Research on Risk Analysis of Enterprise Financial Management Based on AHP and Fuzzy Multiple Attribute Decision Method

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Abstract

In this paper, taking takes the multiple attribute decision making of enterprise financial management risk as the research object, and according to the characteristic that it is difficult to depict the risks in the financial risk management decision problemsand there is a certain degree of fuzziness, the theory of fuzzy multiple attribute decision making (FMADM) was proposed, and it has applicability when applied to the enterprise financial risk decision-making problems. Then an indicator weighting method based on the attribute hierarchy analytic method and a FMADM method based on projection were established.

Keywords: Financial management risk, Risk decision,Fuzzy Multiple Attribute Decision Making(FMADM)

I. Introduction

Financial risk refers to the state in which an enterprise suffers from financial difficulties due to the impact of external environmental factors (such as political factors, economic factors, and natural disasters.) in the production and operationprocess, or the irrationality of its own operation process. When analyzing from the perspective of risk source, financial risk suffers from the dual influence of systemic risk and non-systematic risk. From the perspective of risk control and risk avoidance, it is difficult to effectively control systemic risks, while non-systemic risks can be avoided through enhancing enterprise risk awareness and constructing a risk management system.From the perspective of risk impact analysis, successful financial risk management can effectively reduce the loss of enterprises, but unsuccessful financial risk management often makes enterprises suffer from debt and brand crises, and even results ina financial dilemma that cannot be handled by the enterprise. The occurrence of financial risk is often highly correlated with the financial decision-making of enterprises, the irrationality of the decision-making process and decision-making method is usually the inducement of the occurrence of financial risk. So improving the decision-making level is the key path to avoid the occurrence of financial risk, and the core of improving the decision-making level lies in scientific and efficient decision-making models and methods.Therefore, it is of great theoretical and practical significance to strengthen the research on the multiple-attribute decision-making method of financial risk management from theoretical and practical perspectives.

Through analyzing the existing literature, it can be seen that the related issues of financial risk management are the focus of theoretical research and practice, but there isn't sufficient research on the multi-attribute decision making method combined with the financial risk management decision-

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making problems. Therefore, according to the characteristics of the financial risk management decision problems, this paper intends to introduce the intuitionistic fuzzy multiple attribute decision-making method into the financial risk management problem, in order to not only further expand the application field of intuitionistic fuzzy multiple attribute decision-making method but also provide a feasible path for improving the scientificity and effectiveness of financial risk management decision-making.

II. Construction of Intuitionistic Fuzzy Multi-attribute Decision-making Model for Enterprise Financial Risk

(1) Financial risk decision-making index system

Enterprise financial risks can be divided into systematic risks and non-systematic risks. Systematic risks refer to the influence of macroeconomic political, economic, security and other factors on corporate finance, while non-systematic risks refer to the financing and investment risks generated by enterprises in their production and operation activities.

1) System risk. Systematic risk is also called market risk, which generally refers to the impact on enterprises brought by factors such as politics, economy, and safetyand their consequences, and the risks faced by all the participants in the market. The difference is that, because enterprises are in different developmentstagesandbelong to different industries, the same level of market risks has a different impact on enterprises. For example, China classifies traditional powered automobiles into overcapacity industries and turns to vigorously support the development of the new energy automobile industry. This policy change brings great market risks to traditional automobile manufacturers and provides development opportunities for market participants in the new energy automobile industry.

2) Financing risk. With the expansion of enterprise production scale and the pursuit of scale economy effect, the accumulation of self-owned capital is often difficult to meet the capital needs of enterprises, which also gives rise to the requirements of external financing (including direct financing and indirect financing). The risks brought by financing activities include risks of failure to finance and risks of high capital cost. On the one hand, it is often difficultfor small enterprises in the early developmentstage to effectively raise the required funds in the capital market due to the lack of guarantee ability.On the other hand, there are significant differences in financing costs caused by different financing methods. For example, the bank financing costs based on enterprise credit are significantly lower than those of trust mode. The difference in capital costs leads to significant differences in financial expenses and financial performance of enterprises.

