Investigating the Risk of Paying Loans to Public and Private Companies Using the Logit Model and Comparing it with Altman Z (Case Study: A Private Bank in Iran)

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ABSTRACT

The design of a credit risk measurement model in the monetary and banking system will play an important role in increasing the profitability of banking resources. This article attempts to use two models of Logit and Z Altman to determine and predict the credit risk of facilities provided to legal entities at a private bank in Iran. The variables studied in this research include qualitative variables (company life, financial credit document, experience of managers, type of company) and financial variables (working capital in total assets, book value of equity to book value of debt, total sales to total assets, accumulated profits to total assets, profit before interest and taxes on total assets). The results of this research show that the use of validation models, despite all the technical and statistical considerations, can accurately determine the credit status and credit risk of customers. Both models used more than 80% of the correct predictions, which are a significant figure in the real business environment. But in the Logit model with a slightly better difference than the Z-Altman model, about 83% of its predictions were correct.

Keywords:

Credit risk, Private companies, Logit model and Z Altman, Private Bank in Iran.

1. Introduction

To the extent that it is of value, the word risk is of interest in all countries and its management is issued to banks that, in the direction of a systematic approach and to obtain the confidence of shareholders, their methods of risk management, operations and bank results Scheduled, these banks have assigned risk management to a committee and, with the participation of some members of the board in the committee, will implement the committee's decisions for the entire organization.

In order to reasonably assess and decide on a customer, he first assesses him in his own bank, then among the other domestic banks of the country, and at the end of the world, in an extremely accurate manner. In order to better predict the type of loan and also the power of customer reimbursement, the percentage of deferred bank claims would remain at a very low level relative to the total facility provided in each bank. Most banks in the world use one or more models to measure the credit risk of loans. Because providing financial facilities and attracting resources in the form of deposits is considered an important activity of the banking system. These activities take place in the form of contracts and in accordance with the laws and regulations of the countries. In Islamic banking, due attention is paid to risk management due to the importance of non-binding contracts. Due to financial innovation and the case-existence of contracts in nongovernmental banks, attention has been paid to this risk. Therefore, if it is not possible to calculate the amount of uncertainty for the future, it is not risk; it is only uncertainty that can be managed and controlled in order to calculate some uncertainty in the form of risk (Bellemare & et.al., 2018).

Bank loans are regarded as one of the most important and most valuable assets of the bank, and a large part of the banks' income can be realized through the provision of facilities, but the circulation of money and capital in the society exposed the financial institution to types Risks. The variety of these risks, and sometimes their severity, is such that, if a financial institution fails to properly manage and manage them, it will disappear and even go bankrupt (Schoen, 2017). Therefore, considering the increased demand for facilities and the risk involved in these activities, validating the applicants and offering a suitable model for the payment of facilities is one of the most fundamental principles of credit risk management in banks and financial institutions. The use of credit risk management tools, in particular, validation, allows banks to make more confident decisions about the granting of facilities.

In our country over the past few years, the issue of the risks and the damage caused by it has attracted the attention of organizations and especially financial institutions, but despite its importance, the same framework and coordination for implementation of risk management and precise indicators There was no credit risk rating and the ranking industry was not in a good position in the country. Therefore, in this paper we aim to determine the quantitative factors (financial ratios) and qualitative (such as management history, type of company, company life) affecting credit risk; its effect on the payment of facilities to legal entities using the model. Logite and compare it with the Z-Altman model at the private bank in Iran.

2. Literature Review
2.1. Credit risk

Credit repayment or repayment with delay in the principal and profit of bank loans and other debt instruments by the customer is called credit risk. Designing a model for measuring and rating credit risk for the first time in the year(1909) by John Murray on bonds (Weissova & et.al., 2015). Today, each of the accredited institutions such as Moody's, Standard, and Poor's use special methods for rating bonds and other credit instruments.

