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A Research of Constructing Regional Financial Ecological Main Bodies' Indicator System and Competitiveness Evaluation

DENG Qizhong[a],*; CHEN Rui[b]

[a] PH.D, Associate Professor, Vice Dean, School of Management, Hunan University of Science and Technology, Hunan Province Research Base of New Type Industrialization, Xiangtan 411201, China.
[b] PH.D, Department of Real Estate & Construction, The University of Hong Kong, HKSAR.
* Corresponding Author.

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Abstract
Based on the statistics of 29 provinces of China from 1996 to 2008, regional financial ecological main bodies' indicator system is constructed and their evaluation of competitiveness is studied. For the selection of reasonable evaluation indicators, reliability and validity tests could determine the evaluation method and corresponding indicators. Then the competitiveness of 29 provinces' financial ecological main bodies is listed after quantification. Results suggest that mature financial ecological main bodies mostly located in East China, Beijing, Shanghai and Guangdong are at the top. Undeveloped financial ecological main bodies concentrated in West China, Qinghai, Ningxia and Guizhou is the poorest. Financial ecological main bodies with potential are most common type of the provinces in Central China.

Key words: Financial ecological main bodies; Competitiveness; Principal component analysis

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INTRODUCTION
The Lausanne international institute for management development (IMD) presented a set of competitiveness evaluation methods and indicator systems, the origin of a regional financial ecological competitiveness study. In view of the different research objectives, scholars have moderately improved the indicator system, to build corresponding financial competitiveness evaluation indicator system, and get a quantitative evaluation on regional financial competitiveness.

Existing research divides regional financial ecological competitiveness into two components. One is regional financial competitiveness. Ni (2008) suggests a notion of urban competitiveness in which the concept regional financial competitiveness is a secondary notion. His explanation of regional financial competitiveness contains the amount of financial resources a city could own, control or utilize. Besides that, it also includes the convenience and cost of acquisition and the development status of urban financial industries, etc. Regional financial competitiveness represents the advantages of a city in absorbing and allocating financial resources. The other stream focuses on the regional financial ecological environment competitiveness.

Although, there is a lot of relevant financial eco-environmental competitiveness evaluation research, among these studies we could find comparative research more than empirical research, policy research more than operations research, qualitative research more than quantitative study. The basic reason is that it lacks a set of scientific, reasonable and effective evaluation indicator system. Therefore, it is difficult for us to systematically evaluate the advantages, disadvantages and comprehensive competitiveness of the regional financial eco-environment in China. To overcome the existing disadvantages, we research a large number of literature study, expert argument and statistical analysis, and try to build up a set of regional financial ecological main bodies' evaluation

indicator system. By using principal component analysis methods, this paper will assess and compare the regional financial ecological main bodies competitiveness, thus providing reference a basis for regional financial ecological resource efficient distribution, orderly flow and the scientific policy decision[1].

1. INDICATOR SYSTEM AND ASSESSMENT MODELS

1.1 Establishment of Indicator System

Understanding the difficulty of obtaining relevant data and the needs of universality and operability, seven evaluation indicators are selected from four aspects such as the scale of financial institutions, financial efficiency, insurance market and stock market. These indicators are gross deposits and credits of all financial institutions, credit-to-deposit ratio for all financial institutions, income from insurance premium, insurance density, the stock market turnover, stock market capitalization and the number of listed companies. The regional financial ecological main bodies' indicator system is constructed by these seven indicators.

1.2 Evaluation Method

The purpose of principal component analysis (PCA) is to build a group of new uncorrelated aggregative indicators to replace the original ones. In practice, PCA selects fewer aggregative indicators to reflect the information from original indicators as much as possible. These aggregative indicators are linear combinations of the origin and they are disparate from each other. Meanwhile, the important information has been kept in these new indicators. Evaluation and analysis steps are listed as below:

$$Z_{ij} = \frac{x_{ij} - \overline{x}_j}{s_j^2} \tag{1}$$

Here x_{ij} represents the j_{th} indicator for the i_{th} province, $\overline{x}_j$is the average value of j_{th} indicators for 29 provinces, s_j is the standard deviation of the j_{th} indicator, Z_{ij} is standardized value of the j_{th} indicator for the i_{th} province. Standardized indicator covariance matrix is not affected by dimension and order of magnitude.

