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NEED/IMPORTANCE OF THE STUDY

STATEMENT OF THE PROBLEM

OBJECTIVES

HYPOTHESES

RESEARCH METHODOLOGY

RESULTS & DISCUSSION

FINDINGS

RECOMMENDATIONS/SUGGESTIONS

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APPENDIX/ANNEXURE

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- Sharma T., Kwatra, G. (2008) Effectiveness of Social Advertising: A Study of Selected Campaigns, Corporate Social Responsibility, Edited by David Crowther & Nicholas Capaldi, Ashgate Research Companion to Corporate Social Responsibility, Chapter 15, pp 287-303.

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- Garg, Sambhav (2011): "Business Ethics" Paper presented at the Annual International Conference for the All India Management Association, New Delhi, India, 19–22 June.

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- Garg, Bhavet (2011): Towards a New Natural Gas Policy, Political Weekly, Viewed on January 01, 2012 http://epw.in/user/viewabstract.jsp

PREDICTING DEFAULTS IN COMMERCIAL VEHICLE LOANS USING LOGISTIC REGRESSION: CASE OF AN INDIAN NBFC

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ABSTRACT

This study aims to test the significance and impact of contract specific variables as predictors of defaults in commercial vehicle loans. Two phased research was designed for this study. In-depth interviews of senior managers responsible to approve Commercial Vehicle loans provided a list of contract specific variables which are used to develop a binary logistic regression predictive model generated from data of 12081 commercial vehicle loan borrowers in India. In-depth interviews of senior managers resulted into generation of seventeen contract specific variables having potential impact on defaults. The binary logistic regression model retained eleven out of the seventeen variables. The model suggests that using contractual variables as predictors for default in commercial vehicle loans has potential to provide more benefits to the credit lending institutions. Various insights emerge from this study related to the use of contract specific variables in predicting the commercial vehicle loan defaults. Using the proposed variables has a direct benefit to the companies in question as they can focus on preparing their credit policies on the basis of feasible offers they can provide rather than losing out on business due to credit rationing based on borrowers' demographic characteristics only. Using contractual variables is different from the prevalent practice of considering demographic variables of customers as highly important in decisions for credit granting for commercial vehicles in emerging market like India.

KEYWORDS

Commercial Vehicle Loans, Logistic Regression, Loan Default, Binary Logistic Regression, Contract specific variables.

INTRODUCTION

Indian Commercial Vehicle (Referred to as CV through the article) industry has been contributing significantly to the economic growth of India. The evidence of a bi-directional causality between a country's GDP and Motor Vehicle Output has already been established (Santini and Poyer, 2008). CARE (Credit Analysis and Research Limited based at Mumbai, India) has estimated that 66 per cent of the goods and 87 per cent of the passenger traffic in the country moves via road *(International Atlantic Economic Society 2008).*

Transportation Industry in India is fragmented with small operators accounting for 65 per cent of the fleet. ICRA (Formerly Investment Information and Credit Rating Agency of India Limited, later renamed ICRA Limited) estimates that more than 90 per cent of the CVs in India are brought on credit (ICRA report 2006). Commercial Vehicle lending institutions in India usually follow a credit process, termed as profile based funding, that lays emphasis on the future expected deployment of purchased vehicle based on a detailed field investigation report. CV loan borrowers in India are generally the transporters who are small, unorganized merchants, first time users (FTU). NBFCs in India, which usually have strong funding networks in the rural and semi-urban areas, usually find it difficult to find borrowers with sound financial status and credentials, limiting their business only to the affluent class if the established conventional funding policies are to be followed. Small transporters and FTUs fail to meet these requirements and may remain devoid of funding. At the same time, NBFCs in India have been facing huge pressure to move ahead of the traditional funding policies after the restrictions by the central bank called Reserve bank of India (RBI) on taking public deposits. This restriction and other challenges like unequal competition from Banks and Multi National Companies, absence of a dedicated recovery mechanism, poor availability of medium and long term funding, absence of parity with banks and housing finance in various regulatory provisions forced NBFCs to look for funds from organized banks and institutions, leading to a higher cost of funds and thereby limiting risk appetite. These factors resulted in a greater pressure on Indian NBFCs and a need to move ahead of the traditional funding policies by utilizing more scientific methods for decision making. Most of the studies related to credit granting mechanisms and credit decisions have been focused on lending by established banks and institutions. The results of these studies prove to be of little use by the NBFCs due to an entirely different set of issues and challenges being faced by them. In view of the above mentioned problems, and the potential significance of the commercial vehicle industry in India, this study attempts to propose a different approach to funding decision of Commercial Vehicles in India by NBFCs.

