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Dynamic Spatial Evolution of Market-oriented Supply Level of State-owned Land

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Abstract The purpose of this study is to analyze the characteristics of the spatial distribution and change trend of the marketing level of state-owned land supply so as to provide policy recommendations. Method of spatial autocorrelation analysis is employed. The results indicate that the spatial layout of the land supply marketing level is generally dispersed, but it does assemble in some specific area. The correlation between the marketing level of state-owned land supply and the economic development is not statistically significant. But their relations fluctuate obviously. The overall marketing level of state-owned land supply is increasing and spatially concentrated. The expansion rate of marketing has decreased first and then increased and stabilized now. The high-value cluster center of marketing level of state-owned land supply exists all over the country; however the existence probability of the cluster is bigger in undeveloped areas. It is concluded that spatial autocorrelation analysis is a good method to quantitatively analyze the spatial variation of marketing level of state-owned land supply in China. To grasp the spatial and temporal variations of the marketing level of state-owned land supply is also good to enhance running of the state-owned land market.

Key words Land management, Market-oriented supply, Evolution trend of state-owned land, Spatial autocorrelation indicators

As the specified way for the operating land transfer, the bidding, auction and listing system is of great significance to manifesting the asset characteristics of land, regulating the land market, improving the level of urban land management, and promoting the orderly development of the real estate market. Since the promulgation of Notice on Continuing to Implementing the Law Enforcement and Inspection for Bidding, Auction and Listing of Operating Land Use Rights by the Ministry of Land and Resources in 2004, the bidding, auction and listing system for the transfer of operating land has made progress by leaps and bounds.

Many domestic scholars give a high degree of attention to the bidding, auction and listing system for the transfer of operating land, and the focus is mostly placed on the study of impact of land transfer ways on land and housing prices^[1-3]; they often use the statistics for empirical analysis to explore the impact of bidding, auction and listing policy of operating land use rights on the housing market.

This paper aims to explore the dynamic spatial evolution of the market-oriented supply of Chinese state-owned land, in order to grasp its spatio-temporal variations, and provide policy recommendations for further promoting the bidding, auction and listing work for the operating land use rights. Using the spatial statistical analysis method, this paper calculates the global spatial autocorrelation model, Global Moran's I index, and makes a preliminary study of the market-oriented supply of state-owned land during 2003 – 2008, trying to answer the following questions:

Does the market-oriented supply of state-owned land have

good spatial structure and spatial correlation nationwide? How is the spatial evolution trend of the market-oriented supply of state-owned land? How is the market-oriented supply of state-owned land intrinsically linked to the level of economic development?

To facilitate research, this paper uses the market-oriented supply level of state-owned land to reflect the market-oriented supply of state-owned land and defines it as the ratio of area of state-owned land transferred by the way of bidding, auction and listing to area of state-owned land supplied by the way of selling and allocation.

1 The spatial distribution characteristics of the market-oriented supply of state-owned land: overall judgment

1.1 Definition of research scope and data sources The spatial analysis scale includes mainland China's 31 provinces, autonomous regions and municipalities, and the market-oriented supply level of state-owned land is regarded as the analysis variable to reflect the market-oriented supply of state-owned land.

The data are from Statistical Yearbook of Land and Resources during 2004 – 2009. The relevant economic data are from China Statistical Yearbook in 2009. Due to the lack of relevant data, Hong Kong, Macao and Taiwan are not included in the study.

1.2 Research method: spatial autocorrelation analysis

Spatial autocorrelation is the correlation of the same variable in different spatial locations, and a measure of the degree of clustering of spatial unit property values^[4]. Through the spatial autocorrelation analysis, we can examine whether the observed value of one element has spatial correlation, and identify the changes in the spatial differences^[5].

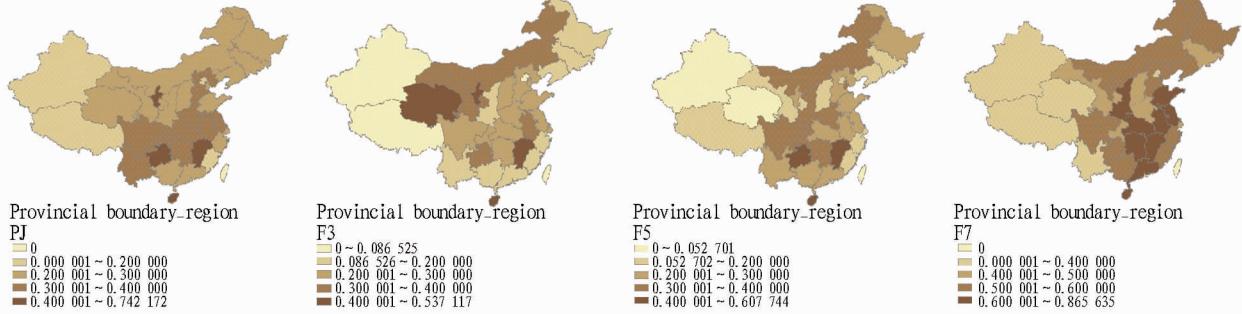
Spatial autocorrelation statistics measure and analyze the degree of dependency among observations in a geographic space.

