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Spatial analysis about the competition among the local governments and the land prices: The case study of Zhejiang province

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Abstract

This is the empirical study that focuses on the local government's competition to attract companies through the auction of the land use right. In the existing researches on the competition between local governments tended to focus on the competition of growth rate through the performance evaluation system, or the tax competition for the attracting companies. And in China, where the system of property tax is still underdeveloped and the local government cannot independently set the tax rate. Therefore, in this study, we have focused on the some kind of dumping activity of local governments in the auction of land use rights, to attract industrial companies, and empirically test this hypothesis by the spatial lag model.

Key words: *Chinese economy, government's competition, land market, price discrimination, spatial autocorrelation, spatial lag model*

1. Introduction

This study mainly focuses on the competition between local governments in China to attract industrial companies. The earliest theoretical studies such as Oates (1972), or Zodrow=Mieszkowski (1986) and Wilson (1986), analyzed fiscal competition by the local governments, and focused on interaction due to tax-base mobility, which is known as "tax competition" or "yardstick competition³". They pointed out that each region finance provision of a public good with a tax on the

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³ Tax competition is a competition of tax rate reductions between local governments which is carried out for the purpose of attracting the tax base such as companies and labor force into the region. In contrast, yardstick competition is a competition that occurs primarily due to the propagation of information between regions. It is the typical case that the residents of each region

locally employed capital⁴. When capital can move among regions in response to tax rate differentials, the tax rate for capital in each region tends to be lower than the optimal level.

Inspired by such pioneering study, various types of fiscal competition are analyzed. For example, Hoyt (1993) examines tax rate competition in case of mobile residents and shows that competition results in higher government service levels when the demand for housing is elastic and lower service levels when the demand is inelastic. Wildasin (1988) compares tax rates competition and public expenditure competition as a policy valuable. Wildasin's study shows that supplies of public goods at equilibriums in both cases are at inefficiently low levels. Furthermore, it also shows that the equilibrium in tax competition is greater than it in public expenditure competition. On the other hand, Noiset (1995) and Matsumoto (1998) point out the possibility of overprovision of public goods, because while a higher tax rate drives out capital, the tax base may be expanded if the raised revenue leads the increase of public inputs that attract capital by increasing its productivity. Therefore, from the above theoretical analysis, if we consider leased land as public goods improve the utility of residents, it may be underprovided, while we consider the land as public input to improve the productivity of firms, it may be overprovided.

Brueckner (2003) overviewed previous studies for such competition between local governments. According to him, the theoretical model for such studies can be classified into two types of basic models, "spillover model" and "resource flow model". In "spillover model," local governments are assumed to directly affect the behavior of residents in other region. Yardstick competition can be categorized as a kind of "spillover model," because in yardstick competition, the spillover of information relating to the policy decisions in other regions to the outside directly impact on the voting behavior by residents of other regions. On the other hand, in "resource flow model", policy decision by some local governments is assumed to indirectly affect to the residents in other regions, through the inter-regional movement of policy elements (capital or labor, etc.). Tax competition in which the tax base is moved toward the area with lower tax rate can be considered as one of the "resource-flow model"⁵.

affect the tax rate of their residence, through the vote in regional local election, with the comparison of tax rate of their area to others.

⁴ Zodrow and Mieszkowski (1986) shows that capital tax rates competition to attract firms among homogenous local governments causes undersupply of public goods as the result of Nash equilibrium.

⁵ Such studies for competition between local governments also have incorporated the results of

From the viewpoint of empirical studies, many existing studies adapt spatial lag framework in spatial econometrics to consider the strength of interaction based on distance or contiguity between governments. One of the earliest studies using this method is Case et al. (1993) which estimates interaction function of public expenditure at US state level. Inspired by their study, a great deal of empirical studies examines expenditure interaction among local governments (e.g. Revelli 2003, Solé-Ollé 2006, etc).

While Case et al. (1993) examines expenditure competition, studies focused on tax competition to attract firms also can be found. For example, Brueckner and Saavedra (2001) estimates response function of property-tax rates among local governments in Boston metropolitan area, and its results indicate the presence of strategic interaction. Buetter (2001) also analyzes tax rate competition using the data of local business-tax rate in Germany, and lead to the conclusion that governments are in tax rates competition. And Chen=Hong (2009) also employs the spatial econometric approach to estimate the tax competition among regions in Taiwan.

With respect to fiscal competition in China, existing empirical studies mainly focused on expenditure competition. This is because, while Chinese local governments cannot choose tax rates by themselves in Tax Sharing System (Fenshuizhi) since 1994, they have larger authority of public expenditure. For example, Guo and Bai (2009) examines strategic interaction of public expenditure at Provincial level during 1986-2006, and shows the existence of expenditure competition. Zhang and Chen (2007) also examines expenditure competition among provinces and leads the same conclusion. On the other hand, studies focused on tax rate or revenue competition are rare. As far as we know, Yao and Zhang (2008) is the only example statistically analyzes revenue competition by local governments. Their study takes spatial statistics approach and calculate Anselin's local spatial autocorrelation index, so called LISA (Anselin, 1995). And Fujii (2015) with the reference to Case et al. (1993), has pointed out that there is a government spending expansion competition between local governments. Fujii also pointed out that there is the mechanism of evaluation system in local

spatial economics in recent days. Ottaviano=Yperseleb (2005) theoretically investigate tax competition, using the concept of "integration rent" which is spatial economics. According to them, when there is the tax competition for attracting companies, the externality of integration provided "integration rent" to companies located in regions where the enterprise integration already exists. So the regions with integration have the force to attract companies, compared to areas where integration does not exist. It means former region possibly impose a higher rate of asset tax than later.

bureaucracy, in the background of such a competition. In short, for the evaluation and promotion in the Chinese bureaucracy system, the growth rate of the region is very important criteria.

