Study on Rural Economic Development Based on Factor Analysis——A Case Study of Hubei Province

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Abstract　Taking the rural economic indicator data in 17 cities（regions）of Hubei Province in 2009 as samples，this paper establishes evaluation index system of rural economic development in Hubei Province，uses factor analysis method for analysis，and draws out four factors. The conclusion is objective and believable，which meshes with the reality well. Finally the policy suggestions and implementation measures are put forward to promote the rural economic development in Hubei Province as follows：first，promote the farmers' income to increase continuously，and improve the living standards of farmers；second，implement the policies of benefiting farmers and making farmers powerful，and propel the resource factors to be allocated in rural areas；third，promote the level of modern agricultural equipment，and promote the transformation of agricultural development mode；fourth，coordinate and promote urban-rural reform，and speed up the improvement of rural livelihood.

Key words　Rural economic development in Hubei Province，Factor analysis，Factor score

　　Issues concerning agriculture，farmers and countryside are the basis and pillar for other industries. Since 30 years of reform and opening-up，the central government has adopted a series of major policies and guidelines to support agriculture and benefit farmers，and achieved fruitful results：the development of agriculture and rural areas shows good trend；the reform of rural system achieves major breakthroughs constantly；comprehensive agricultural production capacity，rural public undertakings，and rural economy further develop rapidly，and farmers' living standards are improved significantly. Hubei Province，as an important part of the strategy of " Rise of Central China" formulated by the State Council，has achieved rapid development in socio-economic aspects. But in reality，there are still many problems as follows：the agricultural basis is still weak；the rural development still lags behind；increasing farmers' income remains difficult. As an important part of the Twelfth Five-Year Plan Strategic Planning of Hubei Province，to explore the healthy and continuous development of rural economy is especially important.

　　Ding Wei analysed the status quo of China's rural economic and social development，and highlighted several deep-seated problems faced by rural economic and social development under the new situation，such as decline in the level of promotion and application of agricultural science and technology，decline in sustainable development capacity of agricultural production factors and ecological environment，and decline in the state's ability to regulate the market of agricultural products[1]；Wang Dexiang and other scholars，from development trends of organization forms，studied the problems concerning China's rural collective economy，and pointed out that we should establish the rural collective economic system which help develop the modernization of agriculture[2]；Liu Wei and other researchers，from establishment of development level index system，discussed the evaluation problems of rural circular economy[3]；Chen Qiaoling，from the status quo of rural education and the existing problems，put forward some countermeasures to promote positive interaction between rural education and economic development[4]. However，there are few studies researching specific provinces，thus taking Hubei Province as an example，by factor analysis method，I conduct research on the economic development in rural areas，and offer reasonable policy proposals and specific implementation measures for rural economic development in cities of Hubei Province.

1　Index selection，data source and research method

1.1　Establishment of evaluation index system and data source　There are many factors influencing rural economic development，so we should take various impacts into consideration，and establish appropriate index system to describe the rural economy of 17 cities（regions）in Hubei Province. In accordance with previous studies，coupled with the principles of integrity，integration，representation and data availability，I design and select the economic indicators of 14 representative villages to establish the following index system：area of farmland in common use X_1（ $\times 10^3$ hm^2 ），total power of agricultural machinery per capita X_2（KW），consumption of chemical fertilizer per unit area X_3（kg/hm^2 ），rural power consumption per capita X_4（kW · h），effective irrigation area X_5（ $\times 10^3$ hm^2 ），total planting area of agricultural crops X_6（ $\times 10^3$ hm^2 ），total fixed assets investment in rural areas X_7（ $\times 10^8$ yuan），general budgetary outlay of agriculture，forestry，and water conservancy X_8（ $\times 10^8$ yuan ），rural residents' net income per capita X_9（yuan），rural residents' living spending per capita X_{10}（yuan），rural housing area per capita X_{11}（m^2），total output value of agriculture，forestry，animal husbandry and fishery X_{12}（ $\times 10^8$ yuan ），agricultural loans from financial institutions X_{13}（ $\times 10^8$ yuan ），total beds in hospitals and clinics X_{14}. Data are from

Statistical Yearbook of China's Regional Economy in 2009, and *Hubei Rural Statistical Yearbook* in 2009.

