Early Warning Method of Credit Risk of Agricultural Enterprises in Guizhou Province Based on AHP

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Abstract. As the basic industry and traditional industry of the national economy, agriculture plays an extremely important role in economic development, especially in today's global food shortage and frequent natural disasters. The supporting position of agriculture is becoming more and more important. Agricultural enterprises, as a channel for the transformation of agricultural value, have gradually received widespread public attention. Therefore, in order to promote the stable development of society, agricultural enterprises must combine their own actual situation, objectively predict the risks they face, and take preventive measures. To realize the accurate early warning of enterprise credit risk, this paper introduces the analytic hierarchy process (AHP) multi-level analysis, and takes agricultural enterprises in Guizhou Province as an example to carry out the research on the design of credit risk early warning method. Based on the current background of supply chain finance, this paper selects the enterprise credit risk early warning indicators and establishes an index system. Through using the AHP, it analyzes the influencing factors of each indicator and the degree of influence, and establishes an enterprise credit risk evaluation model; it takes the default probability calculation value as the condition to judge whether to output early warning signals, and realizes enterprise credit risk early warning. Through the application of the new early warning method in practice, it is proved that the method can realize the early warning of credit risk. According to the early warning results, the specific direction of improving credit degree can be determined, which can promote the improvement of enterprise credit degree.

Keywords: AHP · Agriculture; credit · Enterprise · Guizhou Province · Risk early warning

1 Introduction

The analytic hierarchy process (AHP) is an effective method to deal with multiple criteria decision making with variables that are not easy to be quantified. It was put forward by Professor T. L. Saaty, an American operational research scientist, in the early 1970s. It is a general and practical multi-criteria decision analysis method combining qualitative and

quantitative analysis. It can decompose a complex problem into a hierarchical structure, compare the importance of each element in each level and describe it quantitatively, and then analyze it step by step at a much simpler level than the original problem. Then, the weights of the relative importance order of the elements in each level are calculated by using the mathematical method, and the relative weights of all the elements are calculated by the total ordering among the levels and the consistency check is carried out. It can express and deal with people's subjective judgment in the form of quantity; it can deal with both quantifiable and non-quantifiable factors; it can also indicate whether there is inconsistency in people's subjective judgment. It is rare to apply the AHP to the early warning of credit risk in agricultural enterprises, and it has not become a system. Studies in China mainly include the following ones: Xu Jin and Tao Ketao (2006) also proposed the construction framework of credit rating indicators for technology-based SMEs in China [1]. Hu Jun (2009) studied the credit evaluation of small and medium-sized technological enterprises in Zhejiang Province based on the impact of technological innovation level and technological risk on enterprise development [2]. Liu Jinlin and Huang Gang (2010) took Guangxi as an example to conduct an empirical study on the credit evaluation of technology-based SMEs [3]. The research in the paper focuses on agricultural enterprises in Guizhou province, which is new in research contents.

Early warning "was originally applied in the military field, and its meaning is to minimize the expected losses by predicting the indicators that are expected to cause adverse effects and issuing specific warnings based on the predicted results." "Early warning" covers a wide range, including military early warning, economic early warning, ecological early warning and social early warning. The study of the agricultural enterprise credit risk early warning belongs to the category of economic early warning, which runs through every link in the development of economic operation.

With the continuous improvement of the market economic system and the rapid development of the private economy, small and medium-sized enterprises in China have ushered in an opportunity for rapid development and entered a period of prosperity and development. Under such a background, it is of great significance to alleviate employment pressure, improve people's livelihood and promote the harmonious development of society. But at the same time, small and medium-sized enterprises also encounter many problems, especially the financing problems of small and medium-sized enterprises, which not only restrict their own development, but also hinder the development of the national economy. In recent years, the government and China Banking Regulatory Commission (CBRC) have issued a series of countermeasures to solve the financing difficulties of small and medium-sized enterprises, encouraging them to carry out credit business.

However, in the current situation, despite the strong support of the state and other relevant departments, and the active exploration of commercial banks, the financing problem of SMEs in China has not been effectively solved. Due to the characteristics of small and medium-sized enterprises, such as imperfect financial indicators and the emphasis on non-financial indicators, the existing credit risk assessment and early warning methods are unscientific and unreasonable. In addition, credit risk is also the biggest risk faced by banks at present, and it is also the most complex one among many types of risks. Credit risk is a major factor affecting banking business. Therefore, how to

assess and warn the credit risk of enterprises will directly affect the normal operation and long-term development of banks [4]. Based on this, this paper, on the basis of the introduction of AHP analysis method, carries out the research on the design of enterprise credit risk early warning method, and takes agricultural enterprises in Guizhou Province as an example to carry out case analysis.

