

Enterprise Credit Risk Management Model Based on Super_SBM Model

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Abstract: The current risk management model has the problem that the credit risk type is not clear, which leads to the poor goodness of fit performance of the model the credit risk management model based on SBM model. Calculate the enterprise exploration factor index, study the correlation degree between the observation variables, divide the credit risk types, establish the credit system, and use Super_SBM model obtains index weight, extracts the importance of risk factors, establishes credit risk management model, and forecasts the decision-making results of enterprises. Experimental results: the mean goodness of fit of the risk management model and the other two risk management models is 0.4139, 0.4989, 0.807, proving that the fusion of Super_SBM model has higher practical value in risk management.

1 INTRODUCTION

Generally speaking, when we discuss the basic meaning of credit risk, because the economic meaning of the concept of credit risk is stronger than that of other angles, we usually study it from the economic level. However, the definition of the concept of credit risk has not yet been completely determined (Oliveira, Mexas, Meirino, et al. 2019). Credit is an invisible contractual relationship among the participants in economic activities, which is based on equality and reciprocity. In the economic activities of an enterprise, the specific performance may be that the enterprise obtains money, products or services with the same physical assets (Kuo, Lin, Chien 2020). To grasp the definition of enterprise credit risk, we need to understand the meaning of risk. To understand risk, we need to pay attention to two important factors: firstly, risk refers to the situation that may have bad expectations, and the risk manager is to prevent and deal with the occurrence of bad situations, which will bring losses to people the existence of "risk" means that there are worse than expected results in all the results (Silva, Fernandes 2019). If the probability of those worse than expected results is zero, then the risk does not exist, and the expected good results can always be achieved; secondly, the probability of the expected result or loss is not zero, and the probability of occurrence is a

random value. To sum up, risk includes two important factors: the expected bad loss and the probability of the expected bad result. Traditionally, credit risk is the risk that the borrower fails to repay the debt within the specified period and causes losses to the lender, so it is also called default risk. With the continuous maturity of the financial market and the high attention paid to the credit risk of enterprises, when the repayment ability of borrowers or counterparties declines, that is, the credit quality declines, the price of relevant assets in the market also decreases, resulting in the loss of credit risk (Hiebl, Duller, Neubauer 2019, Corrêa, Neto, Souza, et al. 2019). To define credit risk in a broad sense, we should first define the credit relationship. Where there is credit in the relationship between the two, whether it is on the level of ethics, economy, law or currency, there is a credit relationship between them. In a broad sense, credit risk refers to the possible loss caused by the failure of the other party to perform the contract (Polly, Stevens, Jordan, et al. 2019). From the narrow economic perspective, credit risk is defined as the possible loss to the creditor if the other party defaults in the expectation of obtaining a series of income in a fixed period of time. Generally speaking, a creditor's debt can't be recovered or can't be recovered in time due to the debtor's breach of contract, which may bring losses to the creditor. In short, credit risk refers to the potential loss to the credit provider when the party accepting the credit

refuses or is unable to repay the debt on time and in full. Enterprise credit generally refers to the credit relationship between enterprises due to credit sales. After the credit sales activities, the enterprise will give the customer the corresponding credit line, that is, a part of the accounts receivable of the customer can be paid in the future, which is a financing activity for the customer (González, Santomil, Herrera 2020, Johnston, Soileau 2020, Altuntas, Berry-Stlzle, Cummins 2019). This kind of credit relationship is based on the premise that the enterprise thinks that the customer can repay all the money before the due date. It is a loan relationship guaranteed by the customer's credit. If the enterprise thinks that the customer cannot repay the debt when it matures, it will not grant a credit line. Credit sale is the basis of accounts receivable and the cause of credit risk. At present, the academic circles are concerned about Super_SBM model, applied to the construction of enterprise credit risk management model literature is not very rich, still need to be further explored.

