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Validation Model Design for Corporate Banks' Customers

Mohammad Eftekhari

M.A in Management of government financial trends, Islamic Azad University, Iran

ABSTRACT

Recently one of the main problems in banks and financial institutions is the risk of customers` credit risk that sometimes plays a key role in bankruptcy. It is obvious for credit risk management one useful way is dividing of banking customers into two groups; good pay customers and bad pay customers. Until now, variety of methods such as artificial neural networks, genetic algorithm, linear regression, logistic, probit and logit models have been used in the legal field to authenticate customers. In recent years has been more attention the logistic regression because of the high accuracy. In this research a logit model has been used to determine the probability of Mehr economy bank`s corporate customers default risk. In this model the dependent variable is the condition of customers` loan repayment and the explanatory variables are some financial ratios and corporate characteristics. Data collected from customers credit book from 2008 to 2010. Results show that some management and financial variables e.g. age, asset turnover ratio, bank credit history, Current Ratio, Average current account balance, Profit margins and interest rate are significant. Indeed Estimate provided Predicts Credit status of customers with 0.82 percent.

KEYWORDS
Credit risks, Logistic regression, Probability of default

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Introduction

The correct relationship between productive and financial systems is considered as the most important factors of growth and economic development in every country. Banks as main part of the financial system (banking basic system) play a major role in financing manufacturing, trade, consumption and even the governmental sections. In Iran, financing the real economy sectors is also a responsible for the country's banking network according to the country's

CORRESPONDENCE Mohammad Eftekhari ✉ mohamadeftekhari63@yahoo.com

economic structure and for reasons such as not to develop the capital markets and other non-banking and contracting networks. In this regard, providing financial facilities is one of the important activities of banking system. Credit rating and ability to repay the real facilities and interest on the granting facilities should be determined for granting financial facilities. The probability of the non return of real and interest on granting facilities are called credit risk. Credit risk In summary, refers to the non-fulfillment of the obligations of the receiving facilities (the borrower) to the contracting party (the bank) in accordance with agreed criteria (Amir Koasemi, 2010). Inability of clients to repay loans and facilities, which leads to blocking banks' capital in suspended way and the considerable volume of facilities granted will be unpaid or overdue of banks, is suggesting the lack of use of appropriate models to measure credit risk and the lack of assessment of ability to repay the facilities of loan borrowers so that we observe an increase in these figures and statistics in the different country's banks and it has ascending trend over the time. Focus on high-volume granting the facilities to an individual, company, industry group or specific economic sector are considered as factors to increase this risk. On the other hand entering credit institutions to domestic and international competition field and cope with the extensive volume of demand for credit have created new opportunities and threats for them. So, we observe increasing development of role of technology in the process of credit management of financial institutions and enterprises. The banking system must have a basis in order to assess clients for granting financial facilities so that acts to establish facilities after evaluating because the bank's profits and losses principally are caused by the quality of their granting facilities, so if the granting facilities and benefits are paid easily naturally banking operations is not harmful and as a result, the deposits are not at risk and on the other hand also problems and crisis of debt and receivables collection will not be imposed to credit team. Thus, credit team performs its main task of paying facilities. Indicators that are considered today to determine the probability of non repayment of client commitments are according to detection of credit experts and committees and do not have clear and defined form. Need to identify clients for credit facilities has great importance given the size and importance of the banking systems of country to extend credit operations in various fields and Medium-term and even long-term plans performing. Due to the rapid growth of bad loans in recent years, it seems precautionary measures must be taken to reduce losses from non-repayment. One of the main strategies in this sector (granting facility) is use common patterns to validate the clients before granting the facilities that this solution has been emphasized in the recommendations of the Bal Committee repeatedly, especially in a statement Bal 2. The use of validation models needs access to accurate and correct information from financial statements and as well as the status of the applicant credit firms that correct judgment can be made based on them about granting or denial of facilities to them. First previous researches are be presented according to the above descriptions in this paper and the theoretical foundations of research and methodology are discussed in following and data analysis and results will be discussed in the end.

Research background

Today, credit institutions and also financial institutions and banks in various countries use logistic regression models in ratings and validation of their clients that we have chosen studies among them that we will refer to some of them here.

