RISK CLASSIFICATION BASED ON DISCRIMINANT ANALYSIS FOR SMES’

Srinivas Gumparthi and Dr. V.Manickavasagam

Abstract— Credit rating agencies specializes in analyzing and evaluating the creditworthiness of large corporate and issuers of debt securities. In the new financial architecture, credit rating agencies are expected to become more important in the management of both corporate and credit risk. Their role is limited to the large scale companies and multi corporations. Credit Rating Agencies focus was never on Small and Medium Enterprises where credit worthiness related information asymmetry is too large. On the other hand banks also handicapped by not having robust comprehensive models. To bridge the gap this research attempt has been made to provide solutions to the small and medium enterprises and banks.

Index Terms— Credit Rating, Discriminant Analysis, SMEs’, Economic Cycles, Business Cycle

I. INTRODUCTION

In India, primarily the concept of Small Scale Industry has been in vogue and the medium enterprise definition is of more recent origin. An SSI is defined on the basis of limit of historical value of investment in plant & machinery, which at present is up to Rs.10 million. However, in respect of some specified items, this investment limit has been hiked to Rs.50 million. For the recently announced Small and Medium Enterprises Fund [19], the Government of India has approved the limit of investment in plant and machinery above Rs.1 crore and up to Rs.10 crore for defining a unit as a Medium Enterprise. Amongst the developing countries, India has been the first to display special consideration to SSIs and basic focus has been to make economical use of capital and absorb the abundant labour supply in the country.

India it is often stated that 60 percent of SMEs do not borrow from traditional sources. For those who borrow from traditional sources the question arises of what measures should be used to assess applications for loans. Most of Small and Medium Enterprise operate in very small scale with very limited equity of the owner and more on high cost debt fund from other sources such as external borrowing from Non Banking firms.

Small and Medium Enterprises (SMEs) constitute a significant part of developing economies, this was emphasized in the research works of Zolton ACS & Audretsch (1993)[1], OECD SMEs Outlook (2002)[2] and Allen N. Berger & Gregory F. Udell (2004)[3]. Majority of these enterprises fund their capital through family or other networks, a sizeable group will borrow from traditional suppliers of credit.

Taffler, (1982)[5] “Forecasting Company Failure in the UK Using Discriminant Analysis and Financial Ratio Data In the modeling of default using Accounting based approach within this paper one has extended the range of variables considered and applied standard Credit Scoring approaches in modeling, see Lin, Ansell & Andreeva (2007)[6].

Dr. V.Manickavasagam and Srinivas Gumparthi (2009) [7] A Risk Assessment Model (RAM) is necessary to avoid the limitations associated with a simplistic and broad classification of applicants into a “good” or “bad” category. The absence of appropriate weights in the current evaluation system triggers the need for the development of the comprehensive model based on proven statistical application. Literature survey undertaken brought to surface 28 parameters that need to be taken into account while evaluating a prospect. These parameters were classified under four heads namely credit, operations, liquidity and market risks. Weights developed in this study were based on a conceptual understanding and the importance attached by people proficient in this area. A questionnaire was developed and a judgmental survey was conducted for this purpose amongst various credit officers extending commercial vehicle and construction equipment financing. The sample size was 117 small and medium corporate clients. The existing model was able to classify 28 records correctly. So the predictive power of the original/existing model was about 80%. The proposed/new model is able to classify 30 records correctly. So the predictive power of the propose/new model is 85.71%.

II. NEED FOR COMPREHENSIVE RISK ASSESSMENT MODEL

There is need for simple and easy to understand credit rating model for SMEs.’ At present SME’s are depending on either third party agency rating or at the mercy of the Credit Managers of the bank. To design and develop risk classification model based on Discriminant Analysis for Small and Medium Enterprises (SMEs’) which are major contributors to the growth of Indian Economy.

Primary objective is to develop risk classification model based on Discriminant Analysis for Small and medium enterprise (SMEs’). Discriminant Analysis is a proven statistical application. Inference of the model is easy to understand and simple for implementation.

Limitations of the Study

The purview of the project is limited to Small and Medium Enterprises (SME) division. Only twenty parameters are used.
in developing this model. Parameters selected are indicative in nature and by using them we can clearly establish the intended results.

