Credit Evaluation of Small and Medium-sized Technology Enterprises in the Big Data Environment

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Abstract: In the big data environment, the Analytic Hierarchy Process is used to build credit evaluation with six dimensions (profitability, solvency, operation ability, development ability, corporate basic situation and intellectual property), three layers and 32 basic indicators for small and medium-sized technology enterprises. On this basis, the errors of the credit evaluation be reduced by modifying the indicator weights through big data.

1. Introduction

The financing difficulty of small and medium-sized technology enterprises (SMTEs) is a worldwide problem, the basic reason of which is information asymmetry. In the era of big data, all the main information of the market, including product information, service information, transaction information, etc., are recorded. Therefore, data can be collected, cleaned and mined through the big data technology for building a credit evaluation indicator system, and then using Artificial Intelligence (AI) or Analytic Hierarchy Process (AHP) to measure the credit, which reduces information asymmetry, so that it can alleviate the financing difficulty of SMTEs.

The earliest credit assessment activity occurs in the United States. Before the 1950s, the feature of the credit rating technology is expert experience judgment. The most common is 5C, 5W and 5P.The Wall Marking Way and The DuPont Financial Analysis System are proposed by Wole in the early 20th century. After 1960, it turns into a period of mathematical model, which has M & A and financing portfolio. The Survival Analysis Method is introduced into the credit rating field in 1984[1,2]. After 1990, it enters an innovation period of integrating artificial intelligence, computer technology and system technology. Data Envelopment Analysis (DEA) is introduced into credit rating technology, breaking through the mathematical model method, and some scholars begin to rely on artificial intelligence, computer technology, etc. for credit evaluation, but they are plagued by the need for big sample data [3,4].

The research of credit evaluation begins in 1987 in China. Gu Jiang (1997)[5]made a preliminary discussion on the enterprise credit evaluation indicators system, which has revolutionary progress, but the selection of these indicators mainly depends on subjective feelings. Ren Yongping and Mei Qiang (2001)[6] adopted the basic quality of enterprise to establish the indicators system, which breaking through the pure financial indicator. Recently, with the increasing of financing for the technology enterprises, the research on credit evaluation methods of technology enterprises is focused. Liu Bing (2015) [7] used the expert scoring method and the AHP to select the five dimensions, which are finance, development ability, management ability, innovation ability and external environment to construct a credit evaluation system of technology enterprises. Chen Danhua (2017) [8] proposed a credit evaluation indicators of technology enterprises by considering the development prospects of enterprises, the state of corporate assets and the business conditions of enterprises.

In the big data environment, considering the availability and measurability of data, firstly

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selecting the six dimensions, which are profitability, solvency, operation ability, development ability, corporate basic situation and intellectual property to construct a credit evaluation indicator system for SMTEs, and then using the AHP to determine the weight of each indicator, and finally adopting more than 15,000 enterprises credit assessment data to revise the weight.

2 Modeling

2.1 Credit Evaluation Indicator System

Considering the availability and measurability of data and the core competitiveness of technology enterprises being intellectual property, a credit evaluation indicator system for SMTEs is constructed, which includes six dimensions (profitability, solvency, operation ability, development ability, corporate basic situation and intellectual property), three layers and 32 basic indicators, as shown in table 1.

