Assessment of Regional Agricultural Industrial Competitiveness in China

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Abstract We analyze the agricultural industrial competitiveness in China's 30 provinces (municipalities and autonomous regions), to provide a reference for the relevant state departments to develop the agricultural industry policy. Using factor analysis and expert consulting method, we determine the weight of each indicator, and establish the comprehensive evaluation model suitable for the assessment of agricultural industrial competitiveness. Using the comprehensive evaluation model, we assess the agricultural competitiveness of China's 30 provinces (municipalities and autonomous regions). China's 30 provinces (municipalities and autonomous regions) can be divided into three groups (high competitiveness, middle competitiveness and low competitiveness). The results show that although there are subtle changes in the sequencing within high competitiveness group, the members of high competitiveness group are basically unchanged; compared with high competitiveness group, the agricultural industry in middle competitiveness group and low competitiveness group shows the characteristic of significant geographical concentration, and the competitive agricultural industrial belt is outstanding. We put forward the following recommendations: extending agricultural industry chain and increasing agricultural value added; utilizing regional resources and developing characteristic agriculture; taking the road of large - scale management to promote sustainable and healthy agricultural development in China.

Key words Agricultural industrial competitiveness, Indicator system, Evaluation model, Region, China

Agriculture is the foundation of the national economy, and has made great contribution to the development of China's long-term economic stability. However, the resource endowments and geographical features in each region of China are different, and there are great differences in the agricultural development and competitiveness of agriculture in various regions (Wang Xifan, 2004; Li Kai and Zhou Qiang, 2007). Therefore, based on the actual situation of agricultural development in different regions, the agricultural policy should focus on something, so it is necessary to conduct quantitative evaluation and analysis of agricultural competitiveness in each region. Cheng Guoqiang and Chen Liangbiao (1999) used domestic resource cost coefficient to estimate China's major agricultural products, and the results showed that from 1990 to 1997, the domestic wheat, corn and soybean lacked international competitiveness while rice had the advantage. Using factor analysis and statistical software SPSS, Chen Gongjun *et al* (2007) scientifically and rationally selected eight corresponding indicators to conduct quantitative evaluation of agricultural competitiveness of thirteen prefecture-level cities in Jiangsu Province, and eventually extracted three integrated factors and gave the ranking, to provide an objective basis for understanding of the actual level of agricultural competitiveness. From the concept of industry, Ai Li and Du Liping (2010) explored the sources, development and connotation of industrial competitiveness, conducted a comparative analysis of several popular theoretical analysis models, and finally presented new analysis model. Using Porter's competitive theory, Chen Xuao and Cheng Jinhui (2012) analyzed the selenium-rich agriculture in Ankang, and drew the conclusion that the development of selenium-rich agricultural industry clusters and regional brand operating is an effective strategy to enhance the competitiveness of agriculture. From the existing literature, most of the scholars conducted overall analysis of the agricultural industrial competitiveness at the national level based on comparative advantage and competitive advantage, and usually chose a number of agricultural products to compare, lacking scientific and objective evaluation index system. Using factor analysis and expert consulting method, we determine the weight of each indicator, and establish the comprehensive evaluation model suitable for the assessment of agricultural industrial competitiveness. Using the comprehensive evaluation model, we assess the agricultural competitiveness of China's 30 provinces (municipalities and autonomous regions), to provide a reference for the relevant state departments to develop the agricultural industry policy.

1 Establishment of evaluation indicator system

According to principles of scientificity, systematicness, conciseness, feasibility, operability and continuity, we analyze various factors influencing the agricultural industry development, and evaluate the regional agricultural industrial competitiveness from the competitiveness of agricultural production, agricultural market competitiveness, agricultural technology competitiveness, and agricultural capital competitiveness. The indicator design system is shown in Table 1.

2 Establishment of competitiveness evaluation model and data sources

2.1 Establishment of competitiveness evaluation model

2.1.1 Nondimensionalization of indicators. In the process of the selection of indicators, taking into account the characteristics of

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the model and operability, the selected indicators are positive indicators, and there will be differences in the positive indicators due to different dimensions. In order to eliminate the effect of different dimensions on determining the weight of indicators, this research standardizes the selected indicators using the threshold method. The formula used is as follows:

$$U_i = \frac{x_i - u_{\min}}{u_{\max} - u_{\min}} \quad (1)$$

where U_i represents the standardized value of indicator i; x_i is the original value of this indicator; $u_{\min}$ and $u_{\max}$ are the minimum and maximum original value of the same indicator.