LITERATURE REVIEW

Research aimed at estimating loan defaults have broadly used two approaches. The first approach is to use borrowers' characteristics as predictors. The second approach tried to avoid the borrowers' characteristics and have used other variables to predict loan defaults. Furstenberg and Green attempted to quantify factors determining delinquency risk and used the predicted delinquency rates to estimate the total delinquency risk of mortgage portfolios (Furstenberg and Green, 1974). They used loan to value ratio, mortgagor income, age of mortgage, home location and interest rate to build a regression model. The study has been a noble attempt to help lenders prevent overestimating delinquency risk. Gardner and Mills made an attempt to calculate the likely hood of default on already delinquent loans (Gardner and Mills, 1989). Their study aimed at estimating probability of default based on borrowers' financial and demographic characteristics. The main premise of the study was that the status of a borrower is dynamic through the loan cycle and a fresh analysis would be required once the loan has gone delinquent and efforts are to be made to prevent eventual default. However, ten out of eighteen variables used in the study were not

dynamic. Volkwein, Cabrera, Szelest and Napierski analyzed the defaults using racial and ethnic parameters and found that under similar circumstances, which are independent of demographic factors, different racial groups behaved similarly in their repayment patterns (Volkwein, Cabrera, Szelest and Napierski, 1994). Ross used a simulation approach to examine the effect of lending discrimination and racial differences on mortgage loan defaults (Ross 1997). The study used a sample of 1990 loan applications from the Federal Reserve Bank of Boston and concluded that lending discriminations will not usually create racial differences in default. The variables used were a good mix of both type of determinants i.e. borrowers' characteristics as well as loan contract factors. Canner, Gabriel and Woolley further explored the issue of discrimination mainly using demographic characteristics (Canner, Gabriel and Woolley, 2001). They concluded that most lenders ration credit on the basis of perceived difference in borrower default risk that is measured from lender experiences in similar demographics. Udoh analyzed the extent of default among government sponsored loan schemes in Nigeria based on the demographic characteristics of borrowers (Udoh, 2008).

The possibility of using non-demographic variables for predicting defaults on Automobile loans have also been explored. (Agrawal, 2102).

Though studies focused on the characteristics of borrowers, which are uncontrollable variables, are dominant in this area, a few studies use contract specific variables too in the analysis. One of the early notable studies is by Bierman and Hausman. They approached the credit granting problem both from a single period, two action problem (to give credit or not) as well as a multi period, two action problem and demonstrated the superiority of multi period approach where new information about collections can be incorporated in the model (Bierman and Hausman, 1970). Stiglitz and Weiss discussed the issue of credit rationing with respect to markets with imperfect information, focusing the impact of Interest rate or Cost aspect of a loan contract (Stiglitz and Weiss, 1981). Zhou highlighted the important issue of other industry specific and economic factors bearing on default rates (Zhou, 2001). Heitfield and Sabarwal analyzed the performance of asset backed securities in subprime automobile loans using the cost factor of loan (Heitfield and Sabarwal, 2003).

Other observation evident from the literature survey reveals that a significant amount of research has been done to model the credit processes followed by lenders and for estimating the probable defaults in mortgage lending, business loans, microfinance loans, farm loans, education loans, and rural credit etc. But, similar studies in Commercial Vehicle loans are rare. In addition, most of the research aimed to estimate probable defaults are found focusing the markets in developed economies. There is a need to study CV loans industry using the previously ignored detailed analysis on factors specific to the loan contract which are independent of borrower demographics. This is important because using demographic variables as major determinants of funding would result in rationing against specific customer groups. In other words, not all potential borrowers living in specific localities or not all borrowers following a particularly deemed risky profession, would be defaulters. Therefore, using only demographic based credit granting criteria would in fact ensure that the company loses out on a significant good business. The other advantage of using such factors is that the loan contract variables are under the control of the lenders. Using controllable variables is important because defaults may occur due to the conditions that generally arise out of forcing the predefined policies, terms and conditions of loan on the borrowers. As per the sentiments raised by Industry practitioners during this study, a loan appraisal manager may only accept or reject a loan application which has been evaluated based on customer demographics, Whereas, if controllable variables are used, a specific combination of the contract specific variables may be offered to the customer which may be statistically considered as safe, i.e. having less probability of default. This will ensure getting rid of a major source of potentially good business loss for NBFCs.