Classic spatial autocorrelation statistics include Moran's I, Geary's C, Getis's G and the standard deviational ellipse. These statistics require measuring a spatial weights matrix that reflects the intensity of the geographic relationship between observations in a neighborhood, e. g. , the distances between neighbors, the lengths of shared border, or whether they fall into a specified directional class such as "west".

In general, we use Moran's I index to study the degree of spatial autocorrelation of phenomenal space. In order to accurately reflect the spatial distribution of the market-oriented supply of

state-owned land, this paper uses ArcGIS to estimate the Global Moran's I index that can reflect the spatial autocorrelation, and explore the spatial patterns throughout the study area.

1.3 The overall spatial characteristics of the market-oriented supply of state-owned land To judge the overall spatial distribution characteristics of the market-oriented supply of state-owned land in recent years, this paper measures the annual average market-oriented supply level of state-owned land in various mainland China's provinces (autonomous regions and municipalities) during 2003 – 2008 (Fig. 1).



Neto: (a) The distribution of average value of market-oriented supply level of state-owned land during 2003 – 2008; (b) The market-oriented supply of state-owned land in 2004; (c) The market-oriented supply of state-owned land in 2006; (d) The market-oriented supply of state-owned land in 2008.

Fig. 1 The spatial distribution of market-oriented supply level of state-owned land during 2003 – 2008

Fig. 1 (a) shows the distribution of average value of market-oriented supply level of state-owned land in mainland China's provinces (autonomous regions and municipalities) during 2003 – 2008. In recent years, the market-oriented supply of state-owned land shows the following spatial characteristics:

1.3.1 The overall spatial layout of market-oriented supply level of state-owned land is dispersed. As can be seen from Fig. 1 (a), the four provinces (autonomous regions and municipalities) with the maximum mean of market-oriented supply level of state-owned land are Hainan Province, Ningxia Hui Autonomous Region, Guizhou Province and Jiangxi Province, the value is more than 40%, and the spatial distribution is dispersed. This paper estimates the global Moran's I index that reflects the spatial autocorrelation.

The results show that during 2003 – 2008, global Moran's I value of annual average market-oriented supply level of state-owned land was 0.02 in mainland China's provinces (autonomous regions and municipalities), with positive spatial autocorrelation trend, but not significant. Overall, the spatial correlation of market-oriented supply level of state-owned land is very poor in recent years.

1.3.2 The market-oriented supply level of state-owned land shows a clustering trend in the local area. Although overall, the spatial layout of market-oriented supply level of state-owned land shows a dispersed trend, Fig. 1 (a) also indicates that the market-oriented supply level of state-owned land has begun to show a clustering trend.

area consisting of Northeast China, Northwest China and North China; the clustering area consisting of Central China and Southwest China. Among them, the annual average market-oriented supply level of state-owned land for the former is at 20% – 30%, while the annual average market-oriented supply level of state-owned land for the latter is at 30% – 40%, showing a decreasing trend from north to south.

1.3.3 There is no significant correlation between market-oriented supply level of state-owned land and socio-economic development level. From the situation of various provinces (autonomous regions and municipalities), there is no significant positive correlation between market-oriented supply level of state-owned land and socio-economic development level. For the four provinces (autonomous regions and municipalities) with the highest annual average market-oriented supply level of state-owned land, two of them are in the western region, and the other two are in eastern and central regions, respectively.

During 2003 – 2008, the simple correlation coefficient between the annual average market-oriented supply level of state-owned land and the annual average gross regional product in various provinces (autonomous regions and municipalities) was –0.196, but the correlation was not significant.

2 Analysis of spatial evolution characteristics of the market-oriented supply of state-owned land

2.1 The overall scale of market-oriented supply level of state-owned land shows a rising trend

Fig. 2 shows the variation of market-oriented supply level of state-owned land during

The main clustering area involves two parts: the clustering

2003 – 2008. Except the slight decrease in 2006 over the previous year, the overall scale of market-oriented supply level of state-owned land showed a rising trend.

