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Measurement of credit risk in granted facilities to different economic sectors (case study: Iran Post bank)

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Abstract: Credit risk is one of the most important factors in producing risk in banks and financial institution. This risk arises from the issue that facility receivers do not have willingness or ability of repaying their debt to the bank which is called receivable outstanding that is synonym of credit risk. The aim of this study is to study the credit risk of Portfoy granted facilities of Iran post bank in different parts of economy (industry and mining, business and services, water and agriculture and building and housing) and compare them in these parts of post bank during 2008 till 2013 and it is calculated with the information that gains from different credit facilities in economic parts, the price of granted facilities, repayment of facilities, interest rate of facilities, interest rate without risk (interest rate of bonds) and the remaining facilities (such as current balance, past due and balance due). The estimated coefficient with using of genetic algorithm optimal showed that credit risk in different parts in order from high to low, are such as: business part and services, industry and mining, water and agriculture and finally building. Therefore, we can suggest that the management of the branches with considering the principles of customer validation in offering facilities time, have more control in different part in order from business part and services, industry and mining, water and agriculture and building.

Key words: *Credit risk; Post bank; Genetic algorithm*

1. Introduction

Each kind of business unit that tries to take their interest into maximum like banks will face to risks, in macro level with risks (for example, the effect of market stagnation) and in micro level also with risk (for example, new competitive threats). The growing process of banking industry has caused that managing the assets and debts become a matter of necessity for banks management. In this issue it can be cited to classify the harmonious assets of banks based on risk. Today, managing risk is considered as serious issue in banks. Banks have formed particular organization entitled "debt finance committee" in the world in order to maintain interestability and control various risk. Some banks are called this committee as entitled "debt group committee" or "managing asset and debt" (Farokhiani, 2007, 63).

In credit decision also like other techniques and fundamental criteria which has been offered by experts and professional associations, has been accepted gradually. These conditions and criteria are not certain and practical rules and like other techniques are the production of human idea and therefore, they are changeable, adjustable and correctable.

Using of these conditions and bank criteria involves the health and strength of the credit which means the realization of the principle of the ensuring the return of the allocated resources and its expected interest within the specified period. In fact, the tendency to the principle of returning resources, at first, we should consider the attention and alert based on necessary criteria within giving facilities. Because the more important than what it is mention about credit that giving facilities is easy but keeps and receiving it is difficult, the fact is that leniency and neglect in giving credit facilities causes problem in receiving them. The accuracy and attention to each of criteria in credit decision is not sufficient but it is needed a general idea which can offer a reliable and correct base for posing suggestion or adopt a credit decision. Aside of giving credit facilities like other techniques despite knowing criteria of related rules, it is needed enough knowledge and skill and without knowledge we cannot approach to this issue.

The aim of this research is calculating and determining credit risk of each of economic parts that post bank has performed in those parts to give facilities and also determining the Portfoy risk of granted facilities in this bank in different economic parts and showing the parts those have higher credit risk.

2. The principles of the theory and research background

2.1. Facilities rationing in different economic parts

Before performing expanded forth plan low in Iran, money and credit organization at the beginning

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of each year with the aim of supporting different economic parts determines the share of each economic part from the whole increase of outstanding granted facilities of governmental banks to non-governmental part and it is approved by commission ministers.

Table 1: The approved share of different economic parts from bank facilities and credit institution

1392	1391	1390	1389	1388	1387	Economic part
20	20	20	25	25	25	Water and Agriculture
37	37	37	37	35	33	Industry and Mining
25	25	25	20	20	20	Building
10	10	10	10	12	15	Business and services
8	8	8	8	8	7	Export

2.2. Credit risk

Credit risk is a risk that an asset or a debt does not return (but if the person in contract is bankrupted) or is the risk related to delay in loan install payment. In each of these two states, the recent value of asset will reduce. Therefore, the bank payment ability will decrease. If the contract sets between two counterparts, the counterparty risk is the risk that the counterpart of contract breaches the terms of the contract. Usually related conditions to risk mentions in financial tools and in these contracts credit risk is the probability of breaching the issues of loan contract (Parsaeian and Shirani, 2003: page 262).

