Development of County Economy in Hubei Province Based on Factor Analysis

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Abstract   According to the 2008 *Statistics Bulletin of the National Economic and Social Development of Hubei Province*, factor analysis method is used to study on the development of county economy in Hubei Province. Result shows that there are great differences in the economic development and the development is imbalanced. The 76 counties (cities, districts) in Hubei Province are divided into three types of $F > 1$, $0 < F < 1$ and $F < 0$, that is, areas with relatively developed county economy, areas with medium developed county economy and areas with less developed county economy. Finally, countermeasures to accelerate the development of county economy are put forward, such as adhering to the reform of market economy, developing private economy, speeding up the process of industrialization, making efforts to support leading enterprises, promoting the industrialized operation of agriculture, further attracting foreign investment, carrying out industrialization during the development of projects and enterprises, changing soft environment by measures, and promoting the development of county economy by innovation.
Key words   County economy, Factor analysis, Factor score, Hubei Province, China

Accurately evaluating the social and economic development of a county (city) and comprehensively analyzing and comparing the differences among counties (cities) are of great significance to the overall, healthy and sustainable development of county economy. Objective and accurate description of county economy is the premise and foundation for the research on county economy, as well as the policy making of development of county economy. Description of county development usually adopts the multi-factor comprehensive evaluation method[1]. However, there are two problems in the traditional multi-factor comprehensive evaluation method. Firstly, traditional method, such as Delphi method and AHP method, has certain subjective randomness in the design of index weight. Secondly, although multi-index large sample can ensure a large amount of information, it increases the complexity of the evaluation to a certain extent. Factor analysis method in Multivariate Statistical Analysis can effectively overcome the problems in multi-factor comprehensive evaluation method, and carry out scientific and reasonable evaluation on the development level of county economy. With the implementation of the policy of "Central Rise" in China, county economy has developed rapidly in Hubei Province in recent years. According to the statistics, in the year 2008, growth rates of total output value, county-scale industrial growth and county revenue in 76 counties cities and districts (not including the Echeng District, Huarong District, and Liangzihu District) are all higher than those of the average levels of Hubei Province. Factor analysis method is used to analyze the development levels of county economy in Hubei Province in the year 2007, in order to determine the major factors affecting the development level of county economy, to find out the existing problems and to explore a new road for scientific and harmonious development.

1   Index selection, data source and research method

1.1   Index selection   Development level of county economy in Hubei Province should be correctly described, and a suitable index system should be established. Based on the summary of relevant research results, the index system is established by following the comprehensive, integrated, operational and representative principle[2], which includes population X_1, GDP X_2, gross product of primary industry X_3, gross product of secondary industry X_4, fixed assets investment of the whole society X_5, general budgetary revenue of local governments X_6, taxes of various kinds X_7, per capita net income of rural residents X_8, cultivated area in common use X_9, grain yield X_{10}, total industrial output value X_{11}, total tax and profit X_{12}, total retail sales of consumer goods X_{13}, and per capita GDP X_{14}.

1.2   Data source   Data are from the 2008 *Statistics Bulletin of the National Economic and Social Development of Hubei Province*.

1.3   Research method   SPSS software and factor analysis method are used to analyze the development level of county economy in Hubei Province in the year 2007.

1.3.1   Basic principles of factor analysis. Factor analysis is a statistical method mainly researching on the internal structure of correlation matrix of raw data, and transforming multiple indices into a small amount of uncorrelated random variables which can not be observed (factors), so as to extract most of the information of original indices. When the structure of factor loading matrix is not simplified enough, factor rotation can be used to make factor have more distinct practical significance. At the same time, factor score function is used to carry out relevant evaluation and ranking of sample.

1.3.2 Basic steps of factor analysis. Mathematical model of factor analysis is $X = AF + \varepsilon$, where $X = (X_1, X_2, \cdots, X_p)'$ is original index, $F = (F_1, F_2, \cdots, F_m)'$ is the common factor of X, A is the factor loading matrix, and ε is the special factor. This research uses the method of principal component extraction, which can evaluate the importance degree of the ith common factor by variance contribution value β_i. Its procedure of factor analysis is as follows[3]:

(1) Carry out standardization of the raw data, denoted by X.

(2) Establish correlation coefficient matrix R.

(3) Solve the characteristic equation $|R - \lambda E| = 0$, calculate the eigenvalues and eigenvectors. When cumulative contribution rate is more than 85%, the original m indices are replaced by the first k principal components. Factor loading matrix A is calculated.

(4) Conduct the maximum orthogonal rotation transformation of A.

(5) Name and explain the principal factor.

