

Research on Credit Strategy of small and medium-sized Enterprises based on Analytic hierarchy process

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Abstract: In this paper, through the analysis of the factors that affect the credit decision-making of small and medium-sized enterprises, we find out the optimal credit strategy. First of all, the main problems to be solved are the quantitative analysis of credit risk and the optimal credit strategy under the fixed annual credit amount. Calculate the profit amount of each enterprise and the profit situation of each enterprise every year, and quantitatively analyze the credit risk according to the credit rating in the enterprise information. On the other hand, whether the total number of invoices and the amount of invoices in the backward invoice information and sales invoice information are stable to judge whether the supply and demand of the enterprise is balanced or not. And whether the strength of the enterprise is strong or not to decide whether to grant loans to enterprises, and calculate the weight of enterprises at all levels. From the bank's point of view, the lower the credit risk assessment, the stronger the enterprise must be the more loans, the better the preferential policy of the loan interest rate. Then carries on the credit risk quantitative analysis and the optimal credit strategy to the enterprise. Then it analyzes the relationship between the enterprise and the cancellation ratio range and fluctuation range of the invoice. Finally, the optimal credit strategy is obtained.

1. Introduction

In recent years, the situation of mass entrepreneurship and innovation continues to expand to a larger scope, a higher level and a deeper degree. Small and medium-sized enterprises actively respond to the call of the country, and the depth and width of enterprises are constantly increasing [1]. In order to echo the national economic decision-making and effectively solve the problem of relatively small scale and lack of mortgage assets of small and medium-sized enterprises, banks actively formulate credit policies conducive to the development of small and medium-sized enterprises. As an important index of bank management, credit risk affects the profitability, stability and competitiveness of banks [2] [3]. Therefore, working out a good credit strategy has become an important way to solve the credit risk. The formulation of credit strategy is not only related to credit risk, but also closely related to enterprise reputation, enterprise strength, enterprise supply and demand, and bank interest rate preference and bank loan line.

2. Quantitative analysis of credit risk

2.1 Analytical process preparation

First of all, the factors that affect the credit risk are the strength of the enterprise and the reputation of the enterprise. Through the analysis of the annual profit situation of the enterprise, we can see whether the income of the enterprise is stable or not. On the other hand, the reputation of the enterprise can be evaluated from the enterprise information [4]. Then judge whether the supply and demand of the enterprise is balanced by analyzing the stability of the total number of invoices and the amount of invoices in the input invoice information and sales invoice information [5]. And whether the enterprise is strong [6] or not to decide whether to grant loans to enterprises, and to lend under a limited amount of loans (10-1 million). Here, according to the collected data of 123 enterprises for analysis.

2.2 Factor analysis

Table 1: Factor matrix

| | Strength | Reputation | Relationship between supply and demand | Risk assessment |
|--|----------|------------|--|-----------------|
| Strength | 1 | 1/4 | 2 | 1/2 |
| Reputation | 4 | 1 | 8 | 2 |
| Relationship between supply and demand | 1/2 | 1/8 | 1 | 1/4 |
| Risk assessment | 2 | 1/2 | 4 | 1 |

Then construct the judgment matrix of each factor.

Table 2: Each judgment matrix

| C1 | P1 | P2 | P3 | C2 | P1 | P2 | P3 | C3 | P1 | P2 | P3 | C4 | P1 | P2 | P3 |
|----|-----|-----|----|----|-----|-----|----|----|----|-----|-----|----|-----|-----|----|
| P1 | 1 | 2 | 4 | P1 | 1 | 3 | 5 | P1 | 1 | 1/3 | 1/5 | P1 | 1 | 5 | 9 |
| P2 | 1/2 | 1 | 2 | P2 | 1/3 | 1 | 2 | P2 | 3 | 1 | 1/2 | P2 | 1/5 | 1 | 4 |
| P3 | 1/4 | 1/2 | 1 | P3 | 1/5 | 1/2 | 1 | P3 | 5 | 2 | 1 | P3 | 1/9 | 1/4 | 1 |

