

RISK CLASSIFICATION BASED ON DISCRIMINANT ANALYSIS FOR SMES'

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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

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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 Frame work, Clients are classified in to 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

$$Y = a + k_1X_1 + k_2X_2 + \dots + k_nX_n$$

Where

Y-Dependent variable

a – Constant

X1, X2...Xn- Independent variables

k1, k2- 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 (X1, X2.....X20) are as follows
 - X1 = Client history
 - X2 = Industry status
 - X3 = Relationship with suppliers
 - X4 = Relationship with customers
 - X5 = Competition
 - X6 = Liquidity
 - X7 = Leverage
 - X8 = Sales growth
 - X9 = PBDIT/sales
 - X10 = DSCR (Debt service coverage ratio)
 - X11 = Integrity
 - X12 = Family standing
 - X13= Financial standing
 - X14 = Management competence
 - X15 = Management commitment
 - X16 = Succession
 - X17 = Employee quality
 - X18 = Internal controls
 - X19 = Repayment records
 - X20 = 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 Gumparathi[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 it 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. NO: 1. ANALYSIS CASE PROCESSING SUMMARY

Unweighted Cases		N	Percent
Valid		70	100
Excluded	Missing or out-of-range group codes	0	.0
	At least one missing discriminating variable	0	.0
	Both missing or out-of-range group codes and at least one missing discriminating variable	0	.0
	Unselected	0	0
	Total	0	0
Total		70	100.0

TABLE. NO: 2. GROUP STATISTICS

Category of Risk		Mean		Std. Deviation		Valid N (listwise)	
		Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Moderate Risk	Client History	8.29	.611	20	20.000		
	Industry Status	7.86	.363	20	20.000		
	Relationship with suppliers	8.00	.784	20	20.000		
	Relationship with customers	8.00	.679	20	20.000		
	Competition	7.29	.611	20	20.000		
	Liquidity	7.14	.663	20	20.000		
	Leverage of the company	7.43	.646	20	20.000		
	Sales Growth	7.29	.726	20	20.000		
	PBDIT/Sales	7.29	.611	20	20.000		
	DSCR	7.14	.363	20	20.000		
High Risk	Integrity	8.29	.469	20	20.000		
	Family Standing	7.36	2.170	20	20.000		
	Financial Standing	8.00	.784	20	20.000		
	Management Competence	7.93	.475	20	20.000		
	Management Commitment	8.36	.497	20	20.000		
	Succession	7.64	.633	20	20.000		
	Employee Quality	7.43	.514	20	20.000		
	Internal Controls	7.29	.611	20	20.000		
	Repayment Records	8.64	.633	20	20.000		
	Compliance Records	8.43	.646	20	20.000		

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

Category of Risk		Mean		Std. Deviation		Valid N (listwise)	
		Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
High Risk	Client History	7.69	1.032	23	23.000		
	Industry Status	7.85	.555	23	23.000		
	Relationship with suppliers	7.54	.660	23	23.000		
	Relationship with customers	7.54	.519	23	23.000		
	Competition	6.92	.954	23	23.000		
	Liquidity	7.46	.776	23	23.000		
	Leverage of the company	7.00	.816	23	23.000		
	Sales Growth	7.08	.641	23	23.000		
	PBDIT/Sales	7.15	.801	23	23.000		
	Client History	7.69	1.032	23	23.000		
High Risk	Industry Status	7.85	.555	23	23.000		
	Relationship with suppliers	7.54	.660	23	23.000		
	Relationship with customers	7.54	.519	23	23.000		
	Competition	6.92	.954	23	23.000		
	Liquidity	7.46	.776	23	23.000		
	Leverage of the company	7.00	.816	23	23.000		
	Sales Growth	7.08	.641	23	23.000		
	PBDIT/Sales	7.15	.801	23	23.000		