Table 1 Evaluation indicator system of regional agricultural industrial competitiveness in China

First level indicator	Weight	Second level indicator	Weight
Agricultural production competitiveness	0.30	Agricultural labor productivity	0.30
		The rate of value added	0.15
		Agricultural value added	0.17
		The total value of agricultural production	0.30
		Fee income rate	0.08
Agricultural market competitiveness	0.20	Rate of sales of agricultural products	0.50
		The rate of export of agricultural products	0.30
		The relative share of the international market	0.20
Agricultural technology competitiveness	0.30	Agricultural technical personnel	0.3
		Input intensity of agricultural technical personnel	0.15
		The intensity of the comprehensive agricultural development	0.30
		Input intensity of comprehensive agricultural development	0.25
Agricultural capital competitiveness	0.20	Investment of agricultural fixed assets	0.4
		Rural productive fixed per capita expenditure	0.30
		Per capita agricultural fixed assets	0.30

2.1.2 Determining of indicator weight. (i) In the initially selected indicator system, we select the indicators that can be as factors; for the indicators suitable for being factors, we use factor analysis method to calculate the product of characteristic root and indicator coefficient to determine the weight of each indicator. (ii) For the indicators whose weight has been determined, we use Delphi method to correct the weight, and assign corresponding weight to the indicators not suitable for factor analysis. (iii) Based on expert advice, we correct the weight and ultimately determine the weight.

2.1.3 Establishment of comprehensive competitiveness evaluation model. According to the analytic hierarchy process, we select the corresponding sub-indicators, and the model established is as follows:

$$y = f(M, NPQ) = \sum (u_1 M + u_2 N + u_3 P + u_4 Q) = \sum (u_1 \sum_{k=1}^{k} K_k X_{Mk} + u_2 \sum_{i=1}^{I} \lambda_1 X_{Ni} + u_3 \sum_{j=1}^{J} \alpha_j X_{Pj} + u_4 \sum_{r=1}^{R} \beta_r X_{Or}) \quad (2)$$

where M is production competitiveness function; X_{Mk} is the independent variable of production competitiveness; K_k is the weight of X_{MK}; N is market competitiveness function; X_{Ni} is the independent variable of market competitiveness; λ_1 is the weight of X_{Ni}; P is the technological competitiveness function; X_{Pj} is the independent variable of technological competitiveness; α_j is the weight of X_{Pj}; Q is capital competitiveness function; X_{Qr} is the independent variable of capital competitiveness; β_i is the weight of X_{Qr}; $u_1 - u_4$ are the weight of four first level indicators, agricultural production competitiveness, agricultural market competitiveness, agricultural technology competitiveness and agricultural capital competitiveness; y is agricultural industrial competitiveness.

2.2 Data sources Data are from *China Statistical Yearbook* (2008 to 2010), and *China Rural Statistical Yearbook* (2008 to 2010). By filtering and calculation, we derive the related indicator data concerning China's 30 provinces (municipalities and autonomous regions) in the period 2008 – 2010.

3 Results and analysis

3.1 Ranking of the first level indicator According to the previous paragraphs, we get all levels of indicator weight, as shown in Table 1. By substituting the related data in the period 2008 – 2010 into the formula (2), we calculate the score of agricultural production competitiveness, market competitiveness, technological competitiveness and capital competitiveness, and sequence the regions according to the scores, as shown in Table 2.

3.2 Ranking of comprehensive competitiveness of China's regional agricultural industry The score of comprehensive competitiveness of China's regional agricultural industry is derived by adding the weighted scores of all first level indicators, and the weight of all first level indicators is given in Table 1. The specific scoring results are shown in Table 3, and the ranking is shown in Table 4.