Credit risk is a risk that creates from the not refund by contract counterpart, or in general is a risk that happened from accidental credit. This risk usually and historically happened about bonds, in a way that lenders could not receive the loan that they have paid to borrowers. That is why credit risk is called sometimes default risk.

2.3. Research background

Lei and Song (2013) in an article entitled "Liquidity Creation and Bank Capital Structure in China" has been dealt with the study of the link between creating liquidity and structure of bank capital in China. Research findings show that there is weak link between creating liquidity and bank capital in foreign banks in China which is consistent with the hypothesis of percent absorption of risk that is approved in previous study.

Drehmann and Nikolaou (2013) in an article entitled "Funding liquidity risk: definition and measurement", liquidity risk of financial resources has been played the main role in all critical banking. The main research findings show that liquidity risk of financial resources is generally stable and low.

Ben R. Craig and Valeriya Dinger (2013) in an article entitled "Competitive credit market, credit funds and bank risk", with using of data related to a sample of 589 companies have been dealt with the study of this topic. The main findings in this research approved the hypothesis of increasing risk in competitive market.

Bjorn Imbierowicz and Christian Rauch (2014) in an article entitled "The relationship between liquidity risk and credit risk in banks" with using of data during 1998 to 2010 for the USA have been dealt with the study of this topic. The findings of this research show that both risks have simultaneous connection to each other. However, banks consider both risks by pre hypothesis. The interaction of these two risks also depends on general level of bank risk.

3. Model and variables

3.1. Rating model for calculating possibility of default of bonds and rate of recovery

For modeling, we should recognize decision variables, the objective function and the limitations of the model. Therefore, for this research with regard to contracts of long term facilities, the possibility of default bonds will be estimated by rating model. According to the Jonkhart model, the amount of expected return of credit bonds with risk should be equal to return of governmental bonds without risk. At first, we assume that $V_{i,o}$ is the price of the loan of bank *i* and the number of loans is T_i. Expected Cash Flow of the loan based on evaluation risk model can be offered as the equation in below (Kuang, Chau, 2010: 9):

$$V_{i,o} = \sum_{t=1}^{T_i} \left[P_{i,t} \cdot \frac{B_{i,t}}{(1+r_{i,t})^t} + q_{i,t} \frac{\gamma . \tilde{v}_{i,t}}{(1+r_{i,t})^t} \right], \forall_i \quad (1)$$

In which:

P_{it}: the probability of repayment of original and the interest of the loan in time t

$B_{i,t}$: the original and maturing interest of borrower at time t

r_{it}: the interest rate without risk based on similar time of loan

q_{it}: the possibility of default of borrower from time (t-1) until t

$\tilde{V}_{i,t}$: not paid remain of original and interest of loan in time t

γ: the rate of receiving the bank assets that borrower defaults it in time t

Aside of a model, the possibility of repayment $P_{i,t}$ has same understanding with the possibility of default $q_{i,t}$, therefore, the possibility of default can consider as a possibility of margin repayment between time (t-1) till t (Kuang and Chau, 2010: 10).

$q_{it} = P_{i(t-1)} - P_{i,t}$

Now if we consider $\lambda_{i,t}$ as the possibility of default in time t for the loan i, we have for estimating the linear subordinate of possibility of default order of payment for each loan of i:

$$\lambda_{it} = \alpha + \beta t, \forall_i, t = 1,2,\dots T_i \quad (2)$$

α and β in recent equation are parameters that should estimate during calculation in order to

estimate the subordinate default. If the estimation of β is equal to zero, model is equal to Fons model.