RESEARCH OBJECTIVES

Indian practitioners have been using borrowers' characteristics or demographics as predictors to CV loan default. This study aims to test the significance and impact of contract specific variables as predictors of defaults in CV loans. Practicing managers' insights were obtained to understand the current practice of CV lending followed by the development of a predictive model based on contract specific variables. A comparison of the results of this study against the prevailing assumptions of industry practice may help in studying the possible advantages of a model using contract specific variables to aid in decision of credit granting in CV industry.

RESEARCH METHOD

A two phased research was designed for this study. At first phase, a qualitative research is designed in order to obtain the relevant variables for this study. Ten in-depth interviews of senior managers of one NBFC who are responsible to approve CV credits as well as managers responsible for leading sales teams to source fresh cases (potential borrower/customer) provided a list of contract specific variables to be used in the predictive model. The NBFC used under this study is a public listed non-banking finance company, registered with the Reserve Bank of India as an Asset Finance Company. The company started its operations in the year 1989. It provides a bouquet of financial products including financing of utility vehicles and cars, commercial vehicles, construction equipments, tractors and other small and medium entrepreneurship finance. It has a dedicated base of more than 0.25 million customers and has assets of approximately INR 93.90 billion under management. The company has 172 offices in 21 Indian states and employs around 4950 employees. Data used for this study pertains to a list of all 12081 CV borrowers of this NBFC in the state of Punjab (India) over a period of 5 years capturing various parameters.

Agriculture and related activities form the largest industry in Punjab. Other industries include manufacture of scientific instruments, electrical goods, financial services, machine tools, textiles, sewing machines, sports goods, starch, tourism, fertilizers, bicycles, garments, and the processing of pine oil and sugar. The Indian state of Punjab is considered to have the best infrastructure in the country which includes road, rail, air and river transport links that are extensive throughout the region. All these factors contribute to a high significance of CV finance industry in this state.

VARIABLES

In-depth interviews provided some insights on the process and decision criteria for credit grant to the applicants. Discussion section of this paper explains some of the current common beliefs of the managers and the prevalent assumptions of industry practice revealed from in-depth interviews. A total of 17 independent variables are proposed as predictors of default, the dependant variable used in this study. Table I lists and explains the proposed variables. The term 'Default' denotes delayed payment for loans exceeding 60 days (similar criterion is used by the NBFC from where the data is obtained). In the predictive model, Default is represented by the value of '1' and '0' represents no default. Because, independent variables are nominal and dependant variable is dichotomous, Binary Logistic Regression is used to develop a regression equation. The data was obtained from the same NBFC where the in-depth interviews were conducted. CV loans disbursed to borrowers of state of Punjab and Chandigarh in India over a period of 5 years constituted the data.

TABLE I: PROPOSED INDEPENDENT VARIABLES

(1) S. No.	(2) Independent Variable	(3) Variable explained from the view point of practitioners. (Based on the result of in-depth interviews)	(4) Description	(5) Values	(6) Labels	(7) Occurrence of actual Default Percentage in the data
1	SBU	Each SBU has a separate Underwriting Department. Individual analysis style of the heads may have an impact on the Credit Quality and hence Default	The Strategic Business Unit or Regional Office which processed the loan	1	Ambala	14.25%
				2	Bhatinda	12.75%
				3	Chandigarh	12.83%
				4	Ludhiana	13.22%
2	Source	Direct cases are usually considered to be of a better quality as the company has a direct control on the team.	Direct refers to cases sourced by Direct Sales Force, Non Direct refers to cases referred by agents, brokers and Direct Selling Agents (DSAs)	1	Direct	13.15%
				2	Non-Direct	13.31%