It should be noted that the high level of credit facilities of banks to bonds has led to a grading of the credit risk of banks' facilities, which is to measure the risk of non-repayment of principal and interest on loans by some researchers. The first model used to determine the bankruptcy of companies is the multivariate logistic regression model introduced by Beaver in 1966. One of the first studies to measure corporate credit risk with a multivariate scoring model was by Altman in 1968 and is known for the Z score model. The Score Model is a Audit Analysis Model. Z Altman, who uses important financial ratios to distinguish companies that have financial distress (failed) from companies that are not financially sound. Considering that the lack of repayment of the loan is due to companies that will be distressed in the future.

The Banking Supervision Committee (WPC) has referred to principles 8 and 9 of the Banking Supervisory Principles that have influenced the issue of credit risk and problematic assets. Credit risk is not a redeemable asset or facility, or the risk associated with delays in repayment of facility installments, which in any case reduces the present value of the bank's assets and ability to pay (BIS, 2011). Risks affecting the financial institution can be divided into three levels as follows (Springer, 2009):

- The first level, the risks that the financial institution has no control over and does not affect them, only affects them. Such as government risk, policies, economic, social and natural cycles.
- The second level is the risks the financial institution has on them, but this effect is small and most affected. Like legal risk, good reputation, competition.
- *The third level is the risks that affect the financial institution, but the financial institution can control and manage them by applying methods and tools. Such as credit risk, market, operational liquidity.

Among the risks that threaten banks, credit risk is the most important because of its focus, volume of operations, and especially its sensitivity, so only the third-party risks are that the financial institution uses methods and risk management tools can overcome them and control them.

Generally, four of the following traditional indicators are widely used to determine the level of credit risk for banks:

1) The ratio of past, unpaid debt to grant facilities, the higher the ratio, the higher the credit risk of the institution.
2) The ratio of past due claims, unpaid to assets, which increase in this ratio at two points will indicate a rise in credit risk.
3) The ratio of unpaid debt to concessional facilities that increase the amount of unpaid debts that could indicate a rise in credit risk due to rising past due claims.
4) The ratio of the storage of doubtful claims to total assets, the increase of which indicates an increase in risk and a decrease in risk mitigation.

2.2. Bank liability

The call is against the old customer's commitment, and in all claims banking, it refers to the demands of the bank from customers for the granting of facilities and the transactions and services performed. Which is in two different forms:

A) Current claims: Claims that have expired for more than two months.
B) Non-current claims: Including past due claims Total outstanding claims, past due and unpaid credit facilities, including government, non-government, and debtors for L / Cs are included in this category (Kordloei & et.al, 2016). Without a doubt, one of the consequences of the monetary activity of banks and credit institutions is the emergence of past demands that have significant effects on the economic system. These include: increasing the volume and scope of the informal money market network of the country, influencing other financial markets and real assets such as the capital market, housing, cars, gold and coins, with regard to the bank's debt to this Markets are motivated by economic transaction and the change in the volume of liquidity and the increase in the volume of money supply, the increase in the banking system's debt to the central bank, an increase in the interest rate of the facility and a decrease in investment, and an increase in the interest rates on deposits and increase in savings(Amini et al., 2010). The following figure shows the process of the banking network and their relationship with each other.
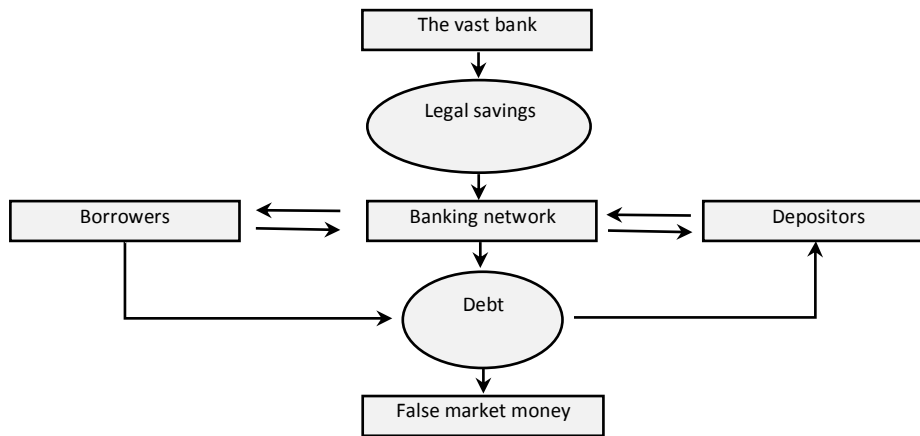
Chart 2. Banking network process