Aside the link between $\lambda_{i,t}$ and P_{it} in equation (1) is as below:

$$P_{i,t}=(1-\lambda_{i,t})'=(1-\alpha-\beta t)'\forall_i, t = 1,2,\dots T_i \quad (3)$$

Marginal probability of repayment of current installment can count with ratio of dividing repayment probability of installment t on installment t-1:

$$P_{i,t} = \frac{P_{i,t}}{P_{i,t-1}} = \frac{(1-\alpha-\beta t)^t}{(1-\alpha-\beta(t-1))^{t-1}}\forall_i, t = 1,2,\dots T_i \quad (4)$$

With replacing equation (3) into equation (1), we can find out equation (5) which estimates the current value of expected loan:

$$\hat{V}_{i,o} = \sum_{t=1}^{T_i}\left[(1-\alpha-\beta t)'.\frac{B_{i,t}}{(1+r_{i,t})^t} + \{(1-\alpha-\beta(t-1))^{t-1} - (1-\alpha-\beta t)^t\}\frac{\gamma.\bar{v}_{i,t}}{(1+r_{i,t})^t}\right], \forall_i \quad (5)$$

Now we can estimate the current value of loans of bank with using of equation (1) to (5). On the other hand, sum of squared errors expresses as below:

$$SSR_O = \sum_{i=1}^{N}(V_{i,o} - \hat{V}_{i,o})^2 \quad (6)$$

Because, there is natural limitations for coefficients (β،α andγ) between zero and one, therefore, these coefficients will estimate simultaneously. Therefore, equation 6 is mentioned as equation 7 for least sum of squared errors under the limited condition for estimation of unknown coefficients:

$$\arg\min_{(\hat{\alpha},\hat{\beta},\hat{\gamma})} SSR_O = \sum_{i=1}^{N}(V_{i,o} - \hat{V}_{i,o})^2$$

$$s.t.\frac{1}{N}\sum_{i=1}^{N}(V_{i,o} - \hat{V}_{i,o})^2 0 \le \lambda_{i,t}(\alpha,\beta) \le 1;\ 0 \le \gamma \le 1\ \forall_i \quad (7)$$

Also in addition of this method, it has used the genetic algorithm model.

3.2. Describe the statistical community

The statistical community in this research is the customers of post bank of Iran who have received facilities from the branches of this bank and it has been still pending until the end of year 2013. Statistical data of this research has extracted as time series from period of year 2008 till 2013 from the total paid facilities of post bank of Iran. According to report from software of bank, the number of facilities with mentioned profile is 224042 which is identified as statistical community of the research.

In order to analyze data, the Matlab, Eviews, and Excel software have been used.

4. Estimation of model

4.1. Statistical description

The statistical description of research variables is as Table 3.

Table 2: Used statistical community in this research

Numbers of facilities	Name of sector	Row
3931	Industry and Mine	1
185648	Business and services	2
4990	Building	3
29472	Water and Agriculture	4
224042	**Total of bank**	

Table 3: Statistical description in industry and mine sector (million Rials)

The rate without risk	The number of average installment	Outstanding receivable	Received amount of facilities	Total facilities	Statistic
10/49	17/74	720/55	9273/43	9995/56	Mean
16	24	0	328	470	Median
20	48	2984	41025	88800/36	Maximum
0	0	0	0	0	Minimum
8/53	15/48	16/02	25/30	17/14	Std.Dev
0/41	0/05	0/98	1/21	2/75	Skewness
1/22	1/70	2/29	2/95	12/62	Kurtosis
10/99	4/85	12/39	3/22	353/13	Jarque-Bera
0/00	0/09	0/00	0/21	0/00	Probability

Source: the calculation of research

4.2. The study of normality of model variables of this research

In continue, it has been dealt with the study of normality of research variable.

4.3. The estimation of model variables of research (optimization of objective subordinate)

According to estimated parameters we can understand that the rate of receiving assts of sector which borrower defaults in time t on average is 0/812 for all sectors. The possibility of installment repayment will calculate with using of α, β parameters. Whatever these two parameters are close to zero, the possibility of repayment will increase.