3	Quarter	Cases processed during Q-4 are usually considered to be poorly judged due to Financial Year Closing Targets, and may have an impact on Default Rates.	April - June	1	Q-1	15.59%
			July - September	2	Q-2	15.96%
			October - December	3	Q-3	12.49%
			January - March	4	Q-4	10.04%
4	Month-end	Heavy workload on Underwriters during month-ends is generally associated with a reduced quality of appraisals.	Weather the application was processed during month-end (25th to 31st of the month)	1	Yes	10.08%
				2	No	14.96%
5	Co-Hirer Taken	Cases with a CH are considered to be better	Weather a Co-Hirer was taken to justify eligibility	1	Yes	10.81%
				2	No	14.48%
6	Customer Category	Categorical differences are considered to be important for loan repayment probability.	Category to which the customer belongs w.r.t size of his setup, fleet, experience and income	1	A	16.58%
				2	B	9.87%
				3	C	9.80%
				4	D	18.18%
7	Tenor Band	Underwriting teams are usually instructed to keep loan tenors between 12 and 48 months, with 36 months being most favourable.	Period for which loan is extended in months	1	<= 12	31.63%
				2	>12 & <= 24	21.37%
				3	>24 & <= 36	11.50%
				4	>36 & <= 48	12.85%
				5	> 48	8.50%
8	Body Funding	Funding the body along with the vehicle is expected to reduce customer equity in the loan and hence may have an adverse effect on loan performance.	Weather money is required for building the body of the truck has been financed as well	1	Yes	7.79%
				2	No	13.62%
9	Make Name	Some brands of vehicles are expected to perform poorly due to many factors such as service quality, spare part availability etc. This is thought to have an impact on loan repayment.	Manufacturer of the Vehicle	1	Ashok Leyland	20.44%
				2	Bajaj	16.95%
				3	Eicher	17.37%
				4	Force Motors Ltd.	4.55%
				5	Mahindra & Mahindra	15.26%
				6	Swaraj Mazda	35.40%
				7	Tata Motors Ltd.	11.44%
10	Product Group	Load and freight constraints certain size and category of vehicles is thought to impact gainful deployment on certain routes.	Category of vehicle to be funded	1	Bus	11.86%
				2	LCV	14.46%
				3	M&HCV	12.58%
				4	MUV	18.83%
				5	Tipper	10.45%
				6	Tractor	11.36%
				7	Trailer	7.48%
11	Quality	Old vehicles are sometimes expected to perform poorer	Weather the vehicle being funded is new or an old vehicle	1	New	12.77%
				2	Old	13.89%
12	Advance Instalment	Deposition of advance is considered to be a reflection of good intentions	Weather an amount equivalent to one month EMI has been deposited	1	Yes	14.02%
				2	No	12.60%
13	Exposure Band	Higher LTVs reduce customer equity and payment quality is expected to deteriorate	Percentage of Vehicle cost provided as loan(LTV)	1	<=50	24.07%
				2	>50 & <=65	13.82%
				3	>65 & <=80	9.37%
				4	>80 & <=85	17.75%
				5	>85 & <= 90	15.59%
				6	>90 & <=95	8.91%
				7	>95	9.03%
14	IRR Band	Higher rate is charged from poor profile customers or for highly delinquent vehicle categories	Effective Rate of Interest on the loan	1	< 8.01	8.59%
				2	>=8.01 & < 9.10	17.07%
				3	>=9.10 & <10.40	18.21%
				4	>=10.40 & <13	14.00%
				5	>13	11.44%
15	Purpose	Loans on vehicles under non-commercial usage are considered to be of better quality	Commercial use implies deployment for fare or freight, non-commercial use implies captive use	1	Commercial	13.65%
				2	Non-Commercial	0.73%
16	Payment Terms	Low customer hassle in PDC cases implies a better repayment quality	Mode of payment is through Post Dated Cheques or cash payment every month	1	Non PDC	13.22%
				2	PDC	12.39%
17	Fleet	Higher the fleet size, higher is the experience and probability of gainful deployment	Number of Vehicles previously owned by Hirer and Co-Hirer	>=0 (ratio scale)	FLEET	NA

Table I suggests that a uniform spread of loan default across the state of Punjab (variable SBU). 'Direct cases' refer to cases sourced by an in-house sales team consisting of executives and senior executives on company roles. The 'non-direct' channels include the channel partners, Direct Sales Agents (DSAs), Direct Marketing Agents (DMAs), company dealers, brokers (for old vehicles) and freelancers. The in-depth interviews suggested that due to the limited control by

company, non-direct channels are regarded as source of poor quality accounts, frequently leading to a high probability of default. This was attributed due to the following reasons cited by the senior managers:

