A Comprehensive Evaluation of the Regional Financial, Ecological Environment in Anhui Province based on Entropy Method

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Abstract

Finance is the leader of economic development, and a good financial, ecological environment can promote and develop together with the development of the regional financial industry. 16 cities of Anhui province are selected as the research object, which includes the economic base, financial development, cultural and legal environment, administrative environment, and social security of the four dimensions. 18 indicators are selected to establish a financial, ecological environment level evaluation index system, which is used the entropy method and K-means clustering algorithm. It is further analyzed and evaluated the financial, ecological environment. The empirical results are shown that there are substantial regional differences in financial ecology level in Anhui Province. Moreover, the existing problems are analyzed according to the conclusions. Several suggestions are provided to develop financial infrastructure construction, which promotes industrial development and improves the literacy of financial consumers.

Keywords

Financial Ecology; Entropy Method; K-means; Anhui Province.

1. Introduction

After the 14th Five-Year Plan, China's economy got off to a good start with steady growth. The 13th Five-Year Plan report points out that China's economy faces many risks and challenges, including severe domestic and international situations. The task of economic and social development is heavy. The "important" financial field also puts forward many requirements and suggestions. The high-quality development of the financial industry cannot be separated from a good financial, ecological environment. Since Zhou Xiaochuan put forward the concept of financial ecology in 2003, the ideas and systems have been formed and improved. In Anhui province, "One Belt And One Road" and "central rise" strategies have a key role. Recently, the province-related policy establishment is not perfect, which is relatively scarce. Therefore, the analysis of the financial, ecological environment data in Anhui province puts forward the corresponding policy for development. It can improve central position and speed up the development of the economy in Anhui province, which has an important role.

Many domestic researchers have done innovative research on the theoretical system of financial ecology. However, there are few types of research and analyses on the subject of Anhui Province. For example, Huang Fan (2022) [1] used the entropy weight method and coupling coordination degree model to analyze the coordination between the financial, ecological environment, and economic growth in Qinghai Province. Du Mingyue et al. (2019) [2] conducted a quantitative and qualitative analysis of the financial, ecological environment in Anhui Province. Moreover, Jin Daozheng (2007) [3] used the unstructured evaluation method to rank the financial, ecological status of each city. However, most of the existing literature is to analyze the impact of ecological indicators. The replacement of indicators is one-sided, and the analysis is carried out at the provincial level. There are few comprehensive empirical

evaluations on the financial ecology of various cities in Anhui Province. This paper is carried out the empirical analysis of the cities in Anhui Province, which provides suggestions from the financial, ecological environment perspective.

2. Quality Assessment Index System and Data Sources

On the basis of kinds of literature [4,5,6], the construction principle of financial, ecological environment index system (China county financial, ecological environment index report 2021), is combined with the research conclusions of existing researchers, personal knowledge, and the actual situation of financial development in Anhui province, This paper establishes the index system of financial, ecological environment level evaluation from four dimensions: economic foundation, financial development, humanistic and legal environment, administrative environment and social security. The construction and development of economic base and financial ecology complement are also involved. As the foundation of financial development, the economic base influences and determines the market size and development space of finance to a great extent. In this dimension, five indicators are selected to measure regional PER capita GDP (yuan/person), tertiary industry /GDP (%), urbanization rate of the permanent resident population (%), total import and export volume (USD 10,000), and growth rate of fixed-asset investment (%). Finance is the core of the economy, and the sound development of the financial industry has a considerable impetus to the economy and the market. Therefore, the development level of the financial industry will indirectly affect the development of the financial ecosystem. The dimension includes the balance of deposits and loans of financial institutions, premium income (100 million yuan), the proportion of financial employees (%), average salary of financial employees (yuan), and added value of listed companies and financial industry (100 million yuan). In addition to economic foundation and financial development, a sound legal environment created by a sound legal system will safeguard the rights and interests of financial personnel severely suppress fraud, debt evasion, and other illegal acts. It maintains the order of the financial ecological environment and promotes social credit awareness. A good credit environment will form the feedback in the form of higher self-supervision law order, which can improve the financial, ecological environment. In this paper, the growth rate of criminal cases (%), the number of patent grants (item), the number of students in ordinary institutions of higher learning (person), and the profit of industrial enterprises above the designated size (100 million yuan) are selected as the measurement indexes of this dimension. Maintaining the financial, ecological environment needs the self-circulation of the market and the government's support in policy and capital. An efficient administrative system will create a more active financial industry. An adequate social security system will improve people's living standards, and it brings stable demand and investment to the financial market. It can create market power and improve the financial ecological environment. This dimension refers to three indicators: general public budget expenditure (ten thousand yuan), per capita disposable income of all residents, and unemployment rate (%).