Table 4: The study of normality in industry and mine sector

Probability	Jarque-Bera	Variable	Sector
0.111	4.397	Proceeds of the private facilities	Industry and mine
0.165	3.456	Private outstanding receivable	
0.201	4.335	The number of average installment	
0.126	4.995	Rate without risk	

Table 5: The study of normality in building sector

Probability	Jarque-Bera	Variable	Sector
0.228	2.959	Proceeds of the private facilities	Building
0.218	2.335	Private outstanding receivable	
0.184	3.099	The number of average installment	
0.209	2.167	Rate without risk	

Table 6: The study of normality in water and agriculture sector

Probability	Jarque-Bera	Variable	Sector
0.228	2.961	Proceeds of the private facilities	Water and Agriculture
0.197	3.999	Private outstanding receivable	
0.231	3.167	The number of average installment	
0.234	3.438	Rate without risk	

Table 7: The study of normality in business and services sector

Probability	Jarque-Bera	Variable	Sector
0.228	2.961	Proceeds of the private facilities	Business and services
0.2156	3.093	Private outstanding receivable	
0.277	2.187	The number of average installment	
0.203	3.345	Rate without risk	

The βparameter has most effect on the possibility of repayment. According to the issue that the amount of this parameter in building sector is less than the other sectors, therefore, the possibility of loan repayment in this sector is more than the other sectors. Also, the amount of βin business and services sector is more than the other sectors. Therefore, the possibility of loan repayment in this sector is less than others.

In below diagrams, the amount of errors or SSR in different repetitions of genetic algorithm has been seen, the vertical axis shows the amount of SSR in each repetition and the horizontal axis also show the number of repetition, the primary amount of parameters determines as accidental way at first and then these amounts will correct by using of algorithm. In diagram in below, the amount of error in first repetition is 5000 and then with increasing in repetition the error will decrease.

In Fig. 1, the amount of error in first repetition is 5000 and then with increasing in repetition the error will decrease. These results show that with regard to decrease in amount of errors in high repetition, the estimation parameters have high concentration and they have high significant ability.

Table 8: The estimated coefficient with using of genetic algorithm

SSR (sum of squared errors)	γ (the rate of resumption)	β (the reaction of risk to time)	α (natural risk)	Economic sector
549/21	0/803	0/016	0/024	**Industry and Mine**
+6e6/20	0/892	0/001	0/009	**Building**
+4e8/6	0/836	0/010	0/019	**Water and Agriculture**
+9e3/4	0/763	0/020	0/035	**Business and services**
+5e4/01	0/812	0/015	0/021	**All Portfoy of bank**

Source: The calculation of research

In Fig. 2, the amount of error in first repetition is 1500 and then with increasing in repetition the error will decrease. The amount of error in third repetition reaches to 1000 and in next level, this swing has continued and always its amount has reduced until it has passed a constant trend.

In Fig. 3, the amount of total square error in water and agriculture sector in first repetition is 3000 and then with increasing in repetition the error will decrease. The amount of error in first repetition sectors has more swings and gradually this amount of swing reduces and it carries this decreasing trend until it reaches to constant trend.

In Fig. 4, the amount of errors in first repetition is and then with increase in repetition the error will decrease. Business and services sector has had more swing error on repetition level to compare with other sectors and last repetitions has decrease trend

and then it reaches to constant trend. In the table in below, default of granted facilities in each economic sectors and Portfoy of facilities has gained.