3.3 Analysis of China's regional agricultural industrial competitiveness In this study, we divide China's 30 provinces (municipalities and autonomous regions) into three groups for analysis. The so-called high competitiveness group consists of top 10 regions in terms of the assessment score of agricultural industrial competitiveness in the year; the middle competitiveness group consists of the regions ranking No. 11 – 20; the low competitiveness group consists of the regions ranking No. 21 – 30. Table 4 shows that in 2008, the high competitiveness group consisted of Shandong, Hebei, Zhejiang, Jiangsu, Guangdong, Henan, Hei-

Table 2 Ranking of regional production competitiveness, market competitiveness, technological competitiveness and capital competitive

Region	Production competitiveness			Market competitiveness			Technological competitiveness			Capital competitiveness		
	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010
Beijing	29	28	29	4	3	4	10	9	12	19	19	19
Tianjin	28	29	28	7	8	7	26	26	26	18	18	18
Hebei	11	12	10	3	4	8	25	25	27	3	3	3
Shanxi	24	22	22	12	10	10	22	24	21	24	22	20
Jilin	20	21	21	18	19	18	4	3	4	8	7	8
Liaoning	26	24	24	13	14	11	6	7	5	7	6	6
Heilongjiang	25	25	25	25	26	23	1	1	1	10	9	15
Shanghai	30	30	30	5	5	3	29	29	29	27	28	28
Jiangsu	16	14	14	8	7	6	16	18	18	4	4	4
Zhejiang	22	27	27	6	6	5	18	19	17	2	2	2
Anhui	10	9	9	16	16	19	28	28	28	16	15	16
Fujian	19	17	16	9	9	9	17	14	15	15	17	15
Jiangxi	7	7	8	26	24	29	14	17	23	17	16	17
Shandong	8	8	7	1	1	1	11	10	14	1	1	1
Henan	1	1	1	14	15	15	24	22	22	5	5	5
Hubei	17	19	20	17	17	16	8	11	10	20	20	21
Hunan	3	2	3	24	25	25	23	23	20	6	8	7
Guangdong	13	10	17	2	2	2	21	20	19	12	11	14
Guangxi	4	5	4	19	18	14	12	12	13	23	24	23
Hainan	18	20	19	30	30	30	5	6	7	30	27	25
Chongqing	9	15	13	15	12	12	30	30	30	29	29	29
Sichuan	6	4	5	11	11	13	9	8	8	14	12	10
Guizhou	5	6	6	10	13	17	27	27	25	26	26	26
Yunnan	12	13	11	21	23	24	7	5	6	21	25	27
Shaanxi	21	18	18	20	20	22	13	13	9	22	21	24
Gansu	15	16	15	22	22	20	19	16	11	28	30	30
Qinghai	2	3	2	28	26	28	20	21	24	25	23	22
Ningxia	27	26	26	23	21	21	15	15	16	13	13	11
Xinjiang	23	23	23	29	27	26	2	2	2	9	10	9
Inner Mongolia	14	11	12	27	28	27	3	4	3	11	14	12

Table 3 Score of regional agricultural industrial competitiveness

Region	2008	2009	2010	Region	2008	2009	2010
Beijing	0.125	0.113	0.107	Hunan	0.389	0.379	0.365
Tianjin	0.139	0.145	0.146	Hubei	0.358	0.382	0.350
Hebei	0.392	0.391	0.379	Guangxi	0.295	0.290	0.324
Shanxi	0.153	0.110	0.146	Guangdong	0.325	0.346	0.353
Inner Mongolia	0.445	0.474	0.451	Hainan	0.288	0.310	0.291
Liaoning	0.372	0.384	0.388	Chongqing	0.195	0.200	0.149
Jilin	0.389	0.410	0.394	Sichuan	0.371	0.377	0.358
Heilongjiang	0.381	0.409	0.366	Guizhou	0.175	0.196	0.188
Shanghai	0.107	0.096	0.103	Yunnan	0.259	0.275	0.276
Jiangsu	0.432	0.397	0.399	Henan	0.461	0.447	0.483
Zhejiang	0.312	0.301	0.269	Shaanxi	0.180	0.183	0.187
Anhui	0.371	0.331	0.340	Gansu	0.174	0.181	0.179
Fujian	0.319	0.310	0.286	Qinghai	0.198	0.198	0.186
Jiangxi	0.309	0.300	0.284	Ningxia	0.181	0.174	0.170
Shandong	0.529	0.530	0.524	Xinjiang	0.341	0.355	0.307