2 ENTERPRISE CREDIT RISK MANAGEMENT MODEL BASED ON SUPER_SBM MODEL

2.1 Calculation of Enterprise Exploration Factor Index

Exploratory factor is to explore the basic structure of observation data by studying the internal dependence of many variables. The basic idea is to find common factors, and ultimately achieve the purpose of dimension reduction. Confirmatory factor analysis (CFA) uses prior information to test whether the previously collected data work according to the predetermined structure. First, we need to use exploratory factors to group financial indicators, then get preliminary factors after analysis, and then carry out confirmatory factor research. The growth rate of total assets is mainly used to reflect the growth degree of enterprise's operating strength, the expression formula is as follows:

$$Q = \frac{P}{W} \times 100\% \quad (1)$$

In formula (1), P represents the growth of the total assets of the enterprise in the current year, and W represents the total assets at the beginning of the year. The important basis to judge whether an

enterprise is out of the expansion period is whether its asset scale is expanded or not. There are two ways for enterprises to expand assets: one is to expand the scale of liabilities, the other is to increase the owner's equity. Companies with single operation and outstanding main business usually have higher growth (Huang 2019, Shi, Wang, Wang 2019). This indicates that the company has a large market demand for its products and a strong ability to expand its business. If a company can maintain a growth rate of more than 30% of its main business income for several consecutive years, it can basically be considered as a growth company. The continuous growth of net profit is the basic feature of a company's growth, the expression formula is as follows:

$$E = \frac{r_1 - r_2}{u} \times 100\% \quad (2)$$

In formula (2), u is the net profit of the enterprise last year, r_1 is the net profit of the enterprise this year, r_2 is the net profit of the previous year. If the increase is large, it indicates that the company has outstanding business performance and strong market competitiveness. On the contrary, if the index is small or negative, then the growth of the enterprise is very poor. For most production-oriented enterprises, the growth rate of fixed assets reflects the expansion of production capacity. Therefore, when calculating the growth rate of fixed assets, we should pay attention to the composition of the increased fixed assets, the expression formula is as follows:

$$L = \frac{T_a - T_b}{Y} \times 100\% \quad (3)$$

In formula (3), T_a represents the net assets at the end of the period, T_b represents the net assets at the beginning of the period, and Y represents the total fixed assets at the beginning of the period. If most of the increased parts are under construction, it is necessary to pay attention to the completion time, because the completion will have a significant impact on the current profits. If the growth part has been completed earlier in this year, then there is no need to expect a substantial increase in future earnings on the current basis (Abu-Qarn 2019). It is closely related to the level of credit risk. The study of solvency can obtain the ability of an enterprise to deal with risks and the efficiency of financing. Based on the above calculation, the steps of obtaining enterprise exploration factor indicators are completed.

2.2 Classification of Credit Risk Types

From the perspective of sources, credit risk can be divided into two types: the risk of counterparties and the risk of issuers. The former is mainly produced in commercial bank loans and financial derivatives transactions, while the latter is mainly related to bonds. In terms of composition, credit risk consists of two parts. One part is default risk, which refers to the possibility that one party of the transaction is unwilling or unable to pay the agreed amount, resulting in the loss of the other party. In terms of level, credit risk can be divided into three levels: one is transaction level, which is related to a single financial transaction. The second is the level of counterparties or issuers, which is generated in all transactions with one counterparties or issuers. The third is the level of asset portfolio, which is related to all transactions of market entities, all counterparties and issuers. The most important step of credit risk management is to examine the credit of the enterprise. Enterprises should control credit risk from the source, require customers to provide business reputation, financial statements and other information within the scope of the overall strategic objectives of the enterprise, strictly review the authenticity and integrity of the information, and grant corresponding credit line according to the evaluation results. If it exceeds the ordinary approval authority, it needs the approval of the company's higher level management personnel (Saeidi, Saeidi, Sofian, et al. 2019, Oliveira, Mexas, Meirino, et al. 2019). Only by establishing a strict credit system can we minimize the risk from the source and reduce unnecessary losses for enterprises. If it is difficult for an enterprise to obtain the corresponding financial statements and other information when examining the customer's credit, it can turn to an independent credit rating agency for help. In some cases, it can ask the enterprise to provide property guarantee or third-party guarantee to ensure the safe recovery of creditor's rights. The establishment of credit system is an effective way to reduce the bad debt rate of accounts receivable. On the one hand, it is strictly controlled from the initial stage to fully understand the credit risk level of customers and reduce the credit risk to the lowest level as far as possible. On the other hand, it increases mutual trust and mutual understanding with customers, standardizes the credit relationship between enterprises and customers, and increases mutual information, laying a foundation for further cooperation between enterprises and customers. As a current asset of an enterprise, the quality of accounts receivable is related to the authenticity of the

