Credit decision of small and medium sized enterprises based on quantitative analysis

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Abstract: Bank credit behavior plays a key role in the operation and development of enterprises. At present, China's market economic structure presents the characteristics of diversification, the rapid economic development of small and medium-sized enterprises, and gradually become an important part of the development of socialist market economy. However, at present, the main credit objects of Chinese banks are large and medium-sized enterprises, and lack of credit strategy planning experience for small and medium-sized enterprises. In order to adapt to the vigorous development of China's small and medium-sized enterprises, the establishment of a practical credit evaluation system has become the primary task of China's banking institutions at all levels. This paper constructs an index system to evaluate the credit risk level of small and medium-sized enterprises from three aspects of enterprise profitability, stability of supply and demand, and enterprise credit. It makes quantitative analysis with entropy method, and then divides the comprehensive score range corresponding to different credit level of enterprises. It draws the interest rate level and customer churn of enterprises with different credit levels by Origin software . It is found that the relationship between them is approximately linear. Based on this, a set of estimated linear regression equations are obtained by linear fitting. Finally, this paper comprehensively expounds the bank's credit strategy when the total amount of annual credit is fixed.

1. Introduction

The operation and development of small and medium-sized enterprises are constrained by bank credit behavior. In real life, limited by their own scale, small and medium-sized enterprises do not have comparative advantages in the loan process. Therefore, before the implementation of the credit policy, the credit risk of the enterprise should be determined by considering the credit status of the enterprise and the credit risk of the enterprise.

A bank set up a loan line of 1 million yuan for each enterprise to be lent, with an annual interest rate of 4% - 15%, and a loan term of one year. According to the above background, combined with the given data information, this paper quantitatively analyzes the credit risk of 123 enterprises, and formulates the credit strategy of the bank to these enterprises under the condition of the annual total amount of credit unchanged, and establishes a mathematical model to analyze and explore the bank's credit strategy for small and medium-sized enterprises.

2. Problem analysis

This requirement quantificationally analyzes the credit risk of 123 enterprises, and based on this, formulates the best credit strategy of the bank to these enterprises when the annual total credit is fixed. The theory of credit rationing proposes that banks need to comprehensively examine risk and profit when choosing lenders. Therefore, this paper considers that it is necessary to consider the economic strength, the stability of supply and demand, reputation and other factors, and build a comprehensive and appropriate index system for quantitative analysis of enterprise credit risk. In addition, the objective entropy method can be used to give the corresponding weight to each index, and combine the comprehensive score and credit rating proportion to divide the risk level; with origin to describe the relationship between interest rate level and customer churn rate, if the relationship is linear, linear regression analysis can be carried out to explore the specific quantitative relationship between the

two, and finally the bank's credit strategy can be obtained.

3. Modeling

3.1 Construction of credit risk index evaluation system

This paper comprehensively considers the credit risk level of each enterprise from the three aspects of enterprise profitability, supply and demand stability and enterprise credit. The higher the index is, the higher the enterprise's ability to repay credit and the higher the credit value, that is, the lower the credit risk. When the credit risk of the enterprise is low, the bank can consider providing credit loan for the enterprise, and formulate the corresponding credit strategy based on the relationship between interest rate and customer churn rate.

Combined with the given data, and referring to the Roca rating method commonly used in traditional banking industry, this paper selects the corresponding indicators to measure the level of the three subordinate indicators. The enterprise's profit level is measured by the monthly average tax burden rate and monthly average turnover; the stability of the enterprise's supply and demand relationship is measured by the effective rate of the input and output invoice; and the enterprise's credit degree is measured by the transaction bad debt rate and credit rate.

3.2 Establishment of credit risk model

There are many comprehensive evaluation methods in empirical analysis, including subjective entropy method and objective entropy method. This paper uses the objective entropy method to determine the weight of each index, and then calculates the comprehensive index score of 123 enterprises. The higher the score, the higher the business stability and the lower the corresponding credit risk. By using the principle of information entropy to determine the weight, we can objectively and accurately evaluate the research object

(1) Select h evaluation objects and K indicators, then X_{ij} is the value of the jth index of the ith evaluation object.($i = 1,2,3,\dots,h;\ \ j = 1,2,3,\dots,k$)

(2) The positive and negative indicators were standardized. In order to exclude the influence of different index dimensions and orders of magnitude on the results, the index data are usually standardized. In this paper, the range method is used to standardize the data. At the same time, because there are both positive and negative indicators in the index system selected in this paper, it is necessary to process the data in positive and negative directions. H_{ij} corresponding to the value of the jth index of the ith evaluation object after standardized treatment, x_{ij} is the value of the jth index of the ith evaluation object, x_{max} is the maximum value of the jth index in each region of the year, Then x_{min} is the minimum value of the jth index in each region of the year.