But these studies were not ones which focused on tax competition among local governments in China. It is mainly because in China, the system of property tax is under constructed, and the local governments cannot be set it independently. It does not mean, however, that there has not been such competition between the governments to attract the companies in China. And we could not find any studies which empirically analyze the competition through land lease by local governments, to the best of our knowledge. In following part of this paper, therefore, we will consider the possibility of the competition among local governments to attract companies through subsidy for investment and land purchase.

2. Structure of Chinese Land Markets

The structure or mechanism of price determination in the Chinese land markets is quite different from those in developed countries. China has been adhering to the public ownership of land since the era of planned economy. So in China, in order to carry out the full-fledged urban development, it was necessary that central government maintenance a series of economic system such as the law system on the land transactions. In 1987, the transaction of state-owned land use rights has been started for the first time in Shenzhen. As a result, local governments had started to sell the land use rights to private developers, and cast the revenue on sale into the urban construction, such as infrastructure. In 1988, the same method of urban development was introduced in Hainan Province.

The method of urban development carried out by the government of Hong Kong during British colonial era had become the model of these policies in mainland. In 1988, the Constitution of People's Republic of China had been modified, and Chinese government officially recognized to transfer or rent the land use rights in accordance with the law. Also by the modification of the land management law in the same year, legal arrangement for such a system has been made. Additionally, the procedure of administrative enforcement was established in 1990, and the period of state-owned land use rights in the city was determined, as the residential areas for 70 years, industrial land is for 50 years, and the commercial land is for 40 years.

These policies are about the institution for the land expropriation in the city. And in rural area,

where the ownership of land belongs to collective, the conversion of agricultural land to non-agricultural land had been under the severe restrictions. As described below, the government must expropriate the agricultural land and make it "state-owned land," before it is transferred to the developers or real estate companies.

It is broadly known that in China, for example, all urban land is owned by the state, and the use rights for land are sold by local governments and are a key source of its revenue.

Since the mid 1990s, local governments tended to intervene in real estate or land markets as the monopolistic suppliers of land-use rights. In this case, the developers and local governments could obtain monopolistic rent through the intervention into the markets of land use rights, and agricultural laborers and urban residents bore the rent in the real estate market.

From the real estate market, the local governments were able to obtain copious extra budget revenue, from the developer or real estate sector. In particular, local governments' revenue from selling land use rights in the markets has been rapidly growing in recent years. This revenue is a kind of monopolistic rent that the governments get by disturbing the market.

In 1998, *Land Management Law* had been modified. This law provided the rule about the non-agricultural use of cultivated lands by the process in which the cultivated lands are expropriated by the center for stockpiling land managed by the local governments, and sold to the agents or developers. This law leads the rent-seeking by the local governments through exclusive expropriation and sale of land use right.

Figure 1

From Figure 1, we can see that this revenue began to grow rapidly since 2002, when the land investment boom started after the China's accession to WTO and that there is a serious distinction between the coastal area and the inland area (central and western areas) in the level of revenue. Most of revenue from the selling land use rights had been reserved by the local governments as the extra budget revenue, until 2007 when such revenue began to be counted as "fund of local governments," which belong to budget revenue.

An important point is that such rent-seeking behavior could be sustained by the special structure of the Chinese real estate market where the local governments exclusively supply the land use rights, in order to maximize the revenue from the land transfer fee.

The Chinese real estate market can be divided into three layers. The first layer is the market in which the local governments dispose of land-use rights, the second layer is the market in which the developers who obtain the land-use rights sell the real estate, such as condominiums or office buildings, and the third layer is the market consisting of transactions among end users.

In the first layer, the local governments have a monopoly power on the supply of the land-use rights, so the amount of the supply is insufficient and the price is more expensive than the market clearing level. After determination of the supply and price of land use rights in the first layer, rental and asset prices of real estate are determined in second and third layer of the market.

In the first layer of the market, a serious distinction exists in the price of land depending on its use. For example, in the case of industrial factory sites, there is serious competition among regions because of the larger elasticity of demand; the governments dispose of land-use rights at a very low price by way of conference⁶.

In contrast, in the case of commercial or residential areas, elasticity of demand is smaller than in industrial zones, and so the elasticity of demand is smaller than in industrial zones, and so the land use rights are sold at the higher price by way of auction. Because of the local governments' monopoly on the supply of land, there is no arbitrage between different uses of land.

This is the typical case of price discrimination between plural markets (Figure2).