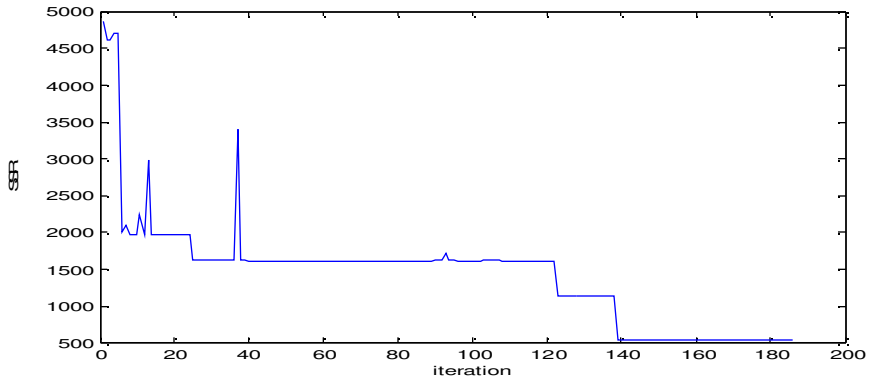

Fig. 1: total square error in industry and mine sector (Source: the calculation of research)

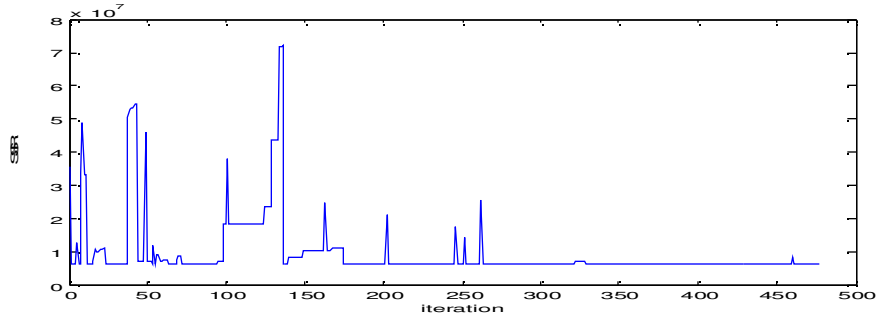

Fig. 2: Total square error in building sector

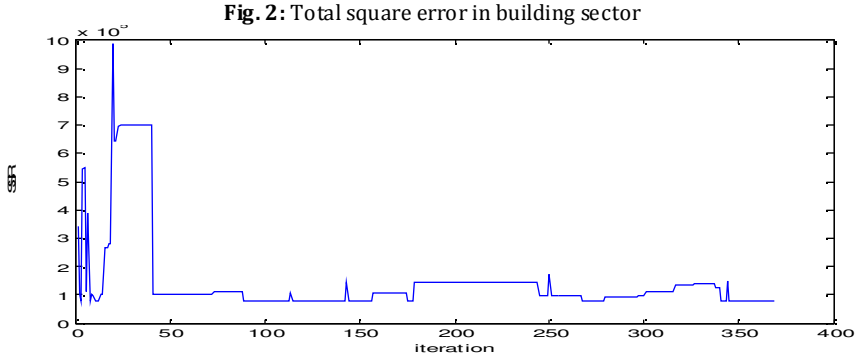

Fig. 3: Total square error in water and agriculture sector

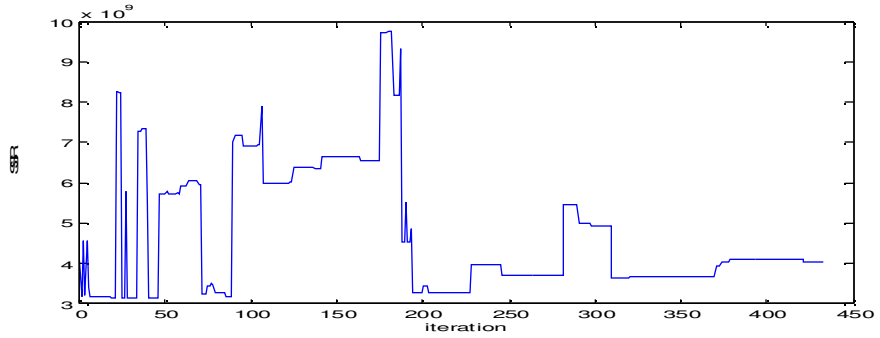

Fig. 4: Total square error in business and services sector

It is observed from comparing the obtained results between granted facilities that with increasing the credit risk and reaction of risk to time which is caused the increase in possibility of default facilities, the rate of receiving granted facilities is increased and with regard to the rate of calculated received in different observed economic sectors in Portfoy of granted facilities of bank, risk was related to business and services and industry and mine and also water and agriculture and building has partly low risk.

