Credit Risk Management and Analysis in an Iranian Bank

Isa Nakhai Kamal Abadi, Esmaeel Saberi, Ehsan Mirjafari

Abstract—While financial institutions have faced difficulties over the years for a multitude of reasons, the major cause of serious banking problems continues to be directly related to lax credit standards for borrowers and counterparties, poor portfolio risk management, or a lack of attention to changes in economic or other circumstances that can lead to a deterioration in the credit standing of a bank's counterparties. Credit risk is most simply defined as the potential that a bank borrower or counterparty will fail to meet its obligations in accordance with agreed terms. The goal of credit risk management is to maximize a bank's risk-adjusted rate of return by maintaining credit risk exposure within acceptable parameters. Banks need to manage the credit risk inherent in the entire portfolio as well as the risk in individual credits or transactions. Banks should also consider the relationships between credit risk and other risks. The effective management of credit risk is a critical component of a comprehensive approach to risk management and essential to the long-term success of any banking organization. In this research we also study the relationship between credit risk indices and borrower's timely payback in Karafarin bank.

Keywords—Financial Ratios; Spearman Test; Bank Operations Risk

I. INTRODUCTION

IN financial activities, credit risk is one of the key effective elements to the work (functionality) of banks and credit institutes[1]. In practice identification and determination of risks in different parts of financial activities have major impact on stability and survival of these institutes. [1]

Nowadays the main reason for the banks' bankruptcy is credit risks. In this research we are to determine credit risk for borrowers' demand for facilities. We use index credit risk for customers that receive long-run payment selling facilities from Karafarin Bank and introduce a model to determine borrowers' credit risk in this bank. In similar cases we can use this method to decrease credit risks.

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II. BASIC CONCEPTS FOR DECISION MAKING ABOUT GIVING FACILITIES TO CUSTOMERS

A. Effectives in evaluating the demander of facilities (customer)

There are several factors that we can use to evaluate the demander of facilities. The main factors are: personality, capacity, situation and surety. In order to decide whether to lend to a person or not and how much lend the appropriate criterion is this person's timely payback. In a firm personality is derived from manager's personality. Hence the information for a firm to be considered is the information derived from its manager. For a firm the main factors are: stability, previous work, long-run strategy and plan. [2]

B. Financial analysis for decision making about giving facilities to commercial firms

In order to give facilities to legal persons and corporation one should study and analyze the demander in areas such as financial situation, operation results, manager's work, etc… in other words a financial analysis should be made which consists of two analysis.

The First is analysis of financial situation, results of operation and work of a unit and analysis of past in order to make decision in future.

The second is analysis of plans and investments which are based on forecast of financial situations and future operational results that a unit or a project brings about (achieves). [3]

III. BANK OPERATIONS RISK

From banking point of view risk is uncertainty about an event. The risks of banking can be divided into six categories, credit risk, cash risk, market risk, interest rate risk, profitability risk and risk of the customer who is unable to pay back his dues. Credit risk, among these risks plays an important role.

Sinkey believes that the main cause of financial crisis in banks is inordinate credit risk which originates from losses due to loans [4]. Hence a question that arises for a banker is: "is customer able to return his dues timely?"

Not paying back can occur in the following ways: [5]

1. The probability that customer does not afford to pay back his dues.(the probability of insolvent customer)

2. The probability that customer doesn't pay back his dues.

3. The probability that customer postpones the payback.

Some causes of credit risk can be as follows: [5]

1. The probability of critical situation in industry

World Academy of Science, Engineering and Technology
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Vol:5, No:6, 2011

2. The due date of payment isn't determined correctly.
3. The customer isn't good pay.
4. Disasters such as fire, flood, etc…

IV. STRUCTURE OF CREDIT RISK MANAGEMENT AND ITS EXECUTION METHODS IN BANK

In order to encourage banks and their supervisors in the worldwide, BAL committee announced the principal for the management of credit risk. These principals are: [6]

1. Providing appropriate condition for management of credit risk
2. Giving credit without fault, according to its process
3. Creating and preserving appropriate credit methods, performing required calculation and supervising the process of crediting
4. Become certain of enough control over the credit risk

V. HELPFUL HINTS CREDIT RISK ANALYSIS

Banks analyze credit risk to see if the commercial institute is able to pay back its dues timely. Financial risk analysis can be done in two ways. In first method one forecasts the future to see whether the unit under consideration will go bankrupt? In second method, smaller risks stemming from financial distress are analyzed.