Figure 2

Figure 3

⁶ According to the announcement of the Ministry of National Land and Resources, the average price of land is 6,701 yuan per square meter in commercial areas and 5,421 yuan in residential areas, but 757 yuan in industrial zones, in September 2015.

Figure3 shows the trend of the average unit price of land use rights in the major 105 cities. This shows that the unit price of residential and commercial land is much higher than that of industrial land in any of the city. These quite big gaps between the price of commercial and residential land and industrial land might be caused by a kind of price discrimination by the local governments, using the difference of the demand elasticity for different land use.

In China, where the system of property tax is still underdeveloped, it is possible that local governments compete each other to attract industrial companies into their own areas, through devaluation activity in the auction of land use rights for industrial use.

Central government concerned the land market is disturbed by the local governments, and promulgated several official regulations that ordered that land use rights should be expropriated through the auction, since 2001⁷. And local governments started selling off the land use rights through the market auction, and also began opening the information about the transaction of land use rights. We can freely get the basic information on the land auction (the site of the land, price, the winners of the auction etc.), through the internet. We also use these data of the transaction of land use rights for our empirical analysis.

3. Theoretical Background

In this section, we investigate the theoretical model to describe the competition between local governments through devaluation activity in the auction of land use rights. For our empirical study, we assume that the following model which is the modified version of the model used in Brueckner=Saavedra (2001).

Fast of all, we think the closed economy consisting of two regions ($i = 1, 2$). The company in region i produces the goods using labor (P_i) and the capital (K_i) which is endowed in each region. And we define the product function as $F = (K_i, P_i)$.

An investor establish the company at the beginning of the year, and buy the land use right from local government, and make the production. In the end of the year, the investors dissolved the companies, after collecting the profits. And we define capital per capita is k_i , return ratio of the

⁷ Please see 《国务院关于加强国有土地资产管理的通知》(国发[2001]15号), and 《招标投标法》, and 《招标拍卖挂牌出让国有土地使用权规定》(国土资源部令第11号).

investment is ρ , and the entire capital of the economy is \bar{K} . We assume that capital is mobile, so net returns must be equalized across regions, and each local government gives subsidies whose rate equals t_i against the amount of investment including land perches to attract companies, so that

$$f'(k_1) + t_1 = f'(k_2) + t_2 = \rho \quad \text{..... (1)}$$

and

$$P_1 k_1 + P_2 k_2 = \bar{K} \quad \text{..... (2)}$$

Let $U_i(x_i, q_i, z_i)$ denote the social utility function of region i , where x_i is private-good consumption, q_i is housing consumption, and z_i is consumption of a public good. Now we define the per capita land area and the amount of capital at the beginning of the year as $q_i^* \equiv \frac{L_i}{P_i}$ and $k^* \equiv \frac{\bar{K}}{(P_1 + P_2)}$, we get the budget constraint equation for the residents and the government of the region i is as follows,

$$x_i = w_i + (\rho + t_i)k^* - (r_i - t_i)q_i \quad \text{..... (3)}$$

$$z_i = r_i q_i^* - t_i (q_i^* + k_i) \quad \text{..... (4)}$$

where w_i is wage income of residents of region i and $w_i = f(k_i) - k_i f'(k_i)$, r_i is the land price which is determined by the economic condition of the region i . Because of fixed land supply and the absence of housing capital, clearing of the housing market requires land consumption to equal the per capita endowment, so that $q_i = q_i^*$.

Substituting for w_i in (3), and using (4), utility function can then be written as

$$U_i[f(k_i) - k_i f'(k_i) + (\rho + t_i)k^* + (r_i - t_i)q_i^*, q_i^*, r_i q_i^* - t_i(q_i^* + k_i)] \quad \text{..... (5)}$$

under the budget constraint (3) and (4). First of all we differentiated the utility function (5) with respect to t_i and using (1), and get the first order conditions as follows, where the terms on the left are marginal utilities.

$$\frac{U_{iz}}{U_{ix}} = \frac{k_i + k^* - q_i^* + (k_i - k^*) \frac{\partial \rho}{\partial t_i}}{k_i + q_i^* + t \frac{\partial k_i}{\partial t_i}} \dots\dots\dots (6)$$

Suppose that f is quadratic, with $f(k_i) = \beta k_i - \gamma k_i^2 / 2$ where $\beta, \gamma > 0$. In addition, suppose that preferences are linear, with $U_i(x_i, q_i, z_i) = x_i + \tau_i q_i + \eta_i z_i$, where $\tau_i, \eta_i > 0$. Then, (1) and (2) yield $k_1 = k^* + (t_2 - t_1) / 2\gamma$, so that $\partial k_1 / \partial t_1 = k^* + -1 / 2\gamma$. Substituting these results in (6) for $i=1$, the equation can be solved to yield region 1's reaction function. The function is linear and is written

$$t_1 = \frac{4\gamma \{ (2 - \eta_1)k^* + (1 - \eta_1)q^* \} \{ 2k^* + q^* - \eta_1(k^* + q^*) \} + (1 - 2\eta_1)t_2}{1 - 4\eta} \dots (7)$$

Since the second-order condition for the maximization problem requires $1 - 4\eta_1 < 0$ the denominator of (7) is negative. Therefore, reaction function's slope, which equals $(1 - 2\eta_1) / (1 - 4\eta_1)$, negative when $1/4 < \eta_1 < 1/2$ and positive when $\eta_1 > 1/2$. Thus community 1 raises (lowers) its subsidy rate in response to an increase in t_2 when the marginal utility of the public good is large (small). Region 2's reaction function is generated by interchanging the 1 and 2 subscripts in (7), so the subsidy rate for investment are determined by the intersection of two kinds of reaction function as Nash=Bertrand Equilibrium.