Write the above table in the form of a matrix to perform the operation, as follows:

$$A = \begin{bmatrix} 1 & 1/4 & 2 & 1/2 \\ 4 & 1 & 8 & 2 \\ 1/2 & 1/8 & 1 & 1/4 \\ 2 & 1/2 & 4 & 1 \end{bmatrix} \quad (1)$$

$$C_1 = \begin{bmatrix} 1 & 2 & 4 \\ 1/2 & 1 & 2 \\ 1/4 & 1/2 & 1 \end{bmatrix} C_2 = \begin{bmatrix} 1 & 3 & 5 \\ 1/3 & 1 & 2 \\ 1/5 & 1/2 & 1 \end{bmatrix} C_3 = \begin{bmatrix} 1 & 1/3 & 1/5 \\ 3 & 1 & 1/2 \\ 5 & 2 & 1 \end{bmatrix} C_4 = \begin{bmatrix} 1 & 5 & 9 \\ 1/5 & 1 & 4 \\ 1/9 & 1/4 & 1 \end{bmatrix} \quad (2)$$

As a result, the weight relation in turn is obtained, and the weight of P1P2P3 is calculated.

$$P1-0.133*0.571+0.533*0.648+0.109*0.066+0.744*0.266=0.63$$

$$P2-0.133*0.285+0.533*0.229+0.309*0.066+0.193*0.266=0.23$$

$$P3-0.133*0.142+0.533*0.122+0.581*0.066+0.063*0.266=0.14$$

As a result, it is found that the weight of A-level enterprises with reputation is 63%, the weight of

B-level enterprises is 23%, and the weight of C-level enterprises is 14%. From figure 1, we can see that the annual interest rate of bank loans has the greatest impact on A-level enterprises, followed by B-level enterprises, and the smallest is C-level enterprises. And according to the weight of different grades obtained above, we can assume that the loan interest rate is divided into the following three segments: 4% -11%, 11%-13.5%, 13.5%-15%.

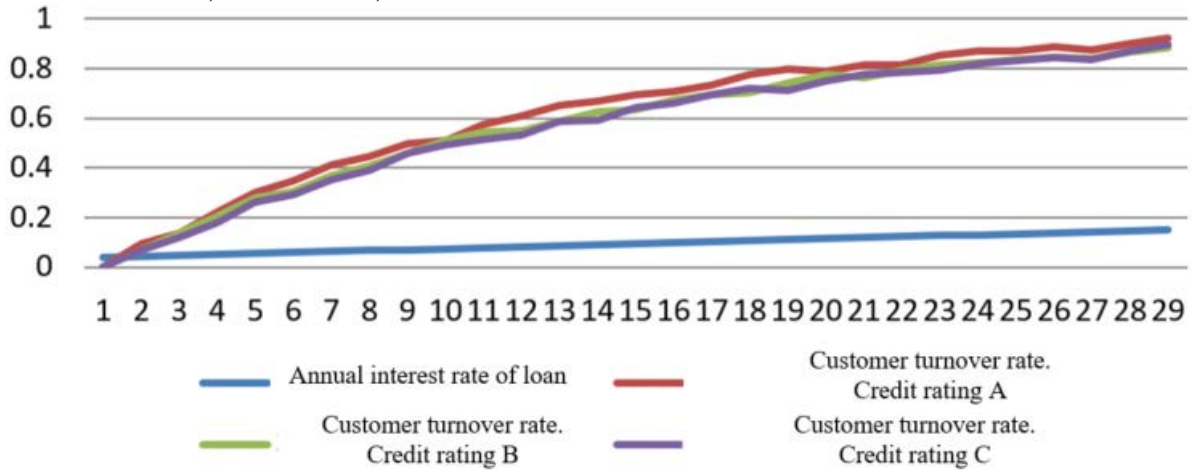


Figure 1: Relationship between loan annual interest rate and customer turnover rate