Table 4 Ranking of regional agricultural industrial competitiveness

Region	2008	2009	2010	Region	2008	2009	2010
Beijing	15	16	16	Hunan	13	14	18
Tianjin	18	17	19	Hubei	16	15	13
Shanxi	25	26	26	Guangxi	23	23	22
Inner Mongolia	12	13	12	Guangdong	5	6	5
Liaoning	8	7	8	Hainan	27	25	23
Jilin	9	10	11	Chongqing	29	27	28
Heilongjiang	7	8	7	Sichuan	11	11	9
Shanghai	22	20	20	Guizhou	26	29	29
Jiangxi	4	3	4	Yunnan	19	22	25
Zhejiang	3	4	3	Hebei	2	2	2
Anhui	14	12	14	Shaanxi	24	24	21
Fujian	17	18	17	Gansu	28	28	27
Jiangxi	20	19	15	Qinghai	30	30	30
Shandong	1	1	1	Ningxia	21	21	24
Henan	6	5	6	Xinjiang	10	9	10

longjiang, Liaoning, Jilin, and Xinjiang; in 2009, the high competitiveness group consisted of Shandong, Hebei, Jiangsu, Zhejiang, Henan, Guangdong, Liaoning, Heilongjiang, Xinjiang and Jilin; in 2010, the high competitiveness group consisted of Shandong, Hebei, Zhejiang, Jiangsu, Guangdong, Henan, Heilongjiang, Liaoning, Sichuan and Xinjiang. From the analysis, we see that although there are subtle changes in the sequencing within high competitiveness group, the members of high competitiveness group are basically unchanged; compared with high competitiveness group, the agricultural industry in middle competitiveness group and low competitiveness group shows the characteristic of significant geographical concentration, and the competitive agri-

cultural industrial belt is outstanding. Heilongjiang, Jilin, Liaoning, Inner Mongolia, Hebei, Henan, Shandong, Jiangsu, Hunan, Hubei, Anhui and Guangdong almost occupy the top 10 places over the years, which is in a large measure related to the natural environment and industrial base; Hubei, Hunan and the Jianghuai area are the main producing areas in every dynasty, which have good natural conditions, advanced agricultural technology and reasonable agricultural structure; the fertile black soil of the Northeast also provides superior natural and geographical environment for agricultural production. Beijing, Tianjin and Shanghai are basically in the low competitiveness group for three consecutive years, because these cities' economy is developed, and agricultural production has a small share in the whole regional economy. In addition, agricultural industrial competitiveness of Shanxi was always in the low competitiveness group during the period 2008 – 2010, because Shanxi's industrial policy is to focus on the development of coal mines, and the development of agriculture does not receive sufficient attention.

4 Recommendations for development

4.1 Extending agricultural industry chain and increasing agricultural value added As a whole, agriculture is still the primary industry in China, and the follow-up processing of agricultural products is not enough, resulting in low agricultural value added in agriculture (Wang Jixia *et al*, 2011). To improve the agricultural value-added, it is necessary to form good pattern of regional industry, and establish sound agricultural industrial system. The East, North and South are recommended to form agricultural industry clusters of deep processing, to give full play to the industrial cluster effect. Anhui, Jiangsu and other strong agricultural provinces should give full play to Shanghai's capital advantage and status of international metropolis, to establish processing enterprises of agricultural products with international level in the surrounding towns of Shanghai, making east China's agricultural products more competitive internationally. Similarly, in southern China, we can also give full play to regional advantages of Guangzhou and Shenzhen, to improve the agricultural industrial competitiveness of Hunan, Hainan and other places close to the areas. The northern China can rely on the regional advantages of Beijing, Tianjin and other major cities to accelerate the pace of agricultural reform, extend the industrial chain of agriculture, and increase agricultural value added.

4.2 Utilizing regional resources and developing characteristic agriculture The quality of modern agriculture and agricultural products is the key to determine the market competitiveness, which requires us to make full use of regional comparative advantage, adjust unreasonable agricultural structure, and strive to develop characteristic agriculture. In the industrial layout, only by the implementation of regional and professional layout can the agricultural belt and related industry groups be formed. At the same time, it is necessary to implement large scale operation, expand the scope of the market, and reduce the cost of the flow of products.

4.3 Taking the road of large – scale management to promote sustainable and healthy agricultural development in China The scale determines whether one industry can better resist impact and reduce the unit cost of production, in other words, economic scale can lead to economies of scale, thereby enhancing competition strength (Luo Guangwang and Xi Xiaolin, 2009). Northeast terrain is flat and wide, with natural advantages for large scale agricultural development. Heilongjiang, Inner Mongolia and other regions are blessed with rich natural resources for agricultural development, but the degree of scale development of agriculture in these regions is low, so the government should actively guide and strive to explore the path to scale agricultural development, to accelerate the pace of large scale development of agriculture.

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