- Jonathan L. Crook, David Edelman, Layn C Thomas in 2007 in their research entitled "Recent developments in estimating the credit risk of consumers" tried to reduce the risk of lenders due to an increase in the percentage of loans (in America and some European countries since 2001 to 2004). Model was estimated by Logistic regression. Results showed that credit scoring and risk determination is one of the most successful set of statistical and operating tools in determining credit decisions, as well as has caused to increase competition in the credit market and reduce risk for lenders (Baha Karan, 2004).
- Mehmet Baha Karan in his article titled "Profile of Turkish households risk for consumer credits" investigates the credit market and Turkish households. Decision trees method, neural networks and logit regression were used in this paper, and the results showed a positive relationship between the variables related to income and savings with consumer credit.
- Thomas Lyn C in his article entitled: "Evaluation of credit and behavioral scoring: Forecast the financial risk of lending to consumer " investigated consumer's credit payment terms in 2000 by using statistical and operational methods including decision tree and logistic regression. He used 5cs, 3cs, 4cs System for characterization of consumers. Used techniques provided communication between scoring and ranking to potential sales of organizations and have made significant progress for organizations In conjunction with the anticipating bad debts, product sales and also profit of a corporation (Moon & Young, 2008)- Soudabeh. Zarinpour Hasan Kiyadeh in 2008 in her thesis entitled: "Development of a classification system and validating bank's clients" evaluated 11 variables based on Generalized Linear Models to study cases of corporate clients of Saderat Bank by using logit regression model. Results showed that history variables in the bank, profitability, debt, collateral type and amount of credit, were more important and finally created a model in ratings and validation of corporate and legal clients of bank.
- Shabnam Amir Koasmi in 2010 in her thesis entitled "Design Validation Pattern of customers and its role in reducing credit risk in banks in case form in the Eghtesade Novin bank" estimated the information by using neural networks and logit regression. Ultimately they provided variables related to the current ratio, debt ratio and admitted profit to differentiate between good and bad clients in terms of credit risk.

Theoretical Foundations of the research:

Among the most important risks that a financial institution such as a bank is encountered with it include credit risk, market risk, operational risk, interest rate risk, liquidity risk, profitability risk and the risk of failure to repay the obligations. The focus of this article is credit risk, and the credit risk is the probability of the non-return of real capital and interest of granting facilities.

Logit and probit models:

Logit and probit models are one of the statistical methods that are raised in credit scoring issues (Hedayati et al., 2010). Logistic regression model or logit model is used a lot as a statistical model when the probability of a result of a two-state depends on a set of independent potential variables. (Jalili, 2011) Logistic regression is one of the most famous statistical tools for classification issues. Joanes in 1993, Laitinen in 1999, Westgaard and Van Der Wijst were from among those who raise the use of logistic regression in miking credit scoring models. (Sadeghi, 2007)
Cumulative distribution functions, create a set of changes that puts the probability rate (p) at a distance of zero and one , while still have their uniform properties (ie they are uniform increasing or decreasing functions).Assume that a standard normal distribution is selected to represent this probability.

$$p=\phi(\beta'X)=\int_{-\infty}^{\beta'x}\varphi(z)\,dz$$

In which $\varphi(z)$ is the standard normal density function.

This function is the management of probit. This is equivalent to say that a person is good if her/his score is above a certain level. But this level varies from person to person and has a normal distribution (Thomas, 2000). Probit model in matters of credit rating assumes that the probability of default in repayment follows probity probability distribution.
If the logistic distribution function is used for expression probability of agreement of p, will lead in the logistic regression model (logit model)
This shows that the total of input variables with weight (independent variables) is correlated in line form with the natural logarithm of the odds that the result of event has occurred.
Unlike normal distribution function, logistic distribution function has the closed form (as can be seen in the equation) that makes much easier the calculation the logit model than probity model. Usually two models are estimated by using maximum likelihood method that includes the most likelihood. (Shadabfar, 2010) So making them computerized, their implementation and application is relatively simple, inexpensive and convenient. (Shadabfar, 2010)
Logistic regression model does not need to assumptions of discriminated analysis, necessarily. The benefits of logistic model is that, unlike discriminated analysis, does not consider multivariate normality assumption and equal variance-covariance matrix assumption. On one hand, Harrell and Lee in 1985 found that logistic regression model is efficient and accurate as much as these models even when, all hypotheses are true in discriminated analysis model. (Tian-Shyug et al., 2002)