Table 1 the credit evaluation indicator system for SMTEs

indicator type(correction weight, weight)	first indicators(correction weight, weight)	second indicators (correction weight, weight)	third indicators(correction weight, weight)
financial indicators(0.6,0.7)	Profitability(0.3,0.3)	sales profit margin (0.1,0.1)	——
		cost margin (0.1,0.15)	——
		investment income (0.1,0.1)	——
		sales average (0.1,0.15)	——
		profit average (0.3,0.25)	——
		return on equity (0.2,0.15)	——
		return on total assets (0.1,0.1)	——
	solvency (0.1,0.15)	asset-liability ratio (0.2,0.2)	——
		quick ratio (0.1,0.1)	——
		current ratio (0.1,0.15)	——
		cash ratio = monetary fund / current liabilities (0.3,0.25)	——
		net cash flow (0.1,0.12)	——
		property ratio = total liabilities / owner equity (0.05,0.06)	——
		operation capital and long-term debt ratio = (current assets - current liabilities) / long-term liabilities (0.1,0.06)	——
		long-term debt ratio = ratio of long-term liabilities to total assets (0.05,0.06)	——
	operation ability (0.1,0.15)	current assets turnover rate = operating income × 2/ (current assets) (0.5,0.4)	——
		inventory turnover = operating costs × 2 /(beginning inventory + ending inventory) (0.3,0.3) (0.3,0.3)	——
		total asset turnover = net product sales revenue / assets (0.2,0.3)	——
	development ability (0.5,0.4)	net profit growth rate (0.5,0.5)	——
		sales growth rate (0.3,0.3)	——
		total asset growth rate (0.2,0.2)	——

non-financial indicators(0.4,0.3)	corporate basic situation(0.7,0.8)	enterprise quality(0.7,0.6)	registered capital (0.1,0.2)
			total assets (0.2, 0.2)
			business years (0.1, 0.1)
			whether high-tech enterprises (0.5,0.4)
			whether to pass the annual inspection (0.1,0.1)
		human resources(0.3,0.4)	executive education level (0.3,0.3)
			corporate legal person education level (0.5,0.4)
			undergraduate ratio (0.1,0.15)
			technical ratio (0.1,0.15)
	intellectual property(0.3,0.2)	number of patents(1,1)	——

2.1.1 Financial indicators

According to the nature of indicators, financial indicators can be sorted in four: profitability, solvency, operation ability and development ability. Profitability reflects the current profitability of the enterprise, to a certain extent, reflects the investment value of the enterprise. The stronger the profitability, the shorter the time for investors to recover their investment costs. The indicators are: sales profit margin, cost margin, investment income, sales average, profit average, return on equity, and return on total assets.

Solvency reflects the ability of an enterprise to use its assets to repay its debts. A better solvency can effectively eliminate investors' investment worry. It includes indicators such as asset-liability ratio, quick ratio, current ratio, cash ratio, net cash flow, property ratio, and operation capital and long-term debt ratio.

Operation ability reflects the ability of enterprises to use funds and the turnover of funds. The indicators are: current assets turnover rate, inventory turnover, and total asset turnover.

Development ability is one of the key factors that investors pay attention to. The goal of investment is to realize the value-added of investment through the growth of SMTEs. The indicators are: net profit growth rate, sales growth rate, and total asset growth rate.

2.1.2 Non-financial indicators

Non-financial indicators include both corporate basic situation and intellectual property. Among them, corporate basic situation consists of enterprise quality and human resources. The enterprise quality includes the following indicators: registered capital, total assets, business years, whether high-tech enterprises, and whether to pass the annual inspection. The indicators of human resources include: executive education level, corporate legal person education level, undergraduate ratio, and technical ratio. Intellectual property is embodied by the number of patents.

2.2 AHP

The problem of weighting the above indicators is a complex decision-making problem, which is a combination of qualitative and quantitative, systematic and hierarchical. This paper uses the AHP. The steps of the AHP are:

(1) Establishing a hierarchical structure model

The components of the object are divided into the highest layer, the middle layer and the lowest layer according to their mutual relationship. The highest level refers to the problem to be solved. The problem to be solved in this paper is the credit evaluation of technology enterprises. The lowest level refers to the alternatives in decision-making. The alternatives are to modify the weight of indicators through the credit evaluation data of more than 15,000 enterprises. The middle layer refers to the considered factors and the criteria for decision-making. The factors considered in this paper are six dimensions and 32 basic indicators for evaluating the credit of technology enterprises in the big data environment.