The increasing demand for the bank's past has led to a reduction in liquidity and, as a result, a reduction in the profitability of banks, which would reduce the stock market value of banks and their market value due to the high demand for deferred loans . The depreciation of banks' shares also increases the risk of bank credit and increases the risk and lower the bank's rank on the international level. When high credit risk can be very difficult to borrow from international sources, this reduces capital adequacy ratio and reduces the access and use of international resources. The amount of bank lending in Iran is about 4 times the annual tax revenues throughout the country. Delays in commercial banks are several times greater than that of specialized banks, which means that the level of corruption in the banking system is severe. It is noteworthy that private bank delinquents have a higher ratio to government banks. Iran's deferred bank debt is 4 times the global standard and more than 12 times the amount of Iran's blocked dollars in the Geneva agreement ($ 4.2 billion). Chart 3-3 shows the trend of the change in the level of bank lag in the late 1990s. The explanation is that the amount of debt in 2014 was based on the report of the Minister of Economic Affairs and Finance on June 27, 2014. The hidden reality in the statistics is that since people pay off debts owed to banks rather than banks, banks have little incentive to try and repay their claims, and so, in the past 10 years, claims have always been bulish.
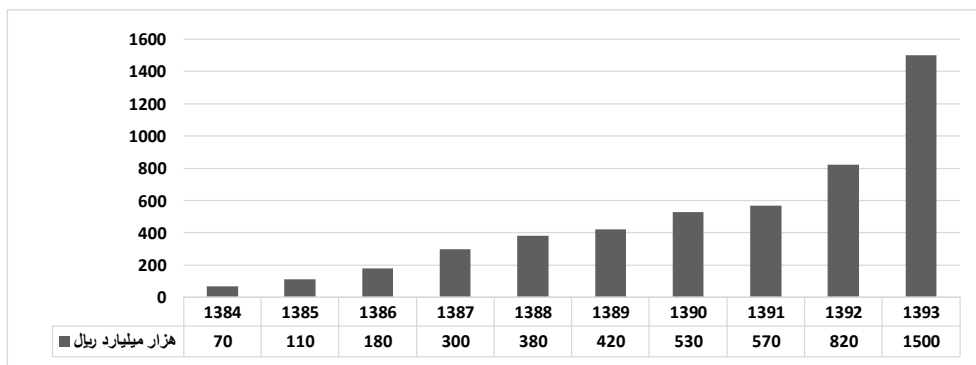

	1384	1385	1386	1387	1388	1389	1390	1391	1392	1393
هزار میلیارد ریال	70	110	180	300	380	420	530	570	820	1500

Chart 3: The amount of lending facilities in the banking system in the past 10 years leading up to 2014

2.3. Foreign Research

In the article, the causes of the emergence of delinquent claims and its solutions in commercial banks of China, examined the factors causing the deferred claims in commercial banks of China, and classified the factors affecting the emergence and increase of this problem in two categories: 1. External factors Non-standard and 2-non-system roots of deferred claims.

In an article on the assessment of credit risk structure in private and public banks, it shows that a major difference between the view of the bankers with regard to their internal credit policies in regulating policies, guidelines, procedures and manual processes in relevant policies There is no risk of credit (Singh, 2015)

Also, by examining the factors affecting the credit risk of banks in Tunisia during the period from 1995 to 2001, it was concluded that the general ownership and return ratio of assets were positively correlated with the credit risk of banks, and the precautionary provisions of capital, the ratio of capital adequacy, Economic growth, inflation, exchange rate and interest rates have a negative effect on credit risk. In addition, there is an increasing trend in the literature on the quality of the loan, which not only addresses the characteristics of the macroeconomic and specific factors of the bank, but also factors such as the type of borrower, type of loan, the quality of the organization and the banking industry.