Second, the standardized correlation matrix is built as below:

$$R = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1j} \\ r_{21} & r_{22} & \cdots & r_{2j} \\ & \cdots & & \\ r_{i1} & r_{i2} & \cdots & r_{ij} \end{bmatrix} \tag{2}$$

Of which r_{ij} is the correlation coefficient of original variable x_i and x_j.

Third, eigenvalue and eigenvector is found by solving a characteristic equation.

$$|\lambda_i - R| = 0 \tag{3}$$

Eigenvalue λ_i is found out by applying Jacobi method and all the λ_i are listed in numerical order. That is $\lambda_1 \geq \lambda_2 \geq \cdots \geq \lambda_i \geq 0$. Eigenvalue is regarded as the indicator for a principal component's impacts, representing how much average original variable's information could be explained when this principal component is included in the model. If eigenvalue is less than 1, that means the power of explanation of this principal component is not as good as an average value of original variables.

Fourth, calculate the variance contribution rate and accumulated variance contribution rate for all principal components. Principal component F_i has a contribution rate of:

$$\frac{\lambda_k}{\sum_{i=1}^{p} \lambda_i} \tag{4}$$

Variance contribution rate stands for the weight of principal component F_i 's variance of total variances. The larger the number, the better principal component F_i can combine information from $x_1,x_2,\cdots,x_p$. Accumulated variance contribution rate is:

$$\sum_{k=1}^{m} \lambda_k \Big/ \sum_{i=1}^{p} \lambda_i \tag{5}$$

Accumulated variance contribution rates summarize the amount of information which was abstracted from $x_1,x_2,\cdots,x_p$ by these k principal components. In general, if the contribution rate achieves to 85%~95%, it means these k principal components have already largely been included the information from all the measured indicators. The number of variables is reduced and it will be easier to carry out further research on practical issues.

Because some indicator group have limited original indicators, if the eigenvalue is set to be above 1, it could be possible to have only 1 principal component and it just has limited contributes. Thus, instead of comparing eigenvalue with 1, the degree of explanation of 85% is made the benchmark. Larger accumulated variance contribution rate represents better explanations capacity of principal components.

[1] Determined by National People's Congress in 1986, East China includes Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong and Hainan, Midland China includes Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei and Hunan. West China has Inner Mongolia, Guangxi, Sichuan, Guizhou, Yunnan, Shaanxi, Gansu, Qinghai, Ningxia and Xinjiang (Chongqing became a centrally administered municipality in 1997 and the data of Chongqing is combined with that of Sichuan province, Tibet is not involved because of lack of data). Thus 29 provincial samples are selected as the research target.

Sixth, list the principal components and find corresponding value for every sample. Principal components can be expressed by original indicators $x_1,x_2,\cdots,x_p$:

$$F_i = a_{1i}x_1 + a_{2i}x_2 + \cdots + a_{ni}x_n, i = 1,2,...,k \quad (6)$$

After calculating the score of a specific principal component for a financial ecological main body, the composite score for the financial ecological main bodies is the weighted average score of specific results and the weight is the variance contribution rate.

2. EMPIRICAL ANALYSIS

2.1 Sample Description, Data Resource, Reliability and Validity Tests

29 provinces, municipalities and centrally administered municipalities are selected as the cross-sectional data source. The research period is 1996 to 2008 for 13 yearly records. All the selected indicators come from The China Statistical Yearbook, Sixty Years of New China's Compilation of Statistics and other province level statistical yearbooks from 1997 to 2009. An Official data source was selected because it is more reliable and also widely accepted. The above regional financial ecological main bodies' competitiveness indicators is selected through certain principals, but whether they are suitable for measuring regional financial ecological main bodies has not been tested. So it is necessary to test the reliability and validity of these indicators and keep abreast of their inherent consistency. If these indicators do have inherent consistency and are suitable for representing regional financial ecological main bodies, their factor scores could be used to describe the performance of provincial financial ecological main bodies. To avoid multicollinearity, the selected variables are standardized to improve the results of reliability and validity tests.

Inherent reliability tests usually use Cronbach's α coefficient to measure the magnitude of reliability. Bigger coefficient means better reliability[2]. Validity refers to whether these 7 financial ecological main bodies' indicators are capable of standing for the competitiveness of financial ecological main bodies and it will affect the rank of competitiveness for 29 provincial financial ecological main bodies. KMO static and accumulated variance contribution rates are two indicators for this measuring purpose[3].

