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Constructing and Empirical Research on Producer Services Development Evaluation System Based on Principal Component Analysis

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Abstract: In Post-industrial society, the development of service industry become the main power of economic growth and the symbol of modernization of the city. This study aims to build evaluation system of the development level of producer services and assess the development level of producer services in China. The study used the methods of literature and data analysis, constructed evaluation system of the level of development of producer services according to the design principles of the index system. Using Principal Component Analysis and statistics of 31 provinces and municipalities in 2010, the level of development of producer services was evaluated. The results show that Guangdong, Beijing, Jiangsu, Shanghai occupied the development level of productive services in four, in the national production service industry in the leading position; the eastern coastal provinces and a part of central provinces, producer service industry development is rapider; western most provinces in the production of the slow development of the service industry.

Key words: Producer services, development level, evaluation system

INTRODUCTION

American economist H. Greenfield first proposed the concept of productive service in research Services industry and its classification in (1966). Browning and Singelman also proposed the concept of productive service industry when classification service industry in (1975), they thought producer services including finance, insurance, legal, business services, brokerage and knowledge-intensive and provide customers with specialized services industry.

Since, the 1980 s, the western developed countries steps gradually from industrial society to post-industrial society, the industrial structure clearly presents the "industrial economy" to "service economy" trend. The development of service industry become the main power of economic growth and the symbol of modernization of the city.

Producer services means to maintain the continuity of industrial production processes, promoting industrial technological progress, industrial upgrading and improve production efficiency to provide guarantee service in the service industry. It is directly related to manufacturing of supporting services, from manufacturing in-house production services. It is the emerging industry that developed from internal production services from manufacturing department. Itself does not provide direct to consumers and independent service utility. Some scholars defined the concept from the angle of the service function of producer services.

Grubel and Walker (1989) argue that producer services are not directly consumption, also can not directly produce utility. It is a kind of intermediate input rather than the final output it plays an important role of an intermediate connection, used to produce other products or services. At the same time, they further point out that most of these producers use human capital and knowledge capital as the main input. So their output contains a large amount of human capital and knowledge capital services, producer services can promote the specialization of production, expand capital and knowledge intensive production, so as to improve the productivity of labor and other production.

Glasmeier and Howland (1995) found U.S. production service industry employment growth rapidly. Driver and Naisbitt (1987) studied the British service industry such as all kinds of professional employment fluctuations on the impact of the UK Gross National Product (GNP) change. They argue that the public service employment fluctuations cyclical will not impact on gross national product but production services employment fluctuations will be more obvious influence on the gross national product. Juleff-Tranter (1996) pointed out that created the value of 67% comes from Columbia business services, only about 16% comes from manufacturing and resource department.

This study aims to build evaluation system of the development level of producer services and assess the development level of producer services in China.

SCOPE AND CHARACTERISTICS OF PRODUCER SERVICES INDUSTRY

China government divided producer services into transportation information service industry, modern logistics, financial services and business services in National Economy And Social Development 11th Five-year Plan Outline.

Shang *et al.* (2008) defined producer services include transport, warehousing and postal communications services, wholesale and retail services, finance and insurance services, computer services, leasing and business services, geological prospecting and water management services and argue that agriculture, forestry and fishing, catering and service industry have more consumption service, therefore do not belong to the producer services.

Considering the characteristic of connection among producer services, this study used Shang's definition about on producer services. Wei *et al.* (2010) thought that producer services mainly has the following four distinct characteristics: Output of betweenness, service objectness, the industrial constitutive property, formal procedural. Evaluation of producer services, needs to be integrated and combined with certain goals and standards, systematically collect key information in the development of producer services for scientific evaluation.

MATERIALS AND METHODS

This study used literature method, theoretical analysis, data analysis, build the level of producer services development evaluation system.

