}} + \text{Net Factor Income} - \text{Indirect Taxes} - \text{Depreciation}}{\text{GDP}_{\text{market price}} + \text{Net Factor Income} - \text{Indirect Taxes} - \text{Depreciation}} - \text{(Roy, 2010)}
\]

GDP is one of the most popular macro-economic indicator used in studies on corporate distress. It is the value of all final goods and services produced within a country in a given period of time, (Mankiw, 2004). GDP represents production and growth. An increase in GDP is marked by low unemployment, wage increase, increased consumption and spending. There are two approaches to determine GDP; Income Approach and Expenditure Approach. In India the expenditure is followed. As per Expenditure approach, GDP is the total of consumption, investment, government spending and net exports. GDP is calculated in nominal as well as real terms. Nominal GDP is based on market prices whereas real GDP is based on constant prices. When GDP is adjusted for factor incomes, taxes and depreciation, Net National Income is derived.
Net National Income is more appropriate measure of level of economic activity in a country since it reflects the net investment in an economy which is required for sustained growth.

3.3.2.2 Inflation Rate (INFL)

Inflation refers to a continuous increase in general price level, (Roy, 2010). It is estimated on the basis of Wholesale Price Index. Wholesale price index is an index of changes in prices of goods viz industrial goods, fertilisers, raw materials, intermediate goods, minerals etc. It measures changes in prices of a large basket of goods. It does not include services. Studies have shown that inflation is one of the key factors which can affect the profitability of a business. A business having high systemic risk w.r.t inflation may be exposed to financial distress in an inflationary economic conditions, (Tirapat and Aekkachai, 1999) The supply and demand in industry and manufacturing purpose is monitored by Wholesale Price Index. High Wholesale Price index reflects increase in material, labour and other costs.

3.3.2.3 Industrial Production Index Manufacturing (IPIM)

IPI measures the growth in various sectors in an economy such as manufacturing, mining, electricity etc. It is a composite indicator of changes in the volume of production of a basket of industrial products during a given period. It is an indicator of the level of Industrial Activity IPI comprises of 682 industrial items of which 473 are from manufacturing sector. A strong positive correlation exists between rate of industrial production and business failures. Industrial Production Index was identified as one of the five major macro-economic factor affecting a company, (Ben Sami, 2014).

3.3.2.4 Bank Rate (BR)

Bank rate is the rate of interest charged by RBI on loans and advances given to commercial banks. It is a monetary tool to control the supply of money in the market. When the bank rates are increased, money supply contracts and commercial bank’s
lending rates increases making corporate loans costly. Inversely when the bank rate reduces, commercial banks loan base increases as corporate loans becomes cheaper. Thus Interest rates or bank rates have a powerful impact on the economy by expanding or contracting supply of money. The supply of money in the market affects a company’s investment decisions, (Jia Liu, 2009). Financial distress is positively related to bank rate. The number of defaults increase when the bank rate increases. For leveraged companies interest rates and availability of credit can be very crucial for its survival.

### 3.3.2.5 Exchange Rate (EXR)

Exchange Rate is the amount of one currency needed to buy another currency, (Roy, 2010). It is determined by the demand and supply of foreign exchange. Exchange rate environment of the country influences the propensity of a company to become bankrupt, (Bhattacharjee et al, 2009). Exchange rate affects exports, imports and interest payments. Exchange Rate directly affects the profitability of all imported and exporter companies. It also indirectly affects the general business climate in an economy.

### 3.3.2.6 Data Source for Macroeconomic Indicators

The data for macroeconomic indicators were obtained from the databank of Reserve bank of India, World Bank, Asian Development Bank and Central Statistical Organisation of Government of India for the period 2005-2015.

### 3.4 Statistical Techniques used

Discriminant Analysis, Logistic Regression and Factor Analysis are the main statistical techniques used in this study to analyse the data and test the hypotheses. Pearson’s Correlation Analysis is used to test the correlation between distress in companies and macro-economic environment of the country.
3.4.1 Discriminant Analysis

Discriminant Analysis is used to predict group membership. This Technique is used to classify observations into one of the pre decided groups based on a set of predictor variables (Chawla and Sondhi, 2011). The objectives of using Discriminant Analysis are:

a) To determine a set of independent variables that discriminate between pre-determined groups categorized dependent variable. The dependent variable is distress or non-distress in the selected manufacturing companies.

b) To identify which independent variables are relatively better in discriminating between groups.

c) To determine the statistical significance of the discriminant function.