When the risks mentioned in second method aren't solved, the bankruptcy will occur[7].

VI. UTILIZATION OF FINANCIAL RATIOS ANALYSIS IN THE BARROWERS' SITUATION. [8], [9] , [10]

Financial indexes that are used to study the barrower's situation are different in credit time and one can divide them in two sets, short-run and long-run. Survey of short-run solvency, Survey of long-run solvency and important ratios in fundamental analysis. Financial ratios in an economic firm are divided into four groups:

1. Cash ratios: the more important cash ratios are as following table

TABLE I
CASH RATIOS

name	concept
Current ratio	Solvency of current debts from current assets
Quick ratio	Solvency of current debts in critical situation
Working capital ratio	Net proportion of current assets in total assets
[1] Current assets ratio	[2] Net proportion of current assets in total assets

2. Activity ratios: in general, these ratios evaluates the manager's efficiency in utilization of capital and total assets

TABLE II
ACTIVITY RATIOS

name	concept
Assets turn over	Calculates relation between 1 unit of sales and 1 unit of assets
Working turn over	Speed of working capital
Inventory turn over ratio	Speed of inventory turn over
Average collection period	Collection situation
Percent change sale	Percent change sale
Percent change profit	Percent change profit

3. Leverage ratios: these ratios show amount of debts in the structure of capital and financial provision in commercial firms. When an institute goes bankrupt and is to settle, who much creditors and lenders to this firm will collect from this firm.

TABLE III
LEVERAGE RATIOS

name	concept
Debt ratio	Proportion of debts in total assets
Proprietary ratio	Stockholders portion in total assets
Debt ratio	Creditor portion in comparison to stockholders
Debt-coverage ratio	Comparison between long-run debt and realty as credit criterion

4. Profitability ratios: in general these ratios calculate profitability of a firm from different viewpoints such as profit ratio to 1 unit sale, profit ratio to 1 unit asset and profit ratio to 1 unit capital (stockholder's due)

TABLE IV
PROFITABILITY RATIOS

name	concept
Gross profit ratio	Portion of cost of finished good from sale
Return on sales	Profit of 1 monetary unit sale
Return on assets	Ability to use assets optimally

World Academy of Science, Engineering and Technology
International Journal of Economics and Management Engineering
Vol:5, No:6, 2011

Return on net worth	Profitability for stockholders
Return on working capital	Utilization of working capital in profitability

Altman's ratios[11]: This ratio is one of Altman's bankruptcy indices which includes the most effective ratios for bankruptcy of productive firms. Altman designated a coefficient to each ratio regarding its efficacy and achieves a numerical criterion.

VII. SPEARMAN'S RANK TEST

There are so many times that we deal with rank data or nominal data, the ordinary correlation coefficient can not be used, instead we can use Spearman's rank correlation coefficient. This coefficient can be calculated from the following procedure: [14]

Rank Xi from independent variable

Rank Y_i from dependent variable

Calculate difference between ranks.

The region lies where r_s>Critical value. Critical value for $4<n<30$ can be calculated from Spearman's rank correlation coefficient table. For sample with n>30, the significance test for r_s can be done using Spearman's correlation coefficient table. In this research we use these methods to test first and second assumptions. [14]

VIII. SURVEY ANALYSIS TEST

When dependent variable is nominal and independent variables are quantitative, in forecasting dependent variable (gregarious membership) in terms of independent variables, we should use *Survey analysis test.* In Survey analysis, groups should not cover each and membership of parameters under test should be characterized. In fact survey analysis is a multivariable linear regression test in which its dependent variable is in nominal or rank scale.

The survey analysis procedure has 3 steps[15]. These steps are

Step1- variable selection is based on theoretical and conceptual surveys, researcher's knowledge and primary two variable analysis.

Step2- In a method of survey analysis we use simultaneous regression and in other method we use step by step regression for all independent variable. The last method is known as Wilks method.

In this research we use step by step regression. First we put the variable with the most severability in the model and then other variables, in each step the variable with less severability will be removed from the model.

This ratio shows rational value of variance of survey marks which can not be achieved by difference between groups. When λ is a small number the mean of groups in different.