3) Investment risk. Acquiring competitive elements such as brand, technology and sales network by means of capital operation such as merger and acquisitionis a frequent investment activity in the operation of enterprises to expand production scale through building new plants, machinery and equipment. The risks in investment activities mainly lie in the irrationality of the investment decision-making process and the non-irrationality of investment project selection. For example, relevant statistics show that 70% of China’s transnational investment activities ended in failure, especially the case of Tengzhong’s acquisition of Hummer, which exposed the risks produced by

typical investment project selection and decision process.

4) Debt repayment risk. The obligations of an enterprise to repay matured debts mainly come from the financing of the enterprise from financial institutions and the debts formed in the production and operationprocess(such as external guarantee, consideration for the payment of goods and services.). The financial risks that enterprises are unable to repay debts are mainly reflected in the following aspects: failure to repay the loans from financial institutions, enterprises will face the risk of the credit rating reduction, and the realization of collateral in the financing process; In the case of failing to repay inter-enterprise loans and failing to implement debt restructuring, enterprises will face serious consequences such as lawsuits and bankruptcy applications.

5) Creditor's rights risk. Credit sale often occurs in the process of enterprise operation, that is, after the enterprise provides goods or services, the transferee delays the payment for goods due to lack of solvency. Such unpaid consideration is the enterprise's creditor's rights. In the case that the transferee of goods or services continuously lacks the ability to pay, the creditor's rights risk of the enterprise will be increased, which leads to difficulties in the subsequent fund arrangement of the enterprise, and even the depreciation of the creditor's rights and the failure to recover the creditor's rights due to the financial difficulties of the transferee.

6) Growth risk. The goal of enterprise development is to obtain economic benefits and achieve sustainable growth through continuous development. Enterprises lacking growth tend to gradually lose market share and customer loyalty, showing low return on assets and main businessprofitability from the perspective of financial indicators. When analyzing from the perspective of the sources of growth risks, the adjustment of macroeconomic policies (such as industrial policies), the cyclical changes of the industry and the internal organizational structure of enterprises may all lead to growth risks of enterprises. It is difficult for enterprises lacking growth to obtain effective financing from the capital market, thus leading to difficulties in enterprise development.

(2) Indicator weighting method

The weight is the embodiment of the importance degree of the index, and calculating the index weight is an important basis for effective multi-attribute decision making. The existing index weighting methods can be roughly divided into subjective weighting methods, objective weighting methods, and combination weighting methods. The analytic hierarchy process (AHP) is the most commonly used index weighting method from the perspective of its operability, but the main defect of AHP is its inconsistency of weight calculation.AttributeHierarchyModel (AHM), which is based on traditional analytic hierarchy process, can effectively overcome the disadvantages of analytic hierarchy process while ensuring its advantages and has been widely used due to its convenient calculation process. The main principle of the attribute analytic hierarchy process is as follows:

C is decision criterion, and $b_1, b_2, \ldots, b_n$ are n decision elements. For criterion C, the importance degree of b_1 and b_j to criterion C is u_{1j} and u_{j1}, respectively. According to the requirements of

attribute measure, u_{1j} and u_{j1} need to meet the following conditions:

$$\begin{Bmatrix} u_{1j} \geq 0, u_{ji} \geq 0, u_{1j} + u_{j1} = 1, i \neq j \\ u_{1j} = 0, i = j \end{Bmatrix}$$

The calculation method of u_{1j} and u_{j1} can be obtained through the decision matrix transformation of analytic hierarchy process. Based on the 1-9 scale of analytic hierarchy process, the transformation formula of u_{1j} and u_{j1} is as follows:

$$u_{1j} = \begin{cases} \dfrac{k}{k+1}, a_{1j} = k, i \neq j \\ \dfrac{1}{k+1}, a_{1j} = \dfrac{1}{k}, i \neq k \\ 0, a_{1j} = 1, i = j \end{cases} \quad (1)$$

The weight of b_1 is $W_1 = \dfrac{2}{n(n-1)} \sum_{j=1}^{n} u_{1j}$, $1 \leq i \leq n$.

