Research on the Temporal and Spatial Evolution of Interprovincial Services in China

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Abstract: Based on the spatial correlation and Markov test and the panel data of 31 provinces in China from 2010 to 2016, this paper has constructed traditional and spatial Markov transition probability matrices and analyzed the spatio-temporal evolution of the development level of interprovincial service industry in China. The results show that there is a non-equilibrium problem in the development of the inter-provincial service industry in China, accompanied by a certain phenomenon of backward development.

1. Introduction

With the improvement of spatial econometric theory, more and more scholars have introduced spatial factors into empirical analysis. In the study of the analysis of the economic factors of time and space evolution, the main theory is spatial markov chain, which takes into account the interaction of development levels between adjacent regions in geographical locations. However, through the analysis of relevant studies, it is found that the researches on the spatial evolution process of the development level of service industry in China are still blank. Based on the existing results, we use spatial markov chain to research the development of the regional correlation between different provincesc contractly. And summarizes the spatial evolution process of the development level of service industry in China, so as to provide a new angle for the research of China's service industry development level, and to provide theoretical basis for the establishment of related policies.

2. Research Methods

2.1 Traditional Markov Chain Analysis.

The traditional Markov chain analysis method essentially constructs the Markov transition probability matrix, and infers the development status in the future according to the current development status. And in this case, the surrounding environment is not considered.The principle of this method is:The probability distribution of the research object studied in the t year is expressed as a $1\times k$ dimentional state probability vector, denoted as $P_t = [P_{1t}, P_{2t}, ..., P_{kt}]$. Then, the transition probabilities between the research objects in different years can be represented by a Markov transition probability matrix of $k \times k$ .The state transition probability P_{ij} represents the one-step transition probability that the study object in t year belonging to type i is converted into type j in the next year, $P_{ij} = \frac{n_{ij}}{n_i}$ .Where n_i represents the number of objects of type i in t year($n_i = \sum_{j=1}^{k} n_{ij}$), n_{ij} indicates the number of object belonging to type i in t year is converted into type j in the next year. $i, j = 1,2,..., k$, k is the number of different states.

2.2 Spatial Markov Chain Analysis.

The spatial Markov analysis takes into account the influence of the surrounding area on the research object, and describes the problem in terms of space and time.The principle of this method is:From the perspective of conditional probability, that is, under the condition that the state of the surrounding environment of the research object (spatial lag type) in the initial year is certain,decompose the traditional $k \times k$ order Markov state probability matrix into k different k*k order conditional transition probability matrices,where the elements of the k-th condition matrix $P_{ij/k} = \frac{n_{ij/k}}{n_{i/k}}$, $n_{i/k}$ denotes the number of research objects of type i when the type of the surrounding environment is k in t year. $n_{ij/k}$ indicates that within the scope of the entire study, when the type of the surrounding environment is k in t year, the number of object belong to type i in t year and is converted to type j in the $t+1$ year.And $n_{i/k} = \sum_{j=1}^{k} n_{ij/k}$.

The calculation of the surrounding area's state (spatially lagging state) can be represented by the product (WY) of the research object's observation vector (Y) and the spatial weight matrix (W).In addition, we choose adjacency spatial weight matrix to measure the spatially related forms, that is, when two provincesare adjacent $w_{ij} = 1$, otherwise $w_{ij} = 0$.

3. Establishment of Service Industry Development Index System

3.1 Index Selection.

By sorting out relevant studies on the development level of the service industry and reconciling the current development of the service industry in China, we select 12 relevant variables from four dimensions to describe the development level of the service industry in 31 provinces of China. The index system is shown in Table 1 below：

Table 1. Index System of Development Level of Service Industry

	First-level indicators	Second-level indicators
Index System	Development scale	GDP per capita
		Output value of service industry
		Service investment in fixed assets
	Industrial structure	The proportion of investment in services in total investment
		The proportion of employed population in services in total population
		The proportion of service industry in GDP
	Development quality	Domestic and foreign currency deposits
		Integrated Cargo
		Total retail sales of social consumer goods
	Development potential	Urbanization rate
		The growth rate of service industry output
		Industrialization rate

3.2 Data Sources.

Taking into account the accuracy and availability of the data,we choose the sample interval from 2010 to 2016, taking China's 31 provinces(excluding Tibet) as the research object, constructing an index system for the development level of China's service industry, and conducting time and space evolutionary analysis. The data are sourced from the "China Statistical Yearbook"and "China Population Yearbook". Due to the time limit for the release of statistical data, this paper does not use the data in 2017.

3.3 Estibalish Index System by Coefficient of Variation Method.

Before using the coefficient of variation method to calculate the weight of each index, it is necessary to standardize the data. Then, we calculate the comprehensive scores of the development level of the service industry in 31 provinces in China by the coefficient of variation method.