- Non-direct channels employ people with poor training and skills
- Non-direct partners generally act as middlemen for different financers and are able to manipulate profiles on the basis of credit policies used by different companies
- For a given customer profile, the application is forwarded to financers with a better commission structure
- Certain channel incentives are dependent on the volume of business given by them with no legal liability in case the borrowers (customers) default later. This leads to intentional non disclosure of important information including past customer payment patterns too, which if disclosed, may have negative impact on credit granting decision

Business sourced by the NBFC seems to be balanced in terms of seasonality, with a slightly higher share sourced during January to March owing to pressure to complete sales targets by the end of financial year. About 36 per cent of the company's business is sourced during month-ends. This poses a significant pressure on the loan underwriters and their teams in terms of quality of proposal scrutiny. Small operators with little or no experience in running a vehicle are usually required to have experienced transporters as a co-hirer in order to mitigate the risk of failure in gainfully deploying the vehicle. Tenor represents the duration over which the repayment in equal monthly installments (EMI) is spread. Most of the borrowers prefer a tenor of three to four years. The company on the other hand prefers to promote loans with a slightly less tenor in order to recover the amount while the vehicle is in good condition.

Most of the vehicle models sold requires a carriage body to be built separately by a third party. The carriage body building cost ranges from INR 0.2 million for a small sized truck to INR 0.7 million for a big truck. The financer provisions for funding body building cost too with the vehicle loan. But, the NBFC assumes that body costs may be overstated and the body is usually not very long lasting. Tata motors accounts for nearly 76 per cent of all vehicles funded in the region. Interaction with various transporters in the region revealed that Tata Motors provides an extensive network of repair centers and workshops in the region leading to higher acceptability. Vehicles from minority manufacturers in the region usually account for a higher rate of default. Medium & Heavy Commercial Vehicle (M&HCV) segment remains the most lucrative one due to a number of Grain Markets and Steel Traders in adjoining areas. Iron Ore, Oil and food grains contribute to a major portion of total load carried.

Nearly 40 per cent of the vehicles funded by the company are re purchase and refinance cases. The performance of old vehicles is generally lower than that of new vehicles and it reduces the ability of hirers to gainfully deploy them in market. To ensure the customer equity, the company requires hirers to pay one month EMI in advance before proposal evaluation. This is an industry standard practice in India. But, NBFC under study provides for waiving off this advance payment under a controlled environment. Cases with the advance installment waived off are perceived to have a higher risk associated. The decision makers in financial institutions often feel very 'comfortable' while dealing with cases having exposure (as a percentage of cost) less than 50 per cent. Majority of business sourced by the company falls in the uneducated rural and semi urban areas, where commercial banking usage is not as high as in urban areas in India. About 99 per cent of the borrowers preferred the option to pay their EMI in cash every month. The option of asking post dated cheques in some predefined risky cases (from prior experience) is usually followed so as to pave the way for legal option if needed. Vehicles bought for captive (non-commercial) use contribute a very low share of total business, due to various documentation requirements. This segment, though very low, amounts to virtually 'clean' business with comparatively less default risk.

DATA ANALYSIS AND RESULTS

SPSS 16.0 is used in this study with backward stepwise (LR) elimination method of Logistic Regression. The regression output suggests elimination of six variables out of seventeen proposed variables. The six eliminated variables are body funding, payment terms, advance installment, source type, Co-Hirer Taken, and strategic business unit/regions.

The final logistic regression model is represented in Equation I

$$Y = -4.086 + \beta Quarter * Qtr + \beta monthend * Monthend + \beta custcat * Custcat + \beta Tenorband * Tenorband + \beta makename * MakeName + \beta ProductGroup * ProductGroup + \beta Quality * Quality + \beta Expband * Expband + \beta IRRband * IRRband + \beta Purpose * Purpose + \beta Fleet * Fleet$$

(Equation I)

The correspondence between the actual and predicted values of dependent variable is investigated by Homser and Lemeshow goodness of fit statistic. A good model fit is indicated by a non-significant chi-square value. Table II shows goodness of statistic fit values for all the seven models developed by SPSS while searching for the best model for this study.

Data analysis suggests that eleven independent variables out of the proposed seventeen variables are statistically significantly affecting the defaults ($p < 0.05$). The result is presented in Table III. This predictive model can be used to calculate the probability of default based on the contract specific variables.