III. DISCRIMINANT ANALYSIS MODEL

Based on developed Credit Risk Framework, Clients are classified into various categories depending on the aggregate score. For further simplification of the under two risk categories such as good and bad assets the Discriminant Analysis has been applied. This is second stage of the total new model. By using model Credit Manager is able to see clear distinction between performing assets and non performing assets. Statistically application of Discriminant Analysis purpose is to classify objects/records into two or more groups based on the knowledge of some variables related to them.

**Discriminant Function**

\[ Y = a + k_1X_1 + k_2X_2 + \ldots + k_nX_n \]

Where

- **Y** Dependent variable
- **a** Constant
- **X_1, X_2…X_n** Independent variables
- **k_1, k_2** Coefficients of the independent variables

In this case, for the development of the model the dependent and independent variables are as follows:

- The dependent variable (**Y**) is the Client Risk Rating (CRR)
- The independent variables (**X_1, X_2……X_20**) are as follows:
  - **X_1** = Client history
  - **X_2** = Industry status
  - **X_3** = Relationship with suppliers
  - **X_4** = Relationship with customers
  - **X_5** = Competition
  - **X_6** = Liquidity
  - **X_7** = Leverage
  - **X_8** = Sales growth
  - **X_9** = PBDIT/sales
  - **X_{10}** = DSCR (Debt service coverage ratio)
  - **X_{11}** = Integrity
  - **X_{12}** = Family standing
  - **X_{13}** = Financial standing
  - **X_{14}** = Management competence
  - **X_{15}** = Management commitment
  - **X_{16}** = Succession
  - **X_{17}** = Employee quality
  - **X_{18}** = Internal controls
  - **X_{19}** = Repayment records
  - **X_{20}** = Compliance records

**Design and Development of Discriminant Analysis Statistical Application**

For designing and development of Discriminant Analysis statistical application; the value of the dependent (credit score of individual firm based on credit frame work) and the 20 independent variables for the 70 records are entered in the SPSS software. The dependent variable in this equation Client Risk Rating based on the credit score obtained from Risk assessment format of Risk Assessment Model for Assessing NBFCs’ (Asset Financing) Customers of Dr. V.Manickavasagam and Srinivas Gumparthi[8] (Stage – 1 of the model). The Client Risk Rating was computed on the basis of successive seven years data of the client from 2002-03 to 2008-09. The period has importance in this model because of its cyclical nature.

The Economic cycle has influenced business cycle of small and medium enterprises in this mentioned period. The Gross domestic production rate fluctuated from 2002-03 to 2008-09. Initially GDP pegged up from 2002-03 to 2006-07 and declined after that due to global economic slow down impact. During mentioned period, small and medium enterprise across the all industry categories followed the same trend. Except Auto and Auto Ancillary sector all other categories taken for studies were impacted by the economic cycle during the period. During the mentioned period it was observed that GDP rate from 2004-05 to 2006-07 was at peak in India over 8 to 9%. Due Economic Slow down even Indian has seen decline in GDP rate below 6% during 2007-08 and 2008-09. The clients who are selected for building this model were with the existing bank through out this period survived at least 24 quarters. Data compiled on continuous basis and obtained on all parameters mentioned in the Risk Assessment Framework. All the observations and out come of the credit score were checked for its accuracy and consistency before formulating into Discriminant Equations. The Discriminant Scores are computed by solving all the 70 equations.

<table>
<thead>
<tr>
<th>TABLE. NO: 1. ANALYSIS CASE PROCESSING SUMMARY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unweighted Cases</strong></td>
</tr>
<tr>
<td>Valid</td>
</tr>
<tr>
<td>Excluded</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Unselected</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>
### TABLE: No. 2. GROUP STATISTICS

<table>
<thead>
<tr>
<th>Category of Risk</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Valid N (Unweighted)</th>
<th>Valid N (Weighted)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unwtd</td>
<td>Weighted</td>
<td>Unwtd</td>
<td>Weighted</td>
</tr>
</tbody>
</table>

#### Moderate Risk
- Client History: 7.17, 1.363, 27, 27,000
- Industry Status: 7.39, 1.037, 27, 27,000
- Relationship with suppliers: 6.94, 1.365, 27, 27,000
- Relationship with customers: 6.89, 1.367, 27, 27,000
- Competition: 5.04, 2.043, 27, 27,000
- Liquidity: 5.22, 2.340, 27, 27,000
- Leverage of the company: 5.19, 1.574, 27, 27,000
- Sales Growth: 5.39, 2.660, 27, 27,000
- PE/NT/Net Sales: 5.83, 2.618, 27, 27,000