The Discriminant Function is modeled as:

\[ Y = (b_0 + b_1x_1 + b_2x_2 + \cdots + b_nx_n) \]

Where Y is the dependent variable  
b_0- bn are coefficients of independent variables  
x_1- xn are independent variables

The dependent variable is a categorical variable and is coded as 0 or 1 like dummy variable coding. The coefficients are estimated based on the principle that ratio of between group sum of squares and within group sum of squares is maximized to ensure that the group differ as far as possible. The mid-point of the mean discriminant score is used as the cut-off point in case the number of observations are identical in both the groups. Once the discriminant model is constructed, the coefficients are used to calculate the discriminant score of new observations and based on cutoff point, the observation is classified into one of the two groups. The accuracy of classification is then determined using classification matrix. The relative contribution of each independent variable in discriminating between groups is obtained through absolute
values of the standardized coefficients. The higher the value of the coefficient, more is the significance of the variable in discriminating between groups.

To ensure the statistical significance of the discriminant function, the ratio between group variance relative to within group variance should be maximized. This ratio is given by Eigen values. Higher the Eigen values better is the function. Wilks’ Lambda is another statistic to test the reliability of the model. Wilks’ lambda is the ratio of within group sum of squares to total sum of squares. This statistic takes a value between 0 and 1. Lower the statistic, higher the significance of the discriminant function. Therefore a zero value would be the most preferred value.

3.4.1.1 Assumptions of Discriminant Analysis

1. Multivariate normality of the variables.
2. Equal variance and covariance of all groups.
3. Absence of multicollinearity amongst independent variables.

3.4.1.2 Relevance of Discriminant Analysis in this study

Multivariate Discriminant Analysis is used to identify the most significant independent variables discriminating a distressed company from a non-distressed company. The dependent variable is event of distress and non-distress and the independent variables are financial ratios. The Discriminant function developed using the coefficients of the significant variables is used to classify the cases into distressed and non-distressed groups. The classification accuracy will determine the robustness of the Discriminant Function.

3.4.2 Logistic Regression

Logistic Regression is a technique used when dependent variable is categorical and independent variables are quantitative or qualitative. It provides for prediction of the probability of a discrete outcome from a set of variables. It is argued as the most appropriate tool for predictive analysis.
The dependent variable is distress or non-distress in the manufacturing company selected for the study. The present study uses binary logistic regression analyses to develop financial distress models. The first model would include only financial ratios and the second model would use both financial ratios and macroeconomic factors as independent variables. As Logistic regression is used for prediction of the categorical outcomes, the dependent variable assumes two values 0 and 1. Since outcome to be predicted is distress, event of distress is coded as 0 and event of non-distress is coded as 1.

Logistic Regression analysis commences with Omnibus Tests of Model Coefficients. It is an overall measure of performance of the model with independent variables compared to one without independent variables. A significant p value indicates that the model with independent variables is better than the model without independent variables. It is also a measure that the model can distinguish between distressed and non-distressed firms. The next statistic to be checked is Cox Snell R square and Nagelkerke R square values. These values indicate the amount of variance in the dependent variable explained by the independent variable. The coefficient values are used to develop the Regression model. The relationship between the mean or expected value of the dependent variable and independent variables is described in a non-linear equation. The probability of an event occurring can be modelled as:

$$P(y=1) = \frac{e^{(b_0+b_1x_1+b_2x_2+\cdots+b_nx_n)}}{1 + e^{(b_0+b_1x_1+b_2x_2+\cdots+b_nx_n)}}$$

Where b1…..bn are coefficients values for independent variables x1….xn.