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

Category of Risk		Mean		Std. Deviation		Valid N (listwise)	
		Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Very High Risk	Client History	7.17	1.383	27	27.000		
	Industry Status	7.39	1.037	27	27.000		
	Relationship with suppliers	6.94	1.305	27	27.000		
	Relationship with customers	6.89	1.367	27	27.000		
	Competition	5.94	2.043	27	27.000		
	Liquidity	6.22	2.340	27	27.000		
	Leverage of the company	6.39	1.754	27	27.000		
	Sales Growth	5.39	2.660	27	27.000		
	PBDIT/Sales	5.83	2.618	27	27.000		

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

Category of Risk		Mean		Std. Deviation		Valid N (listwise)	
		Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Very High Risk	DSCR	5.94	1.984	27	27.000		
	Integrity	7.22	1.833	27	27.000		
	Family Standing	7.22	1.592	27	27.000		
	Financial Standing	6.89	1.745	27	27.000		
	Management Competence	7.28	1.179	27	27.000		
	Management Commitment	7.11	1.568	27	27.000		
	Succession	7.17	1.043	27	27.000		
	Employee Quality	6.78	1.003	27	27.000		
	Internal Controls	6.56	1.042	27	27.000		
	Repayment Records	6.67	2.870	27	27.000		
Total	Compliance Records	7.06	2.235	27	27.000		
	Client History	7.67	1.168	70	70.000		
	Industry Status	7.67	.769	70	70.000		
	Relationship with suppliers	7.44	1.078	70	70.000		
	Relationship with customers	7.42	1.076	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	1.949	70	70.000		
	PBDIT/Sales	6.67	1.846	70	70.000		
Total	DSCR	6.62	1.435	70	70.000		
	Integrity	7.84	1.296	70	70.000		

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

Category of Risk		Mean		Std. Deviation		Valid N (listwise)	
		Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Total	Family Standing	7.44	1.589	70	70.000		
	Financial Standing	7.49	1.308	70	70.000		
	Management Competence	7.62	.860	70	70.000		
	Management Commitment	7.78	1.204	70	70.000		
	Succession	7.42	.812	70	70.000		
	Employee Quality	7.11	.775	70	70.000		
	Internal Controls	6.96	.852	70	70.000		
	Repayment Records	7.69	2.087	70	70.000		
	Compliance Records	7.80	1.618	70	70.000		

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:3. RISK CLASSIFICATION OF BANK -1 SME CLIENTS

Industry Category	Samples	Bank -1 – Risk Classification			
		High Risk	Medium Risk	Low Risk	NPA
Auto OEMs & Ancillary	8	0	1	7	0
Logistics	5	1	2	0	2
Electrical & Electronics	5	1	1	2	1
IT & ITES	7	2	2	2	1
Textile & Apparel	3	1	0	2	0
Engineering	5	1	2	0	2
Total	33	6	8	13	6

Among the performing assets approximately 20 percent of SME clients are in high risk category, which is concerned issue to the bank. These four clients are to be closely monitored. Further diagnosis is possible through this model to identify exactly what type of sub classification risk each of this clients are facing. There are 8 clients in the category of medium risk most of them in this position due Economic slow down which was identified through their market risk analysis (Economic Cycles) of the proposed model. Since all clients are from SME sector such type analysis helps them in knowing their risk level.

TABLE. NO: 4. RISK CLASSIFICATION OF BANK -2. SME CLIENTS

Industry Category	Samples	Bank -2 – Risk Classification			
		High Risk	Medium Risk	Low Risk	NPA
Auto OEMs & Ancillary	3	1	1	1	0
Logistics	4	1	1	1	1
Electrical & Electronics	5	0	3	0	2
IT & ITES	5	2	1	1	1
Textile & Apparel	4	1	2	1	0
Engineering	6	1	2	1	1
Total	26	6	10	5	5

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 with stand 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:5. RISK CLASSIFICATION OF BANK -3 SME CLIENTS