financial situation of the enterprise. The enterprise shall make an agreement with the debtor that when the debtor fails to repay the relevant debts on time, the creditor shall have the right to recover the money in advance or mortgage the relevant assets with a third party, so as to ensure the safety of the creditor's rights. Statistical method is the summary of human-machine operation and experience (Ojeka, Adegboye, Adegboye, et al. 2019). The use of modern statistical methods combined with computer technology can greatly improve the efficiency of evaluation. With the development of statistical theory and computer technology, many new risk assessment methods have emerged in recent years, such as neural network, support vector machine and so on. Although they also have a high correct rate of discrimination, it is difficult to understand the evaluation process, and the evaluation results are lack of explanation and persuasion; other traditional statistical methods, such as multivariate discriminant analysis, require the sample distribution to conform to multivariate normal distribution, which also limits the practical application. There is no special requirement for the distribution of sample data, and the result is a probability value belonging to a certain risk category, which has a clear meaning and is easy to compare different evaluation objects. Based on the above description, complete the credit risk type step.

2.3 Super_SSBM Model to Obtain Index Weigh

In 2002, tone proposed the DEA efficiency analysis method based on SBM, that is, when building the DEA model, we should consider its relaxation variables, and then study the influence of angle and radial selection on the input-output relaxation (Huang, Liu 2020, Zhu, Zhu, Shan 2021). All DMUs are divided into efficient DMUs and inefficient DMUs to form Pareto boundary. As a non radial and non angle data envelopment analysis (DEA), it follows the basic idea of DEA and envelops the input-output data set with the most effective technology frontier (An, Wu, Li, et al. 2019, Lin, Zhu, Han, et al. 2020). Different from the previous methods, super SBM model puts the relaxation variables into the objective function to solve the problem of input and output relaxation. Super SBM model can be solved directly by software, without setting production function in advance, and without considering the problems of index dimension. This process is the first step in the process of credit risk management. Enterprises need to conduct a detailed study on the credit of the opposite party of credit sales, and also conduct market risk research on

the related industries, because different industries have different market risks. Some industries are cyclical and fluctuate with the change of the cycle. If we do not pay close attention to the change of market risk, it may cause great credit risk loss to the credit seller. For example, as a kind of high-quality non renewable energy, the mining scale of coal industry will be affected by government policies, and will be greatly affected by seasonal changes. In contrast, the higher the solvency, the lower the corresponding credit risk. If we want to get credit risk income, we must adopt scientific credit risk management methods, seriously and comprehensively collect customers' credit information, and pay close attention to customers' business dynamics. The characteristic analysis of enterprise credit risk factors can establish a special language to describe customer characteristics, which is commonly used by sales, marketing, credit and other departments of the enterprise, so as to strengthen the understanding and cooperation among various departments. The entropy weight method is used to determine the index weight in the index layer, the expression formula is as follows:

$$S = -k \sum_{i=1}^c d_{ij} k \tag{4}$$

In formula (4), k is the enterprise credit score vector, c is the standardized value, d is the indicator vector, i is the criterion layer, and j is the number of indicators. Enterprises are not professional evaluation institutions, so in the selection of characteristic indicators, we should fully consider the incomplete information collection, information distortion and other factors, try to make

the technical indicators easier to understand, the conclusion is relatively accurate and easy to use. Due to the difficulty and poor accuracy of obtaining credit information in China, we should focus on qualitative index analysis, supplemented by quantitative index analysis.