Figure 4 shows equilibrium for the case where both reaction functions are upward slope. It can be shown that if the population of the two regions are the same, Nash equilibrium exists in the point where $k_1 = k_2 = k^*$, $r_1 = r_2$. If the population of region 1 is getting relatively larger than region 2, the reaction function of region 1 will shift upward, so as Figure 4 shows, t_1 should relatively increase and k_1 relatively decrease.

Figure 4

If theoretical investigation above shows when there is a devaluation competition about land price

between local governments, the subsidy rate t_i in neighbor areas affect each other, and tend to converge in quite lower level.

Unfortunately, we cannot directly observed the data of t_i . But if the hypothesis described in this section is correct, the land prices $r_i - t_i$, also should have strong geographic correlation between neighbor regions.

Therefore, in the following section, we will try to verify whether there is a geographic correlation of each prefecture, using the price of land usage data of Zhejiang Province. If there are competition among the local government to attract the companies by subsidies for land purchase, the land usage prices should be geographically correlated.

4. Data and Empirical Method

4.1 Data

Based on the theoretical analysis we showed in the former section, we deduce a hypothesis that local governments compete each other to attract firms through the dumping of the land-use rights for the industrial purpose. This dumping by local governments can be thought as subsidies for firms as well. In order to verify this hypothesis, we use county-level socio-economic data of Zhejiang province including land auction price for the industrial purpose in 2010.

We choose Zhejiang province as the sample for this research, because there are following three reasons. First, Zhejiang province is the highly developed region and its scale of public finance is quite large, therefore, local governments may be able to afford to join the inter-governmental fiscal competition. Second, trading of the land-use rights has been carried since the early stages, and most part of farmland has been already fluidized. Third, there are many distinctive industrial agglomerations, especially in the coastal area in the province.

Our dataset consists of the average land-use price for the industrial purpose, population, density of population, GRP, public revenue, labor population ratio, and the existence of national industrial parks of 89 counties in Zhejiang province. In this data set, the average land-use price for the industrial purpose is calculated from the publication of land-use rights auction by Zhejiang provincial department of land resources, and the average price of each auction in a county for the whole year of 2010. GRP and public revenue are per capita data. Labor population ratio is the share

of the population aged between 15 and 59. The existence of national industrial park is treated as dummy variable. These data are obtained from “Zhejiang Statistical Yearbook,” “Zhejiang Yearbook,” “China 2010 County Population Census Data with GIS Maps,” and the website of Zhejiang Provincial Department of Land Resources (<http://www.zjdlr.gov.cn>). The descriptive statistics of our data set is shown as Table 1.

In addition to the socio-economic data, we use spatial information to consider the geographical relationship of county-level governments. This spatial information is quoted from “China Geo Explorer” which is provided by China Data Center, University of Michigan (<http://chinageoexplorer.org/cge/>). We combine this spatial information of population census data and socio-economic data in 2010, and compose so-called GIS data set. Using our GIS data set, we draw the map of the spatial distribution of the average price for the industrial purpose as Figure 5. This map shows that the land use price is quite higher in the coastal area including the CDB of big cities, such as Wenzhou, Hangzhou, Ningbo, and Xiaoxin. On the other hand, the price is quite lower in the inland area such as Lishui and Quzhou.

Furthermore, it seems that there exists the spatial autocorrelation of the price of land-use rights between counties. To examine the spatial autocorrelation, we calculated Moran’s I index. If this index is positive value, the spatial distribution has positive spatial correlation (Moran 1948). The score of Moran’s I index of the price is 0.608 and it is significant at 1 percent level, therefore it can be considered that the price has positive spatial autocorrelation.

4.2 Empirical method

In order to examine the dumping interaction by local governments in our hypothesis, we basically follow models of Case et al. (1993) and Brueckner (2003), and adopt the spatial econometrics method. They apply spatial lag model (SAR) which has spatially lagged dependent variable in the right side of the estimating formula to examine interaction by governments. In other words, the model suppose that the price is influenced by both the characteristics of the region and the price of surrounding regions at the same time. Whereas Case et al. use taxation and Brueckner use public expenditures as the dependent variable, we use the price of land-use rights as the dependent variable to examine our hypothesis. Furthermore, we consider the possibility of interaction effects among the error terms as well. The model which considers the interaction error terms is so called

spatial error model (SEM). To consider both endogenous interaction effects and interaction among the error terms, we combine SAR and SEM models. This combined model is called SAC model (Elhorst 2014).