If sorting is needed, scores of principal components are calculated according to $F_i = \alpha_i x$. Taking contribution rate as the weight, score of comprehensive factor is calculated based on the weight of F_i.

2 Result and analysis

2.1 Factor analysis Bartlett and KMO Tests on original data are carried out by statistical software SPSS17. 0[4]. Observed value of Bartlett Test is 1 878. 708, its corresponding probability is 0.000 < 0.050, indicating that there are significant differences between correlation coefficient matrix and unit matrix. And the correlation among variables is significant. At the same time, KMO value is 0.814 > 0.800. According to the measurement standard put forward by Kaiser, it is suitable to use factor analysis.

Standardization of original data can eliminate the effects of different dimensions of indices on analysis result. Establish correlation coefficient matrix R among indices, and calculate the eigenvalues and cumulative contribution rates. Table 1 reports the first three eigenvalues and their cumulative contribution rates.

Table 1 Eigenvalues and contribution rates of correlation coefficient matrix

Serial number	Eigenvalue	Contribution rate //%	Cumulative contribution rate //%
1	9.186	65.613	65.613
2	2.567	18.334	83.947
3	0.794	5.674	89.621

Table 1 shows that the first three eigenvalues and their cumulative contribution rates have reached 89.621%, with the information loss of only 10.35%. The first three eigenvalues are selected to establish factor loading matrix. Since the structure of initial factor loading matrix is not simple enough, the meaning of each factor is not prominent. Therefore, the maximum orthogonal rotation transformation is carried out to obtain a factor loading matrix after rotation (Table 2).

Table 2 Factor loading matrix after rotation

Serial number number of factor	X_1 $\times 10^4$	X_2 $\times 10^8$ yuan	X_3 $\times 10^8$ yuan	X_4 $\times 10^8$ yuan	X_5 Yuan	X_6 $\times 10^4$ yuan	X_7 $\times 10^4$ yuan	X_8 Yuan	X_9 $\times 10^3$ hm^2	X_{10} $\times 10^4$ t	X_{11} Yuan	X_{12} $\times 10^4$ yuan	X_{13} $\times 10^4$ yuan	X_{14} Yuan
1	0.397	0.694	0.394	0.807	0.796	0.882	0.899	0.386	0.095	0.010	0.800	0.816	0.608	0.499
2	0.879	0.601	0.872	0.391	0.435	0.180	0.080	0.343	0.946	0.949	0.286	0.124	0.692	−0.129
3	−0.154	0.344	0.193	0.346	0.212	0.183	0.186	0.785	0.043	0.162	0.391	0.285	0.222	0.822

2.2 Name and explanation of the factors Factor loading matrix after rotation shows that a factor only has large factor loading on several indices. Table 3 classifies the indices into three types and names the factors according to relevant professional knowledge.

The first principal factor has relatively great loads on GDP X_2, gross product of secondary industry X_4, fixed assets investment of the whole society X_5, general budgetary revenue of local governments X_6, taxes of various kinds X_7, total industrial output value X_{11}, and total tax and profit X_{12}. The first principal factor mainly reflects the overall level of economic development and the production scale of industry of counties (cities, districts). It is the main factor evaluating the development level of county economy. Therefore, it can be named as the comprehensive economic strength factor. The second principal factor has relatively great loads on population X_1, gross product of primary industry X_3, cultivated area in common use X_9, grain yield X_{10}, and total retail sales of consumer goods X_{13}. We call it rural development strength factor. The third principal factor

has relatively great loads on per capita net income of rural residents X_8, and per capita GDP X_{14}, reflecting the per capita economic scale and the wealth degree of residents in counties (cities, districts). Therefore, we call it living standard factor of residents.

2.3 Comprehensive score and ranking After orthogonal rotation, score of factor is calculated by regression method. Proportion of variance contribution rates of factors in total variance contribution rate is taken as the weight in order to calculate and rank the comprehensive scores of the three principal factors of counties (cities, districts). Comprehensive score only represents the relative differences of economic development among counties (cities, districts) under the indices constructed. Greater value means stronger comprehensive economic strength, and vice versa. Hence, its equation is

$$F = 0.732\ 1F_1 + 0.204\ 6F_2 + 0.063\ 3F_3$$

Economic strength of 76 counties (cities, districts) in Hubei Province is calculated in the year 2008. Table 3 reports the calculation results of the part of the counties (cities, districts).