4. Analysis of Spatio-temporal Evolution

Using the traditional and spatial Markov chain analysis methods, we can calculate the traditional Markov and spatial Markov transition probability matrix for the development of the provincial service industry in China during the periods of 2010-2013 and 2013-2016, as is shown in the Table 2 and Table 3.

Table 2. Traditional Markov State Transition Probability Matrix for 2010-2016

t/t+1	n	2010-2013					n	2013-2016				
		1	2	3	4	5		1	2	3	4	5
1	42	0.929	0.024	0.047	0.000	0.000	40	0.975	0.025	0.000	0.000	0.000
2	6	0.000	0.200	0.800	0.000	0.000	10	0.200	0.400	0.200	0.200	0.000
3	16	0.000	0.312	0.437	0.125	0.125	8	0.000	0.125	0.625	0.250	0.000
4	3	0.000	0.000	0.500	0.250	0.250	9	0.000	0.000	0.111	0.667	0.222
5	26	0.000	0.000	0.000	0.077	0.923	26	0.000	0.000	0.000	0.000	1.000

Table 3. Space Markov State Probability Transition Matrix for 2010-2016

Lag	t/t+1	n	2010-2013					n	2013-2016				
			1	2	3	4	5		1	2	3	4	5
1	1	31	0.903	0.032	0.065	0.000	0.000	28	0.964	0.036	0.000	0.000	0.000
	2	2	0.000	0.000	1.000	0.000	0.000	7	0.287	0.571	0.143	0.000	0.000
	3	3	0.000	0.333	0.667	0.000	0.000	1	0.000	0.000	1.000	0.000	0.000
	4	3	0.000	0.000	0.000	0.333	0.667	3	0.000	0.000	0.000	0.667	0.333
	5	9	0.000	0.000	0.000	0.111	0.889	9	0.000	0.000	0.000	0.000	1.000
2	1	1	1.000	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000
	2	2	0.000	0.500	0.500	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000
	3	2	0.000	0.500	0.500	0.000	0.000	3	0.000	0.000	1.000	0.000	0.000
	4	0	0.000	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000
	5	0	0.000	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000
3	1	0	0.000	0.000	0.000	0.000	0.000	2	1.000	0.000	0.000	0.000	0.000
	2	0	0.000	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000
	3	1	0.000	0.000	1.000	0.000	0.000	2	0.000	0.000	0.500	0.500	0.000
	4	0	0.000	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000
	5	0	0.000	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000
4	1	2	1.000	0.000	0.000	0.000	0.000	4	1.000	0.000	0.000	0.000	0.000
	2	0	0.000	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000
	3	2	0.000	0.000	1.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000
	4	0	0.000	0.000	0.000	0.000	0.000	1	0.000	0.000	0.000	1.000	0.000
	5	2	0.000	0.000	0.000	0.000	1.000	0	0.000	0.000	0.000	0.000	0.000
5	1	10	1.000	0.000	0.000	0.000	0.000	6	1.000	0.000	0.000	0.000	0.000
	2	1	0.000	0.000	1.000	0.000	0.000	3	0.000	0.000	0.333	0.667	0.000
	3	8	0.000	0.500	0.166	0.167	0.167	2	0.000	0.500	0.000	0.500	0.000
	4	3	0.000	0.000	0.333	0.667	0.000	5	0.000	0.000	0.200	0.600	0.200
	5	17	0.000	0.000	0.000	0.067	0.933	17	0.000	0.000	0.000	0.000	1.000

4.1 The Analysis of Traditional Markov State Transition Probability Matrix.

In the traditional Markov State Transition Probability Matrix, the elements on the main diagonal represent the probability that the state of the study object does not transfer, and the elements on the non-primary diagonal represent the probability of the study object shifting from one state to another state.As we can see from Table 2, comparing the transition probabilities of the development level of the provincial service industry in China during the two periods of 2010-2013 and 2013-2016, we can find: (1) The level of development of the provincial service industry in China is severely polarized and the current imbalance state is difficult to change.Among the five different states corresponding to the elements on the diagonal line, the most are the low level and high level provinces, and the numbers in the two states from the 2010-2013 period to the 2013-2016 period have not changed substantially. This indicates that with the development of time, regional imbalances in China will not be able to achieve significant improvement in a short time. (2)It is difficult for China's inter-provincial service industry to develop by leaps and bounds. In the two periods, there have been only two leap-forward development. In the remaining cases, the types of inter-provincial service industries can only be transferred to the lower or higher level. For example, Hunan Province,with the middle level, can only shift to the low-medium level or the high-medium level, and it is difficult to quickly leap over to a higher level. (3) The phenomenon of backward development has been well resolved. During the period of 2010-2013, there has been a general and serious retrogressive development phenomenon. Except for low-level, low-medium level areas, there has been a phenomenon that the level of development in the next year is lower than the level of the current year, and by 2013-2016, the occurrence of this phenomenon was significantly reduced both in terms of frequency and probability. This also indicates that the development policy of the service industry in recent years has promoted the balanced development of the region.