TABLE II: HOMSER AND LEMESHOW GOODNESS OF FIT STATISTIC FOR MODELS

Step	Chi-square	df	Sig.
1	3.94	8.00	0.86
2	4.01	8.00	0.86
3	4.24	8.00	0.83
4	5.63	8.00	0.69
5	5.44	8.00	0.71
6	7.10	8.00	0.53
7	6.62	8.00	0.58

TABLE III: LOGISTIC REGRESSION OUTPUT

Step 7	B	S.E.	Wald	df	Sig.	Exp(B)
Qtr			32.77	3.00	0.00	
Qtr(Apr-June)	0.38	0.08	23.32	1.00	0.00	1.47
Qtr(July-Sep)	0.37	0.08	23.40	1.00	0.00	1.45
Qtr(Oct-Dec)	0.16	0.08	3.75	1.00	0.05	1.17
Monthend(Yes)	-0.31	0.06	25.21	1.00	0.00	0.73
CUSTCAT			15.44	3.00	0.00	
CUSTCAT(A)	-0.91	0.34	7.35	1.00	0.01	0.40
CUSTCAT(B)	-1.04	0.31	11.04	1.00	0.00	0.36
CUSTCAT(C)	-0.79	0.30	6.84	1.00	0.01	0.45
Tenorband			60.99	4.00	0.00	
Tenorband(<= 12 M)	1.09	0.30	13.52	1.00	0.00	2.98
Tenorband(>12 & <= 24 M)	0.58	0.20	8.25	1.00	0.00	1.79
Tenorband(>24 & <= 36 M)	-0.04	0.19	0.06	1.00	0.81	0.96
Tenorband(>36 & <= 48 M)	-0.07	0.17	0.17	1.00	0.68	0.93
MakeName			174.94	6.00	0.00	
MakeName(Ashok Leyland)	0.79	0.11	48.16	1.00	0.00	2.21
MakeName(Bajaj)	0.60	0.38	2.45	1.00	0.12	1.81
MakeName(Eicher)	0.63	0.12	27.25	1.00	0.00	1.88
MakeName(Force Motors)	-1.51	1.05	2.06	1.00	0.15	0.22
MakeName(Mahindra & Mahindra)	-1.19	0.19	38.83	1.00	0.00	0.31
MakeName(Swaraj Mazda)	1.52	0.16	91.66	1.00	0.00	4.56
ProductGroup			93.18	6.00	0.00	
ProductGroup(Bus)	0.27	0.23	1.31	1.00	0.25	1.31
ProductGroup(LCV)	0.08	0.20	0.16	1.00	0.69	1.08
ProductGroup(M&HCV)	0.47	0.18	6.73	1.00	0.01	1.60
ProductGroup(MUV)	1.82	0.25	54.46	1.00	0.00	6.19
ProductGroup(Tipper)	0.62	0.34	3.32	1.00	0.07	1.85
ProductGroup(Tractor)	0.50	0.33	2.39	1.00	0.12	1.66
Quality(New)	-0.36	0.13	7.40	1.00	0.01	0.70
EXPBANDS			64.11	6.00	0.00	
EXPBANDS(<=50)	0.30	0.20	2.31	1.00	0.13	1.35
EXPBANDS(>50 & <=65)	-0.15	0.19	0.63	1.00	0.43	0.86
EXPBANDS(>65 & <=80)	-0.26	0.15	2.93	1.00	0.09	0.77
EXPBANDS(>80 & <=85)	0.43	0.14	9.74	1.00	0.00	1.54
EXPBANDS(>85 & <= 90)	0.25	0.14	3.43	1.00	0.06	1.29
EXPBANDS(>90 & <=95)	-0.04	0.15	0.06	1.00	0.82	0.97
IRRband			46.70	4.00	0.00	
IRRband(< 8.01)	0.15	0.17	0.76	1.00	0.38	1.16
IRRband(>=8.01 & < 9.10)	0.69	0.13	29.80	1.00	0.00	1.99
IRRband(>=9.10 & <10.40)	0.53	0.10	26.36	1.00	0.00	1.70
IRRband(>=10.40 & <13)	0.30	0.07	17.99	1.00	0.00	1.34
Purpose(Commercial)	2.55	0.58	19.19	1.00	0.00	12.86
Fleet	-0.10	0.02	22.70	1.00	0.00	0.90
Constant	-4.09	0.72	32.35	1.00	0.00	0.02

As an illustration: According to this model, the probability of committing a default for a CV borrower of category '2', having a fleet of six vehicles, applying for a 45 per cent loan on an Old Tata Medium & Heavy Commercial Vehicle on a month-end, for a period of 18 months, at an IRR of 13.5 per cent, for commercial deployment is 22 percent that is high than the accepted level of 15 percent. Thus it would be advisable not to extend a loan to the applicant.