Thus our estimation model in matrix notation is expressed in eq. (6a) and (6b).

$$\mathbf{Y} = \alpha \mathbf{I} + \delta \mathbf{WY} + \mathbf{X}\boldsymbol{\beta} + \mathbf{u} \quad (6a)$$

$$\mathbf{u} = \lambda \mathbf{Wu} + \boldsymbol{\varepsilon} \quad (6b)$$

In this model, α , $\boldsymbol{\beta}$, δ , and λ are unknown parameters to estimate. If $\delta = 0$ in eq. (6a), this SAC model is equivalent to SEM model, and if $\lambda = 0$ in eq. (6b), this model is equivalent to SAR model. In addition, both $\delta = 0$ and $\lambda = 0$, this model is equivalent to OLS model. For the robustness check, we estimate SAR, SEM, and OLS models also.

\mathbf{Y} denotes the average price of the land-use rights in each county in Zhejiang province. \mathbf{X} denotes the matrix of explanatory variables, and we use population, density of population, GRP, public revenue, labor population ratio, and the dummy of national industrial parks. Dependent and explanatory variables except national park dummy and labor population ratio are in logarithm form. \mathbf{W} denotes weight matrix to consider the geographical location of county-level governments. We apply two types of weight matrix here. One is the k -nearest method. In this method, the element of the matrix w_{ij} is binary value. If j county is one of the k -nearest to i county, w_{ij} is one, and otherwise, w_{ij} is zero. We set the value of k as 4. Another is inversed distance method. In this method, when the distance between i county and j county d_{ij} , the element of matrix become $1/d_{ij}$. These spatial weight matrices are normalized in each row.

In this estimation, the result we are most interested in is the sign of parameter δ and its significance. If δ is significantly positive value, it means the price of land-use rights in influenced by the price of nearby countries, and it implies that there is the bargaining competition among local governments. If δ is significantly negative, it means that if a government select the act of lowering land price, surrounding governments raise the price. If the value δ is not significant, it means there is no interaction between counties. In next section, we show the result of the estimation.

5. Result of Empirical Analysis

Table 2a shows the estimation results of SAC, SAR, SEM, and OLS models in upper part and spatial dependence tests in lower part using 4 nearest type spatial weight matrix. Table 2b shows the

estimation results and spatial dependence tests using inversed distance type spatial weight matrix.

Anselin and Rey (2014) show the procedure of model choice by Lagrange Multiplier and Robust Lagrange Multiplier tests. Following their procedure, the results show that SAC models are appropriate in both matrices. Even so, estimation results are also stable in other models, and coefficients of determination in all models are at sufficient level.

Recall that δ is the parameter we are most interested in. The estimation results of δ are all positive in SAC models and significant at 1 percent level, and in SAR models as well. The results in SAC models means that a government lower (or raise) 0.841 or 0.711 yuan of the price of land-use price rights, if nearby governments falls (or raise) 1 yuan. This response of local governments is consistent with Figure 4.

The estimation results of parameter β are as follows. In the model using 4 nearest type spatial weight matrix, GRP per capita is significantly negative at 1 percent level, population is significantly positive at 1 percent level, and labor population ratio is significantly positive at 5 percent level in SAC model. The results in other models are similar. In the model using inversed distance type spatial weight matrix, GRP per capita is significantly negative at 5 percent level, labor population ratio is significantly positive at 1 percent level in SAC model. Based on the result of SAC and other models, it can be said that the land price for industrial purpose is higher in the high labor population ratio and high populated area. This result is persuadable. On the other hand, the results in some models show that the price become cheaper in high GRP per capita area.

6. Concluding Remarks

From the results of our empirical analysis show that the prices of land for industrial use are strongly influenced by the land price of neighbor region, besides the attribute valuables which determine the land prices of the region. These findings are consistent with the hypothesis that there is competition between the local governments to attract companies through the auction of the land use right. And this suggest, in China, where the system of property tax is still underdeveloped, discounting of land use price is a kind of powerful tool for local governments to attract industrial companies. But these competitions through the dumping of land use price might disturb the price mechanism of real estate market, and induce the short supply of land use right for residential and commercial use and steep rise of those prices. It is necessary that central governments will start

reform for institute about land market, and break down the monopoly system of land supply by the local governments.

Our analysis contains many inadequate matters to modify, and these are the challenges for our next research.

First, in this analysis we do not directly investigate the correlation of subsidy rate t_i because it is difficult to get the data of t_i . But actually, we can estimate the value of t_i , as following steps. First of all, we can estimate the fundamentals of land price at each region land using the hedonic function. Next, we can get the value of subsidy from difference between the fundamentals and real land price. We would like to directly investigate the correlation of subsidy rate t_i which is estimated as above, in our next research.

Second, in the area where the data of land auction cannot be obtained, we perform data compensation by placing a fairly unreasonable assumption. So we should revise the method of data mining.

Third, it is necessary for the analysis that incorporates the geographical factors such as the highway and rail, the access to the port, etc., which would influence the formation of land prices.

Fourth, there is a need to extend the analysis subject to a broader region, for example, the Yangtze River Delta area including Shanghai and Jiangsu province.