In this test F is the same as sideway variance analysis and is equal to sum of squared t in independent samples. P is significance level for the variable under study.

It is noticeable for researcher that the significant survey analysis is not the only criterion and he should test the Significance of difference between groups based on distance between two group centers (mean grade of each group under its survey function.

Since the dependent variable in survey analysis is non-metric we cannot use indices such as R^2 to increase accuracy of the model. Also statistical tests for determination of significance level for survey function cannot determine the recognition power of survey function.

One way to determine power of division power is hit ratio. For this purpose we calculate cutting score. The success ratio in survey analysis is like in ordinary regression. In credit determination of survey function in order to construct dividing matrix, researchers would like to calculate optimum cutting score. If number of observations in two groups are equal (as are in this research), optimum cutting score is medium point between two cancroids. If Z_a is the cancroids of group A and Z_b the centric of group B and Z_{ce} is medium point between two cancroids.

Step3- results are interpreted using Wilks' step by step method.

In order to study validity of results achieved by survey function, there are several methods. One uses classification matrix. This matrix shows the precision of survey function in forecasting (this matrix determines how many of forecasts are valid). The other important method uses cross-validation function.

The assumptions to be tested are:

H_0: There isn't any meaningful relationship between credit risk indices and customers' commitment.

H_1: There is a meaningful relationship between credit risk indices and customers' commitment.

Commitment variables such as surety, ratios in last two fiscal years before achieve facilities[1], and ratios in last two fiscal years before take loan[2], commercial receipt ratio in one fiscal year before that, and net profit difference ratio have larger significance interval than errors in a 95% significance level.

For customer's work history variable such as amounts of cheque, ratios in last two fiscal years before achieve facilities[3].

For customer's background variables such as amount of returned cheque, ratios in two successive fiscal years before getting facilities[4] and ratios in one year before getting facilities[5] and recovery of commercial charges in two fiscal year before getting facilities, ratio of unrecovered charges sales change ratio and surety ratio on achieved facilities significance level is less than level. Hence H0 hypothesis will be rejected in 95% significance level. As a result we claim that variables that have positive relation means that the larger these indices the more the better is demander credit situation

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[1] such as current ratio, inventory turn over ratio, proprietary ratio, debt ratio, debt coverage ratio, ratio of total debts to net worth, marginal sales ratio

[2] Quick ratio, assets turn over, Altman ratio

[3] Current assets ratio, working capital ratio to assets, working capital ratio,

[4] Current assets ratio, ratio of working capital on assets, working capital ratio, return on sale ratio, ROA ratio, ROE ratio and return on working capital ratio

[5] Quick ratio, asset turn over ratio Altman ratio

World Academy of Science, Engineering and Technology
International Journal of Economics and Management Engineering
Vol:5, No:6, 2011

and vice versa, for variables with negative relation the larger these indices the worse the demander credit situation.

In first hypothesis in 95% level there is a severe correlation between presented credit risk indices and customer commitment to payback and in evaluating the borrower firms we can use it.

Now we use survey analysis test to determine credit risk situation for productive firms which are bank's customer.

IX. RESULT OF SURVEY ANALYSIS AND INTRODUCTION TO MODEL

In this test first we enter all variables into the model gradually omit some of them until we achieve optimal model. In the following table you can see results of net value, Wilks λ and correlation coefficient.

TABLE V
RESULT OF SURVEY ANALYSIS

result	error	Freedom degree	X2	λ	r	Particular Value
significance difference	0/05	22	310/127	0/002	0/999	493/001

As sees in above table, significance level (i.e. p) is less than error (5%). So there is a significance difference between mean of all independent variables in two groups and Wilks λ is also small and shows that independent variables are not correlated. Because the significance level for Wilks 'λ is less than error the hypothesis that there isn't any linear relationship between independent variables and timely payback will be rejected. Hence estimation of survey analysis function is meaningful and has the power to segregate between two groups. In next step we estimate survey function step by step. Bellow formula gives the non-standardized coefficients for survey function

$$Z = -7.931 + 3.842X_1 - 0.262X_2 + 0.001X_3 + 348^*10^{-10}$$

$$X_4 + 2082^*10^{-9}X_5 + 79.548X_6 + 0.217X_7 - 0/012X_8 +$$

$$26.659X_9 +$$

$$73.683X_{10} + 5.731X_{11} - 19.567X_{12} - 0.709X_{13} - 4.99X_{14} -$$

$$47.435X_{15} + 8.108X_{16} - 1.705X_{17} + 21.813X_{18} - 84.503X_{19} +$$

$$3.884X_{20} - 1.715X_{21} - 14.345X_{22}$$

In order to study intensity of variable effects or their share in determining behaviour of dependent variable(the effect of each independent variable entered in the function in dividing desired groups) one should use the table of standardized coefficient table.