2 Selection of Early-Warning Indicators of the Enterprise Credit Risk

From the perspective of supply chain financing, according to the complexity and decentralized characteristics of supply chain financing, this paper selects credit risk early warning indicators from three perspectives: financial capacity, the degree of development of supply chain finance, and the overall situation of the supply chain. Financial capacity indicators can be verified by the company's main income, assets and liabilities, and will not be affected by the subjective factors of operators, which can quickly reflect the company's credit risk and effectively warn it. The development level of supply chain financing can reflect the situation of advance payment financing and the overall financing level of enterprises [5]. The overall supply chain status index can reflect the specific position of a company in the whole industry. Some core enterprises cooperate with the government to provide guarantees for the invested objects, which can effectively reduce the financing risk [6]. Figure 1 shows the credit risk early warning index system composed of the above three selected indicators.
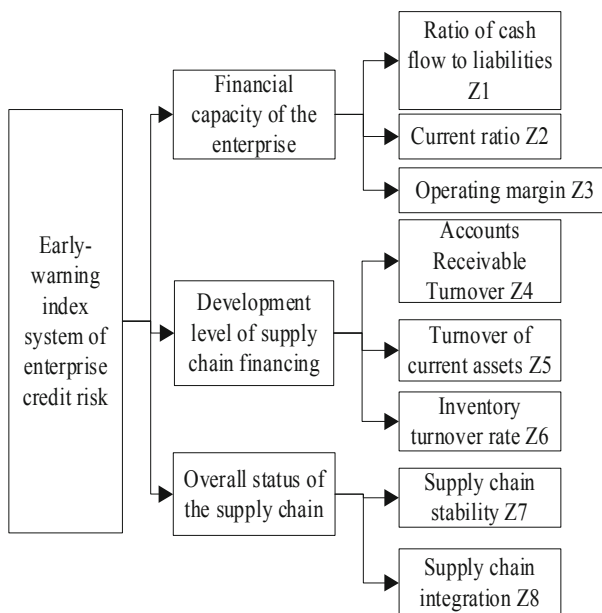

Fig. 1. Credit risk early warning index system

For the indicators in Fig. 1, the specific values are obtained by mathematical calculation. Taking the ratio of cash flow to liabilities as an example, the calculation formula is as follows:

$$v = l/f * 100\% \tag{1}$$

where, v represents the ratio of cash flow to liabilities of the enterprise; l represents the net cash flow from operation of the enterprise; and f represents current liabilities. Combined with the above formula, the calculation formula of current ratio can be further obtained as follows:

$$\zeta = e/f * 100\% \tag{2}$$

where ζ is the current ratio and e is the total working capital. According to the above logic, the specific value of each index is obtained, and the change of each value provides the basis for the subsequent risk assessment.

3   Establishment of Enterprise Credit Risk Evaluation Model Based on AHP

After the completion of the selection of early warning indicators of enterprise credit risk, it evaluates the enterprise credit risk according to the indicators. In the evaluation process, the AHP method is introduced [7]. Figure 2 is a schematic diagram of the basic structure of the AHP.

For each early warning index selected above, it is brought into the AHP hierarchy analysis structure shown in Fig. 2. On this basis, a pairwise comparison matrix is constructed. Starting from the second layer, score the influence of each factor in the previous layer on the factors in the next layer, and compare the importance of multiple indicators [8]. In order to have a regular understanding of the problem, more information must be
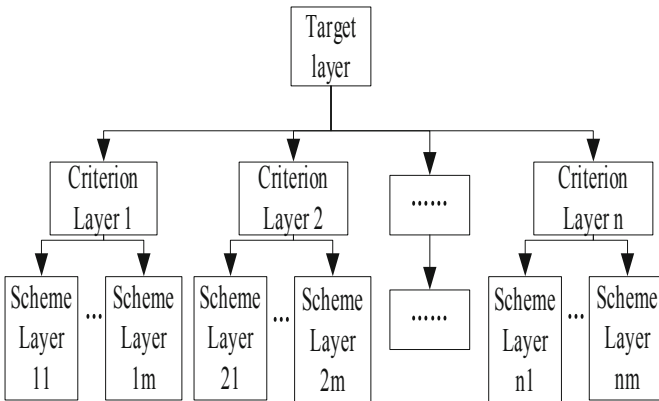

Fig. 2. Basic structure of AHP

extracted from the discriminant matrix and normalized for each element in the matrix [9]. The formula for normalization processing is:

$$a_{ij} = \frac{u_{ij}}{\sum_k^n u_{kj}} \tag{3}$$

where, a_{ij} represents the normalized index; u_{ij} represents the index elements in row i and column j of the matrix; and k represents the number of indexes to be normalized. After completing the normalization processing of all indexes, an enterprise credit risk evaluation model as shown in formula (4) is constructed:

$$P = \begin{cases} Z_1 = a_{11}F_1 + \cdots + a_{1m}F_m + \varepsilon_1 \\ \cdots \\ Z_8 = a_{81}F_8 + \cdots + a_{8m}F_m + \varepsilon_8 \end{cases} \tag{4}$$

where, P represents the output result of the model; Z_1 represents the evaluation result of the cash flow liability ratio index; Z_8 represents the evaluation result of the supply chain integration index; a_{11}; … …, a_{81}, a_{81}, ……, a_{8m} represents the normalized index; F represents the common factor; ε represents the special factor. Through the establishment of the enterprise credit risk assessment model, the credit risk is assessed.