Industry Category	Samples	Bank -3 – Risk Classification			
		High Risk	Medium Risk	Low Risk	NPA
Auto OEMs & Ancillary	6	1	3	1	1
Logistics	3	0	1	1	1
Electrical & Electronics	5	1	2	2	0
IT & ITES	4	1	1	1	1
Textile & Apparel	7	2	2	1	2
Engineering	6	2	2	0	2
Total	31	7	11	6	7

SME clients belongs 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:6. RISK CLASSIFICATION OF BANK -4 SME CLIENTS

Industry Category	Samples	Bank -4 – Risk Classification			
		High Risk	Medium Risk	Low Risk	NPA
Auto OEMs & Ancillary	4	1	2	1	0
Logistics	4	0	2	2	0
Electrical & Electronics	3	1	1	0	1
IT & ITES	5	1	1	2	1
Textile & Apparel	2	1	1	0	0
Engineering	4	2	0	0	2
Total	22	6	7	5	4

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.

TABLE.NO:7. RISK CLASSIFICATION OF BANK -5 SME CLIENTS

Bank -5 – Risk Classification					
Industry Category	Samples	High Risk	Medium Risk	Low Risk	NPA
Auto OEMs & Ancillary	4	1	1	2	0
Logistics	6	2	1	1	2
Electrical & Electronics	5	3	1	0	1
IT & ITES	5	1	2	1	1
Textile & Apparel	4	1	2	1	0
Engineering	4	0	2	0	2
Total	28	8	9	5	6

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.

TABLE.NO:8. ALL BANKS SME CLIENTS RISK CLASSIFICATION

All Banks SME Clients Risk Classification					
Industry Category	Samples	High Risk	Medium Risk	Low Risk	NPA
Auto OEMs & Ancillary	25	4	8	12	1
Logistics	22	4	7	5	6
Electrical & Electronics	23	6	8	4	5
IT & ITES	26	7	7	7	5
Textile & Apparel	20	6	7	5	2
Engineering	25	6	8	1	9
Total	140	33	45	34	28

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

- [1] Acs, Zoltan J. and David B. Audretsch, eds. (1993), *Small Firms and Entrepreneurship: An East-West Perspective*. Cambridge, MA: Cambridge University Press.
- [2] *OECD Small and Medium Enterprise Outlook 2002*, published by OECD Publication Services, France
- [3] Allen N. Berger & Gregory F. Udell (2004)[World Bank Conference on Small and Medium Enterprises: Overcoming Growth Constraints World Bank, MC 13-121 October 14-15, 2004
- [4] R J Taffler "Forecasting Company Failure in the UK Using Discriminant Analysis and Financial Ratio Data (1982)" *Journal of the Royal Statistical Society*
- [5] Lin, S.M., Ansell, J., Andreeva, G. (2007) Predicting default of a small business using different definitions of financial distress. *Proceedings of Credit Scoring & Credit Control X*.
- [6] Lin, Ansell & Andreeva (2007), "Predicting default of a small business using different definitions of financial distress" www.crc.man.ed.ac.uk/publications/papers/.../workingpaper07-4.pdf
- [7] Dr. V.Manickavasagam and Srinivas Gumparthi "Credit Rating Model Based on Discriminant Analysis", at International Conference on Information & Financial Engineering (ICIFE 2009). I EEE & IACS&IT at Singapore, April 17th to 20th 2008. International Journal of Financial Engineering by IACSIT of IEEE April 2009 ISBN: 978-0-7695-3606-4. Website: <http://www.computer.org/portal/web/csd/doi/10.1109/ICIFE.2009.39>
- [8] Dr. V.Manickavasagam and Srinivas Gumparthi Risk Assessment Model for Assessing NBFCs' (Asset Financing) Customers in

International Journal of Trade, Economics, and Finance (IJTEF) accepted for publishing in June,2010 issue

- [9] Definition Small & Medium Business Development Chamber of India as defined in SME chapter

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