Many researchers prefer logistic regression because this method is similar to conventional regression and has appropriate accuracy. (Zarrin Poor, 2008)

Research Methodology:

The statistical population and sample size:

The statistical population of research consists of all corporate and legal clients (, industrious - manufacturing companies) of Mehre Eghtesad bank in the years 2008 till 2010 in levels of branches in Big Tehran. Considered companies act mainly in sectors such as production of spare parts, electrical equipments, food, industrial products, chemicals, machineries, plastics and transportation.

The number of records in the case for corporate and legal clients was 70 during these years. 59 acceptable samples of 70 credit files of corporate and legal clients of the Mehre Eghtesad bank were introduced by using Krejcie and Morgan Table. To have an equal chance, records were selected in simple random sampling that 30 observations were in the category of good clients (repayment loans) and 29 observations in the category of bad clients (postponed).

The data collection method

Researched information on the relation with companies, such as location of trade, time of establishment, the staff rate, transactions volume, new ownership, Company activity records, client basic features, and information about the credit and legal history were prepared by referring to the documents and records of credit in the banks and related officials.

introducing the variables of the model:

Since many variables that are considered, are extracted of the main financial statements (balance sheet and profit and losses statement) and its basic information they may have solidarity with each other in two to two form. If these variables are entered in the regression, they will cause to be nonsense other coefficients and, consequently, low efficiency of model estimators because of existence the co linearity. Therefore, this matter should be considered in entering independent variables in the logistic regression model and overall significant investigation in selected model.

Financial ratios and variables owned by the same factor can be assumed the sizes of a similar dimension of a company. This analysis helps us to decide about this point that which variables and ratios should be included in the validation algorithm to avoid the existence of co linearity among variables.

Model variables are divided into two parts of independent and dependent variables. As mentioned in the logistic regression model, the dependent variable is a binary variable that the dependent variable is customer performance (bad or good account , deferred or defaulted ,the repayment or no repayment, etc.) in this research that is correspond to the numbers zero and one.

Zero is assigned to bad clients that have defaulted on their payments and one is a corresponding number with good clients or clients who have not defaulted on their payments. The purpose of good clients are clients that had no delay in payment of their installments while bad clients have at least three months delay in their payments, or their files have been deferred and have no repayment at all. But independent variables that can be considered in this model are a lot and it is more than 120 variables in some researches. But this number significantly decreased after passing through the refinery filters and the availability of information.

In this research, our goal was first using variables in the form of main variables of character, earning capacity, capital, collateral and main financial ratios , but we rely on 30 following variables because being limited the data and the lack of adequate information and lack of access to all data, that in addition to have theoretical relationship with default risk of corporate and legal clients of the bank have the highest used cases in various studies and they are also notable for experts for banks.

These 30 variables that are used to determine client performance can be divided into two categories:

The main variables 2. Financial Ratios

These 30 variables include 14 financial ratios and 16 variables related to the non-balance Sheet basic information.

Main variables

All parameters that each client presents to get credit facilities to banks and non-balance sheet basic information as basic research variables were taken into account to Identify variables affecting the client's credit status. But Only 16 following variables was selected due to lack of sufficient data.

- Legal form of the company : Type of company is evaluated from the perspective of business and legal division and rules on them in this index that includes : joint stock, public joint stock, limited liability companies, cooperatives and other companies
- Age of Manager
- Accuracy and integrity of financial statements, including audited financial statement of real individual, personal financial statements, the financial statements audited in stock, audited financial statements of audited organization and tax return.

