Research on Regional Financial Ecological Balance of Shandong Province in China Based on Multi-level Fuzzy Comprehensive Evaluation Model

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Abstract: The multi-level fuzzy comprehensive evaluation model is used to empirically test the balance of regional financial ecology in Shandong Province. The results show that the regional financial ecological balance of Shandong Province has the following characteristics:(a).From the overall quantity, the regional financial ecological balance of each sample city in Shandong Province The level of sex is high, which depends on the balance of the main body of the system, the balance of the market and the coordination of the environment. (b). from the system level, there are structural differences in the regional financial ecological balance of each sample city in Shandong Province. The difference between the highest and lowest scores of regional financial ecological balance in each sample city is larger.(c).From the relationship with the economic level, the overall financial balance of the sample cities in Shandong Province is different from the economic development level of the sample cities. There is no significant difference between the overall financial ecological balance and the regional economic development level. The conformity relationship, but the level of regional economic development affects the main body balance of financial ecology.

1. Introduction

From the perspective of enterprises in the region, the balance of regional financial ecology is evaluated.

Sample data was obtained in the form of a questionnaire. Taking enterprises in Shandong Province as the survey object, the company owner or middle and senior management personnel should fill in the object to ensure the validity of data acquisition. The questionnaire survey was conducted mainly through field visits and entrusting the People's Bank of the relevant cities. A total of 200 questionnaires were distributed, 106 were recovered, and the recovery rate was 53%. After screening, 77 valid questionnaires were obtained, and the proportion of valid questionnaires was 38.5%.

2. Evaluation index system

From the perspective of demand (enterprise), the evaluation index system of regional financial ecological balance is constructed. In order to avoid the influence of excessive subjective factors, the analysis of index weights is based on the combination of Analytical Hierarchy Process (AHP) and principal component analysis. The indicator system constructed is shown in Table 1 [1]~ [4].

3. Research methods

The fuzzy comprehensive evaluation method is a method of analyzing and evaluating fuzzy systems using the principle of fuzzy transformation. In view of the multi-level and multi-factor characteristics of the evaluation index system of innovative small and medium-sized technology enterprises' growth ability, the research selects the multi-level fuzzy comprehensive evaluation model, and the steps are as follows:

(1) For the evaluation factor set U, according to a certain attribute c, divide it into m subsets to satisfy:

$$\begin{cases} \sum_{i=1}^{m} U_i = U \\ U_i \bigcap U_j = 0 (i \neq j) \end{cases} \tag{1}$$

This gives the second level of evaluation factors:

$$U / c = \{U_1, U_2, ...U_m\} \tag{2}$$

In Equation 2, $U_i = [u_{ik}]$ (i = 1, 2, ..., m; k = 1, 2, ..., n) indicates that there are k evaluation factors in the subset U_i.

(2) For each of the k evaluation elements in each subset U_i, the evaluation is based on the single-level fuzzy comprehensive evaluation model. If the weights of the factors are assigned as $\overline{A}_i$, and the judgment decision matrix is R_i, then the comprehensive evaluation result of the i-th subset U_i is obtained.

$$\overline{B}_i = \overline{A}_i \cdot R_i = [b_{i1}, b_{i2}, ..., b_{in}] \tag{3}$$

(3)A comprehensive evaluation of the m subset U_i of evaluation factors U / c (i = 1, 2, ..., m), and the judgment decision matrix is

$$R = \begin{Bmatrix} \overline{B}_1 \\ \overline{B}_2 \\ ... \\ \overline{B}_m \end{Bmatrix} = \begin{Bmatrix} b_{11} & b_{12} & ... & b_{1n} \\ b_{21} & b_{22} & ... & b_{2n} \\ ... & ... & ... & ... \\ b_{m1} & b_{m2} & ... & b_{mn} \end{Bmatrix} \tag{4}$$

If the weight of each subset of the judgement factors U / c is assigned as $\overline{A}$, then the comprehensive evaluation result is obtained.

$$\overline{B} = \overline{A} \cdot R \tag{5}$$

In Equation 5, $\overline{B}$ is both the comprehensive evaluation result of the pair and the comprehensive evaluation result of all the evaluation factors in U.