Table 3   Comprehensive score and ranking of 76 counties（cities and districts）in Hubei Province in the year 2008

Region	F_1		F_2		F_3		F_4	
	Score	Rank	Score	Rank	Score	Rank	Comprehensive score	Rank
Qianjiang City	3.383 31	1	0.184 16	24	0.089 45	33	2.520 263	1
Daye City	3.041 99	2	−0.577 22	54	−0.250 21	43	2.093 103	2
Jiangxia District	2.572 85	3	−0.509 24	52	1.014 41	13	1.843 605	3
Xiantao City	1.863 76	4	2.019 69	6	0.217 64	29	1.791 464	4
Zengdu District	1.326 68	11	2.663 22	2	−0.171 82	42	1.505 281	5
Huangpo District	1.829 45	5	0.762 62	12	−0.382 9	47	1.471 135	6
Hanchuan City	1.569 18	8	0.718 36	14	−0.088 5	41	1.290 171	7
Tianmen City	1.132 34	12	2.406 58	4	−0.574 99	52	1.284 976	8
Xinzhou District	1.634 72	7	0.363 56	21	−0.083 62	40	1.265 87	9
Xiaonan District	1.651 67	6	−0.368 83	44	−1.201 38	70	1.057 678	10
Yiling District	1.535 34	9	−0.966 12	66	0.940 61	16	0.985 895	11
Yidu City	1.356 92	10	−1.405 17	75	1.801 82	3	0.819 959	12
Caidian District	1.102 78	13	−1.083 96	71	1.561 47	6	0.684 408	13
Enshi City	1.068 64	14	−0.231 92	38	−2.021 19	76	0.606 959	14
Yangxin County	0.556 11	16	0.293	22	−0.858 12	59	0.412 757	15
Zhijiang City	0.472 32	17	−0.226 82	37	1.748 05	4	0.410 03	16
Danjiangkou City	0.840 67	15	−1.099 08	72	−0.447 18	48	0.362 276	17
Zhongxiang City	−0.051 53	26	1.643 25	7	0.832 02	17	0.351 151	18
Guangshui City	0.298 95	20	0.547 49	17	−0.050 71	37	0.327 668	19
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
Zhuxi County	−0.620 76	60	−0.631 00	56	−0.842 05	58	−0.636 86	67
Xianfeng County	−0.600 5	58	−0.662 88	58	−0.998 12	64	−0.638 43	68
Chongyang County	−0.780 76	68	−0.428 17	46	0.018 93	34	−0.658 00	69
Xuanen County	−0.625 4	61	−0.690 62	60	−0.987 29	63	−0.661 65	70
Hefeng County	−0.594 16	57	−1.025 89	70	−0.541 92	50	−0.679 19	71
Nanzhang County	−1.020 56	72	0.182 07	25	0.229 65	28	−0.695 36	72
Wufeng County	−0.723 01	66	−1.004 27	68	−0.312 05	45	−0.754 54	73
Shayang County	−1.449 34	75	1.034 24	10	1.365 56	10	−0.763 02	74
Shennongjia	−0.777 67	67	−1.409 76	76	0.135 16	31	−0.849 21	75
Jiangling County	−1.387 49	74	−0.001 42	31	0.463 39	23	−0.986 74	76

2. 4   Discussion on the analysis result of factor   According to the result of factor loading, counties（cities, districts）in Hubei Province have made great progress in economic development and in improving the living standard of people. Comprehensive economic strength factor has become the primary factor of economic differences among counties（cities, districts）. However, special attention should be paid to the rural infrastructure construction and the improvement of per capita income in order to achieve the all-round development.

As for the comprehensive economic strength factor F_1, there are great differences among the 76 counties（cities, districts）in Hubei Province. The maximum value of Qianjiang City and the minimum value of Jianli County have a difference of 4. 9 points. Moreover, only 22 counties（cities, districts）are above 0, such as Qianjiang City, Daye City, Jiangxia District, Xiantao City, Huangpo District, Xiaonan District, Xinzhou District, Hanchuan City, Yiling District, Yidu City, Zengdu District and Tianmen City. Scores of the rest counties（cities, districts）are all below 0, which coincides with the actual situation of the economic development levels of counties（cities, districts）in Hubei Province. This indicates that most of the counties（cities, districts）are below the average economic development level of Hubei Province. Counties（cities, districts）with relatively sound development have unique geographic advantages. Some belong to the prefecture of provincial capital Wuhan, such as Jiangxia District, Huangpo District and Xinzhou District. Some are directly under the jurisdiction of Hubei Province, such as Xiantao City, Qianjiang City and Tianmen City. They have significant location advantages and take the top place in the development of county economy in Hubei Province.