#### Very High Risk
- Client History: 7.17, 1.363, 27, 27,000
- Industry Status: 7.39, 1.037, 27, 27,000
- Relationship with suppliers: 6.94, 1.365, 27, 27,000
- Relationship with customers: 6.89, 1.367, 27, 27,000
- Competition: 5.04, 2.043, 27, 27,000
- Liquidity: 5.22, 2.340, 27, 27,000
- Leverage of the company: 5.19, 1.574, 27, 27,000
- Sales Growth: 5.39, 2.660, 27, 27,000
- PE/NT/Net Sales: 5.83, 2.618, 27, 27,000

### TABLE: No. 2. GROUP STATISTICS (contd.)

<table>
<thead>
<tr>
<th>Category of Risk</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Valid N (Unweighted)</th>
<th>Valid N (Weighted)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unwtd</td>
<td>Weighted</td>
<td>Unwtd</td>
<td>Weighted</td>
</tr>
</tbody>
</table>

#### High Risk
- Client History: 7.69, 1.022, 23, 23,000
- Industry Status: 7.85, 1.555, 23, 23,000
- Relationship with suppliers: 7.54, 0.600, 23, 23,000
- Relationship with customers: 7.54, 0.519, 23, 23,000
- Competion: 6.92, 0.954, 23, 23,000
- Liquidity: 7.46, 0.776, 23, 23,000
- Leverage of the company: 7.00, 0.816, 23, 23,000
- Sales Growth: 7.08, 0.641, 23, 23,000
- PE/NT/Net Sales: 7.15, 0.001, 23, 23,000

#### Very High Risk
- Client History: 7.96, 2.235, 27, 27,000
- Industry Status: 7.57, 1.168, 70, 70,000
- Relationship with suppliers: 7.47, 0.749, 70, 70,000
- Relationship with customers: 7.42, 1.078, 70, 70,000
- Competition: 6.64, 1.525, 70, 70,000
- Liquidity: 6.87, 1.646, 70, 70,000
- Leverage of the company: 6.89, 1.301, 70, 70,000
- Sales Growth: 6.47, 1.940, 70, 70,000
- PE/NT/Net Sales: 6.67, 1.846, 70, 70,000
- DSCR: 6.92, 1.435, 70, 70,000
- Integrity: 7.24, 1.256, 70, 70,000

### Table continued...

- Compliance: 7.96, 2.235, 70, 70,000
- Client History: 7.57, 1.168, 70, 70,000
- Industry Status: 7.47, 0.749, 70, 70,000
- Relationship with customers: 7.42, 1.078, 70, 70,000
- Competition: 6.64, 1.525, 70, 70,000
- Liquidity: 6.87, 1.646, 70, 70,000
- Leverage of the company: 6.89, 1.301, 70, 70,000
- Sales Growth: 6.47, 1.940, 70, 70,000
- PE/NT/Net Sales: 6.67, 1.846, 70, 70,000
- DSCR: 6.92, 1.435, 70, 70,000
- Integrity: 7.24, 1.256, 70, 70,000

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From the above results it is clearly evident that out of 70 SME clients, 64 are performing clients and 6 are defaulters.

IV. DATA ANALYSIS BASED ON DISCRIMINANT ANALYSIS

The second phase of this model application was using Discriminant Analysis for further validation reinforcement of model robustness. By using this analysis all 140 clients were classified as Performing Assets and Non-Performing Assets. By using range sub-classification method, the Performing Assets are further regrouped under High Risk, Medium Risk and Low Risk, which is useful for monitoring progress of the client.

TABLE. NO: 2. GROUP STATISTICS (CONTD..)