The above is a simple two-level model building step. If there are still many factors in U / c, it should be divided again to obtain a multi-level model. For example, based on the extraction of the principal components, a three-level fuzzy comprehensive evaluation model should be established. . The multi-level model can be regarded as the superposition of multiple two-level models, and the specific evaluation steps are the same as the two-level evaluation model.

In addition, in this study, the decision matrix is R_i judged as the form of the membership matrix. Combined with the characteristics of the evaluation index system of innovative small and medium-sized technology enterprises, the method of obtaining membership degree is as follows:

Let $a_{ij}^{*} = \left[u_{ij}^{*} - u_{ij}^{*(\min)}\right] / \left[u_{ij}^{*(\max)} - u_{ij}^{*(\min)}\right]$, then a_{ij}^{*} is the degree of membership of the superior indicator for the evaluation indicator U_{ij}^{*}. Where $u_{ij}^{*(\max)}$ is the upper limit of the three-level

indicator U_{ij}^{*} and $u_{ij}^{*(\min)}$ is the lower limit. For the 5-point quantitative indicator, the upper and lower limits are the maximum and minimum values of the indicator; for the direct observation indicators, based on the comparison of the technological innovation capability level of the sample enterprises with the national average level and the opinions of the consulting experts, this paper uses the indicators. The average value is taken as the upper limit value and the minimum value of the index is used as the lower limit value.

4. Conclusions

4.1 Evaluation on the Balance of Regional Financial Ecological Subjects in Shandong Province

1) In terms of the overall number, the balance scores of the sample cities in Shandong Province are all above 70, and the highest in Qingdao is 86.04. This indicates that the average profitability of small and medium-sized science and technology enterprises in each sample city in Shandong Province is relatively high, reflecting that the status of regional financial ecology in Shandong Province can better promote corporate financing and profitability, and the financial ecological operation status can achieve the balance of the whole body.

2) Judging from the structural differences, the difference between the highest score and the lowest score of the main body balance of each sample city in Shandong Province is above 20, and the biggest difference is Jinan City, with a gap of 35.56. This indicates that there is a large gap in profitability among small and medium-sized science and technology enterprises in each sample city in Shandong Province, reflecting that there is a preference for supporting the financing and profitability of enterprises in the regional financial ecology of Shandong Province, and the structural balance of financial ecological subjects is structurally different.

3) From the relationship with the economic level, the balance scores of regional financial ecological subjects in the sample cities of Shandong Province are from Qingdao to Jinan, Weifang, Rizhao and Dezhou, which are in line with the economic development level of the above sample cities. It indicates the mutual influence and close relationship between the level of regional economic development and the financing and profitability of enterprises in the region, reflecting the positive promotion of the regional economic environment to the balance of regional financial ecological subjects.

4.2 Equilibrium Evaluation of Regional Financial Ecology Market in Shandong Province

1) In terms of the overall number, the market equilibrium scores of each sample city in Shandong Province were all below 62, the lowest was 49.22 in Qingdao and the highest was 61.75 in Rizhao. This indicates that the financial market of each sample city in Shandong Province is not perfect, the mechanism is imperfect, and there is no competitive market condition. The financial competition between small and medium-sized technology enterprises is characterized by excessive competition or conspiracy monopoly, and it is difficult to achieve financial market equilibrium.

2) In terms of structural differences, the difference between the highest score and the lowest score of the market in Qingdao and Dezhou in each sample city of Shandong Province is 36.08 and 37.25 respectively, and the difference between sunshine and Jinan is also above 20, the difference between Weifang City and the smallest difference. Also above 14. This indicates that there is a large gap in the development of financial markets in the sample cities in Shandong Province, and the regional financial markets in Shandong Province are structurally different.

3) From the perspective of the relationship with the economic level, the regional financial eco-market balance scores of the sample cities in Shandong Province are from Rizhao, Weifang, Dezhou, Jinan and Qingdao in order of high and low, which is different from the economic development level of the above sample cities. Large, indicating that the level of regional economic development has no significant correlation with the level of development or equilibrium of financial markets in the region, reflecting the differences in regional economic systems due to regional financial systems.