As for the rural development strength factor F_2, Jianli County takes the first place, with its score of 3. 503 67, which is mainly due to its largest cultivated land area（171. 54 thousand hectares）and greatest grain output（1 060. 3 thousand tons）. Scores of 30 counties（cities, districts）are above 0, such as Jianli County, Zengdu District, Zaoyang City, Tianmen City, Xiangyang District and Xiantao City. This indicates that most counties（cities, districts）in Hubei Province have good basis for agricultural production, having huge potential for agricultural industrialization. However, there is weak interaction between the primary and secondary industries and the industrialization degree is relatively low. Besides, a lot of counties and cities in northwestern Hubei have relatively low scores, indicating that the agricultural development is relatively backward. Therefore, it is necessary to improve their degree of agricultural modernization, and to promote the new countryside construction in these areas. As for the living standard factor of residents F_3, scores of Dongbao District, Dangyang City, Yidu City, Zhijiang City and Caidian District are high, showing that theses areas have relatively high living standard and more disposable consumption expenditures. During the development in the future, the rational and healthy consumption of residents should be paid attention in order to promote the economic development.

According to the score of comprehensive score F, there are only 28 counties（cities, districts）exceeding 0. A total of

63.2% counties (cities, districts) are below the average level of Hubei Province, showing that there are great differences in the economic development and the development is imbalanced. According to the rank of F, the 76 counties (cities, districts) are divided into three types. The first type is $F > 1$, including Qianjiang City, Daye City, Jiangxia District, Xiantao City, Zengdu District, Huangpo District, Hanchuan City, Tianmen City, Xinzhou District, Xiaonan District. They belong to areas with relatively developed county economy; and their comprehensive scores of economic development are far higher than other regions. The second type is $0 < F < 1$, including Yiling District, Yidu District, Caidian District, Enshi City, Yangxin County, Zhijiang City, Danjiangkou City, Zhongxiang City, and Guangshui City. They belong to areas with medium developed county economy. The third type is $F < 0$, including the rest of 48 counties (cities, districts). They belong to areas with less developed county economy.

3 Countermeasures

County economy is not equal to economy at county level. It is a modern regional economy with regional characteristics. Development of county economy should be planned from the aspects of building modern industrial system, promoting the industry and agricultural complementation, and enhancing the coordinated development of regional economy. Affected by the strategic arrangements and policies, county economy in Hubei Province has achieved rapid development with great contribution, dynamic strength, and good economic returns. However, it also has some disadvantages, such as imbalanced development, poor comprehensive quality and inferior economic struc-

ture, which are also the major factors for the backward development of county economy in Hubei Province. Therefore, during accelerating the development of county economy, a good job should be done mainly in the following aspects: adhering to the reform of market economy, developing private economy, speed up the process of industrialization, making efforts to support leading enterprises, promoting the industrialized operation of agriculture, further attracting foreign investment, carrying out industrialization during the development of projects and enterprises, changing soft environment by measures, and promoting the development of county economy by innovation. During the economic development in the future, counties (cities, districts) should adopt development strategies according to their own characteristics and promote the harmonious and healthy development of economy and society.

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3.2 Expanding the developing channel of non-agricultural economy and attracting the rural surplus labors
The non-agricultural income is an important income source. The higher regression coefficient of the gross value of the non-agricultural industry in the model indicates that it has great positive influence on the net income of farmers. So the government should strengthen the support on improving the non-agricultural income of farmers and it can be realized by transferring the rural surplus labors. Firstly, the geographic advantages of adjacent to Beijing and Tianjin and the Bohai Economic Circle should be fully displayed. In addition, the government should develop the production and deep processing of the distinctive agricultural products as well as to encourage developing the agricultural enterprises to absorb more rural surplus labor. Secondly, the government should strengthen the guidance on agricultural enterprises by establishing a perfect rural labor market and training farmers to increase their working skills. Moreover, the export and shift of surplus labor between regions and countries is a good choice to promote the employment rate of the farmers.
3.3 Increasing the local financial expenditure and expanding the developmental space of agricultures The favorable environmental and financial support policy is the ba-

sis for farmers' income increase. The government should increase the financial support, lessen the burden of farmers and provide certain preferential policies. For example, the government should provide financial support and loose loan policy to set up more township enterprises. Secondly, the government should increase the fund input to improve the infrastructure construction and ensure the sustainable development of the primary industry, which will provide a favorable space to improve the income of farmers. For example, more money should be invested to construct the mountain roads so as to transfer the agricultural by products and the internet should be generalized for farmers to know more about the market demand and adjust the production plan. Finally, we should try to apply for the national financial subsidies to increase the total financial expenditure. Chinese government attaches great importance to three agricultural problems concerning agriculture, countryside and peasants. Hebei Province should take this opportunity to positively win over the financial subsidies provided by the nation to develop the rural economy.

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