(3) Intuitionistic fuzzy multi-attribute decision model and algorithm

Definition 1[2] Suppose X is a non-empty set, then $A = \{< x, \mu_A(x), v_A(x) | \ x \in X >\}$ is called intuitionistic fuzzy set, where $\mu_A(x)$ and are the membership degree and non-membership degree of element x in X belonging to A, and meet the conditions $0 \leq \mu_A(x) + v_A(x) \leq 1$, and $x \in X$. In addition, $\pi_A(x) = 1 - \mu_A(x) - v_A(x)$, $x \in X$ represents the hesitancy or uncertainty of element x in X belonging to A.

Definition 2[2]For any arbitrary intuitionistic fuzzy number, $S(\alpha)$ is called its score function. $S(\alpha) = \mu_a - v_a$,and $S(\alpha) \in [-1,1]$.

Definition 3[2] For any intuitionistic fuzzy multi-attribute decision making problem, $D = \left(d_{1j}\right)_{n-m}$, m is intuitionistic fuzzy decision making problem. $d_{ij} = \left(\alpha_{1j}, \beta_{1j}\right)$, where α_{1j} and β_{1j} represent non-membership degree and non-membership degree, respectively.

$Y_1 = \left(d_{11}, d_{12}, \cdots, d_{1m}\right)^{\mathrm{T}}$ $(i = 1, 2, \cdots, n)$ represents the object to be evaluated,

$s\left(Y_1\right) = \left(s\left(d_{11}\right), s\left(d_{12}\right), \cdots, s\left(d_{1m}\right)\right)^{\mathrm{T}}$ is called the score vector of object Y_1,

and $\left|s\left(Y_1\right)\right|=\sqrt{\sum_{j=1}^{m} s^2\left(d_{1j}\right)}$ is the modulus of $s\left(Y_1\right)$.

Definition $4^{[2]}$ $\alpha_j^+=(1,0)(j=1,2,\cdots,m)$ is set as m maximum intuitionistic fuzzy numbers, then $Y^+=\left(\alpha_1^+,\alpha_2^+,\cdots,\alpha_m^+\right)^{\mathrm{T}}$ is called intuitionistic fuzzy ideal points and the score vector of intuitionistic fuzzy ideal points, and $s\left(Y^+\right)=\left(s\left(\alpha_1^+\right),s\left(\alpha_2^+\right),\cdots,s\left(\alpha_m^+\right)\right)^{\mathrm{T}}$ is called the score vector of intuitionistic fuzzy ideal point. Obviously, $s\left(Y^+\right)=(1,1,\cdots,1)^{\mathrm{T}}$.

Definition $5^{[2]}$ $s\left(Y^+\right)=\left(s\left(\alpha_1^+\right),s\left(\alpha_2^+\right),\cdots,s\left(\alpha_m^+\right)\right)^{\mathrm{T}}$ is set as the score vector of intuitionistic fuzzy ideal point, and $\left|s\left(Y^+\right)\right|=\sqrt{\sum_{j=1}^{m} s^2\left(\alpha_j^+\right)}$ is called the modulus of intuitionistic fuzzy ideal point Y^+.

Define 6

$s\left(Y_1\right)=\left(s\left(d_{11}\right),s\left(d_{12}\right),\cdots,s\left(d_{1m}\right)\right)^{\mathrm{T}}$ and $s\left(Y^+\right)=\left(s\left(\alpha_1^+\right),s\left(\alpha_2^+\right),\cdots,s\left(\alpha_m^+\right)\right)^{\mathrm{T}}$ are set as the score vectors of object Y_i and intuitionistic fuzzy ideal point Y^+, respectively, then

$$\cos\left(s\left(Y_1\right),s\left(Y^+\right)\right)=\frac{\sum_{j=1}^{m} s\left(d_{1j}\right)s\left(Y_j^+\right)}{\left|s\left(Y_1\right)\right|\left|s\left(Y^+\right)\right|}$$