<table>
<thead>
<tr>
<th>Category of Risk</th>
<th>Mean</th>
<th>Deviation</th>
<th>Variance (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Unweighted</td>
<td>Weighted</td>
</tr>
<tr>
<td>Total</td>
<td>7.44</td>
<td>1.239</td>
<td>70</td>
</tr>
<tr>
<td>Financial</td>
<td>7.49</td>
<td>1.308</td>
<td>70</td>
</tr>
<tr>
<td>Banking</td>
<td>7.62</td>
<td>0.560</td>
<td>70</td>
</tr>
<tr>
<td>Management</td>
<td>7.78</td>
<td>1.204</td>
<td>70</td>
</tr>
<tr>
<td>Competence</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Empowerment</td>
<td>7.40</td>
<td>1.618</td>
<td>70</td>
</tr>
<tr>
<td>Supervision</td>
<td>7.42</td>
<td>0.812</td>
<td>70</td>
</tr>
<tr>
<td>Employee Quality</td>
<td>7.11</td>
<td>0.735</td>
<td>70</td>
</tr>
<tr>
<td>Internal Controls</td>
<td>6.96</td>
<td>0.352</td>
<td>70</td>
</tr>
<tr>
<td>Equipment Records</td>
<td>7.69</td>
<td>2.087</td>
<td>70</td>
</tr>
<tr>
<td>Compliance</td>
<td>7.30</td>
<td>1.618</td>
<td>70</td>
</tr>
<tr>
<td>Records</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Above table states that 6 out of 25 Performing SME clients are in High Risk Category and 10 Assets are in the Medium Risk Category. On further probing the High Risk Category assets it was observed that these clients very small to withstand the competition especially when economy has slow down considerably in 2007-08 to 2008-09. But there is fair chance doing well when turn round happens in the business.

TABLE. NO: 3. RISK CLASSIFICATION OF BANK -1 SME CLIENTS

<table>
<thead>
<tr>
<th>Industry Category</th>
<th>Bank 1 - Risk Classification</th>
<th>Samples</th>
<th>High Risk</th>
<th>Medium Risk</th>
<th>Low Risk</th>
<th>NPFA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto OEM &amp; Ancillary</td>
<td>8</td>
<td>0</td>
<td>1</td>
<td>7</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Logistics</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Electrical &amp; Electronics</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>IT &amp; ITES</td>
<td>7</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Textile &amp; Apparel</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Engineering</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>38</td>
<td>6</td>
<td>8</td>
<td>13</td>
<td>6</td>
<td>0</td>
</tr>
</tbody>
</table>

SME clients belonging to Engineering in the high risk category are facing Business risk due to slow down in economy. No fresh order in from the market has further complicated their business model. In depth analysis shows that 2 assets of Textile and Apparel industry category are facing high risk, which is mainly due slump in exports to European Countries. Past Record of the company was very good export performance.

TABLE. NO: 5. RISK CLASSIFICATION OF BANK-3 SME CLIENTS

<table>
<thead>
<tr>
<th>Industry Category</th>
<th>Bank 3 - Risk Classification</th>
<th>Samples</th>
<th>High Risk</th>
<th>Medium Risk</th>
<th>Low Risk</th>
<th>NPFA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto OEM &amp; Ancillary</td>
<td>6</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Logistics</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Electrical &amp; Electronics</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Textile &amp; Apparel</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>31</td>
<td>7</td>
<td>3</td>
<td>6</td>
<td>7</td>
<td>0</td>
</tr>
</tbody>
</table>

SME clients of engineering industry category were facing high risk and two other are in Non-Performing assets class. This clearly shows that SMEs’ are facing severe impact of economic slow down. These companies have to be internally strong enough to sustain during this face till they get new orders. This analysis is possible due the accurate risk class of the client.
From analysis it is clear that 50 percent of bank’s SME clients are either in Non Performing assets category or in high risk class. This classification is useful for the bank to formulate its strategies to overcome default issues. Bank has to reformulate its lending portfolio composition. Further diagnosis will help in guiding their SME clients.

All 140 samples considered for this study has been first categorized into Performing Assets and Non Performing Assets based on their performance by using discriminant analysis. Further sub classification was done. The model capability was demonstrated through this classification of assets, which is third added feature of this model, not many models which are available in the market have three important features such rating, discrimination between good and bad assets and risk classification.

**REFERENCES**


[8] Dr. V.Manickavasagam and Srinivas Gumparthi Risk Assessment Model for Assessing NBFCs’ (Asset Financing) Customers in

Srinivas Gumparthi. SSN School of Management & Computer Applications, Chennai – 603 110. India.Email:srigumparthi@gmail.com or srinivasg@ssn.edu.in

Dr. V.Manickavasagam, Professor & Controller of Examinations, Department of Corporate Secretariatship, Alagappa University, Karaikudi, India. Email: drvimalcorp@yahoo.com