- Average of current account balance
- Last amount of capital
- Location of the project implementation: personal property within the city, leased, multi-owners released property, property in mortgage and personal property outside the city.
- History of activity in the field (in years)
- The number of personnel
- Type of collateral: promissory notes and collateral property, stock in the mortgage bank, Czech and residential property, residential property and Czech.
- How to repay
- Credit history with banks (in years)
- Circulation creditor

- Loan type: According to the way of depositing and all conditions of companies (splitting participation, buy the loan, civic participation, exchange contracts and managed funds) were considered.
- Loan amount
- Type of company: Productive, service, manufacturing - service, merchandising and other
- Percent of interest

Financial ratios:

14 variables are related to financial ratios in this research. These ratios have been chosen among ratios of liquidity, activity, profitability and debt that were more considered by banks. Although more than can be considered, but we ignore of rest ratios due to lack of access to information on other ratios.
These ratios include the following cases:
Current liabilities / current assets = Current ratio
(Current liabilities / {(current assets + Accounts receivable) - Inventories} = quick ratio
Gross / Net sale = profit margin
Average total assets / net sale = assets turnover ratio
Total assets / net income ratio = assets return ratio
Total equity /Net profit = return on equity rate
Equity / Total short and long term debt = debt-to-equity ratio
The average of inventory / finished cost of sold goods = Inventory turnover ratio
Inventory turnover ratio / year = number of inventory
Average of receivable Accounts / net sale = Accounts receivable turnover ratio
Receivable accounts turnover ratio / year = number of debt collection
Receivables collection period + flow of goods period + production period = Volume of Operations of Total Assets / Total Liabilities = ratio of debt to total assets
Net sales / net income = return on sales ratio
That the kind of these ratios and their relationships with repayment the facilities are brought in the table below

Table 1. Ratio title and type

Relation between ratio and facilities repayment	Ratio title	Ratio type
+	Current ratio[1]	Liquidity ratios
+	Quick ratio[2]	

[1]. Current Ratio
2. Quick Ratio

+	Profit margin[3]	Profitability ratios
+	Percentage Return on Assets[4]	
+	Return on Equity[5]	
+	Return on Sales Ratio[6]	
+	Asset Turnover Ratio[7]	Activity ratios (performance (
+	Good inventory turnover	
–	Receivable Collection Period[8]	
+	Operation turning period	
–	Debt-Equity Ratio [9]	Debt ratios
–	Debt-Equity Ratio	

Analysis of the results:
estimate logit model:

Estimate logit model in this study was conducted using the software package of eviews. All variables were entered into the model by using data from mentioned variables for 59 customers of authentication clients. We start first with a model consists of several regressors to build an appropriate model then we reduce that into a model that contains only the important variables. Remove variables so far has continued to maintain that consistent with the theory and of course is according to special methodology of this research.

Finally, after estimation the model, the following variables were identified as effective variables that significant of coefficients is as follows.

Table 2. significant of coefficients

Prob.	statistic z	coefficients	variable
0.0140	2.456730	0.977308	X02
0.0565	-1.907415	-0.024944	X04

[3]. Profit Margin
[4]. Percentage Return on Assets
5. Return on Equity
[6]. Return on Sales Ratio
7. Asset Turnover Ratio
[8]. Receivable Collection Period
9. Debt-Equity Ratio

0.0870	1.711313	0.421345	X07
0.1687	1.376276	0.400832	X08
0.0419	2.034082	0.903689	X10
0.3350	-0.964137	-0.274220	X29
0.0033	2.936310	0.681887	X18

✓ Age of manager:

In this research, age of manager variable as theoretical expectations has maximum effect and significant and positive relationship with the repayment of granting facilities. In the interpretation of the above variable that has been significant at the possibility level of 10% with a coefficient of 0.97, it can be ststed that, enough experience of manager had been effective in the company's success and the companies that have used experienced and skillful managers observe the right policies to receive and repay loans and facilities and are good clients.

✓ Assets turnover ratio:

Asset turnover ratio variable with coefficients of 0.90 at the possibility level of 10% after the age of manager has the most positive effect on the repayment of granting credit facilities in accordance with theoretical expectations. Sell rate of the company can be calculated by using asset turnover ratio (according to its productive capacity) (by assuming constant prices). When the company reaches its productive capacity, this ratio will reach to maximum level.