is the cosine function of the angle between the scoring vectors $s\left(Y_1\right)$ and $s\left(Y^+\right)$,

$$\mathrm{Prj}_{s\left(Y^+\right)}\mathrm{s}\left(\mathrm{Y}_1\right)=\left|\mathrm{s}\left(\mathrm{Y}_1\right)\right|\cos\left(\mathrm{s}\left(\mathrm{Y}_1\right),\mathrm{s}\left(\mathrm{Y}^+\right)\right)=\left|\mathrm{s}\left(\mathrm{Y}_1\right)\right|\frac{\sum_{j=1}^{m} s\left(d_{1j}\right)s\left(Y_j^+\right)}{\left|s\left(Y_1\right)\right|\left|s\left(Y^+\right)\right|} \tag{2}$$

is the projection of $s\left(Y_1\right)$ on $s\left(Y^+\right)$. It can be seen that the greater the value of $\mathrm{Prj}_{s\left(Y^+\right)}\mathrm{s}\left(\mathrm{Y}_1\right)$ is, the closer $s\left(Y_1\right)$ is to $s\left(Y^+\right)$, i.e. the better the object is.

III. Empirical Application of Enterprise Financial Risk Decision-Making Model

Taking the financial risk management decision of five subsidiaries of an enterprise group as an example, this paper introduces the specific application of intuitionistic fuzzy multi-attribute decision

making method.

(1) Calculation of index weight

According to the analysis of enterprise financial management risk sources, the method of brainstorming is used and industry experts are hired to evaluate the importance degree of financial risk indexes. The systemic risk, financing risk, investment risk and solvency risk, credit risk and risk of growing reciprocal judgment matrixbased on the 1-9 scale of analytic hierarchy process (AHP) are shown in Matrix 3, and the transformation method of Formula 1 is applied to transform the reciprocal judgment matrix into the attribute judgment matrix, as shown in Matrix 4:

$$\begin{bmatrix} 1 & \frac{1}{3} & \frac{1}{5} & \frac{1}{4} & \frac{1}{3} & \frac{1}{2} \\ 3 & 1 & 2 & 1 & 3 & 2 \\ 5 & \frac{1}{2} & 1 & 2 & 2 & 3 \\ 4 & 1 & \frac{1}{2} & 1 & 1 & 2 \\ 3 & \frac{1}{3} & \frac{1}{2} & 1 & 1 & 2 \\ 2 & \frac{1}{2} & \frac{1}{3} & \frac{1}{2} & \frac{1}{2} & 1 \end{bmatrix} \tag{3}$$

$$\begin{bmatrix} 0 & \frac{1}{4} & \frac{1}{6} & \frac{1}{5} & \frac{1}{4} & \frac{1}{3} \\ \frac{3}{4} & 0 & \frac{2}{3} & \frac{1}{2} & \frac{3}{4} & \frac{2}{3} \\ \frac{5}{6} & \frac{1}{3} & 0 & \frac{2}{3} & \frac{2}{3} & \frac{3}{4} \\ \frac{4}{5} & \frac{1}{2} & \frac{1}{3} & 0 & \frac{1}{2} & \frac{2}{3} \\ \frac{3}{4} & \frac{1}{4} & \frac{1}{3} & \frac{1}{2} & 0 & \frac{2}{3} \\ \frac{2}{3} & \frac{1}{3} & \frac{1}{4} & \frac{1}{3} & \frac{1}{3} & 0 \end{bmatrix} \tag{4}$$

According to the calculation, the weights of system risk, financing risk, investment risk, debt repayment risk, debt risk and growth risk are 0.08, 0.22, 0.22, 0.19, 0.17, and 0.12, respectively.