According to statistics, the average annual growth rate of market-oriented supply level of state-owned land at this stage exceeded 25% (Table 1). To more accurately reflect the above changes, we use the relevant data in Fig. 2 to fit the following exponential model:

$$y = 1E - 182e^{0.282x} \quad (1)$$

where y is the market-oriented supply level of state-owned land; x represents the year.

The goodness of fit of the model (R^2) is 0.816, indicating that the exponential growth trend of the market-oriented supply of state-owned land is significant in recent years. From the specific changes of various provinces (autonomous regions and municipalities), the trend of increasingly expanded scale is very clear.

Table 1 shows the annual average increase in the market-ori-

ented supply level of state-owned land in various provinces (autonomous regions and municipalities) during 2003 – 2008. Except the negative value in Yunnan Province, the market-oriented supply level of state-owned land increased in other provinces (autonomous regions and municipalities), and 17 of them experienced the average annual increase of over 20%.

2.2 The spatial expansion trend of market-oriented supply of state-owned land is obvious To reveal the spatial distribution characteristics and changes of market-oriented supply of state-owned land in different years, we choose 2004, 2006 and 2008 to draw the spatial distribution map of market-oriented supply level of state-owned land, respectively, as shown in Fig. (b), (c), (d).

It is easy to find that during 2003 – 2008, the market-oriented supply of state-owned land in mainland China's provinces (autonomous regions and municipalities) was greatly improved, and the local clustering trend was increasingly evident.

Table 1 The annual average increase in the market-oriented supply level of state-owned land during 2003 – 2008

Provinces (autonomous regions and municipalities)	The average annual increase	Provinces (autonomous regions and municipalities)	The average annual increase	Provinces (autonomous regions and municipalities)	The average annual increase
Beijing	57.78	Anhui	28.91	Sichuan	19.32
Tianjin	40.59	Fujian	21.57	Guizhou	9.14
Hebei	9.19	Jiangxi	10.55	Yunnan	-1.87
Shanxi	15.80	Shandong	38.00	Tibet	4.97
Inner Mongolia	10.15	Henan	24.29	Shaanxi	49.53
Liaoning	20.26	Hubei	47.61	Gansu	34.36
Jilin	33.56	Hunan	24.66	Qinghai	16.27
Heilongjiang	34.00	Guangdong	16.39	Ningxia	7.03
Shanghai	19.88	Guangxi	22.30	Xinjiang	41.36
Jiangsu	26.75	Hainan	11.39	The national average	25.74
Zhejiang	34.39	Chongqing	12.85		

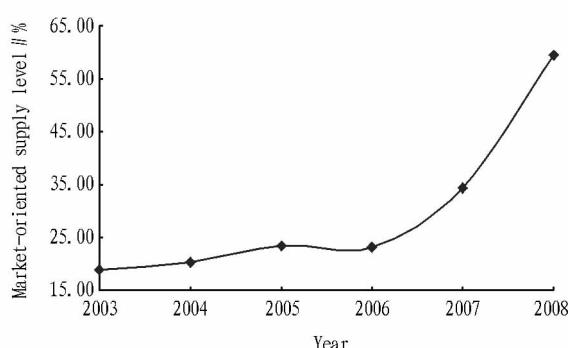


Fig. 2 The trend of changes in the market-oriented supply level of state-owned land during 2003 – 2008

In 2004, there were 8 provinces (autonomous regions and municipalities) with market-oriented supply level of state-owned land more than 30%, and Ningxia had over 50% of market-oriented supply level of state-owned land. In 2006, the market-oriented supply level of state-owned land experienced different degrees of increase in most of the provinces (autonomous regions and municipalities), and the number of provinces (autonomous regions and municipalities) with the level of over 30% increased to 10.

As of 2008, the market-oriented supply level of state-owned

land significantly increased in all provinces (autonomous regions and municipalities), all more than 26%, and 3 of them had the market-oriented supply level of state-owned land more than 80%.

2.3 It shows stage characteristics of spatial clustering The market-oriented supply of state-owned land in the provinces (autonomous regions and municipalities) also shows the stage characteristics of spatial clustering. Using the spatial autocorrelation analysis and ArcGIS software, we estimate the annual global Moran's I coefficient. Using the random assumption, we calculate the corresponding Z values. The specific results are shown in Table 2.