3. Methodology

The research method is in terms of nature and content, inferential and correlation, and in terms of purpose, is applicable. The statistical population of this study is all legal clients of Private Light Bank, 10% of which is about 400 of them as a sample of loans received from 2012 to 2014. In this study, were used two logic and Z-Altman models.

3.1. Logit Model

The Logit model is one of the most commonly used models for credit risk analysis. The advantage of the Logit model in comparison with other models used, such as linear probability model, audit analysis model, tree classification method and artificial neural network model, is that logistic regression in cases where the response variable is only two states of zero

and one Can be used. Therefore, in the logistic regression, there is no limitation of the normality of the independent variables and the equality of the variances of the two groups.

Logistic regression is defined as follows:

$$\log it : \ln\left(\frac{P}{1-P}\right) = A + B_1(x_1) + B_2(x_2) + B_3(x_3) + \ldots$$

✓ P :Likely to happen
✓ 1-P: Likely occurrence of the desired phenomenon
✓ A is the width of the origin or the logarithmic variation of the probability of the occurrence of the incident
✓ Bn: The change in logit for a unit of change in Xn is shown (Keshavarz Haddad and Ayati Gazar, 2008).

2.4. Model of Forecasting Disability and Bankruptcy Z Altman

Investors always want to prevent the risk of the disappearance of their capital from being foreclosed by the prospect of a bankruptcy of a company. Hence, they are looking for ways to estimate the bankruptcy of corporations, because in the event of a bankruptcy, the stock prices of companies will be sharply reduced and their debts will be defaulted. The prediction of bankruptcy is carried out using various methods. Among these methods, the three common methods of Altman, Springer, Zimsky have been used due to ease of use and proper accuracy.

Altman, in 1968, selected multiple ratios of 22 ratios, combining 5 ratios as the best predictor of bankruptcy. After years of using the model, critics from credit analysts, accountants and even the companies themselves came up with the model, they believed that the model was only for institutions with commercial and marketable nature The stock exchange can be used. In 1983 Altman made a modification to the model.

This amendment included the replacement of the book value of the stock instead of its market value, and then the modification of the coefficients and range of bankruptcy of the model. Altman, in 1995, analyzed the pecification and accuracy of the model, regardless of the variable sales to total assets, due to Altman's elimination of the proportion of sales to total assets, which sought to minimize the potential impacts of the

industry. In his reforms, he corrected the elimination of the proportion of sales to the total assets, changes in the company's bankruptcy coefficients and limits. Note that the Altman model has the potential for bankruptcy of companies over the next two years. Springer also continued Altman's studies and presented a four-variable model. Zimsky has also presented a model based on financial ratios that measure the company's liquidity, performance and leverage. The model also has a high probability of forecasted bankruptcy of companies over the next two years. Therefore, the models and variables used are presented in the table below.

Table 1: Information on prediction models for financial failure

Model		Model	
$Z_1 - Score = 1/2X_1 + 1/4X_2 + 3/3X_3 + 0/6X_4 + 0/99X_5$ (1)	1968		
$Z_2 - Score = 0/717X_1 + 0/847X_2 + 3/1X_3 + 0/42X_4 + 0/998X_5$ (2)	1983	Altman Multiple-discriminant analysis	
$Z_3 - Score = 6/5X_1 + 3/2X_2 + 6/72X_3 + 1/05X_4$ (3)	1993		
X1=Turnover Capital to Total Assets X2= Profit (loss) accrued to total assets X3=Profit before interest and taxes (operating profit and loss) to total assets X4=The market value of the equity is at the value of the debt X5=Sales (earnings) net to total assets	Variables		
$SP - Score = 1/03X_1 + 3/07X_2 + 0/66X_3 + 0/4X_4$	1978	\Springate Logit model	
X1=Turnover Capital to Total Assets X2=Profit before interest and taxes (operating profit and loss) to total assets X3= Profit before tax to current debt X4 = Sales (earnings) net to total assets	Variables		
$ZM - Score = -4/513(ROA) + 5/679(FINL) - 0/004(LIQ) - 4/336$	1984	Zmijewski Probit model	
ROA FINL LIQ	Variables		