This paper selects panel data of 16 prefecture-level cities and 18 indicators in Anhui province as evaluation data. The data are from Anhui Statistical Yearbook 2021, Choice Financial Terminal, and Anhui Statistical Bulletin (2021).

3. Measurement Method and Result Analysis

3.1. Research Ideas

To visually observe and compare the financial, ecological environment of all dimensions of cities in Anhui Province, the weight of every single indicator in each dimension and degree in the index system is obtained. The total score and ranking can be obtained after weighing each score. Therefore, determining the weight of dimension and single index is the key evaluation

step. The methods to solve this problem include expert evaluation, factor analysis, AHP, etc. This paper finally selects the entropy method for analysis. First of all, compared with the subjective assignment method, the entropy method has higher accuracy and observability to avoid the deviation caused by human factors. Secondly, compared with other objective evaluation methods, the entropy method allows the number of indicators to be larger than the number of samples. Since the number of single indicators selected in this paper is larger than the number of cities, the results of the entropy method are more accurate, which conforms to the scientific selection of the method.

3.2.   Data Processing and Weighting Process

The main idea of the entropy method is to measure and determine the objective weight of the item by analyzing the variation degree of each index. The data processing and weighting process of this paper are as follows.

(1) Data standardization

To eliminate the differences between dimensions and indicators, the original data of 18 indicators were firstly processed without dimensionality. There are 16 cities and 18 indicators from matrix A of 16×18. Xij represents the original data of the JTH evaluation indicator of the ith city in the matrix [9].

For the 18 indicators are collected:

$$X_1, X_2, ..., X_{18}$$

Were:

$$X_i = \{x_1, x_2, ..., x_n\}$$

It is assumed that the standardized value of each indicator data is:

$$Y_1, Y_2, ..., Y_m$$

When Xij is a positive indicator:

$$Y_{ij} = \frac{X_{ij} - \min(X_i)}{\max(X_{ij}) - \min(X_i)}$$

When Xij is a negative index:

$$Y_{ij} = \frac{\max(X_{ij}) - X_{ij}}{\max(X_{ij}) - \min(X_i)}$$

(2) Calculate the information entropy Ej of each indicator:

$$P_{ij} = \frac{Y_{ij}}{\sum_{i=1}^{n} Y_{ij}} , i=1, \cdots, 16, j=1, ..., 18$$

$$E_j = -\ln(n)^{-1} \sum_{i=1}^{n} P_{ij} \ln p_{ij}$$

Where $E_j \geq 0$, if $p_{ij} = 0, E_j = 0$.

(3) Determine the weight of each indicator w_j

The information entropy of each indicator is calculated from the above formula as $E_1, E_2..., E_m$,

$$Dj = 1 - E_j$$

Then, it calculates the index weights:

$$w_j = \frac{D_j}{\sum_{j=1}^{m} D_j}(j = 1, 2..., 18)$$

Here k refers to the number of indicators, that is k=m.

(4) Calculate the comprehensive score of each scheme

$$S_i = \sum_{j=1}^{m} w_j \cdot x_{ij}$$

3.3. Result Analysis

The weight results of each dimension and each index determined by the entropy method are shown in Table 1. It can be seen from the results that among the four dimensions, financial development has the greatest impact on the financial, ecological environment, followed by economic basis. The sum of the weight of the two influences on the financial, ecological system exceeds 50%. The administrative environment and social security influence on the financial ecosystem are the weakest, exceeding 10%. Therefore, the support from government finance and other aspects and the guarantee role of the social security system should not be ignored. In comparing the results of 18 individual indicators, the total amount of imports and export, the number of listed companies, and the number of students in ordinary institutions of higher learning have a relatively large impact on the ecosystem. In contrast, the growth rate of criminal cases and unemployment rate have less than 2% impact. It is shown the importance of foreign trade in the development of the urban economy. The social credit environment plays an important role in promoting the maintenance of the financial ecosystem.

Table 1. Weight of each dimension and index

Dimension	Dimension weight	Indicator	Indicator weight
The economic base	0.2709	Regional PER capita GDP (yuan/person)	0.0430
		Tertiary Industry /GDP (%)	0.0281
		Urbanization rate of permanent population (%)	0.0320
		Total import and export volume (TEN thousand US dollars)	0.1475
		The growth rate of fixed-asset investment (%)	0.0203
Financial development	0.3532	Balance of deposits and loans of financial institutions	0.0911
		Premium Income ($100 million)	0.0812
		The proportion of Financial employees (%)	0.0273
		The average salary of Financial Employees (yuan)	0.0261
		The listed company	0.1014
		Added-value of the financial industry (100 million yuan)	0.0261
Humanities and legal environment	0.2463	The growth rate of criminal cases (%)	0.0173
		Number of patents granted (items)	0.0864
		Number of Students in regular institutions of Higher Learning	0.1034
		Profits of industrial enterprises above designated size (100 million yuan)	0.0392
Administrative environment and social security	0.1296	General Public Budget Expenditure (Ten thousand yuan)	0.0590
		Per capita disposable income of all residents	0.0559
		Unemployment rate (%)	0.0147