Table 1
Reliability and Validity Tests of Financial Ecological Main Bodies' Ingredients

Variable	Period	KMO	Accumulated variance contribution rate (No. of principal components)	Cronbach's α
Financial ecological main bodies	1996-2000	0.767	94.00%(2)	0.663
	2001-2005	0.659	86.60%(2)	0.657
	2006-2010	0.752	86.33%(2)	0.678
	1996-2008	0.783	87.88%(2)	0.694

Table 1 provides reliability and validity test results. Reliability test results suggest all the 7 regional financial ecological main bodies' indicators have their Cronbach's α values above 0.65. Thus these 7 indicators have good inherent consistency and could be used as indicators for the competitiveness of regional financial ecological main bodies. From the results of reliability tests we can conclude that the entire era has the reliability coefficient exceeds that of other three sub-periods. It is clear that in the long term view, these indicators are suitable and reliable. Meanwhile, the reliability coefficients lie between 0.6 and 0.8 and belong to a preferable class.

The results of validity tests show that most of the 7 indicators' KMO coefficients fall between 0.7 and 0.8, which suggests an unsatisfactory result. These indicators correlate strongly and have high degrees of overlap. These features suggest the adoption of principal component analysis. Again, the entire period has a validity coefficient which exceeds that of other three sub-periods. So it's no doubt that in the long term view, these indicators are suitable and reliable. Moreover, for every researched period, two principal components are abstracted and they have accumulated variance contribution rates above 85%. This indicates that the principal components can represent original variables quite well. They explain the same as the original variables and have factor validity, which could reflect regional financial ecological main bodies' basic connotations.

2.2 Results of Competitiveness Evaluation and Explanations

To eliminate negative numbers and make the evaluation results easy to understand, the composite score is converted into a decimal system, which is a kind of normalization for the indicators. The formula is listed below:

$$F = \frac{F_i - F_{i,\min}}{F_{i,\max} - F_{i,\min}} \times 10 \quad (7)$$

Here F_i is the score of target (province, centrally administered municipality or municipality) i $F_{i,\max}$ is the

[2] Formulas for reliability test: $r_{xx} = \frac{S_T^2}{S_X^2}$, r_{XX} represents reliability coefficient, S_T is true variance, S_T is Overall variance. Cronbach's α is between 0 and 1, bigger α indicates more reliable in internal consistency. α bigger than 0.8suggests excellent internal consistency, between 0.6 and 0.8 means preferable and below 0.6 means bad internal consistency. In practice, Cronbach's α needs to be above 0.5 and preferably above 0.7.

[3] Kaiser provides standards of KMO measurements: above 0.9 represents perfect match, 0.8-0.9 represents good match, 0.7-0.8 represents ordinary, 0.6-0.7 represents barely match, 0.5-0.6 represents not match and below 0.5 stands for totally not match.

highest score of all and $F_{i,\min}$ is the lowest one. Table 2 is the summary of 29 financial ecological main bodies' composite scores for 1996 to 2008.

Table 2
Rank and Trend of 29 Province Level Financial Ecological Main Bodies' Competitiveness

District	1996-2000	2001-2005	2006-2008	Trend	1996-2008	Type
Beijing	3	3	3	Stable	3	Ⅱ
Tianjin	16	16	13	Ascendant	13	Ⅲ
Hebei	9	10	10	Ascendant	9	Ⅲ
Liaoning	7	8	8	Descendant	8	Ⅲ
Shanghai	2	1	2	Fluctuant	2	Ⅰ
Jiangsu	4	4	4	Stable	4	Ⅱ
Zhejiang	5	5	5	Stable	5	Ⅱ
Fujian	10	9	11	Fluctuant	10	Ⅲ
Shandong	6	7	7	Descendant	7	Ⅱ
Guangdong	1	2	1	Fluctuant	1	Ⅰ
Hainan	25	26	27	Descendant	25	Ⅴ
Shanxi	19	18	16	Ascendant	16	Ⅲ
Jilin	14	23	19	Fluctuant	20	Ⅳ
Heilongjiang	13	13	17	Descendant	14	Ⅲ
Anhui	18	15	14	Ascendant	17	Ⅲ
Jiangxi	21	20	22	Fluctuant	21	Ⅳ
Henan	11	12	12	Descendant	12	Ⅲ
Hubei	12	11	9	Ascendant	11	Ⅲ
Hunan	15	14	15	Fluctuant	15	Ⅲ
Sichuan	8	6	6	Ascendant	6	Ⅱ
Inner Mongolia	26	25	23	Ascendant	26	Ⅴ
Guizhou	27	27	26	Ascendant	27	Ⅴ
Yunnan	23	22	21	Ascendant	24	Ⅳ
Shaanxi	17	17	18	Descendant	18	Ⅳ
Gansu	24	24	25	Descendant	23	Ⅳ
Qinghai	29	29	29	Stable	29	Ⅴ
Xinjiang	22	19	20	Fluctuant	19	Ⅳ
Guangxi	20	21	24	Descendant	22	Ⅳ
Ningxia	28	28	28	Stable	28	Ⅴ