Reducing this ratio probably is a sign of reducing the activity size of the company and hence, lower asset turnover ratio may be consider a warning and forces analysts to calculate the ratios related to the specific items of assets to understand the factors associated with the decrease in the volume of activity. According to a 0.90 coefficient can be said that there is a significant and positive relationship between assets turnover ratio and repayment of credit granting facilities which theoretical expectations also prove this matter.

✓ Credit history besides the bank:

Third variable that has a positive impact on the repayment of credit obligations in this study is credit history besides the bank. Researchers have shown that companies that have a good credit history besides the banks, and in other words are among the good clients in repayment of credit facilities have necessary commitment and less see that the company with a proper experience and timely payment of its installments has default on repayment in the future. Credit history besides banks is significant at the 5% possibility level by a coefficient of 0.68. Thus, it can be concluded that one of the important factors in granting the facility is considering the number of granting the loans and how to repay it that as a result, bad client or good client can be determined by this method.

✓ Current ratio:

The next factor that has a significant and positive effect on the repayment the facilities is company current ratio by a coefficient of 0.42 percent. As previously stated, the current ratio is among ratios that shows liquidity power of company, and being high this ratio in company raises financial resources and as well as company acts more successful to repay debts and obligations. So according the results of this reach, it can be stated that attention to liquidity of a company requesting a loan is one of the determining factors in the validity of legal clients because a company that does not have good financial power cannot repay properly.

✓ Average of current account balance:

The average of current account balance of the company with banks in this study has had a negative effect on the repayment of commitments, which means that as much the company has better average balance of current account, the risk of pending case credit will increase that it is contrary to expectations, but ,it seems that emphasis of bank on the mentioned variable has been caused that clients act to increase current account turnover besides the banks only in time to get the facility that causes a positive attitude towards mentioned company from the side of bank a positive attitude towards due to the conducted negotiations with Bank experts in investigation the credit records of clients.

According to the results of this research, reliability and attention to this factor cannot be reliable and sure standard in order to valuation the companies to pay for the facilities.

✓ Profit margin:

Another variable that has a positive impact on the repayment of granting facilities is profit margin of the company. This ratio that is resulted of profit dividing after deduction the tax by net sales, calculates profitability per cent of sales. It is expected to reduce the probability of default of company by increasing the profitability of a company and increases the possibility of being a good client (company) according to the research results. The positive coefficient of 0.40% of the relevant variable suggests that this ratio is directly related to a lack of default.

✓ Interest rate:

The latest variable that was effective in the repayment of bank credit granting facilities to corporate and legal clients is interest rate in Mehre Eghtesad Bank. The results of this research suggest that companies are subjected to high interest rates of the loans have had more defaults to repay the obligations than companies with low interest rates. Perhaps, it can be stated that the companies that do not have good financial conditions and are in bankruptcy are trying to escape from the crisis with loans with high interest and are trying to improve their economic situations, which unfortunately risk of these companies is very high and virtually will be in default to repay loan and record of such companies will be placed among deferred cases. In general, demanding loan without attention to percentage of interest and being indifferent about it can be questionable from the perspective of credit experts.

Marginal effect:

In connection with the interpretation of the parameters in the probit and logit model, it should be said that data coefficient estimation cannot interpret the effect rate of independent variables and the dependent variable as well as linear regression model. What is important in the case of variable coefficients are their signs that being positive it indicate increasing the possibility of incidence of the selected condition (1) on the dependent variable and being negative is evidence of its decline. In general, the coefficients in binary models (Logit, Probit, Tobit and linear) cannot be interpreted as marginal effect on the dependent variable. Therefore, we investigate the estimation the marginal effect by stata software that shows the effect of each variable on the dependent variable with assuming that other variables are constant. It should be noted that signs of marginal effects of the explanatory variables are the same with signs of coefficients of variables in the original model. (Shadabfar, 2010)

Marginal effect estimation:

Table 3. Variable

Variable	dy/dx
X02	0.2423
X04	-0.0061
X07	0.1044
X08	0.0993
X10	0.2240
X29	-0.0679
X18	0.1690

Interpretation of the results of the marginal effect:

The obtained results of the calculation of the marginal effect of the available variables in the model indicate that the answers are the same according to the original model that are as follows:

0.24 percent of possibility to postpone the records is reduced with increasing age of one year to manager of the Company and assuming that other variables are constant.