Through the weight index system, the comprehensive scores of each city can be calculated, and the scores are sorted from high to low, as shown in Table 2. From the total score results, we can see that there are great differences in financial ecology among cities in Anhui Province. With a score close to one, Hefei was far ahead of the rest. Wuhu was second but still more than 0.4 points behind the top city, Hefei. The gap between Maanshan city and Wuhu city, the third place, is reduced, but overall, the score difference is relatively large.

Table 2. Each dimension and comprehensive score

region	Composite scores	Economic Basis score	Financial Development Score	Humanities and legal environment score	Administrative environment and social security score
hefei	0.9536	0.2628	0.3353	0.2381	0.1174
wuhu	0.3918	0.1178	0.1104	0.0963	0.0673
maanshan	0.2887	0.1087	0.0524	0.0560	0.0716
chuzhou	0.2357	0.0727	0.0650	0.0647	0.0333
Tongling city	0.2104	0.0885	0.0642	0.0303	0.0274
Anqing city	0.2041	0.0521	0.0795	0.0365	0.0360
Regarding luan	0.1869	0.0371	0.0896	0.0306	0.0297
Fuyang city	0.1752	0.0300	0.0665	0.0345	0.0442
bengbu	0.1641	0.0397	0.0484	0.0364	0.0396
Xuan city	0.1634	0.0528	0.0454	0.0269	0.0383
Huaibei city	0.1531	0.0637	0.0336	0.0311	0.0247
Huangshan city	0.1496	0.0669	0.0495	0.0088	0.0244
Chuzhou	0.1359	0.0515	0.0376	0.0202	0.0266
Huainan city	0.1339	0.0430	0.0351	0.0309	0.0250
Suzhou city	0.1148	0.0309	0.0377	0.0175	0.0287
Bozhou city	0.1080	0.0155	0.0559	0.0172	0.0194

As a double-node city of the Belt and Road Initiative and the Yangtze River Economic Belt, Hefei has unique advantages in original innovation, land resources, ecological environment capacity, labor, and living cost. In recent years, it has accelerated the construction of the "Made in China 2025" pilot demonstration city, promoted the cross-border and integrated development of the three industries, built a regional financial center with high positioning, made tourism an important pillar industry, and further promoted the reform of state-owned assets and state-owned enterprises, commercial system and financial system. Measures such as vigorously developing the private economy have steadily improved the quality of its economic and financial development. The inevitable conditions for its high evaluation score are the coordination and integration of ecology, culture, and people's livelihood and the improvement of its comprehensive strength. Furthermore, the score of each dimension is very similar to the weight of the whole dimension of Anhui Province. Therefore, it can be seen that the overall level of Hefei has a great impact on the level of the whole Anhui Province. Wuhu, Hefei is not the original attractive terms, financial development is not strong. However, its conscientiously implemented prudent monetary policy in recent years, it is focused on the optimization of financial services. It is used to promote "1% execution of work" for financial enterprises authors during the active measures to improve the financial industry, such as ecological energy. From the dimension scores, the financial industry still has great development space.

For the ranking of haowu City, its financial, ecological environment is insufficient. It can be seen from the weight data of dimensions that the weight of economic basis is far less than that of financial development, and the economy is weak. Although traditional Chinese medicine and the tribute wine trade are popular in Bozhou, the trade of traditional Chinese medicine is

difficult to be included in GDP, and the development of wine merchants is far inferior to that in the north. Under the condition that agriculture occupies a large proportion and there is no economic support from heavy industry, the economic strength is relatively backward. In recent years, Anhui province has increased its efforts to help bozhou, attract investment, improve its financial situation and improve its infrastructure, which can also be seen in the score of financial development. Although Bozhou city ranks last, the difference between the scores of the last six cities is small, and the level is similar.

The average score of the 16 cities is 0.2356, and the extreme difference is 0.8456. It can be seen that the development level of financial ecology of all cities in Anhui province is relatively high except for the top three cities, and other cities have little difference in financial ecology environment. However, as the "leader," Hefei is a driving force and a challenge for other cities.