Modified cut off value classification

In a logistic regression, the classification cut off relates to the sensitivity and specificity of results. Using the default value of 0.5 as cut off would mean accepting a proposal with a default probability of 50 percent. To align the model with a very low risk appetite of NBFC's, the logistic regression results are computed for classification cut-off of 15 per cent instead of the default value of 50 per cent. This signifies that any proposal with a default probability of 15 percent or more is liable to be rejected. Though NBFCs would prefer to ignore any case with even a slight probability of default, taking a value below 15 percent would practically result in rejecting most of the cases, which is not desirable from business point of view. A similar approach was used by Gardner and Mills by evaluating three Logit Regression models at different classification accuracies (Gardner and Mills 1989). A comparison of the classification tables at a 15 per cent and 20 per cent cut-off is presented in Table IV.

TABLE IV: COMPARING THE RESULTS AT DIFFERENT CLASSIFICATION CUT-OFFS

Observed			Predicted at 15%*			Predicted at 20%*		
			Default		% correct	Default		% correct
			No	Yes		No	Yes	
Step 7	Default	No	7765	2720	74.1	9015	1470	86
		Yes	735	861	53.9	975	621	38.9
	Overall Percentage				71.4			79.8

**Calculations at a 20 per cent cut-off percentage yield a higher accuracy of 79.8 per cent overall.*

But, a 20 per cent cut-off results in a decrease in the correct predicted defaults. Thus, keeping in view the higher risk involved in a 20 per cent cut-off, 15 per cent cut-off level is proposed in the final model.

DISCUSSION

Various insights emerge from this study related to the use of contract specific variables in predicting the loan defaults. Out of the predictors analyzed, some of them conform to the industry practice, beliefs and expectations.

Default rates at all four SBUs are about equal in the data. The absence of SBU variable in the final model suggests that SBU specific variations are insignificant and cannot be used as a predictor of default rates. This conforms to the industry practice of following similar funding norms and processes across offices.

Among all manufacturers, the cases with customers using Tata vehicles do not show any significant impact on defaults. Swaraj Mazda and Ashok Leyland are the variables that significantly increase chances of default, whereas Mahindra & Mahindra and Force Motors have the opposite impact.

Funding of MUVs in the region has been found to be more risky than other vehicle types in the CV segment. This is in line with the expectations of managers interviewed in this study. Similar expectations about the performance of new vehicles as against old vehicles also emerge true. This is also in line with financers' efforts to promote new vehicle market in spite of low interest earned by the finance company.

With respect to IRR bands, it has been found that customers who are charged with higher IRRs have low odds of defaults with a lower band of '>=8.01% and < 9.10%' leading to an increased odd of default. Practitioners don not seem to have any specific belief in this regard as the IRR bands are not variable and are calculated as per a uniform table based on various factors not under the scope of this study.

Commercial usage cases in the data reflect a significant increase of odds of default. This behavior is exactly in accordance with expected results. Non-commercial cases, which contributed to a clean business, though have been found to be insignificant. Experience of customer as well as the number of vehicles owned has long been considered a crucial factor while lending. Customers with a higher fleet size are not expected to commit defaults. This assumption has been confirmed in the present study.

On the other hand there are some of the variables that seem to challenge the industry established beliefs and practices. Though source type has traditionally been considered as a significant variable in lending decisions, the analysis shows that the impact of source is insignificant. As Preferential treatment to direct sourced cases, though statistically insignificant and uncalled for, may be due to the ease of collections and approachability of the customer once default has been committed. Further non-direct cases are not encouraged by such companies due to the scope of malpractices discussed earlier in the '*Variables*' section of this paper.

The industry belief that loans offered during later part of the financial year post a significant amount of pressure on credit teams due to a relatively high pressure in terms of business and compliance; actually seems to improve the quality of their appraisal process. Similarly cases sourced during lean months are expected to perform better due to low pressures as per industry belief. As against the beliefs of industry practitioners, impact of cases sourced in the final quarter on default is insignificant whereas cases sourced during the lean months of first two quarters significantly increase the odds of default. Similar interpretation can be made about month-end cases which are found to decrease the odds of default significantly. As per the feedback taken from practitioners, it was found that since such cases were considered to be risky, the appraisal of these cases was based on more cautious approach.