1.2 Factor analysis and the steps Currently, the relevant research on the performance evaluation of the economic development has tended to be mature[5]. Two kinds of methods are mainly adopted: factor analysis method and comprehensive evaluation method (DEA method, fuzzy evaluation method, gray correlation analysis, *etc.*). Through research on internal structure of correlation coefficient matrix of the original data, the factor analysis is a statistical method of converting multiple indicators into a small amount of unrelated and non-observable random variables (ie factors), and extracting most of the information of the original indicators. When the structure of factor loading matrix is not simplified, we can rotate the factor so that the factor has distinct practical significance, and at the same time, use the factor score function to offer the corresponding evaluation and ranking of samples. The mathematical model of factor analysis is as follows:

$$X = AF + \varepsilon$$

where $X = (X_1, X_2, \cdots, X_p)'$ is the original index; $F = (F_1, F_2, \cdots, F_m)'$ is the common factor of X; A is factor loading matrix; ε is the special factor. We commonly use principal component factor extraction method, whose characteristics lie in that it can use contribution of variance β_i to measure the importance of common factor i. The steps of factor analysis are as follows[6]:

First, standardize the original data, still denoted by X.

Second, establish correlation coefficient matrix R.

Third, solve the characteristic equation $|R - \lambda E| = 0$, and calculate eigenvalue and eigenvector. When the cumulative contribution rate is not less than 85%, we select the front k principal components to replace the former m indices, and calculate factor loading matrix A.

Fourth, conduct maximum orthogonal rotation transformation of variance on A.

Fifth, name and explain the main factors. If it needs to conduct ranking, then we should calculate the score of all main factors $F_i = \alpha_i X$, take the contribution rate as weight, and weight F_i to calculate the score of comprehensive factors.

2 Results and analysis

2.1 Factor analysis I first standardize the raw data in order to eliminate the impact of different dimensions of indices on the analysis results. From Barlett test of sphericity on data by statistical software SPSS17.0, and KMO test results, we know that KMO value is 0.581, and according to measurement standard offered by Kaiser, KMO value is too small, but the observational value of Bartlett sphericity test statistic is 263.957, and the corresponding probability value is 0.000 < 0.05, indicating that there is prominent difference between the correlation coefficient matrix and unit matrix, and the correlation of all variables is big. After taking the former variables into consideration comprehensively, it is appropriate to conduct factor analysis[7].

According to standardized sample data, I establish the correlation matrix of the indices. Then I calculate the eigenvalue

and cumulative contribution rate, and the first four eigenvalues and the contribution rate can be shown in Table 1. From Table 1, the cumulative contribution rate of the variance of the first four eigenvalues has reached 85.418%, which has reflected most of the information of the raw data, thus extracting four common factors is feasible, achieving the purpose of simplification and dimensionality reduction.

As the structure of initial factor loading matrix is not simple and clear, and the meaning of all factors is not prominent, so we adopt maximum orthogonal rotation transformation of variance, so that all variables generate big load on some factors, small load on other factors, thus we get rotated factor loading matrix, which can be shown in Table 2.

Table 1 Eigenvalue of correlation coefficient matrix and contribution rate of variance

Sequence number of factor	Eigenvalue	Contribution rate//%	Cumulative contribution rate//%
1	6.575	46.964	46.964
2	2.497	17.833	64.797
3	1.866	13.332	78.129
4	1.020	7.289	85.418

Table 2 Rotated factor loading matrix

Index variable	Factor 1	Factor 2	Factor 3	Factor 4
X_1	0.964	0.143	−0.052	−0.073
X_2	0.071	−0.304	0.451	0.751
X_3	−0.411	0.007	−0.219	0.778
X_4	−0.311	0.428	0.505	−0.312
X_5	0.900	−0.019	0.284	−0.059
X_6	0.921	0.271	−0.121	−0.127
X_7	0.545	0.549	0.210	−0.131
X_8	0.508	0.821	0.022	−0.094
X_9	0.100	0.097	0.945	0.021
X_{10}	0.175	0.285	0.887	0.074
X_{11}	−0.133	0.815	0.242	−0.041
X_{12}	0.913	0.316	0.149	−0.045
X_{13}	0.566	0.746	0.040	−0.098
X_{14}	0.419	0.777	0.189	−0.115

From Table 2, we know that factor 1 has high load in index X_1, X_5, X_6 and X_{12}, and these indices mainly reflect different comparisons in farmland area, planting area of agricultural crops and other natural factors in all regions, which can be generalized as the factor of rural natural resources level. Factor 2 has high load in index X_7, X_8, X_{11}, X_{13} and X_{14}, which can be generalized as the factor of rural social service and social security. Factor 3 has high load in index X_4, X_9 and X_{10}, which can be generalized as the factor of rural affluence level. Factor 4 has high load in index X_2 and X_3, which can be generalized as the factor of agricultural modernization level.