Zmijewski	Springate	Altman			Model
ZM	**Z4**	**Z3**	**Z2**	**Z1**	**Model**
Increasing the ZM value indicates the probability of increasing the probability of a bankruptcy, but it does not have a defined limit	SP ≤ 0/862	Z3 ≤ 1/1	Z2 ≤ 1/23	Z1 ≤ 1/8	failure
	-	1/1 < Z3 ≤ 2/6	1/23<Z2 ≤ 2/99	1/8 < Z1 ≤2/99	Disability
	SP > 0/862	Z3 > 2/6	Z2 > 2/99	Z1 > 2/99	Good economy

4. Results

The best estimate of the Logit model and its comparison with the Z-Altman model. So, at first, all the important variables that can be used to predict the likelihood of failure of the facility are computed and we estimate the probability of default. Therefore, the overall model of this research is as follows: y is the probability of non-failure of the facility, and when a case is denied, the number is zero and in case of non-failure, the number one is assigned. Other variables are presented as follows:

N represents the life of the company and it is expected that companies of higher age will have more experience in managing investments, costs and flow of cash inflows and outflows, and hence the probability of debt defaults They are less.

E is the leader's experience. Since the possibility of aggregating data for all managers was not possible, this variable has been limited to the years of experience of the company's CEO. The more experience management is expected to be, the more risk-based budgeting and serious oversight of the flow of funds and revenues and costs. Therefore, the

likelihood of non-availability of facilities will be reduced.

T represents the liability of shareholders to corporate debt. If the company is notorious, or shareholders in any case have a greater responsibility than investing in the company, the likelihood of non-availability of the facility is expected to decrease. In this case, the variable is the number 1, otherwise it is a zero number.

R is a variable that shows the client's goodness at the time of obtaining the facility. If the company has a record check or non-recurring facility, then the number is zero and otherwise the number 1 is assigned.

A loan is a property of a civilian value, the variable co is 1 and otherwise it will be zero. Customers who have credible, credible and easy-going mortgage clients are expected to have more willingness to repay installments at maturity. The variable x1 represents the ratio of working capital to total assets. Capital-intensive companies first have more cash-close assets, and then they can repay cash deficits by selling them quickly, and secondly, a high turnover ratio can be a sign A provider of high-level business and high capacity production. The x2 variable represents the ratio of accumulated profits to total assets. The higher the value of this variable, the more important the shareholders are to continue the company's activity, and in order to prevent the debt default and reduce the company's power and control the exit from it, a larger amount of its profits in the capital company Redone. The x3 variable represents the earnings before interest and taxes on total assets.

The higher the ratio, the greater the power of the company and its ability to generate profits and high return on investment in it. The companies with higher ratios are expected to have less likelihood of default. The ratio of the book value of equity to the book value of debt (x4) somehow reflects the risk of participation. Not. The higher the ratio, the lower the risk of the company and the lower the probability of default. This indicator indicates that managers are very cautious and financing is often made through shareholders. The total sales to total assets (x5) represent the ability to participate in the creation of income to give The higher this ratio, one can expect to pay off its debts, including those received in its own earnings.

4.1. Results of Logit Model

McAdam and Akaic (AIC) optimized the model using the appropriate explanatory variables index and after deleting the well-adjusted variables (r) and accumulated total assets (X2) from the model We conclude with the results presented in Fig. 4. According to these results, the pre-tax profit before tax on total assets (X3) was not statistically significant, and the book value of equity to book value of debt (X4) and total sales to total assets (X5) have been negated. Like the linear probability model and probit, it can be said that because of the variable values of time before granting facilities and the default situation after the granting of facilities, it seems that many companies that have a favorable financial and They have not been able to meet their obligations due to reasons such as inappropriate market or unwillingness.