Table 2 Global Moran's I index of market-oriented supply level of state-owned land during 2003 – 2008

Year	Global Moran's I index	Z values
2003	-0.02	0.23
2004	-0.05	-0.16
2005	0.1	1.89
2006	0.07	1.3
2007	-0.02	0.18
2008	0.11	1.81

It can be found that there was significant positive spatial au-

tocorrelation in the market-oriented supply level of state-owned land in 2005 and 2008, showing the spatial clustering pattern. The spatial correlation in the remaining years was poor, similar to the spatial distribution of the average annual market-oriented supply level of state-owned land. Nevertheless, from the trend of change, the spatial correlation of market-oriented supply level of state-

owned land will be enhanced.

2.4 Spatial transfer path of clustering centers and isolated points

The transfer path analysis can better show the dynamic spatial evolution pattern of construction land expansion. Table 3 shows the spatial transfer path of clustering centers and isolated points of the market-oriented supply of state-owned land.

Table 3 The spatial transfer path of clustering centers and isolated points of the market-oriented supply of state-owned land

	2003	2004	2005	2006	2007	2008
High-high (high value clustering center)	Hainan	Gansu	Hainan, Guizhou	Hunan		Jiangxi, Hubei, Guangdong
Low-low (low value clustering center)						
High-low (high value isolated point)	Ningxia	Jiangxi				
Low-high (low value isolated point)				Tibet		Xinjiang, Tibet

(i) High Value clustering center. In 2003, Hainan was the high value clustering center of the market-oriented supply of state-owned land. In 2004, this center was in Gansu. In 2005, it moved to Hainan and Guizhou. In 2006, it transferred to Hunan. In 2007, there was no significant high value clustering center in China. In 2008, this center moved to Jiangxi, Hubei, Guangdong. It indicates that the high value clustering center of the market-oriented supply of state-owned land is not fixed.

(ii) Low value clustering center. The low value clustering center of the market-oriented supply of state-owned land did not appear over the study period.

(iii) High value isolated points. In 2003, the high value isolated point of the market-oriented supply of state-owned land was in Ningxia Hui Autonomous Region. In 2004, it was in Jiangxi, and four years afterwards, there was no significant high value isolated point.

(iv) Low value isolated points. In 2006, the low value isolated point of the market-oriented supply of state-owned land was in Tibet. In 2008, it was in Tibet and Xinjiang, and there was no significant low value isolated point in the remaining years.

3 Analysis of spatial expansion rate of the market-oriented supply of state-owned land

3.1 Establishment of econometric model The spatial expansion of the market-oriented supply of state-owned land can be defined as the fact that the regions with originally low market-oriented supply level of state-owned land constantly improve the market-oriented supply level of state-owned land, and gradually get close to the high market-oriented supply level of state-owned land in some regions.

Clearly, a necessary condition for the formation of this trend of spatial expansion is that the regions with originally low market-oriented supply level of state-owned land improve the market-oriented supply level of state-owned land at a higher rate. Based on the regional economic absolute convergence model, we measure the spatial expansion rate of the market-oriented supply of state-owned land^[6-7]. Specific formula is as follows:

$$\ln \frac{y_{i,t}}{y_{i,t-1}} = \alpha = \beta \ln y_{i,t-1} + \xi_i \quad (i=1, 2, \dots, 31) \quad (2)$$

where $y_{i,t}$ represents the market-oriented supply level of state-owned land of region i in year t ; $y_{i,t-1}$ represents the market-oriented supply level of state-owned land of region i in year $t-1$; β is the spatial spread rate; α is a constant; ξ_i is the error. If $\beta < 0$, there is spatial expansion in the market-oriented supply of state-owned land in year t , and if the absolute value of β is larger, the spatial expansion will be faster.

3.2 Estimation results of spatial expansion rate Using the data on market-oriented supply level of state-owned land in mainland China's provinces (autonomous regions and municipalities) during 2003–2008, we perform the ordinary least squares estimation of the above model, and get the estimation results of spatial expansion rate of the market-oriented supply of state-owned land, as shown in Table 3.

The results show that since 2004, there has been significant spatial expansion in the market-oriented supply of state-owned land. Specifically, the trend of spatial expansion of the market-oriented supply of state-owned land was significant during 2004–2006, but the expansion rate decreased year by year, and the expansion was slowest in 2006. Since 2007, the pace of expansion has begun to accelerate, faster than in previous years.

The reason is that China has long implemented government-led land transfer agreement system and the land market has formed inherent trading habits that are difficult to change in the short term. In addition, the relevant policies have a significant impact on the expansion rate of market-oriented supply level of state-owned land, and these policies play a significant role in curbing real estate development enterprises' hoarding of land using the bank loans.