(2) Calculate the score vector of intuitive fuzzy set

The original data of intuitionistic fuzzy sets of decision-making objects on each index are shown in Table 1:

Tab 1: Intuitionistic fuzzy decision matrix of enterprise financial risk

	I1	I2	I3	I4	I5	I6
Y1	(0.4,0.3)	(0.5,0.0)	(0.4,0.3)	(0.4,0.0)	(0.0.0.1)	(0.3,0.1)
Y2	(0.3,0.2)	(0.6,0.0)	(0.6,0.3)	(0.4,0.1)	(0.7,0.5)	(0.6,0.0)
Y3	(0.5,0.2)	(0.8,0.0)	(0.7,0.2)	(0.6,0.0)	(0.3,0.5)	(0.4,0.0)
Y4	(0.3,0.1)	(0.9,0.1)	(0.4,0.0)	(0.8,0.0)	(0.6,0.4)	(0.7,0.2)
Y5	(0.4,0.2)	(0.5,0.2)	(0.9,0.1)	(0.6,0.4)	(1,0.0.1)	(0.5,0.4)
Y+	(1,0,0,0)	(1,0,0,0)	(1,0,0,0)	(1,0,0,0)	(1,0,0,0)	(1,0,0,0)

According to the intuitionistic fuzzy sets of each decision-making object on each indicator, its score vectors are calculated, as shown in Table 2:

Tab 2: Decision object and score vector of intuitive fuzzy ideal point

	I1	I2	I3	I4	I5	I6
S(Y1)	0.1	0.5	0.1	0.4	-0.1	0.2
S(Y2)	0.1	0.6	0.3	0.3	0.2	0.6
S(Y3)	0.3	0.8	0.5	0.6	-0.2	0.4
S(Y4)	0.2	0.8	0.4	0.8	0.2	0.5
S(Y5)	0.2	0.3	0.8	0.2	0.9	0.1
S(Y+)	1.0	1.0	1.0	1.0	1.0	1.0

2.3 Calculate the projection of intuitionistic fuzzy sets on ideal points

According to Formula (2), the projection value of each decision object on intuitionistic fuzzy ideal point is shown in Table 3:

Tab 3: Weighted intuitive fuzzy number score vectors and projection values of decision objects

	I1	I2	I3	I4	I5	I6	Projection value
S(Y1)	0.008	0.008	0.024	0.016	0.016	0.08	0.0044
S(Y2)	0.11	0.132	0.176	0.176	0.066	0.22	0.0065
S(Y3)	0.022	0.066	0.11	0.088	0.176	0.22	0.0088
S(Y4)	0.076	0.057	0.114	0.152	0.038	0.19	0.0097
S(Y5)	-0.017	0.034	-0.034	0.034	0.153	0.17	0.0085
S(Y+)	0.024	0.072	0.048	0.06	0.012	0.12	/

According to the projection value of each decision object on intuitionistic fuzzy ideal point, it can be seen that Enterprise 4 andEnterprise 1have the highest (0.0097)and lowest (0.0044)financial risk

management levels, respectively.

IV.Conclusion

In this paper,taking the multi-attribute decision making of enterprise financial management risk as the research object, and according to relevant studies, it is found that the major sources of enterprise financial management risks are mainly embodied in system risk, financing risk, investment risk, debt repayment risk, debt risk, and growth risk.The main characteristic of enterprise financial management risk decision-making problem is that it is difficult to quantitatively depict the risk and there is a certain degree of fuzziness. To solve this problem, the intuitionistic fuzzy multiple attribute decision making theory has theoretical applicability when applied to the enterprise financial risk decision-making problem. Then the index weighting method based on the attribute analytic hierarchy processand the intuitionistic fuzzy multiple attribute decision making method based on projection were established, and the main application steps of the method are introduced through a case.Follow-up study can be further perfected from two perspectives: one is the refinement of the financial management risk evaluation system account consideringindustrydifferencesand enterprise development stage differences, and the other is the further application ofnew intuitionistic fuzzy multiple attribute decision making methods such as interval intuitionistic fuzzy number and correlation-based intuitionistic fuzzy number in the field of financial risk assessment.

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