From the bank's point of view, the lower the credit risk assessment, the stronger the enterprise must be the more loans, the better the preferential policy of the loan interest rate. Therefore, we list the objective function to find the optimal solution according to the loan quota weight and loan interest rate calculated above.

$$MAX = I_{ij} \times \theta_{ix} \times (1 - \phi_{I_{ij}}) \tag{3}$$

Table 3: Optimal scheme table

| | A-class enterprise | B-class enterprise | C-class enterprise |
|--------------------|--------------------|--------------------|--------------------|
| Credit line | 63%X | 23%X | 14%X |
| Loan interest rate | 4%-11% | 11%-13.5% | 13.5%-15% |
| Loan term | 1 | 1 | 1 |

3. Pearson correlation analysis

The reduction of the credit rating of known companies is considered here, which requires us to calculate the credit ratings of 302 enterprises by analyzing the data. By analyzing the known data, we find that there is a significant correlation between reputation rating and the proportion of invalid invoices.

Table 4: Correlation between reputation rating and invalid invoice

| | | Reputation rating | Percentage of invalid invoices |
|--------------------------------|-------------------------|-------------------|--------------------------------|
| Reputation rating | Pearson Relativity | 1 | -.270** |
| | Significant (bilateral) | | .003 |
| | N | 123 | 123 |
| Percentage of invalid invoices | Pearson Relativity | -.270** | 1 |
| | Significant (bilateral) | .003 | |
| | N | 123 | 123 |

4. Optimal credit strategy

Because there is a significant correlation between credit rating and the proportion of invalid invoices, we make the proportion relationship between enterprises with various credit grades and invalid invoices. As can be seen from the following pictures, the proportion of invalidated invoices of A reputation grade is about 0.030-0.080 B reputation grade, about 0.035-0.130 meme C credit grade, about 0.040-0.200 billion D reputation grade, about 0.050-0.357 of invalid invoices. The proportion of invalid invoices is about 0.080 to 0.080, and the proportion of invalid invoices of credit grade C is about 0.040-0.200. The proportion of invalid invoices is about 0.050-0.357. From the proportion of invalid invoices, we can judge the stability of the income of this type of enterprise and whether its reputation abides by the contract or not.