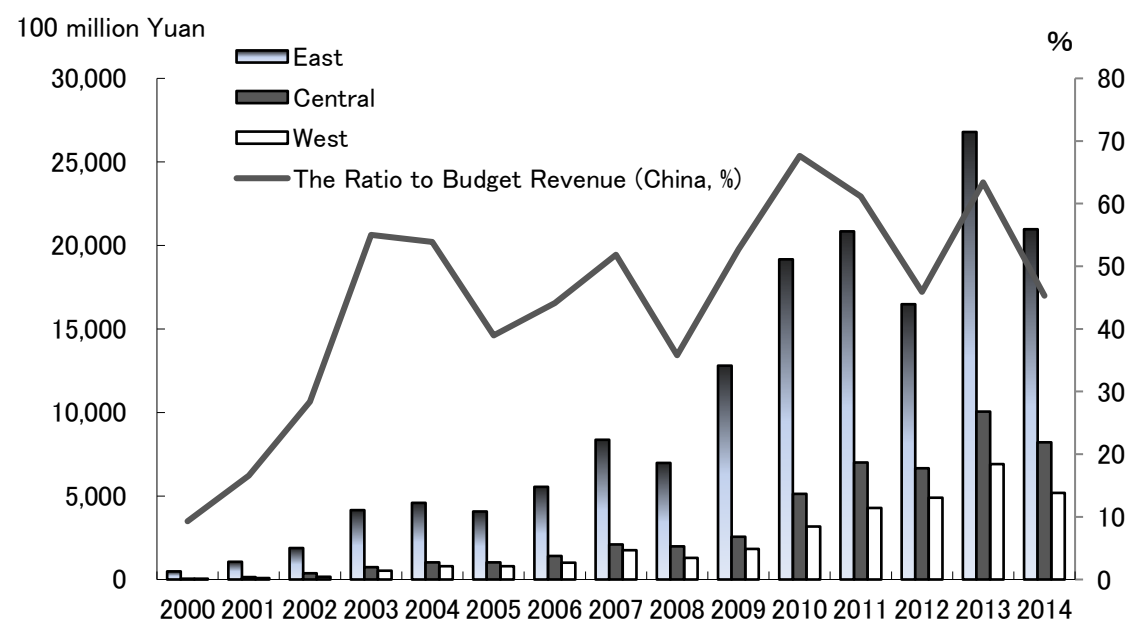
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Figure1. Total Sale of Land Use Rights in China



Source: Almanac of Chinese Land Resource, every year.

Figure2. Rent-seeking by the local governments through land market

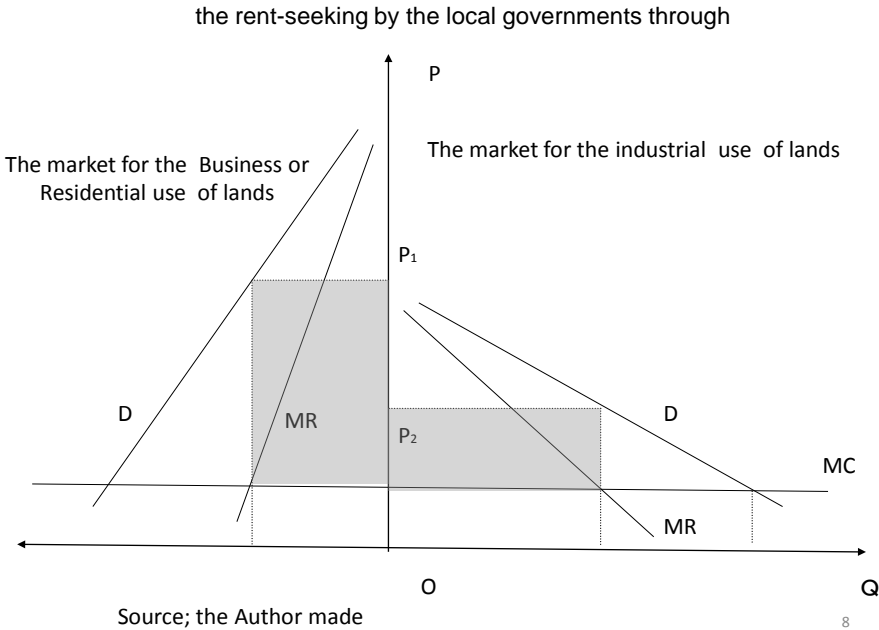
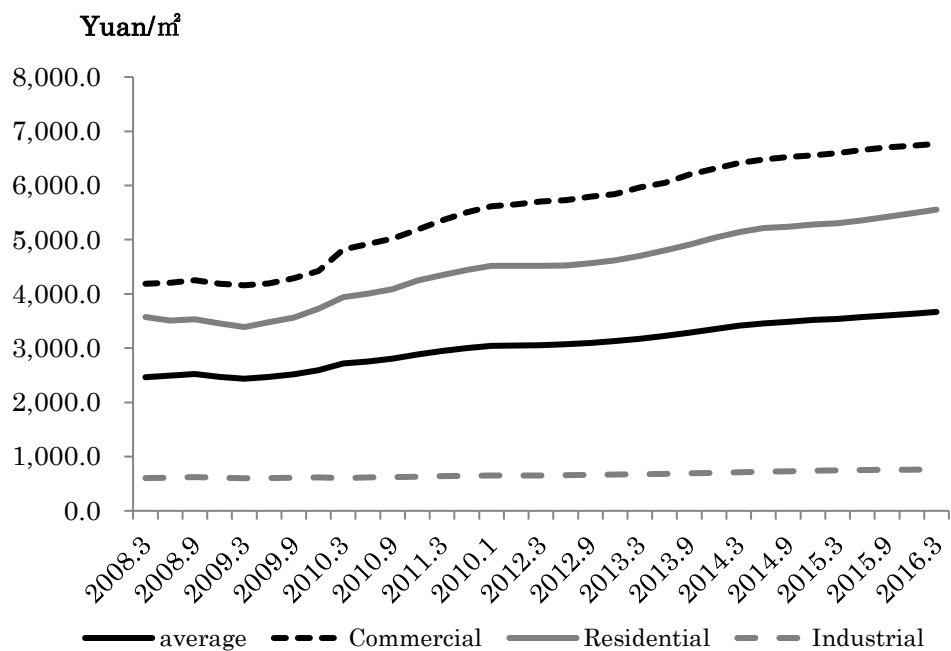