2.4 Establishing Credit Risk Management Model

According to the credit management department's investigation of customers' credit, enterprises identify and analyze the risk degree of credit sales, formulate corresponding contract conditions such as collection method and credit line in combination with their own control objectives of financial risk, and then track the financial status and market risk changes of the enterprise to be granted credit in time before recovering all funds, so as to ensure the safe recovery of funds. Perfect credit risk management measures can effectively reduce the risk of financial loss caused by credit sales. When a shareholder of a company borrows a debt, it is equivalent to buying an asset whose underlying asset is the value of the company's assets. The principle of the call option whose default point is the exercise value is shown in Figure 1.

According to Figure 1, to establish a credit risk management model, we should follow the following steps: 1. Credit risk identification and evaluation. The enterprise conducts a detailed investigation and Research on the financial status, solvency and other information of customers, further studies and analyzes the factors that may cause development and change, analyzes and evaluates with the evaluation model, and links the evaluation data with the corresponding authorization mechanism of the

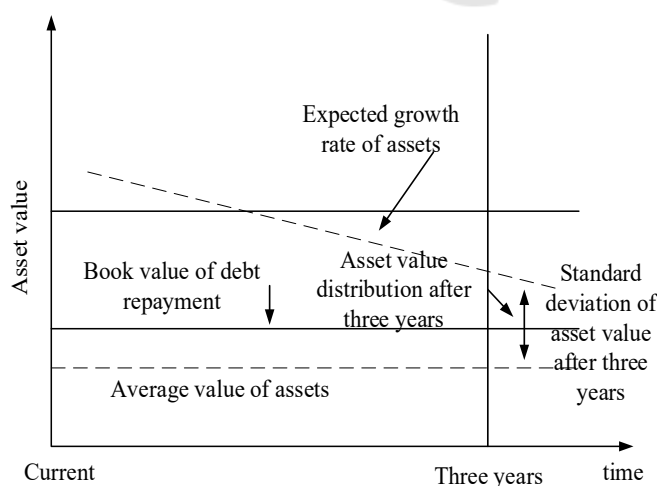


Figure 1: Schematic diagram of enterprise anticipatory breach of contract.

enterprise, so as to give customers the corresponding credit line. Enterprises revise credit risk management methods and procedures. (Vij 2019). All members of the enterprise need to create their own unique credit culture, which can increase the cohesion of employees, improve the company's reputation and market competitiveness. Due to the neglect of the influence of credit behavior, the credit risk awareness of Chinese enterprises is generally not high. On the basis of identifying and measuring enterprise credit risk, credit risk managers must take appropriate credit risk control strategies to achieve the goal of credit risk management. The control before the occurrence of enterprise credit risk is the control of credit risk in advance. In modern credit risk management, this kind of control method is more and more valued and widely used by people. Before making business decisions, the credit risk factors inside and outside the enterprise are analyzed in detail, various risk factors are estimated comprehensively, and the trend of the decision results of the enterprise is predicted. It is assumed that when the asset value of an enterprise is at a certain value level, the default probability of credit risk is higher, the default probability of an enterprise is expressed as:

$$G = \frac{m(f_n \leq f_z)}{\sqrt{q}} \quad (5)$$

In formula (5), m is the asset value of the enterprise, f is the critical asset value of credit risk default, q is the standard distribution value, n is the initial asset value of the enterprise, and z is the market risk coefficient. If the possible credit risk factors are found, preventive corrective measures should be taken in advance to ensure that the enterprise's business decisions are always on the right track, so as to achieve the enterprise goals. To a certain extent, it can avoid and prevent the mistakes of control in the event and control after the event. Credit risk control is also a necessary form of control. When credit risk problems occur, necessary measures should be taken in time to control the increase of

losses and reduce losses. Because credit risk may occur at any time, and the occurrence time of risk events is extremely short, the credit risk control requires enterprise decision-makers to have a high degree of risk perception, and be able to deal with risk events in time.