In Table 2, the competitiveness of 29 province level financial ecological main bodies appear to vary significantly according to different districts. 29 provinces and cities could be categorized into 5 groups by their scores: Type Ⅰ financial ecological main bodies get score between 7 and 10, members of this group have the strongest competitiveness and belong to mature financial ecological main bodies. Type Ⅱ financial ecological main bodies get score between 4 and 7, members of this group also have strong competitiveness and belong to developing financial ecological main bodies. Type Ⅲ financial ecological main bodies get score between 2 and 4, members of this group have moderate competitiveness and belong to growing type financial ecological main bodies. Type Ⅳ financial ecological main bodies get score between 1 and 2, members of this group lack competitiveness and belong to financial ecological main bodies with potential. Type Ⅴ financial ecological main bodies get score below 0 and above 1, members of this group are the worst in competitiveness and belong to undeveloped financial ecological main bodies. Specific results could be concluded as follows:

First, from a geographic perspective of the ranking, East China is the best area of financially sound ecological main bodies. Members of this group all belong to the top three types of financial ecological main bodies. Only Hainan (undeveloped type) is an exception. Guangdong, Shanghai and Beijing are mature type financial ecological

main bodies. Jiangsu, Zhejiang and Shandong belong to developing financial ecological main bodies. Tianjin, Hebei, Liaoning and Fujian are growing type financial ecological main bodies. Midland China takes second place in the condition of financial ecological main bodies. Most of the members belong to type Ⅲ financial ecological main bodies, e.g. Shanxi, Heilongjiang, Anhui, Henan, Hunan and Hubei. Jilin and Jiangxi are potential type financial ecological main bodies. West China is the worst in the development of financial ecological main bodies. Sichuan is the only one belongs to type Ⅱ and the rest belong to type Ⅳ or Ⅴ. Yunnan, Shaanxi, Gansu Xinjiang and Guangxi are financial ecological main bodies with potential. Inner Mongolia, Guizhou, Qinghai and Ningxia belong to undeveloped.

Second, in terms of financial ecological main bodies' grouping, Guangdong, Shanghai and Beijing have their score above 8, far exceeding other provinces. They are grouped as the first group, namely mature type financial ecological main bodies. These three provinces have already built a modern financial ecological main body in which banks, securities and insurance industries lead other types of financial institutions.

Jiangsu, Zhejiang, Sichuan and Shandong rank from 4th to 7th. They have scores between 4 and 7 and belong to developing financial ecological main bodies. Jiangsu and Zhejiang are crucial to the Yangtze River Delta and they are still developing. With the process of integration in Yangtze River Delta and the connection with Shanghai, these two provinces are promoting the developments of financial ecological main bodies. The trend supports the growth of banks, securities and insurance industries, improvement and perfection of financial institutions, financial markets and financial regulations. They are the key of financial ecological main body systems.

Ten provinces have scores between 2 and 4, thus belong to growing type financial ecological main bodies. They are Liaoning, Hebei, Fujian, Henan, Hubei, Hunan, Shanxi, Tianjin, Heilongjiang and Anhui. This kind of financial ecological main body is usually located in East and Midland China. No West China province is involved in this group. However, in Midland China, all the provinces are of growing type of financial ecological main bodies, Jilin is the only exception. As mentioned above, Midland China provinces have the smallest difference in developments. This feature makes the scale and pattern difference of financial ecological main bodies relatively small as well.