0.0061 percent may be added to the possibility of postponing the records with the increase in the average balance of one million rial to the current account and assuming that other variables are constant.

0.104 ercent is reduced of deferred possibility of customer credit records with an increase of one percent to current ratio and by assuming that other variables are constant.
0.099 percent is reduced of deferred possibility of customer credit records with an increase of one percent to profit margin of company and by assuming that other variables are constant.
0.22 percent is reduced of deferred possibility of customer credit records with an increase of one percent to asset turnover ratio of company and by assuming that other variables are constant.
0.067 percent is increased to deferred possibility of records with an increase of one percent to interest ratio receivable of facilities and by assuming that other variables are constant.
0.169 percent is reduced of deferred possibility of customer credit records with an increase of one year to credit history of bank of demanding company got credit facilities and by assuming that other variables are constant.

Conclusion

Experimental studies results showed that logit model concluded more correct results among various models. For this reason, recently tendency to this model has been strengthened in banks and credit institutions. It is necessary to set up a database of credit customer and statistics are maintained and kept in the form of time series by using logistic regression,. Then, the mentioned model is implemented and results to be extracted using the statistics that are taken from client in question of the certificate,. Also application of statistical models, such as logistic regression due to quality of statistical analysis has priority than the artificial neural network models
Overall, findings of this research can be summarized in following cases:

- There is significant statistical model based on logistic regression to determine legal clients' credit status of Mehre Eghtesad Bank. The proposed model can be considered as a basic strategy to improve the capital adequacy ratio of banks
- This model can present the appropriate solutions for validated companies in line with productivity, so that as an expert system identifies often strengths and weaknesses of any company and suggests appropriate and basic solutions specifically to increase productivity that are based on scientific standards.
- Corporate and legal clients of Iran’s Mehre Eghtesad bank can be assessed in terms of credit risk based on the financial ratios and main variables.
- With the establishment of this system and determine the level of clients risk, the opportunity will be provided for the banking system that the interest rate on the credit facilities granted to any client to be identified but not according to credit section but also according to risk of each client.
- Among the variables used in this research, variables related to the "profit", "History in the bank", "credit rate", and "current ratio" was significant in this model. So bank have to pay more attention to these factors.

- variables related to the "age of manager, asset turnover ratio and credit history with the bank" because of having the biggest coefficient have the highest participation in the breakdown of the clients into the two companies with high credit risk and companies with low credit risk.

Suggestions

1- It is suggested to banks, that do not consider high capital as a positive factor in granting the facilities and consider also the duration of the promotion of the capital of client according to the results of a negative significant relationship between capital and the likelihood of facilities repayment,

2. According to the research results, it is recommended to age Manager, asset turnover ratio, credit history with the bank, the current ratio, the average current account balance, profit margin and interest rate variables are included as the most important variables affecting the credit risk in Bank clients assessment, respectively.

3. The research results show, one of the major challenges in assessing the credit risk of clients of Mehre Eghtesad is, loss database. Therefore, it is proposed to act to develop new questionnaire and save relevant information in data base according to extract the key variables affecting the credit risk in investigation the internal and external studies that were addressed in the review part on studies,

4. Although assess the credit risk of clients is one of the basic steps in controlling and risk management, but it can be acted given the range of other risks and provide a context for the design and implementation of a comprehensive system of risk.

Limitations of the research:

Among the research limitations that the researcher has:

1. Choose a small sample size, due to lack of access to sufficient information about the corporate clients of the Mehre Eghtesad bank, because first there are not some information about corporate bank clients in set of banking documents and files and also all documents and information in credit files were not available to researchers and, secondly, how to store information and its type is not based on technology oriented and computerized information systems.

2. Lack of quick and easy access to the needed information was one of the major problems facing the researcher.

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Mohammad Eftekhari
M.A in Management of government financial trends, Islamic Azad University, Iran

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