Standardization of positive and negative indicators:

$$H_{ij} = \frac{x_{ij} - x_{min}}{x_{max} - x_{min}}; H_{ij} = -\frac{x_{ij} - x_{min}}{x_{max} - x_{min}}$$

(3) Calculate the proportion of the ith sample under the jth index

$$P_{ij} = \frac{x_{ij}}{\sum_{i=1}^{h} x_{ij}}$$

(4) Calculate the information entropy of each index, M represents the number of evaluation objects in a data matrix.

$$Y_j = -\frac{1}{\ln(M)} \sum_{i=1}^{h} P_{ij} \ln(P_{ij})$$

(5) The greater the entropy value, the smaller the information utility value.

$$F_j = 1 - Y_j$$

(6) Calculate the weight of index J, as shown in table 1.

$$W_j = \frac{F_j}{\sum_{j=1}^{k} F_j}$$

(7) The score of each object was calculated.

$$score = \sum_{j=1}^{k} W_j H_{jm}$$

Table 1 Index weight coefficient

term	Information entropy Y_j	Information utility value F_j	weight coefficient W_j
Average monthly turnover	0.9952	0.0048	17.69%
Input effective invoice rate	0.9911	0.0089	33.08%
Sales invoice efficiency	0.9952	0.0048	17.79%
Bad debt rate	0.9959	0.0041	15.42%
Credit rate	0.9981	0.0019	7.25%
Monthly average tax rate	0.9976	0.0024	8.76%

In order to quantitatively analyze the credit rating corresponding to different scores, this paper makes statistics on the proportion of 123 enterprises with four types of credit rating
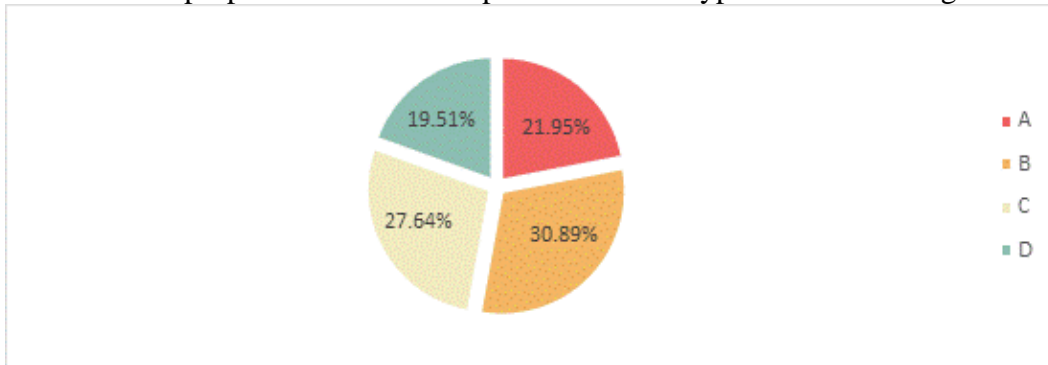

Figure 1 proportion of enterprises with various credit grades

4. Model solving

In this paper, the interest rate level is taken as the independent variable, and the customer churn rate of enterprises with different credit rating under the corresponding interest rate level is taken as the dependent variable. With the help of Origin software, the rough relationship between the two is drawn, as shown in the following figure:
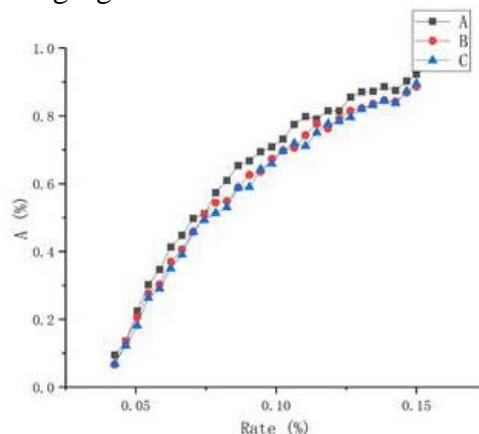

Figure 2 relationship between interest rate level and customer churn rate under different credit rating

It can be seen from figure 2 that there is a linear relationship between interest rate and customer churn rate. Therefore, it can be considered that the relationship between the interest rate level and the customer churn rate is real. The impact of interest rate on the customer churn rate of enterprises under different credit levels is similar, but not completely the same. If the interest rate level increases by one unit, the customer churn rate of enterprises with credit rating a will increase by 7.131 units, that of enterprises with credit rating of B will increase by 7.01 units, and that of enterprises with credit rating of C will increase by 7.157 units.

According to the statistics of the data, it is found that the default probability of enterprises with different reputation levels is different, and the specific default probability is shown in the table below:

Table 2 Default rate of enterprises with different credit rating

classification	Default rate
A	0
B	0.037
C	0.059
D	1

It can be found from the above figure that the default rate of enterprises with credit rating of a is 0, and that of enterprises with credit rating of D is 100%. This paper holds that when the total amount of the bank's annual credit is fixed, priority should be given to enterprises with credit rating of a, B and C. At the same time, due to the different default probability of these three types of enterprises, the bank gives priority to enterprises with credit rating of a, and sets the lowest loan interest rate to ensure the number of credit customers; at the same time, the bank can provide loans with slightly higher credit interest rate to enterprises with credit rating of B and C, so as to ensure the maximization of bank profits.

5. Summary

Based on the data and text information, this paper constructs a set of evaluation index system of credit risk level of small and medium-sized enterprises, and then uses entropy method to carry out quantitative analysis, divides the corresponding score range of four types of enterprises' credit level, explores the relationship between the change of interest rate level and the customer churn rate of enterprises with different credit grades, and finally obtains the conclusion that when the total amount of credit of the bank is fixed in the year credit strategy.

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