Seven provinces have their scores between 1 and 2, for this reason they are categorized as potential type financial ecological main bodies. They are Shaanxi, Jilin, Yunnan, Jiangxi, Guangxi, Xinjiang and Gansu. West China provinces are the chief components of this type. Jilin, Yunnan, Jiangxi and Guangxi get similar scores and it indicates that a growing type is the main stream in West China financial ecological main bodies. Their specific features such as good in the development scale but lack efficiency. Quantitative growth is still the popular way of development which is reasonable in underdeveloped provinces. On the other hand, insurance and securities industries are not good, either in quantity or quality. Existing circumstances make the competitiveness of this group relatively weak and they are lack of advanced path of developments. Although Xinjiang province has already done lots to promote financial markets, but the late start, small openness and inferior financial assets drag further developments of financial ecological main bodies.

Hainan, Inner Mongolia, Guizhou, Ningxia and Qinghai get their scores between 0 and 1 and they belong to undeveloped type financial ecological main bodies. As a coastal province, Hainan gets a low score primarily because of the impact of Asia financial crisis in 1990s. The rest 4 provinces are all located in West China. Both scale and development are at the bottom of all the provinces. The development of financial ecological main bodies are not just constrained by the abundance of natural resources, but are also affected by the central government's policies and the local government support. Thus these 4 provinces could promote the quantity development of financial institutions and more focus on accumulations. Besides that, more policy support could also accelerate healthy.

Third, based on the analysis of 29 provinces' changing trend of financial ecological main bodies' competitiveness, they could be divided into 4 evolution types, as below:

First type, the competitiveness of financial ecological main bodies progresses step by step. 8 provinces belong to this type. Tianjin is the only one from East China, Shanxi, Anhui and Hubei belongs to Midland China, Sichuan, Inner Mongolia, Yunnan and Guizhou are West China provinces. It could be concluded that the fastest growth rate comes from the West China provinces. Their undeveloped financial and economic situations make more space for development. Half of these types of provinces come from West China. Anhui is the most significant which ranked 18th in year 1996-2000, then got 15th place in year 2001-2005 and grab 14th place in year 2006-2008.

Second type, the competitiveness of financial ecological main bodies remains stable throughout the research period. They are Beijing, Jiangsu, Zhejiang from East China and Qinghai, Ningxia from West China. The top group and the worst ones remained stable for 20 years.

Third type, the competitiveness of financial ecological main bodies declines gradually. Out of the 9 provinces, 4 are located in East China. They are Hebei, Liaoning, Shandong and Hainan. Besides, Heilongjiang and Henan are Midland China provinces. Gansu, Shaanxi and Guangxi belong to West China. Out of them, Heilongjiang and Guangxi lose their competitiveness rapidly; their rankings fell from 13th and 20th respectively during the year 1996 – 2000 to 17th and 24th during 2005-2008. This is the fastest falling speed for all the provinces in analysis and most of them fell 1 or 2 places in their ranking if it happens. What

worth our attention is that although there are 4 provinces in East China records a decline in ranking, but they have a mild decline. On the other hand, Only 2 Midland provinces decline in ranking, but these are sharp drops.

Fourth type, the competitiveness of financial ecological main bodies fluctuates for 7 provinces. Three of them are located in East China, Shanghai, Fujian and Guangdong. There are 3 other members in Midland China, Jilin, Jiangxi and Hunan. Xinjiang is the only one in West China. Find that more than 80% of the provinces having competitiveness changed are East and West China provinces. This group of provinces could also be divided into several types. Fujian, Hubei, Hunan, and Xinjiang first experienced an upward trend and then went down. Shanghai, Guangdong and Jilin are moving in the opposite way. Jilin has the biggest fluctuation range with ranking. The ranking started from 14th place in the first period and fell to 23th in the following period, but returned to 19th during the last research period. Other provinces usually have fluctuations within 2 places.

CONCLUSION

Our research takes 29 provincial level statistical data from 1996 to 2008 and empirically finds a way to evaluate the competitiveness of financial ecological main bodies. During the process, an evaluation system of 7 indicators for financial ecological main bodies is constructed. It focuses on aspects such as financial institutions and financial markets. Results reveals that Guangdong, Shanghai and Beijing are mature type financial ecological main bodies and perform the best of all. Qinghai, Guizhou and Ningxia belong to undeveloped financial ecological main bodies and are the worst ones in performance. For the entire research period, Anhui is the fastest in promoting competitiveness while Heilongjiang and Guangxi are the fastest ones in declining. Beijing, Jiangsu, Zhejiang, Qinghai and Ningxia are stable in the terms of change. Meanwhile, Jilin is the most fluctuant.

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