Dependent Variable: Y
Method: ML - Binary Logit (Quadratic hill climbing)
Date: 06/25/17   Time: 14:00
Sample: 1 400
Included observations: 400
Convergence achieved after 5 iterations
Covariance matrix computed using second derivatives

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-4.358253	0.639947	-6.810335	0.0000
N	0.058233	0.016524	3.524097	0.0004
CO	1.063645	0.471646	2.255176	0.0241
E	0.107996	0.025350	4.260227	0.0000
T	1.767331	0.361328	4.891208	0.0000
X1	9.235343	1.228419	7.518073	0.0000
X3	1.057334	1.062351	0.995278	0.3196
X4	-1.510027	0.540559	-2.793455	0.0052
X5	-5.866466	0.917956	-6.390795	0.0000

Mean dependent var	0.500000	S.D. dependent var		0.500626
S.E. of regression	0.335388	Akaike info criterion		0.749855
Sum squared resid	43.98176	Schwarz criterion		0.839663
Log likelihood	-140.9711	Hannan-Quinn criter.		0.785421
Restr. log likelihood	-277.2589	Avg. log likelihood		-0.352428
LR statistic (8 df)	272.5755	McFadden R-squared		0.491554
Probability(LR stat)	0.000000			

Obs with Dep=0	200	Total obs	400
Obs with Dep=1	200		

Table 2: Logit Regression Model Results

In order to evaluate the predictive power of the model and compare it with other methods, the following table is based on prediction and reality. In this table, if the estimated results are greater than 50%, then the value is equal to 1, otherwise it is considered zero.

Z-Altman Model Z-Score

As previously stated, the latest Altman model was extracted in 1993 with modifications to variables and coefficients as follows.

$$Z_3 - Score = 6/5X_1 + 3/2X_2 + 6/72X_3 + 1/05X_4$$

According to Altman estimates, domain Z is calculated and probability of bankruptcy of companies can be calculated according to table 4. It's worth mentioning that Altman's third model has been used for being up-to-date and available.

Table 4: probability of bankruptcy and the Altman Z in the third model

Z	Probability of bankruptcy
Z3 ≤ 1/1	Bankruptcy
1/1 < Z3 ≤ 2/6	Helplessness
Z3 > 2/6	Financial health

5. Discussion and Conclusions

The identified qualitative factors in the logit model include the company's life, the experience of executives, and the type of effective company. The longer the company lives, the lower the likelihood of a facility losing. This illustrates the experience of the organization and its credibility in the market. On the other hand, the experience of managers (here the chairman of the board) stabilizes the company's position and controls the inflow and outflow of funds to finance short-term and long-term financing. It is important to note that the above qualitative variables in the Altman model have no place and are not investigated in any way, so no mention has been made.

Like Altman's trilogy models, the analysis models only focus on the company's financial ratios and predict the likelihood of helplessness, bankruptcy, and creditworthiness of companies using them. In this research, the Altman III model was used and the variables of working capital in total assets, accumulated profits to total assets, pre-tax profit to total assets, and book value of equity in value Debt bills were all used with positive coefficients, but in econometric models, depending on how each variable contributes to explaining the variation of the dependent variable (here the default or non-default) in the model entered or It is removed from it. In the Logit model, the ratio of working capital to total assets with a significant and positive coefficient explained a straightforward relationship with the default or non-compliance of legal customers' debts. But the book value of book ownership variables to book value of debts and total sales to total assets, although significant, were not consistent with previous studies and theoretical foundations. One reason for this could be the incorrect information, and sometimes the manipulation and presentation to the institution. Because some of the information and data from their financial statements are not disclosed or unaudited, they are extracted and not reliable. The second reason can be due to the macroeconomic stagnation and prosperity that, in the event of a recession, the appropriate financial ratios for the facility would be changed and the company in question would be in crisis, therefore, contrary to the institution's proper decision when granting the facility and given its appropriate financial ratios, companies are in a severe recession, with no debt defaults. The results of this study indicate that the use of validation models, despite all the technical and statistical considerations, can accurately determine the credit status and credit risk of customers. Both models used more than 80% of the accurate predictions that are significant in the real business environment. But in the Logit model with a slightly better difference than the Z-Altman model, about 83% of its predictions were correct.

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