4   Credit Risk Warning Signal Output

According to the above discussion, it is suggested to realize the evaluation of enterprise credit risk, make the evaluation as a basis, and combine with enterprise credit default probability to determine whether to make credit risk warning. If the enterprise has a high probability of default, it will be recorded as 0, otherwise, it will be 1. At the same time, the target enterprises are examined, the independence of each sample is analyzed, and the factor analysis method is used to solve the collinearity problem between indexes [10]. The following formula is a linear relationship between the independent variable and the probability of default.

$$\ln\left[\frac{p_i}{1 - p_i}\right] = a + \sum_{k=1}^n \beta_k x_{ki} \tag{5}$$

where p_i is the probability of default; a and β are the coefficients; and x_{ki} is the cumulative distribution function [11]. On the basis of the above formula, a parameter P is set, which is used to represent the probability that the target enterprise may default. When the value of P is infinitely close to 1, the default possibility of the enterprise is smaller; on the contrary, when the value of P is infinitely close to 0, the default possibility of the enterprise is greater. In this way, the value is used as the basis for judging whether the early warning signal is output or not, and $Q = 0.5$ is set as the threshold. When the value of P exceeds 0.5, the early warning signal is not output, and the current early warning indicator of the enterprise is recorded as a normal group; when the value of P is less than 0.5 or equal to 0.5, the early warnings signal is output, and the current early warning indicator of the enterprise is regarded as a default group [12]. After defining the role of the parameter P, its specific value can be obtained by the following formula:

$$P = \frac{1}{1 + \exp[-a + \sum_{k=1}^n \beta_k x_{ki}]} \tag{6}$$

According to the above discussion, the early warning of enterprise credit risk is completed. At the same time, according to the evaluation results of each early warning index, the specific aspects of credit risk can be obtained intuitively, which provides a direction for the improvement of enterprise credit.

5 Case Analysis of Credit Risk Early-Warning of the Agricultural Enterprises in Guizhou Province

On the basis of the above discussion, taking agricultural enterprises in Guizhou Province as an example, this paper uses the new early warning method to carry out credit risk early warning for the agricultural enterprises. The registered capital of the agricultural enterprise is 10 million yuan, and the total number of employees is 120, including 10 managers and 5 middle and senior titles. In the last year, the actual annual sales revenue of the agricultural enterprise was 232 million yuan, the total actual utilization was 2.65 million yuan, and the net profit was 2.43 million yuan [13]. The future development momentum of the enterprise is good, and the demand for capital is gradually increasing.

Therefore, in the second year, apply for a one-year working capital loan from the bank, the loan amount is 20 million yuan, which is used to increase the working capital needed in the operation of the enterprise. Under the above background, the credit risk is assessed, and if there is a risk in the assessment, the corresponding early warning signal is given according to the degree of risk [14].

According to a number of risk early warning indicators selected above in this paper, the corresponding evaluation results are given for the data and related information provided by the agricultural enterprise, as shown in Table 1.

It can be seen from the evaluation results in Table 1 that the evaluation results of most indicators of the agricultural enterprise are greater than 0.500, which will not trigger the generation of early warning signals. But when evaluating the indicators Z4, Z6 and Z7, the results are less than 0.500, which will trigger the generation of early warning signals. Therefore, through the above assessment, it is concluded that the agricultural enterprise is currently not allowed to apply for a loan from the bank because it has a credit risk

Table 1. Risk assessment results of each index of agricultural enterprises

Number	Indicators	Evaluation results	Alert or not
(1)	Z1	0.825	No
(2)	Z2	0.823	No
(3)	Z3	0.548	No
(4)	Z4	0.426	Yes
(5)	Z5	0.536	No
(6)	Z6	0.468	Yes
(7)	Z7	0.495	Yes
(8)	Z8	0.526	No

problem. If it still wants to continue to apply for loans, it must take effective measures to optimize the corresponding aspects of indicators Z4, Z6 and Z7. After optimization, the bank needs to evaluate its credit risk again. If the evaluation results of all indicators are greater than 0.500, it is considered that there is no credit risk for the enterprise and its loan can be allowed. In addition, it can be seen from the evaluation results that when the index Z3, index Z5 and index Z8 are evaluated, although the evaluation results are greater than 0.500, they are close to the critical value. Therefore, if the agricultural enterprise wants to further enhance its own credit, it can try to further enhance the overall credit of the agricultural enterprise on the basis of the above three aspects. Through the analysis of the above examples, we can see that the early warning method proposed in this paper can realize the early warning of enterprise credit risk, and can determine the causes of specific risk problems according to the specific values obtained, which can be adopted as an important basis for enterprises to enhance credit.

6   Conclusion

In a word, through the above research of this paper, it makes a certain contribution to the enterprise credit risk early warning. Using the early warning method based on AHP to evaluate the enterprise credit risk, we can find out the credit risk problems existing in the operation of enterprises. By solving the risk problem reasonably, it can bring more convenience to improve the credit of enterprises and apply for bank loans. On the basis of the application of this risk warning method, enterprises should standardize financial statements to ensure their authenticity, and then provide a more reliable basis for credit risk warning.

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