2.2 Comprehensive score of all cities (regions) Based on the rotated factor loading matrix and factor score coefficient matrix, we can calculate the score of four main factors in 17 cities (regions). From different angles, they reflect the competitiveness of rural economic development in cities (regions). We take the corresponding variance contribution rate of four main

factors as weight, to calculate the composite score, and the formula of composite score is as follows:

$$F = 0.549\ 8F_1 + 0.208\ 8F_2 + 0.156\ 1F_3 + 0.085\ 3F_4$$

We use this formula to calculate the composite score of all regions, and sequence the level of competitiveness of rural economic development in 17 cities (regions) of Hubei Province in 2008. The results can be seen in Table 3.

Table 3 Factor score, comprehensive score and ranking of 17 cities (regions) in Hubei Province in 2008

Area	F_1		F_2		F_3		F_4		F	
	Score	Ranking	Score	Ranking	Score	Ranking	Score	Ranking	Score	Ranking
Jingzhou City	2.079 1	1	−0.597 6	12	0.260 57	8	−0.070 2	8	1.052 9	1
Xiangfan City	1.671 3	2	−0.196 0	9	−0.017 6	10	0.896 5	3	0.951 6	2
Wuhan City	0.010 4	8	2.764 4	1	1.478 9	1	0.031 1	6	0.816 4	3
Jingmen City	0.680 5	5	−0.646 6	13	1.445 6	2	1.077 1	2	0.556 6	4
Huanggang City	0.747 3	4	1.037 7	3	−0.700 9	14	−0.577 5	13	0.468 9	5
Yichang City	0.180 0	6	1.556 0	2	−0.039 2	12	0.546 8	4	0.464 3	6
Xiaogan City	0.882 0	3	−0.843 3	15	−0.038 1	11	−0.766 6	16	0.237 5	7
Suizhou City	−0.084 9	10	−0.589 5	11	0.516 3	5	−0.111 9	9	−0.098 7	8
Enshi Prefecture	0.113 1	7	0.459 7	4	−2.238 5	17	−0.401 9	12	−0.225 5	9
Xianning City	−0.286 4	11	0.060 8	6	−0.249 2	13	−0.587 8	14	−0.233 8	10
Shiyan City	0.001 9	9	−0.263 8	10	−1.848 8	16	−0.710 0	15	−0.403 2	11
Tianmen City	−0.474 7	12	−0.948 2	16	0.448 6	6	−0.301 9	11	−0.414 7	12
Xiantao City	−0.545 7	13	−1.085 9	17	0.823 4	3	−0.281 0	10	−0.422 2	13
Qianjiang City	−0.828 0	14	−0.724 1	14	0.357 7	7	0.169 94	5	−0.536 1	14
Shennongjia forest region	−1.383 6	16	−0.065 3	7	−0.989 7	15	2.881 7	1	−0.683 0	15
E' zhou City	−1.301 2	15	−0.174 0	8	0.168 6	9	0.017 6	7	−0.723 9	16
Huangshi City	−1.460 7	17	0.255 8	5	0.622 1	4	−1.811 9	17	−0.807 1	17

Table 3 shows that only the total score of Jingzhou City, Xiangfan City, Wuhan City, Jingmen City, Huanggang City, Yichang City, and Xiaogan City , and the score of other 10 cities (regions) is below 0. There are great differences in rural economic development of all cities (regions) in Hubei Province, and there is difference of 2 points between Jingzhou City with the highest score and Huangshi City with the lowest score. Jingzhou City, Xiangfan City and Wuhan City, are considered as the traditional strong agricultural cities in Hubei Province, with score ahead of that of other regions. The score of Tianmen City, Xiantao City, and Qianjiang City, under the direct control of Hubei Province, is below 10. Their agricultural production is mainly confined to the lack of natural resources, and the most prominent manifestation is that the indices of farmland area and other natural resources rank behind (just above E'zhou and Shennongjia). On the whole, the rural economic development in most of cities (regions) in Hubei Province is still below the average provincial level of development. Such ranking result is also in line with practical development of the agricultural economy in Hubei Province.

For the factor of the level of natural resources in rural areas, the overall ranking and the final ranking of composite scores change little. In terms of score, Jingzhou City, Xiangfan City, and Xiaogan City, by relying on the outstanding indicators of area of farmland in common use, effective irrigation area, planting area of agricultural crops, total output value of agriculture, forestry, animal husbandry, fishery and so on, keep ahead of other cities (regions), while E'zhou City, Shennongjia, and Huangshi City rank at the bottom of list. The value of the four indicators in Jingzhou City is 462.2 (1 000 hm²), 387.9 (1 000 hm²), 973.4 (1 000 hm²), and 335.7 (0.1 billion yuan), respectively, ranking first in Hubei Province, and the highest score of the factor of the level of rural natural re-

sources is very consistent with the actual situation.