4. Cluster Analysis of Financial, Ecological Environment Development Trend in Anhui Province

Based on the total score obtained by the entropy method, this paper will use the k-means clustering algorithm to classify the current development of the financial, ecological environment in Anhui Province. Compared with other algorithms, the k-means clustering algorithm can arrange appropriate classification standards according to the data status. Without the limitation of the total number of classifications, it has a good clustering effect and strong interpretability of the model. Moreover, according to the conclusions of relevant literature and the actual situation of our data, it is more scientific and appropriate to divide the results into four categories: excellent, good, medium, and poor. The final classification results are shown in Table 3.

Table 3. Classification of financial, ecological environment development in Anhui Province

classification	region
excellence	Hefei
good	Wuhu
medium	Maanshan, Chuzhou, Tongling city, Anqing city
poor	Regarding luan, Fuyang city, Bengbu, Xuan city, Huaibei city, Huangshan city, Chuzhou city, Huainan city, Suzhou city, Bozhou city

It can be seen from Table 3 in the 16 prefecture-level cities in Anhui Province, there is only one excellent financial, ecological environment and one good financial, ecological environment, and the middle level includes four cities. In comparison, the poor level covers 10 cities. It is shown that the regional development of financial ecology in Anhui province is greatly different and uneven. Based on the actual situation analysis, there are three main reasons.

1) Uneven distribution of financial resources. For Hefei and Wuhu, the urbanization rate of their population is higher. Although the value of targeted poverty alleviation credit and small and micro-enterprise credit has increased in recent years, the financial service facilities in rural areas still lag behind those in cities. Furthermore, there are many problems and defects in constructing the agricultural credit system. Therefore, areas with a large agricultural population such as Bozhou City, Fuyang City, and Suzhou City can affect the development of the financial level to a certain extent, thus affecting the financial ecological environment.

2) Uneven development of the industrial base. Hefei and Wuhu, as dual-core cities in The Wanjiang Urban belt, are ahead of other cities in terms of economic scale and industrial competitiveness. Meanwhile, they have good resource allocation in technology and human resources, which lays a good foundation for developing a financial, ecological system. Ma 'Anshan, Tongling, and other cities have a solid industrial foundation, many listed companies, a

balance of resources among financial institutions, and a large financial market. However, the weak industrial foundation and the relative outflow of financial resources and human resources in Bozhou city make economic development slow, which seriously hinders the financial, ecological environment development.

3) Great differences in financial consumer literacy. According to the scores of the number of students in ordinary institutions of higher learning (used to represent individual credit) and the profit of industrial enterprises above designated size (used to represent enterprise credit), the individual credit and enterprise credit of excellent, good, and middle-grade cities are generally higher than those of poor cities. Meanwhile, compared with urban consumers, financial consumers in rural areas have lower financial literacy and less knowledge of financial planning, which restricts the development of the financial industry and hinders the establishment of the financial, ecological environment system.

5. Conclusions and Policy Recommendations

Because of the above analysis of problems in the financial ecological environment of Anhui Province, this paper gives the following suggestions.

(1) Promoting the construction of financial infrastructure According to the empirical score, the financial development dimension of cities with the highest comprehensive score is generally higher. The financial development dimension score is greatly different, representing the unequal distribution of financial resources in Anhui Province. Therefore, we should constantly improve and strengthen financial services benefiting farmers, improve financial infrastructure construction in rural areas, and adequately merge and cancel the financial outlets and withdrawal points around rural areas. For rural areas, especially poor villages, targeted information-sharing platforms and credit assistance and distribution systems should be innovatively developed. Rational use of scientific and technological means while optimizing service quality, reducing service cost, making inclusive financial services more differentiated, and improving convenience.

(2) Supporting and promoting industrial development, focusing on the common progress of the province. In the empirical results, the scores of the first and second cities are much different, and the extreme difference is enormous. Recently, the overall development of Anhui province has had great regional differences. Therefore, the government should take measures according to local conditions and make personalized development plans according to the industrial structure and advantages and disadvantages of different regions. For Hefei, Wuhu, Ma 'Anshan, and other regions with a solid economic foundation and relatively balanced resource structure, innovative reform and development strategies such as technology, industry, and system should be adopted to cultivate new economic driving forces. For areas with lower financial, ecological environment ranking, targeted assistance will be provided to different degrees in rural revitalization, credit structure, and rural services. It is started from the economy, and it improves the level of urbanization and enhances the balance of resources.

(3) Strengthen the publicity of financial knowledge and improve the literacy of financial consumers. In the empirical results, cities with higher total scores tend to have higher scores in urbanization level and credit level, with great differences in scores. Therefore, because of the situation differences in different regions, while providing different financial services to meet consumer needs, different financial knowledge publicity programs should be formulated according to local conditions to promote the diversification, differentiation continuously, and individuation of the financial system, meet the diversified needs of consumers at different levels and improve the sense of gain of consumers. Meanwhile, expand consumer rights protection channels, perfect the supervision system, and improve society's credit consciousness as a whole.

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