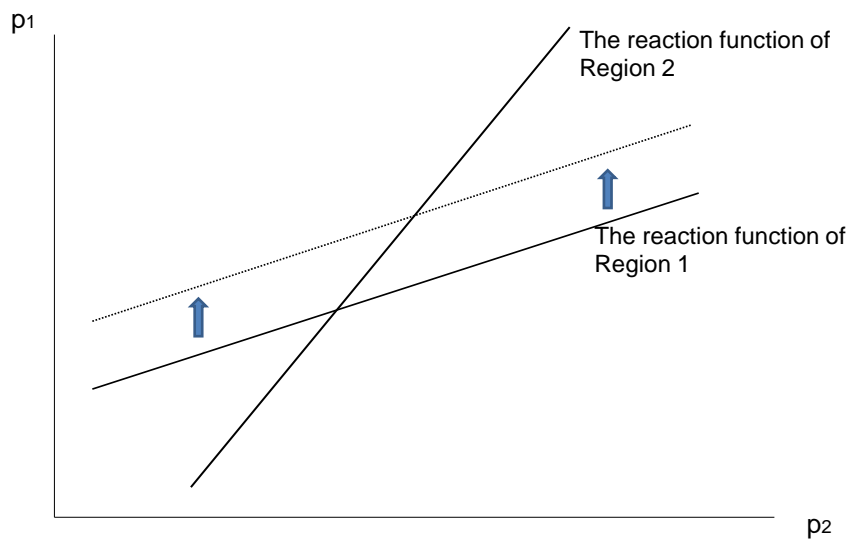
Figure3. Trend of the price of land use rights



Data : CEIC Data (<http://www.ceicdata.com>)

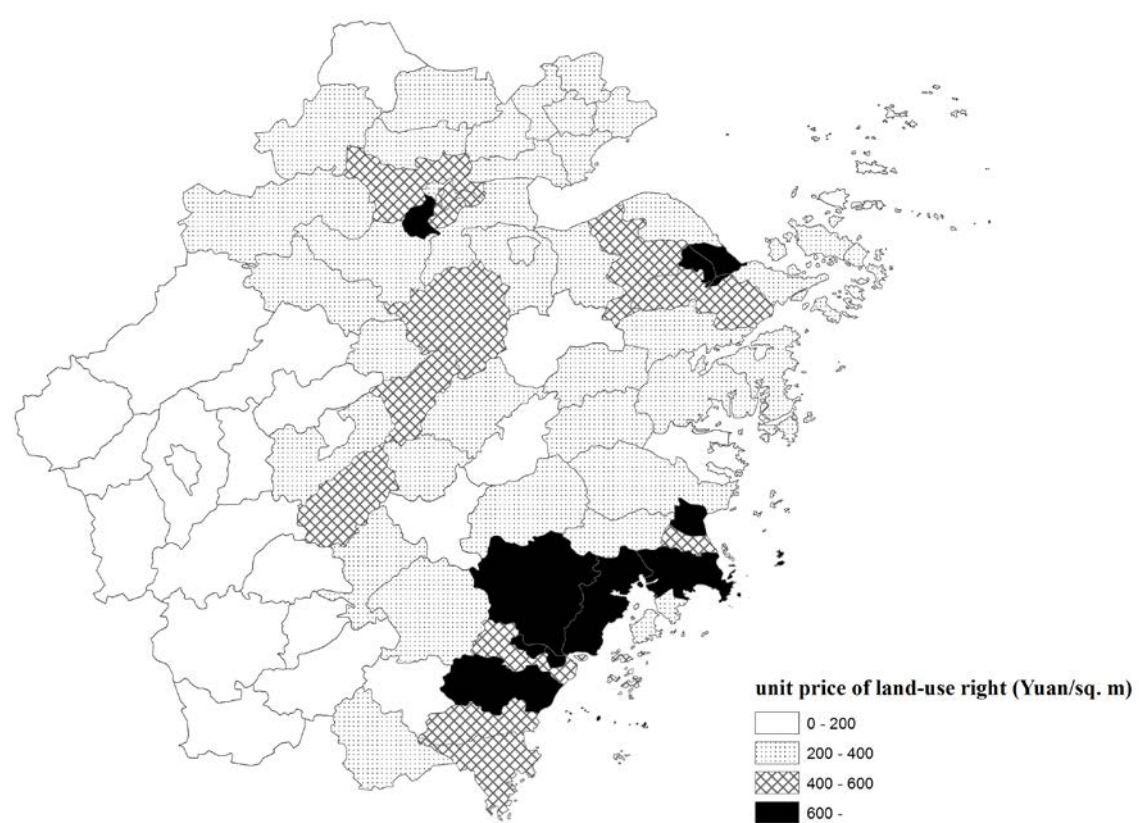
※Each line stands for the average value of land use rights in national major 105 cities.