3 EXPERIMENTAL ANALYSIS

3.1 Experiment Content

Firstly, the most significant regression coefficient of the variable with the largest partial correlation coefficient was tested to determine whether the variable entered the regression equation. Then, each variable in the equation is taken as the last variable selected into the equation to calculate the index weight, and the variable with the smallest index weight is tested to determine whether it remains in the equation. Repeat this process until no variables are introduced and no variables can be eliminated. In this way, the application of stepwise regression method can introduce and eliminate variables, and the original eliminated variables may be introduced into the regression equation later. Because the stepwise regression method is a general term of a large category, the selection forward LR method in SPSS software is mainly selected to test the goodness of fit of the model under different iterations.

3.2 Experimental Result

In the experiment, the enterprise credit risk management model based on machine learning and the enterprise credit risk management model based on logistic are selected to compare with the designed risk management model. The goodness of fit of the three models is tested under different iteration times. The closer the goodness of fit is to 1, the better the fitting degree of the regression line to the observed value is.

Table 1: Experimental results of goodness of fit.

| Iterations (times) | Enterprise credit risk management model based on machine learning | Enterprise credit risk management model based on Logistic | Risk management model of design |
|--------------------|---|---|---------------------------------|
| 100 | 0.3016 | 0.6445 | 0.7849 |
| 200 | 0.3699 | 0.7031 | 0.6638 |
| 300 | 0.2647 | 0.5432 | 0.7934 |
| 400 | 0.4458 | 0.6019 | 0.8025 |
| 500 | 0.5537 | 0.3376 | 0.6974 |
| 600 | 0.6029 | 0.4116 | 0.8569 |
| 700 | 0.4631 | 0.3871 | 0.7774 |
| 800 | 0.3397 | 0.4036 | 0.8639 |
| 900 | 0.6080 | 0.6003 | 0.9468 |
| 1000 | 0.6682 | 0.4319 | 0.8533 |

Table 2: Average goodness of fit of. three models.

| Number of experiments (group) | Enterprise credit risk management model based on machine learning | Enterprise credit risk management model based on Logistic | Risk management model of design |
|-------------------------------|---|---|---------------------------------|
| 1 | 0.4618 | 0.5011 | 0.7984 |
| 2 | 0.4839 | 0.5026 | 0.8001 |
| 3 | 0.3364 | 0.4967 | 0.8948 |
| 4 | 0.4012 | 0.5113 | 0.7866 |
| 5 | 0.3207 | 0.4837 | 0.8631 |
| 6 | 0.3489 | 0.5006 | 0.6485 |
| 7 | 0.4068 | 0.4988 | 0.7933 |
| 8 | 0.4816 | 0.5022 | 0.7204 |
| 9 | 0.4553 | 0.4886 | 0.8546 |
| 10 | 0.4431 | 0.5036 | 0.9102 |

The experimental results are shown in Table 1.

According to Table 1, the mean goodness of fit of the three risk management models can be obtained under different iterations, as shown in Table 2.

It can be seen from Table 2 that the average goodness of fit of the enterprise credit risk management model based on machine learning, the enterprise credit risk management model based on logistic and the design risk management model are 0.4139, 0.4989 and 0.807 respectively. The average goodness of fit of the risk management model designed in the three models is closest to 1, which proves that the design model has better performance.

4 CONCLUSION

The risk management model designed in this paper has better performance than the current model, and enriches the academic literature on enterprise risk management. At the same time, it broadens the scope of Super_SBM model, it provides new feasible ideas for enterprise risk management. Due to my limited ability, the article is about Super_SBM model in other fields is not comprehensive enough, in the future, I will continue to work on related research.

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