Taking a co-hirer in the assumed risky cases is commonly believed to decrease the default rates. But the absence of the variable in the model suggests that its impact is insignificant. A logical explanation could be that quality of most of the assumed risky cases are improved by taking a co-hirer and thus the overall impact on default ceases to exist. But the data provided by the company does not capture details of the underwriting process and no data was available to indicate the conversion of such cases to co-hirer based cases. Another explanation to the phenomena could be that induction of co-hirers could be to reassure the appraiser of the presence of an experienced or existing customer who would be helpful for a better vehicle deployment and who could later be approached in case of a default for recovery. During our interviews, industry practitioners seemed to agree to the second explanation.

Three out of four customer categories have been found to decrease the odds of default with comparable coefficient values. This may be due to the variables that impact the classification of customers in these categories, which are not covered in this study. Higher tenor bands have proved not to have significant impact on defaults as against the industry belief. The absence of this predictor seems to arise from the fact that in case of a default, the re-sale value of the vehicle in recovered would be very low due to age of the vehicle. Alternatively, the reason for preferring medium tenor bands by companies may be due to some other factors like cost, operations efficiency and not only on default rates.

Vehicle body funding is found to be insignificant in the study. Reluctance to fund the vehicle body may exist due to other reasons like variation in body building costs due to unorganized nature of the industry, thereby inducing variability in the resale values of recovered vehicles. Advance Installment cases are being preferred by practitioners. But, the result of the data analysis suggests an insignificant effect of this variable. This practice seems to have evolved in an effort to reduce pressure on early delinquency teams (Those dealing with non repayment for less than 60 days and non-starters) by collecting one or two installments in advance. This may further reduce the higher effort by sales team in the fields while convincing borrowers to avail a loan.

Impact of Exposure bands (LTV) presents most unexpected result in the analysis. In general, it is expected that higher the customer equity (or lower the LTV), lower are the chances of a default. The analysis shows a mixed result. Very low LTVs have been found to increase odds of default and very high LTVs has shown to decrease the odds of default. The reason for such a result warrants further analysis as it may be due to some other predictors not included in the study or due to company specific reasons.

Preferential treatment for PDC case customers by most financers seems to be an effort not to reduce defaults but to reduce overheads and costs associated with reminder calls to customers as this variable has been found to be insignificant.

Tables V & VI list factors significantly increasing and factors significantly decreasing odds of default.

TABLE V: FACTORS SIGNIFICANTLY INCREASING THE ODDS OF DEFAULT

S.No.	Variable Name	Variable Value	Coefficient	Significance
1	Purpose	Commercial	2.554	0.00
2	Product Group	MUV	1.823	0.00
3	Make Name	Swaraj Mazda	1.517	0.00
4	Tenor Band	<= 12 Months	1.093	0.00
5	Make Name	Ashok Leyland	0.794	0.00
6	IRR Band	>=8.01% and < 9.10%	0.689	0.00
7	Make Name	Eicher	0.632	0.00
8	Product Group	Tipper	0.615	0.07

TABLE VI: FACTORS SIGNIFICANTLY DECREASING THE ODDS OF DEFAULT

S.No.	Variable Name	Variable Value	Coefficient	Significance
1	Make Name	Force Motors Ltd	-1.508	0.15
2	Make Name	Mahindra & Mahindra	-1.185	0.00
3	Customer	CategoryB	-1.036	0.00
4	Customer	CategoryA	-0.909	0.00
5	Customer	CategoryC	-0.789	0.00
6	Quality	New Vehicle	-0.355	0.00
7	Month-end	Yes	-0.312	0.00
8	Exposure Band	>= 65% and <= 80%	-0.258	0.08
9	Exposure Band	>= 65% and <= 80%	-0.258	0.08

CONCLUSION

This study has tried to put most of the contract specific variables to test their ability to predict loan defaults. The results suggest possibility of modeling defaults using eleven contract specific variables. This approach is different from the prevalent practice of considering demographic variables of customers as highly important in decisions for credit granting. Using the proposed variables has a direct benefit to the companies in question as they can focus on preparing their credit policies on the basis of feasible offers they can provide rather than losing out on business due to credit rationing based on borrowers' demographic characteristics only. The accuracy of the models using contract specific variables can be further increased by using advanced non-linear models using neural networks and advanced data mining tools.

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