The construction of producer services development level comprehensive evaluation system must follow a comprehensive, scientific nature and operability, principle of combination of lagging indicators and leading indicators. (1) Comprehensive. When designing the evaluation index of the development level of producer services, should not only consider the macro environment on the influence of the development level of producer services and to consider of producer services agglomeration level, should not only consider the economic scale of producer services and take into account the industrial structure of producer services and development potential. (2) Scientific principles. Scientific of comprehensive evaluation system refers to evaluation indexes should be has high validity and reliability. Validity refers to the measurement tools can really measure to gauge the level of quality, or simply refers to the accuracy, usefulness of a test. Reliability refers

primarily to the reliability, consistency and stability of the test results which are the test results reflect the real were stable and consistent characteristics. (3) Operability principles. Maneuverability principle mainly includes two aspects, one is the availability of data, evaluation system of the indicators used data sources can be gained from authoritative statistics, professional, or through simple processing on the available data; the second is data processing must be scientific and effective. (4) Lagging indicators and leading indicators combined principle. Namely, producer services development level evaluation system design should not only consider the current level of economic development and need both future development potential.

CONSTRUCT THE INDES SYSTEM OF THEORY

Building the level of producer services development comprehensive evaluation system according to the scope of producer services industries and industry characteristics, combining previous research results of the evaluation system of producer services and asked the two regional economic research experts to build the evaluation index which is to ultimately. This system includes four aspects: macro environment, agglomeration level, industrial structure, development potential, these factors are identified as primary index and further refine it as 18 secondary indexes as shown in the Table 1.

PRODUCTION SERVICE INDUSTRY: AN EMPIRICAL STUDY OF EVALUATION SYSTEM OF DEVELOPMENT LEVEL

Computer correlation coefficient matrix's eigenvalues and eigenvectors and calculate the contribution rate: Collecting and sorting needed for processing data from (TNBS, 2011a) "China statistical yearbook 2011", "China's third industry yearbook 2011, (TNBS, 2011b) collected data into SPSS software to carry on the principal component analysis. When using SPSS do factor analysis, SPSS will standardize the original data automatically. This can eliminate the indicators impact on the evaluation results in the difference size, unit et. Three principal components of F1, F2, F3 were chosen based on the principle of eigenvalues greater than 1 its characteristic value and the cumulative contribution rate, such as Table 2. As Table 2 shows, the cumulative variance contribution ratio of the three principal components reached 86.194%, represents the most of the information. It can reflect the level of producer services development significantly.

Table 1: Producer services development level comprehensive evaluation index

Parameters	Level-I indicator	Level- 2 Indicator
Producer services development Level		
Macro environment	GDP per capita	X1
	Urban residents' consumption expenditure	X2
	Per capita investment in fixed assets	X3
Industrial structure	Producer services of investment in fixed assets	X4
	The added value of the tertiary industry proportion of GDP	X5
	The added value of producer services	X6
	The added value of the tertiary industry	X7
Agglomerationlevel	Manufacturing service companies density (No. sq. km ⁻¹)	X8
	The third industry on-the-job No.	X9
	On-the-job No. of producer services	X10
Potential for development	Producer services on the No. of on-the-job No. of the third industry to GDP	X11
	Effective No. of invention patents	X12
	An application for a patent for acceptance	X13
	Regional division research spending	X14
	No. of professional and technical personnel	X15
	Technical market volume	X16
	Regional institutions	X17
	No. of regional colleges and universitie	X18

Table 2: Characteristic value of the principal component, contribution rate and the cumulative contribution rate

Principal components	Eigenvalue	Contribution rate	Cumulative contribution rate	Principal component weights
Factor 1	10.211	56.73	56.730	0.658
Factor 2	4.078	22.655	79.385	0.263
Factor 3	1.226	6.809	86.194	0.078

Calculation of factor loading matrix: According to Table 3 principal component matrix, the principal components of F1 had a higher load in X2 town residents' consumption expenditure, X6, the added value of production services, X7 tertiary industry added value, by 8 producer services of investment in fixed assets, X9 on-the-job No. of tertiary industry, the No. of X10 on producer services, X12 effective No. of patent for invention patents, X13 acceptance, X14 region scientific research spending, X17 regional research institutions quantity, X18 most universities most of which reached more than 0.75.

Principal component F2 in X1 GDP per capita, the density of X4 production service companies, X5 value added of the tertiary industry proportion of GDP, X11 on-the-job No. of producer services on-the-job number accounts for the third industry to GDP, X15, X16 technology market turnover by the No. of professional and technical personnel have relatively high load.

Principal component F3 had a higher load in X3 urban fixed asset investment.