Figure4. Nash=Bertrand Equilibrium of discount competition



Source: the Author made

Figure 5. Spatial distribution of the average price of the land-use rights for the industrial purpose by county.



Source: Authors' draw

Table 1 Descriptive Statistics of valuables used for empirical analysis

Variable(unit, year)	Obs.	Mean	Stand. Dev.	Min	Max
Average price for the industrial purpose (Yuan/km ² , 2010)	89	353.0	207.5	1239.2	102.1
GRP per capita (Yuan, 2010)	89	45883.9	22857.4	16655.7	152968.4
Public revenue per capita (10000 Yuan, 2010)	89	219979.3	209412.0	0.0	981659.0
Labor population ratio (% , 2010)	89	71.4	5.1	60.0	84.4
Population (persons, 2010)	89	516074.7	285392.0	88362.0	1233348.0
Density of population (persons/km ² , 2010)	89	1271.4	2754.5	78.5	18308.7
National Industrial Park (unit, 2010)	89	0.157	0.364	0.0	1

Source: Authors' calculation.

Table 2 Estimation result

a. K=4

	OLS		SAR		SEM		SAC	
Constant	-0.047	(0.975)	-0.258	(0.846)	0.753	(0.639)	-0.205	(0.816)
GRP per capita	-0.185	(0.193)	-0.207	(0.085)	-0.052	(0.699)	-0.246	(0.004)
Public revenue per capita	0.524	(0.063)	0.452	(0.104)	0.647	(0.023)	0.306	(0.093)
Labor population ratio	0.054	(0.000)	0.031	(0.002)	0.027	(0.001)	0.025	(0.014)
Population	0.238	(0.014)	0.177	(0.003)	0.214	(0.001)	0.121	(0.007)
Density of population	0.106	(0.016)	0.067	(0.141)	0.086	(0.069)	0.032	(0.253)
National industrial park	-0.244	(0.024)	-0.160	(0.110)	-0.054	(0.607)	-0.146	(0.060)
W*land price			0.539	(0.000)			0.842	(0.000)
W*u					0.610	(0.000)	-0.816	(0.000)
Obs.	89		89		89		89	
\bar{R}^2	0.528		0.551		0.5271		0.6060	
Degree of freedom	82		81		82		81	
AIC	86.384		64.111		64.223			
Test for spatial dependence	DF	Value						
LM (lag)	1	34.451	(0.000)					
Robust LM (lag)	1	15.750	(0.000)					
LM (error)	1	18.978	(0.000)					

Robust LM (error)	1	0.277	(0.599)
LM (lag and error)	2	34.728	(0.000)

Provability values are given into parentheses

Source: Authors' calculation

Table 2 Estimation result (continued)

b. Inversed distance

	OLS		SAR		SEM		SAC	
Constant	-0.047	(0.975)	0.046	(0.973)	0.965	(0.553)	0.021	(0.981)
GRP per capita	-0.185	(0.193)	-0.165	(0.184)	-0.036	(0.791)	-0.192	(0.019)
Public revenue per capita	0.524	(0.063)	0.433	(0.130)	0.599	(0.040)	0.323	(0.062)
Labor population ratio	0.054	(0.000)	0.033	(0.001)	0.030	(0.007)	0.030	(0.001)
Population	0.238	(0.014)	0.137	(0.030)	0.168	(0.015)	0.091	(0.086)
Density of population	0.106	(0.016)	0.072	(0.129)	0.105	(0.033)	0.040	(0.169)
National industrial park	-0.244	(0.024)	-0.164	(0.114)	-0.081	(0.441)	-0.150	(0.052)
W*land price			0.476	(0.000)			0.711	(0.000)
W*u					0.562	(0.000)	-0.636	(0.000)
Obs.	89		89		89		89	
\bar{R}^2	0.528		0.6060		0.527		0.626	
Degree of freedom	82		81		82		81	
AIC	86.384		83.971		81.393			
Test for spatial dependence	DF	Value						
LM (lag)	1	27.753	(0.000)					
Robust LM (lag)	1	13.509	(0.000)					
LM (error)	1	15.216	(0.000)					

Robust LM (error)	1	0.972	(0.324)
LM (lag and error)	2	28.726	(0.000)

Provability values are given into parentheses

Source: Authors' calculation