From the analysis above, it can be seen that the gap between low-level provinces and high-level provinces is still relatively large, and the gap has been no obvious reduction in the development process in recent years. The provinces at the medium level have ushered in good development trends in recent years, like Anhui, Hunan and Hubei provinces.This also shows that the development level of interprovincial service industry in China has the characteristics of extreme imbalance at both ends and narrowing of the gap in the middle.

4.2 The Analysis of Spatial Markov State Transition Probability Matrix.

Through the spatial Markov State Transition Probability Matrix of the development level of inter-provincial service industry in China, we can intuitively analyze the role of a neighboring province in the development of the service industry in a region.From Table 3, we can see that spatial factors have a significant impact on the level of service industry development. Usually when the areas surrounding a province are in a better state than their own, the probability of the province shifting to a better state will increase, and the probability of shifting to a worse state will decrease. Conversely, when the areas surrounding a province are worse, the probability of a shift to a better state will decrease, while the probability of a shift to a worse state will increase.

In comparison with Table 2 and Table 3, we can find that the provinces in different development states generally follow the above-mentioned laws while also exhibiting their own characteristics. That is, the development status of neighboring regions will have different effects on provinces with different levels of service development. (1) For the low level provinces, because of their large defects in their own infrastructure and talent pool, the surrounding provinces have no obvious effect on their development. For example,in Gansu Province, due to the limitations of its own geographical environment, no matter what state Hunan and Chongqing stay in, it still can not have a state transition. (2) For the provinces in the middle level, the state transition process is more complicated and difficult to predict. In the middle-level provinces, when the development status of the surrounding areas is similar to its status, there will be a certain degree of competition, and therefore changes in certain resources may produce greater differences. For example, in Anhui and Henan provinces, under the premise that the development environment is similar, if these two provinces want to substantially increase their own development level, they must obtain resources from their neighboring regions, thus creating a competitive relationship between the two provinces. (3) For provinces with high levels of status, the probability of a state transition is also very small. Because of its good geographic location and high level of economic development, its own strong competitiveness guarantees its stability compared to its surrounding areas. For example, Beijing, Shanghai, Guangzhou can maintain their states whatever state their surrounding areas are in.

5. Conclusion

In our paper,we construct the service industry development level index system for the current status of 31 provinces in China from 2010 to 2016, and on the basis of relevant tests, the traditional and spatial Markov State Transition Probability Matrix are separately constructed. After that, we analyze the spatio-temporal evolution of the development of interprovincial service industry in

China. Our research indicates:

(1) From the perspective of space, according to the results of the spatial correlation test, there is a significant positive correlation between the development levels of the provincial service industry. That is, the development of the service industry in a certain area will not only affect its surrounding areas but will also be affected by its neighboring regions.

(2) During the period of 2010-2016, there was a serious imbalance in the development of the inter-provincial service industry in China, and this issue has not been effectively resolved in recent years. However, the existing backward developments has been well solved.

(3) In the process of spatio-temporal evolution of interprovincial services in China, although the development status of neighboring regions has different effects on provinces with different levels of service development, it is still not reasonable to ignore the impact of the development of surrounding regions on the region.

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References

[1] Guanghai Zhen ,Suzhen Qin. The Analysis of the Temporal and Spatial Evolution of Interprovincial Tourism Economy in China [J]. Geography and Geographical Information Science, 2014 , 30(02) : 44-48+55.

[2] Geng Wang ,Jiali Wang et al. The Rresearch on the Spatial Evolution of Ecological Security Based on GIS-Markov Region [J]. Geographical Science , 2013 , 33(08) : 957 -964.

[3] Liang Xue, Zhiyuan Ren. Spatial-temporal Evolution of Ecological Security in Guanzhong Based on Spatial Markov Chain[J].Journal of Ecology and Environment , 2011 ,20(01) : 114-118.

[4] Mengyang Hou, Shunbo Yao.Measurement of Urban Eco-efficiency and Its Spatial-temporal Dynamic Evolution in China [J]. China's Population , Resources and environment, 2018 , 28(03) : 13-21.

[5] Li Zhou ,Shulei Xie.An Analysis of Rural Economic Development Based on Spatial Markov Chain--Taking Sichuan Province as an Example [J]. Agricultural Resources and Regional Planning in China , 2016 , 37(12) : 186-191+208.