Wuhan City, Yichang City, and Huanggang City get outstanding score in terms of the factor of rural social services and social security, while Xiaogan City, Tianmen City, and Xiantao City show poor performance. In terms of general budget expenditure in agriculture, forestry and water conservancy, agricultural loans of financial institutions, and total beds in hospitals and clinics, Wuhan City ranks on top of the list, which is in line with the status of Wuhan City as the political, economic and cultural center in Hubei Province. Yichang City, as the " water conservancy capital", and Huangshi City are ahead of other cities (regions) in terms of total social fixed asset investment in rural areas (6.79 billion yuan) and power consumption per capita in rural areas (623.9 kilowatts hours), respectively.

In terms of rural residents' net income per capita, rural residents' living spending per capita and other indices, Wuhan City, Jingmen City and Xiantao City have a good performance, and the affluence degree of the farmers in these regions is relatively high. Taking Wuhan City as an example, the pulling effect of the capital city makes the rural residents' net income per capita in Wuhan City (6 349 yuan) nearly 2.5 times that in Enshi Tujia and Miao Autonomous Prefecture (2 519 yuan, the lowest), with obvious gap. With the development of society, the level of agricultural modernization in Hubei Province has been greatly improved, and total power of agricultural machinery per capita has also been rapidly promoted. In terms of score of the factor of agricultural modernization level (F_4), Shennongjia, Jingmen City, and Xiangfan City, make an eye-catching performance. Shennongjia forest area scores 2.88, 4.7 higher than that of Huangshi City (−1.81, the lowest), which is mainly ascribed to the high consumption of chemical fertilizer per unit area.

3   Conclusion and proposals

From the factor analysis results, the factor of the level of natural resources in rural areas explains 46.694% of the total amount of information, nearly half, and it also fully shows that the current economic development in rural areas of Hubei Province still takes natural resources as the main body, and the mode of agricultural production and management is extensive. From analysis results of cities (regions), there is a great difference in the level of economic development in rural areas of Hubei Province, and the development is uneven. How to achieve harmonious and balanced development in all cities (regions), so that "powerhouse is an eternal powerhouse and the weak is no longer weak", is the top priority of Hubei Province in the next development cycle. Specifically, we should note the following points. First, promote the continuous increase in farmers' income, and improve the living standard of farmers. On the basis of stabilizing planting area of grain, we should spare no efforts to improve the product structure; focus on improving the grain yield and quality; stick to the guideline of industrialization and take a new road to industrialization; constantly enhance the overall strength of the county economy; adopt more ways to promote farmers' employment and beginning an undertaking. Second, implement the policies of benefiting farmers and making farmers powerful, and propel the resource factors to be allocated in rural areas. We should constantly increase inputs into agriculture and countryside, implement policies of agricultural subsidies and market regulation, strengthen the support for building of new countryside, and strive to improve rural financial services. Third, promote the level of modern agricultural equipment, and promote the transformation of agricultural development mode. We should actively promote the standardization of agricultural production, strengthen the building of water conservancy infrastructure and stand-

ard farmland, reinforce agricultural technology innovation and promotion capacity, and strengthen ecological construction in rural areas. Fourth, coordinate the promotion of urban and rural reform, speed up the improvement of rural livelihood. We should improve the development level of culture, education, and health care in rural areas, perfect the new rural cooperative medical care and other rural social security systems, strengthen rural infrastructure building, constantly propel poverty alleviation and development, and deepen comprehensive rural reform.

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solve this conflict, Zhemi Town must establish suitable production relation to realize economic transition and promote development of their backward productivity on the condition of adhering to two-tier management system that integrates unified with separate management on the basis of household contract management. To suit economic transition of Kucong people, Zhemi Town should bring into play its advantages as ethnic town and build grass-roots government service system, to provide policy favor, institutional guarantee, technical service and human resource for its economic transition. To promote economic transition, natural villages where Kucong people are concentrated should establish collective producers' cooperatives to organize Kucong people to conduct collective production and allocation.

Kucong people are "direct change" people, so their social development must be improved from economic transition. Economic development is the precondition and foundation of Kucong people's social development. Thus, it is significant to explore economic transition of Kucong people. It is not only favorable to shaking off poverty and getting rich, but also im-

proving their social development level. Besides, it will provide ideas for promoting healthy development of backward minorities in China. Finally, it is favorable to stability, unity, prosperity and progress of ethnic minorities.

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