Calculating weight coefficients of each principal component score coefficient and for various purposes:

Principal component divided by the principal component of data in the corresponding load matrix characteristic value to open square root gets two principal component in each index of the coefficient, so get the winner composition expression:

$$F1 = 0.199X1+0.296X2+0.072X3+0.120X5+0.244X18$$

$$F2 = 0.340X1-0.101X2+0.221X3+0.380X5-0.191X18$$

$$F3 = 0.286X1-0.036X2+0.737X3-0.107X5+0.094X18$$

To each main component the corresponding eigenvalue of the total proportion of the sum of the eigenvalues to extract the principal component as the weighting principal component comprehensive model:

$$F \text{ comprehensive} = \frac{(F1*56.73+F2*22.655+F3*6.809)}{86.194}$$

Though this way, weight coefficient of each objective can be gei, as shown in Table 4.

Producer services development level evaluation results and analysis:

Using the institute's building of producer services development level evaluation system, in combination with the data of the various provinces and cities in statistical yearbook 2011, using the principal component analysis determine the development level of producer services in 31 provinces and cities, obtained the national each provinces and cities scores ranking and comprehensive principal component scores as shown in Table 5:

- Guangdong, Beijing, Jiangsu, Shanghai, occupy the top four of the development level of producer services. Especially Guangdong, occupy the position of the productive service industry ranked first, for the first time exceed Beijing, the score hit 5.26. The

Table 3: Principal component matrix.

	Component		
	1	2	3
X1 GDP per capita	0.637	0.687	0.317
X2 Urban residents' consumption expenditure	0.947	-.204	-.040
X3 Per capita investment in fixed assets	0.231	0.447	0.817
X4 Producer services of investment in fixed assets	0.977	0.043	0.131
X5 The added value of the tertiary industry proportion of GDP	0.305	0.769	-.406
X6 The added value of producer services	0.991	-.071	0.005
X7 The added value of the tertiary industry	0.988	-.098	0.009
X8 Manufacturing service companies density (No. sq. km ⁻¹)	0.384	0.714	-.118
X9 The third industry on-the-job No.	0.799	-.506	-.136
X10 On-the-job No. of producer services	0.862	0.238	-.241
X11 Producer services on the No. of on-the-job No. of the third industry to GDP	0.251	0.898	0.049
X12 Effective No. of invention patents	0.753	-.182	-.194
X13 An application for a patent for acceptance	0.882	-.106	0.105
X14 Regional division research spending	0.975	-.020	0.003
X15 No. of professional and technical personnel	0.604	-.656	-.009
X16 Technical market volume	0.482	.689	-.325
X17 Regional institutions	0.867	-.163	0.128
X18 No. of regional colleges and universities	0.782	-.386	0.104

Table 4: The weight coefficient of each index

Indicators	Weight coefficient
X1 GDP per capita	0.243
X2 Urban residents' consumption expenditure	0.165
X3 Per capita investment in fixed assets	0.163
X4 Producer services of investment in fixed assets	0.216
X5 The added value of the tertiary industry proportion of GDP	0.134
X6 The added value of producer services	0.195
X7 The added value of the tertiary industry	0.191
X8 Manufacturing service companies density (No. sq. km ⁻¹)	0.164
X9 The third industry on-the-job No.	0.089
X10 On-the-job No. of producer services	0.192
X11 Producer services on the No. of on-the-job No. of the third industry to GDP	0.172
X12 Effective No. of invention patents	0.118
X13 An application for a patent for acceptance	0.175
X14 Regional division research spending	0.198
X15 No. of professional and technical personnel	0.038
X16 Technical market volume	0.166
X17 Regional institutions	0.166
X18 No. of regional colleges and universities	0.118

Table 5: Comprehensive evaluation score and ranking

Region	Score	Ranking	Region	Score	Ranking	Region	Score	Ranking	Region	Score	Ranking
Guangdong	5.26	1	Henan	0.1	9	Sanxi	-0.51	17	Xinjiang	-1.63	25
Beijing	4.91	2	Hubei	0.09	10	Heilongjiang	-0.63	18	Guizhou	-1.84	26
Jiangsu	4.57	3	Hebei	0.05	11	Jilin	-0.84	19	Ningxia	-1.86	27
Shanghai	3.73	4	Fujian	0	12	Shanxi	-0.91	20	Gansu	-1.95	28
Shangdong	2.94	5	Hunan	-0.12	13	Chongqing	-0.97	21	Hainan	-1.97	29
Zhejiang	2.82	6	Sichuan	-0.16	14	Guangxi	-1.19	22	Qinghai	-2.15	30
Tianjing	1.17	7	Neimenggu	-0.43	15	Jiangxi	-1.24	23	Xizang	-2.31	31
LiaoNing	1.01	8	Anhui	-0.46	16	Yunnan	-1.44	24			