3.3 Analysis of the trend of spatial expansion rate Through the econometric model, the estimated values of spatial expansion rate of the market-oriented supply of state-owned land from 2004 to 2008 help judge the future spatial expansion trend of the market-oriented supply of state-owned land, and provide a reference for further promoting the market-oriented supply of state-owned land.

Based on the absolute value of β , Fig. 3 shows the changes in the spatial expansion of the market-oriented supply of state-owned land during 2004–2008. As can be seen from the figure, the spatial expansion rate of market-oriented supply of state-owned land

first declined, then climbed and finally became stabilized from 2004. With two years as a period, the moving average trend is drawn, and the changes in this trend show that the spatial expansion rate of the market-oriented supply of state-owned land first shows an obvious decline and then rises steadily.

Based on this, we can judge that in the context of current socio-economic development, promoting the bidding, auction and listing on land supply is of great significance to improving the market-oriented supply level of state-owned land.

Table 4 Estimation results of spatial expansion rate of the market-oriented supply level of state-owned land

Year	β value	Standard deviation
2004	-0.555 023	0.125 852
2005	-0.452 042	0.154 793
2006	-0.241 344	0.178 104
2007	-0.655 818	0.138 888
2008	-0.721 328	0.097 385

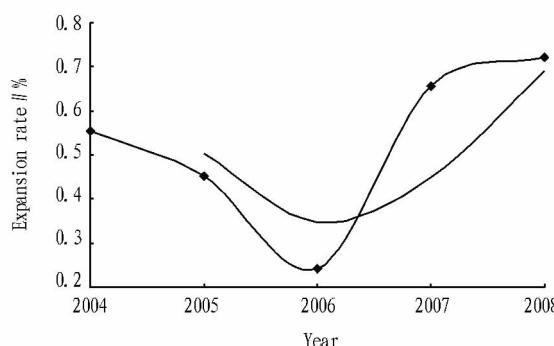


Fig.3 The spatial expansion rate of the market-oriented supply of state-owned land from 2004 to 2008

4 Conclusions and recommendations

4.1 Conclusions This paper analyzes the overall spatial pattern and evolution characteristics of the market-oriented supply of state-owned land during 2003–2008, and builds the econometric model to further demonstrate the spatial evolution trend of the market-oriented supply of state-owned land in recent years, as well as the spatial expansion rate of the market-oriented supply of state-owned land.

(i) The overall spatial layout of market-oriented supply level of state-owned land is dispersed but there is a clustering trend in some areas. The correlation between market-oriented supply level of state-owned land and socio-economic development level is not strong, showing the "up-down-up" trend.

(ii) The overall scale of the market-oriented supply of state-owned land shows a rising trend, and there were significant spatial clustering characteristics in 2005 and 2008. There is also a spatial expansion trend, and the expansion rate first declined, then climbed and finally became stabilized.

(iii) From the spatial transfer path of clustering center and isolated points of expansion of the market-oriented supply of state-owned land, the high value clustering center of the market-oriented

supply of state-owned land is not fixed; the low value clustering center of the market-oriented supply of state-owned land did not appear over the study period; in 2003, the high value isolated point of the market-oriented supply of state-owned land was in Ningxia Hui Autonomous Region, and in 2004, it was in Jiangxi, and four years afterwards, there was no significant high value isolated point; in 2006, the low value isolated point of the market-oriented supply of state-owned land was in Tibet, and in 2008, it was in Tibet and Xinjiang, and there was no significant low value isolated point in the remaining years.

4.2 Recommendations Based on conclusions, we put forth the following recommendations:

(i) Further promoting the bidding, auction and listing work for the supply of land. The overall scale of the market-oriented supply of state-owned land shows a rising trend, but market-oriented supply level of state-owned land in the provinces (autonomous regions and municipalities) is not improved every year. It is necessary to implement and constantly optimize various policies for the market-oriented supply of state-owned land.

(ii) Actively exploring the establishment of regional market-oriented supply management system of state-owned land. There are some common characteristics in the market-oriented supply of state-owned land between the neighboring provinces (autonomous regions and municipalities). With the region as object, there is a need to take differentiated policies to promote the market-oriented supply of state-owned land.

(iii) Focusing on promoting the market-oriented supply of state-owned land in economically underdeveloped areas. The low market-oriented supply level of state-owned land in the less developed areas is a fact that can not be ignored. Nationally, there is still much room for further improvement of market-oriented supply level of state-owned land, so promoting the market-oriented supply of state-owned land in less developed areas becomes the key to market-oriented supply of state-owned land.

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