(2) Constructing judgment matrix

The proportion of each factor in the credit evaluation of technology enterprises is different. How to give them their own weight is the key to construct the scientific evaluation system. Saaty T L(1988) [9]proposed a method to compare the factors affecting a certain factor and establish a comparison matrix. Suppose we want to compare the influence of n factors M={x1,x2…,xn} on the factor N of the upper level, then compare the two of x1,x2…,xn, and aij denotes ai and aj to N,the ratio of influence effects, all the comparison results are expressed as a matrix A=(aij)n×n. Then matrix A is the judgment matrix between M and N. At the same time, Saaty T L gives the scale of aij and the meaning of each scale (see table 2). According to table 2 and the expert score, the indicator weight value of table 1 can be obtained.

Table 2 the scale of aij and the meaning of each scale

factor i vs. factor j	quantization value
equally important	1
slightly important	3
more important	5
strongly important	7
extremely important	9
intermediate value of two adjacent judgments	2,4,6,8

2.3 Big Data Correction Indicator Weights

The scale of judgment matrix and expert score are given by subjective judgment, and there must be some errors. In order to reduce the error, we modify the weight through big data. Specifically: First, calculating the credit rating of more than 15,000 enterprises by the credit evaluation indicator system (table1), and comparing with the previously evaluated credit rating. Then, by correcting the weight that affects a certain factor until the error cannot be reduced. Finally, repeating the second step, and modifying all the weights to get the final correction weight. The error changes in the correction process are shown in table 3. As can be seen from table 3, the average error rate is changed from 13.188% to 12.2273%, a decrease of 0.9607%.

Table 3 the error

	total error	average error	average error rate /%
weight	60763	3.9564	13.1880
correction weight	56336	3.6682	12.2273
weight - correction weight	4427	0.2882	-0.9607

Note: the total error =∑|a-b|,a is the credit rating of 15358 enterprises evaluated by the three major evaluation agencies in China in recent years, b is the credit rating calculated according to the credit evaluation indicator system in this paper. Average error = total error / 15358, where 15358 is the number of enterprises. Average error rate = average error / credit rating, where the credit rating

is divided into 30 ranks.

3. Conclusion

Due to the characteristics of light assets, high growth and the subjectivity of AHP, the credit evaluation error of SMTEs is large. In the era of big data, the evaluation indicator system can be modified by big data to reduce the error of credit evaluation.

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References

[1] Greenhouse J B, Stangl D, Bromberg J. An introduction to survival analysis: Statistical methods for analysis of clinical trial data[J]. Journal of Consulting and Clinical Psychology, 1989, 57(4): 536.

[2]Lee M C. Business bankruptcy prediction based on survival analysis approach[J]. International Journal of Computer Science & Information Technology, 2014, 6(2): 103.

[3]Wang C H, Gopal R D, Zionts S. Use of data envelopment analysis in assessing information technology impact on firm performance[J]. Annals of operations Research, 1997, 73: 191-213.

[4]Tandon D, Tandon K, Malhotra N. An evaluation of the technical, pure technical and scale efficiencies in the Indian banking industry using data envelope analysis[J]. Global Business Review, 2014, 15(3): 545-563.

[5]Gu Jiang. The establishment of corporate credit rating methods and models [J]. Journal of Quantitative and Technical Economics, 1997(09): 46-48+65.

[6]Ren Yongping, Mei Qiang. Discussion on the Credit Evaluation Index System of SMEs[J]. Modern Economics Research, 2001(04): 60-62.

[7]Liu Bing. Research on the construct of the index system of the value of the Scientific and technological SMEs which are invested by Gansu Science and Technology Investment Company[D]. Lanzhou University,2015.

[8]CHEN Danhua.Initial Analysis on Index Selection of Science and Technology SME Financing Credit Evaluation[J],Science and Technology Management Research,2017,37(13):64-68.

[9]Saaty T L. What is the analytic hierarchy process?[M]//Mathematical models for decision support. Springer, Berlin, Heidelberg, 1988: 109-121.