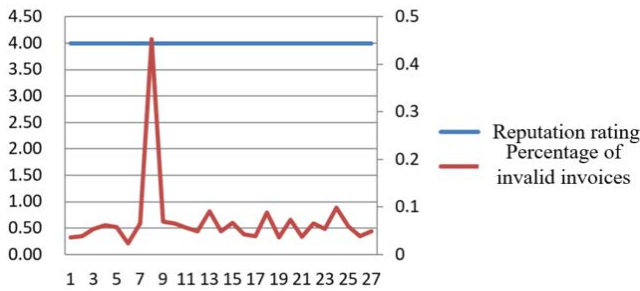


Figure 2: A credit rating and the proportion of invalid invoices

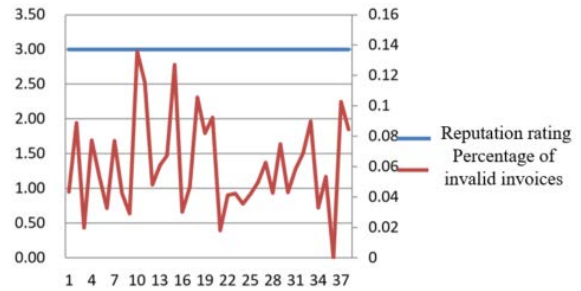


Figure 3: B credit rating and the proportion of invalid invoices

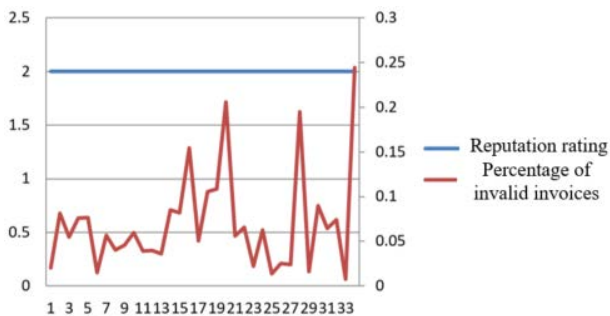


Figure 4: C credit rating and the proportion of invalid invoices

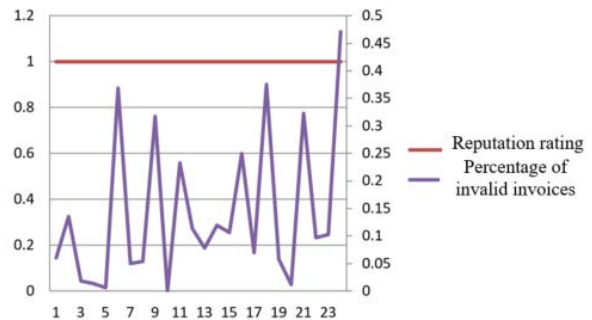


Figure 5: credit rating and the proportion of invalid invoices

According to the relationship between the above analysis and the known credit rating A, B, C, D enterprises and the range of cancellation ratio of invoices, the reputation ratings of 302 enterprises can be obtained. Then a model is established to solve the problem, and the optimal loan strategy is

calculated when the total amount of fixed loan is 100 million. From the bank's point of view, the lower the credit risk assessment, the stronger the enterprise must be the more loans, the better the preferential policy of the loan interest rate.

Table 5: Optimal scheme

| | A-class enterprise | B-class enterprise | C-class enterprise |
|--------------------|--------------------|--------------------|--------------------|
| Total credit line | 0.63 billion | 0.23 billion | 0.14 billion |
| Loan interest rate | 4%-11% | 11%-13.5% | 13.5%-15% |
| Loan term | 1 | 1 | 1 |

5. Conclusion

First of all, this paper calculates the profit amount of each enterprise and the profit situation of each enterprise every year, so as to see the strength of the enterprise and the stability of income. On the other hand, whether the total number of invoices and the amount of invoices in the backward invoice information and sales invoice information are stable to judge whether the supply and demand of the enterprise is balanced or not. As a result, it is calculated that the weights of A, B and C-level enterprises are 63%, 23%, 14%, respectively. It can be known that the credit risk is mainly determined by the strength and reputation of the enterprise, and the credit risk and credit degree of the enterprise affect the loan interest rate of the enterprise. Then carries on the credit risk quantitative analysis and the optimal credit strategy to the enterprise. Then it analyzes the relationship between the enterprises with credit rating A, B, C and D and the range of cancellation ratio and fluctuation range of invoices. Finally, the optimal credit strategy is obtained.

References

- [1] Yang Ningjia. Analysis on the influence of China's Monetary Policy under the epidemic situation of COVID-19--based on the case of Xinyu City, Jiangxi Province [J]. Finance and Economics, 2020 (08): 93-96.
- [2] Zhu Qiangbiao. Unified credit: a realistic choice to control bank credit risk [J]. Financial Theory and practice, 2003 (06): 32-34.
- [3] Liang Di. Research on the influence of Bank-Enterprise relationship on loan financing of small and medium-sized Enterprises [D]. Central University of Finance and Economics, 2015.
- [4] Wu Tielin. Research on risk Control of Credit Business of Commercial Banks [J]. Management and Technology of small and medium-sized Enterprises (first ten days), 2014 (01): 68-70.
- [5] Huang Jing. Quantitative Research on Bank Credit risk based on Fuzzy Analytic hierarchy process [D]. Huazhong University of Science and Technology, 2007.
- [6] Wei Canqiu. Research on unified commercial bank risk management system and capital allocation risk management model [D]. Sichuan University, 2004.