5. Conclusion and Recommendation

According to the results of estimated coefficients with using of genetic algorithm and errors diagrams

in different granted facilities sectors which has descending trend, first of all we can say that calculated credit risk granted facilities of bank is able to calculate in different economic sectors and with regard to different coefficient of Beta, we can say calculated credit risk granted facilitiesof bank are different in different economic sectors and the amount of risk in different sectors are in order of highest to lowest, including business and services sector, industry and mine, water and agriculture, and building.

Table 9: the possibility of default granted facilities with using of genetic algorithm

$\lambda_{i,t}$ (the possibility of default)	Economic sector
×%100t(0/024+0/016)	Industry and Mine
×%100t(0/009+0/001)	Building
×%100t(0/019+0/010)	Water and Agriculture
×%100t(0/035+0/020)	Business and services
×%100t(0/021+0/015)	Total Portfoy of bank

According to the results of research and measurement credit risk in post bank of Iran in different sectors, political suggestions are offer in below:

1-According to the results of estimated coefficients with using of genetic algorithm, we can say that credit risk is possible to calculate in different sectors and in order to reduce the banking risk, banks and different branches step for calculating credit risk.

2-According to the result of estimated coefficients with using of genetic algorithm that showed credit risk in different sectors in order of low to high sectors building, water and agriculture, industry and mine, and business and services, we can suggest that with considering the savings and interest of the bank, we deal with in tem of increasing incomes, granted facilities in order in sectors building, water and agriculture, industry and mine and business and services.

References

Adrian C.H. Lei and Zhuoyun Song, 'Liquidity Creation and Bank Capital Structure in China', Global Finance Journal, No 28, 2013.

Ahmed Arif, Ahmed NaumanAnees, "Liquidity risk and performance of banking system", Journal of Financial Regulation and Compliance, Vol. 20 Iss: 2, pp.182 – 195, 2012.

Ben R. Craig and Valeriya Dinger (2013) "Competitive credit market, credit funds and bank risk", Journal of Banking & Finance, Vol. 37, PP. 2173–2182, 2013.

Bjorn Imbierowicz and Christian Rauch (2014 "The relationship between liquidity risk and credit risk in banks ‹" Journal of Banking and Finance, 3(3), 253-262.

Drehmann and Nikolaou (2013) "Funding liquidity risk: definition and measurement", Journal of Finance, 29(2), 449-470.

Farrokhyan, F. (2007), earned value management criteria for assessing the performance of the projectand its applications, Third International Conference onProject Management

Jhankhany,A, Shirani, A.(2003), Financial Management, Tehran, publisher side.

Jonkhart, M. (1979), "On the Term Structure of Interest Rates and the Risk of Default: An Analytical Approach," Journal of Banking and Finance, 3(3), 253-262.

Kuang-Erh Lai, Chau-Jung Kuo, How to Gauge the Credit Risk of Bank Loans: Evidence from Taiwan, International Research Journal of Finance and Economics ISSN 1450-2887 Issue 39 (2010) EuroJournals Publishing, Inc. 2010 http://www.eurojournals.com/finance.htm

Lei and Song (2013) "Liquidity Creation and Bank Capital Structure in China"Volume 16, Issue 1, 2007, Pages 60–77, 2007.

Michiru Sawada, 'Liquidity risk and bank portfolio management in a financial system without deposit insurance: Empirical evidence from prewar Japan', International Review of Economics & Finance, Vol. 19, PP. 392–406, 2010.

RifkiIsmal, "Strengthening and improving the liquidity management in Islamic banking", Humanomics, Vol. 26, pp.18 – 35, 2010.

Todd, A. Gormley, "The Impact of Foreign Bank Entry in Emerging Markets", Journal of Financial Intermediation, Vol. 19, pp. 26-51, 2010.