TABLE VI
STANDARDIZED COEFFICIENT

number	standardized coefficient	number	standardized coefficient	number	standardized coefficient
0	5/035	9	6/298	16	12/758
1	5/035	10	24/605	17	-6/199
2	-6/182	11	5/433	18	10/652
3	3/632	12	-2/835	19	-17/301
4	11/882	13	-3/073	20	11/022

5	-10/493	14	-16/999	21	-15/894
6	29/24	15	10/827-	22	-9/1

After we achieved survey function and become sure that function and its coefficients are meaningful, we should determine cutting score by means of survey function between two groups of customers which are 17.721 and -26.936 respectively. The sizes of two groups are equal and the cutting score will be -5. This means that if the score of an observation under survey function is less than -5 then it belongs two first group and if it is larger than or equal to -5 then it belongs to second group.

X. RESULT OF CREDIT MODEL (SURVEY FUNCTION)

Validity of survey function will be studied in two states: ordinary and crossed. Once we assist the precision of forecast over the sample and another time we use the U model to evaluate the validity of crossed survey validity which is similar to survey function test over observed sample that its (shich) size is equal to original sample. The results are summarized in below table. [17]

TABLE VII
RESULT OF CREDIT MODEL

			Predicted Group Membership		Total
			On time	With delay	
Original	Count	On time	44	4	48
		With delay	14	29	43
	%	On time	91.7	8.3	100
		With delay	32.6	67.4	100
Cross-Validated	Count	On time	44	4	48
		With delay	0	43	43
	%	On time	91.7	8.3	100
		With delay	100	100	100

Results show that in original method survey function can cathegorize 67.4% of group and 91.7% of group correctly. Because the size of two groups are equal the power cathegorizing of this function is

$$\frac{50 \times (\%67/4) + 50 \times (\%91/7)}{100} = \frac{\%67/4 + \%91/7}{2} = \%80$$

Based on cross validity method(U method) survey function mentioned above cathegorized 100% of and 91.7% of customers correctly. Hence the cathegorizing power 0f cross credit method is equal to 96%.

$$\frac{50 \times (\%100) + 50 \times (\%91/7)}{100} = \frac{\%100 + \%91/7}{2} = \%96$$

Second hypothesis in this article" is there any attention in Karafarin Bank to credit risk ratios".We show the useful ratios for bank.

World Academy of Science, Engineering and Technology
International Journal of Economics and Management Engineering
Vol:5, No:6, 2011

TABLE VIII
RATIOS

Ratios that are useful for bank: 1- Altman's ratios 2- Other financial ratios	
Cash ratios	Current ratio, Quick ratio, Working capital ratio, Current assets ratio
Activity ratios	Activity ratios Assets turn over, Working turn over, Inventory turn over ratio ,Average collection period, Percent change sale, Percent change profit
Profitability ratios	Return on working capital Return on net worth, Return on assets , Return on sales, Gross profit ratio

As is seen above leverage ratios are not important .

XI. RESULT

This article resulted in discovery of credit risk model that is shown as:

$$Z = -7.931 + 3.842X_1 - 0.262X_2 + 0.001X_3 + 348^*10^{-10}$$

$$X_4 + 2082^*10^{-9}X_5 + 79.548X_6 + 0.217X_7 - 0/012X_8 + 26.659X_9 +$$

$$73.683X_{10} + 5.731X_{11} - 19.567X_{12} - 0.709X_{13} - 4.99X_{14} -$$

$$47.435X_{15} + 8.108X_{16} - 1.705X_{17} + 21.813X_{18} - 84.503X_{19} +$$

$$3.884X_{20} - 1.715X_{21} - 14.345X_{22}$$

But the second hypothesis test shows that the credit risk ratios which are used in bank are not optimal; then we advised them to replace some seemingly important parameters by some other indicators.

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