Since in this study, non-distress is coded as 1, the probability derived from the above equation would indicate the probability of non-distress. In most practical cases, 0.5 is a recommended cut-off value for overall correct classification rate, (Hui Hu, 2011). A probability score of > 0.5 would thus indicate non-distress and a probability score < 0.50 would indicate distress.
To examine the robustness of the model, probabilities of each sample company is calculated using the logistic model. The proportion of data correctly classified into the two groups (distress and non-distress), indicates the performance of the model.

### 3.4.2.1 Assumptions for Logistic Regression

(i) Number of cases in the sample must be larger than the number of independent variables.

(ii) Independent variables should be strongly correlated to dependent variable but not strongly related to each other. (Pallant, 2007)

(iii) Absence of outliers.

### 3.4.2.2 Relevance of Logistic Regression in this study

Logistic Regression is used to develop distress prediction models in this study. This technique will enable to identify the influence of each financial ratio and macro-economic factors on the occurrence of distress in manufacturing companies.

### 3.4.3 Factor Analysis

Factor Analysis is a tool used to data reduction. Factor Analysis extracts the most significant factors that account for the variance between groups. It is a broad technique which includes two different methods. Principal Component Analysis and Factor analysis. Both these methods develops linear combination of variables which accounts for most of the variances. In Principal Component Analysis, linear combination includes all variances whereas in Factor analysis only shared variance are analysed.

The analysis commences with a test of adequacy of sample given by Kaiser-Meyer-Olkin statistic. A KMO statistic of more than 0.5 indicates that reliable factors can be produced. Bartlett’s test of sphericity with $p$ values demonstrates the correlation between variables. A $p$ value < 0.05 rejects the null hypothesis that correlation matrix is an identity matrix.
Factor Analysis extracts factors that best represent the underlying relation amongst variables. Principal Component is the most commonly used method. These factors explain most of the variance in the data set and at the same time minimises the number of such factors. Kaiser’s criterion based on Eigen values is used to decide the number of factors to be retained for further analysis. The Eigen values explain the variances between the variables and the percentage of variance accounted by a factor. A factor with Eigen value of more than 1 is retained. Catells scree test is another technique which graphically depicts the Eigen values of each factor. The factors upto the point of flattening of the curve are retained. After extraction these factors are rotated for further interpretation. SPSS provides different approaches to interpret the factors through rotation. The most commonly used approaches are (i) Orthogonal and (ii) Oblique. In SPSS both these approaches use different methods of rotation like Quartimax, Varimax, Promax, Oblimin etc. Orthogonal method identifies non correlated factors whereas oblique method identifies related factors. Since the study uses independent variables which are not strongly correlated, Orthogonal method of rotation using Varimix technique is applied. The rotation reduces complex variables and simplifies interpretation of factors. The factor loading cut off is kept at 0.5. All variables having a loading of more than 0.5 on the factor will be produced in a matrix. Once the factors are identified, they are interpreted based on the variables included in each factor.

3.4.3.1 Assumptions of Factor Analysis

(i) Large sample size is preferred. A minimum of 5 cases for each variable is recommended.

(ii) Correlation matrix should have some correlation with r being at least 0.3. (Pallant, 2007)

3.4.3.2 Relevance of Factor Analysis for this study

This study uses eighteen financial ratios and five macro-economic factors as variables to develop distress prediction model. Factor analysis would help in identifying and grouping these variables into meaningful factors. The significance of each variable can be determined. This will facilitate selection of variables for model building.
3.5 Statistical Package

To analyse and test the data using the selected statistical techniques, the study uses IBM Statistical Package for Social Sciences (SPSS) version 22.0. IBM SPSS version 22.0 is a reliable tool which provides descriptive and inferential statistics of data. This software also provides various techniques for primary and advanced data analysis. The procedure for each technique was understood manually.

3.6 Summary

The objective of this study is to identify financial ratios which can discriminate distressed company from a non-distressed company and to develop a distress prediction model for listed manufacturing companies in India. A company reporting net losses for three consecutive years is defined as a distressed company. 288 distressed companies and 288 non-distressed companies are selected for the study. Eighteen financial ratios and five macro-economic factors are used as variables. These ratios represent Profitability, Solvency, Liquidity, Efficiency and Cash flows. Using Discriminant analysis, Factor Analysis and Logistic Regression, data is examined and analysed to achieve the research objectives.