4.3 Coordinated Evaluation of Regional Financial Ecology Environment in Shandong Province

1) In terms of the overall number, the environmental coordination scores of Weifang, Dezhou and Rizhao in the sample cities of Shandong Province were nearly 80, 78.42, 77.99 and 77.74 respectively, and the environmental coordination scores of Jinan and Qingdao were below 70, respectively 64.52 and 59.78. This indicates that there is a difference in the coordination between the financial ecology of the sample cities in the Shandong Province and the external environment, ranging from high to low.

2) In terms of structural differences, there is also a significant difference between the highest scores and the lowest scores of environmental coordination in each sample city in Shandong Province. The difference is Jinan, the difference is 46.95, followed by sunshine, the difference is 39.13, and the difference between Dezhou and Weifang is also both are above 25. This indicates that the small and medium-sized science and technology enterprises in the Shandong Province have a large gap in the ability to adapt to and adapt to the financial ecological environment, reflecting the different sensitivity of financial ecology in various regions of Shandong Province, and the structural differences in the coordination of financial ecological environment.

3) From the relationship with the economic level, the coordination scores of the regional financial eco-environment in each sample city of Shandong Province are Weifang, Dezhou, Rizhao, Jinan and Qingdao, which are different from the order of the economic development level of the above sample cities. It shows that there is no significant correlation between the level of regional economic development and the environmental coordination of the financial system. The quality of the environment does not mean the coordination between the system and the environment.

4.4 Evaluation of Regional Financial Ecology Balance in Shandong Province

1）In terms of the overall quantity, the average value of regional financial ecological balance evaluation in each sample city of Shandong Province exceeded 70 except for slightly lower in Qingdao. The average values of Weifang and Rizhao were the highest, respectively, 78.01 and 78.06. Although the financial ecology of Qingdao has a higher level of balance, the balance of the financial system market and the coordination between the system and the environment are lower than those of other regions, resulting in the overall balance of financial ecology in Qingdao ranking the last in each sample city. The advantages of the balance between the financial market and the environmental coordination of the financial system in Weifang and Rizhao compensated for the deficit in the balance of the main body. Therefore, the overall balance of the financial ecology of the two places is relatively high, ranking in the sample cities. Forefront. The overall balance of financial ecology in Texas and Jinan is in the middle, due to moderate financial system balance, financial market balance and system environmental coordination.

2) From the perspective of structural differences, there are structural differences in the regional financial and ecological balance of each sample city in Shandong Province.The difference between the highest and lowest scores of the regional financial ecological balance in the city is more than 25 except Weifang. The largest difference is Jinan, with a difference of 33.00, due to the higher main body balance gap, market equilibrium gap and environmental coordination gap. The difference between the highest and lowest scores of regional financial ecological balance in Weifang City is the smallest, with a score of 12.4. The city has a good balance of the main body, market equilibrium and environmental coordination structure.

3) From the perspective of the relationship with the economic level, the overall financial ecological balance scores of the sample cities in Shandong Province are from Rizhao, Weifang, Dezhou, Jinan and Qingdao, which are different from the order of the economic development level of the above sample cities. It shows that there is no significant correlation between the overall balance of regional financial ecology and the level of regional economic development. The level of economic level does not necessarily represent the pros and cons of financial ecological balance.

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Table 1. Evaluation Index System of Regional Financial Ecology Balance

general goal	sub-goal	guidelines
regional financial ecology balance(O)	subject balance(A)	R&D investment as a percentage of sales revenue(A1) annual employee training cost growth rate(A2) scientific and technical personnel quality satisfaction(A3) employee life and working conditions(A4) incentive and restraint mechanism perfection(A5) employee training intensity(A6) informationization degree of production process(A7) advanced level of production equipment Capital (A8)
	market balance(B)	market development degree(B1) financing channel perfection degree(B2) risk investment development degree(B3) private capital adequacy(B4) capital withdrawal channel spaciousness(B5) enterprise financing difficulty level(B6) improvement of financial institutions'services(B7) types and quantities of enterprise cooperative financial institutions(B8)
	environmental coordination(C)	the improvement of policy and law(C1) the implementation of policy and law(C2) the reasonable degree of policy and law(C3) the protection of intellectual property rights(C4) the fairness of the trade environment(C5) the degree of information network service support(C6) the credit system construction and credit rating agencies(C7)