results show of get good grades in the adjustment of industrial structure in Guangdong since the implementation of the industrial structure adjustment and industry transfer in 2008. The productive service industry developing rapidly, has become the domestic leader, the results also show that guangdong is gradually recovering from the industrial structure adjustment of labor and a good momentum of development. Beijing, Shanghai, as a traditional financial center, the political center and comprehensive service center, gathered a large No. of research institutes, has a very high human capital

stock, producer services, development and stability. But they have lost the advantage of industry for the first, the future need to take advantage of the political center, financial center and further we will increase support to the producer services, create agglomeration effect, promote the vigorous development of producer services. In recent years, through the optimization and upgrading of industrial structure of Jiangsu province, the proportion of primary industry gradually declined, the proportion of secondary industry hit 56.6% of the peak of 2005 then began to decline gradually, steadily increase the

proportion of tertiary industry. In this context, producer services of Jiangsu province ranks the fourth it is not surprising. These four areas' high-speed development of producer services conform to the state's overall economic strategy deployment, strengthen the development of producer services in central cities. Strengthen the development of producer services in central cities

- Producer services in eastern development fast. Shandong, Zhejiang, Tianjin, Fujian's economy gradually rise in recent years. This leads to increase the demand of productive service, effectively promoted the germination and development of producer services. Along with the advancement of industrial relocation, foreign investment continues to increase in eastern, central, advanced productive service and knowledge and technology are introduced, also effectively promote the development of producer services. Especially in the manufacturing industry developed regions, the high technical knowledge of advanced manufacturing industry to drive the development of the local producer services
- The central region momentum of development is good Henan, Hubei, Hebei, Hunan, Anhui and other provinces in central have a good development momentum on producer services. In rapid economic development provinces, such as Henan, Hubei, has been ranked top 10 in China. Other provinces such as Hebei, Hunan, Anhui are intermediate level, dominate ranked between 10 to 20. On the level of economic development in central China, there is a distance on human capital stock, compared several municipalities directly under the central government and the eastern coastal cities. But it is worth rejoicing that along with the country strategic adjustment, industrial structure adjustment, the central region of the economy have good development momentum, under this environment, the development of producer services also had a good opportunity
- Western region developed slowly, Ranked in the order in Sichuan, Inner Mongolia, Shaanxi, Heilongjiang, Jilin, Shanxi, Chongqing, Guangxi, Jiangxi, Yunnan, Xinjiang, Guizhou, Qinghai, Ningxia, Gansu, Yunnan, Hainan, Tibet. Western region due to closed geographical environment, the influence of poor infrastructure. Due to closed geographical environment, the impact of poor infrastructure, Western regions producer services exist the problem that enterprise is small, service function is not complete, service level is not high development. These serious impact on the development of producer services. In producer services competitiveness is basic ranked in 15-31. The results show that the

current slow development of producer services of most provinces in China, competitiveness is not high. There China's producer services to the overall increase, also need to increase traction and guidance for the western region. The Chinese government also needs to increase traction and guidance for the western region, if you want to improve the overall level of producer services in China. This also show that under the current economic development model, dependence on the manufacturing development of producer services development

CONCLUSION

Through building the appraisal system of development level of producer services, analyzing on the data of economic development of China's 31 provinces and cities in 2010, comprehensive evaluation result of the development level of various cities and provinces have been gotten. The research results show that Guangdong, Beijing, Jiangsu, Shanghai, occupy the top four of the development level of producer services, dominate at the top of the producer services throughout the country; producer services in eastern coastal provinces and part of the central provinces developed rapidly. Most of the western provinces of producer services develop slowly.

According to the results of study it is recommended that the provinces adjust measures to local conditions the development of producer services industries or characteristics, fully play regional comparative advantage. In addition, there is a stronger interactive effect between the development of producer services and regional industrial economy. Central and local governments can promote the further optimization and upgrading of industrial structure through take certain preferential policies, pulling producer services of industry, upgrading industrial competitive advantage.

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