

Strategic interaction in local governments' industrial land supply: Evidence from China

Zhonghua Huang

Zhejiang University of Technology, China

Xuejun Du

Zhejiang University of Science and Technology, China

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Abstract

Land is an important tool for local governments to attract investments and promote local economic growth in China. Based on panel data of Chinese prefecture-level cities from 2003 to 2012, this paper employs spatial panel data models to examine the strategic interaction among local governments in industrial land supply and to identify its possible sources. The empirical results show that there exists strategic interaction among local governments in industrial land leasing price. **Local governments' industrial land leasing price is significantly impacted by the action of neighbouring cities.** They mimic each other – in terms of industrial land leasing price to attract outside investments. Empirical evidence reveals that the strategic interaction comes from both yardstick competition and resource flow effects. **Local governments react more to their neighbours' industrial land leasing price during political cycle periods.**

Keywords

China, industrial land leasing price, local government, spatial panel data model, strategic interaction

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Introduction

Land is an important tool for local government to attract investments and drive economic development in China. On the one hand, as a major production factor dominated by local governments, these governments can use cheap land to compete with each other to attract investors (He and Huang, 2014; Tao et al., 2010). On the other hand, local governments can easily pursue

extra revenues by leasing out land (Kung and Chen, 2014; Yew, 2011; Zhan, 2012). In addition, local governments use land to finance urban infrastructure and

Corresponding author:

Xuejun Du, School of Economics and Management, Zhejiang University of Science and Technology, Hangzhou, 310023, China.

Email: duxuejun@aliyun.com

urbanisation (Cao et al., 2008; Lin and Yi, 2011). Therefore, land is also an important factor for China's growth. Government-led land supply has contributed to industrial development, infrastructure investment and urban expansion in China in the past 30 years (Yew, 2012).

In contrast with Western countries, Chinese local governments use land, instead of tax, as a tool to implement regional competition. As Chinese local governments do not have legislative power to tax, interregional tax competition does not apply in China. Instead, industrial land leasing has gradually become an important alternative to tax for regional competition. Chinese local governments are all subject to the same laws and rules, and have some discretionary power over land. They are able to monopolise urban primary land markets, and thereby have exclusive right to convert rural collective-owned land to state-owned land with low compensation and lease it out to potential commercial users at their discretion. Since the decentralising fiscal reform in 1994, local governments have been incentivised to use land to attract outside investors and compete with others for investments. As a result, local governments' industrial land leasing policies influence each other.

Strategic interaction among local governments has long been an important issue in public economics. There are three main hypotheses to explain the strategic interaction among local governments. First, the spill-over effect hypothesis, developed by Brueckner (2003), proposes that policies implemented in local jurisdictions could have spill-over effects (positive or negative) on neighbouring jurisdictions. Second, the resource flow hypothesis, introduced by Tiebout (1956) and developed by Brueckner (2003), rests on the idea that local governments compete with each other for mobile resources. In contrast to the spillover model, the decision variable of a jurisdiction

is influenced by a particular resource (for example, mobile investment or tax base). Third, the yardstick competition hypothesis, developed by Besley and Case (1995), is based on the idea that voters use information about policies implemented in neighbouring jurisdictions as a yardstick to help assess the relative performance of their politicians. Although the yardstick competition hypothesis was developed in the context of Western countries, it also applies to China. The Chinese central government considers relative performance as a yardstick to help evaluate local government officials' performance and to decide whom to promote, which is similar to the scenario regarding voters in Western countries (Kung and Chen, 2014; Su et al., 2012; Xu, 2011).

The distinction between the three hypotheses mainly lies in the different aims and choices of local governments, and the nature of the interaction. Within the resource flow hypothesis, local governments implement strategic interaction to attract particular mobile resources (for example, in the context of our paper they use cheap land to attract investments). Within the spillover hypothesis, local governments' behaviours are directly influenced by those of their geographically close neighbours because of externalities or free-riding. Regarding the yardstick competition hypothesis, local governments behave strategically toward their voters in order to seek reelection or promotion. The main difference between the spillover hypothesis and the other two hypotheses is that local governments actively seek to free-ride. For our study, as local governments use cheap industrial land for attracting investments and promoting economic growth to overcome the related performance competition, we focus on examining the resource flow effect and yardstick competition hypotheses.¹

These three hypotheses provide rich insights into the strategic interaction

behaviours of local governments. Indeed, in addition to these explanations, Manski (1993) suggested that the strategic interaction of local government may result from 'common intellectual trends', which induce policy implementations in the same direction. However, in many cases, the source of local governments' strategic interaction is not clear. Few empirical studies have investigated the sources of the strategic interaction among local governments.

The aims of this paper are twofold. First, we examine the existence of strategic interaction among local governments in industrial land supply in China. Second, we analyse the possible sources of strategic interaction among local governments in industrial land supply.

Our study sheds new lights on the literature regarding land supply, as well as local governments' behaviour in China. We provide new evidence of the strategic interaction of industrial land supply among local governments in China, while most studies in this specific context have focused on Western democratic countries. Furthermore, we investigate and indentify the sources of strategic interaction among local governments in industrial land supply, which is rare in existing studies.

Background and characteristics of China's industrial land supply

Context and institution of land supply in China

Under China's current two-tier land policy, land is segmented into state-owned land (all urban land and some rural land) and rural collective-owned land (most rural land). In the planned economy, China set up a socialism land supply system, in which industrial land was granted to state-owned enterprises to use free of charge (*Huabo*). The user rights of urban land are allowed to be

transferred until an amendment was made to the constitution in 1988, which has initialised the urban land market (Ho and Lin, 2003; Lin and Ho, 2005; Liu et al., 1998). Local governments have monopolised the urban primary land market, whereby they lease out user rights for 40–70 year terms according to the land use type (industrial and mixed-use land 50 years, residential land 70 years, commercial land 40 years). Urban state-owned land is transferable in the secondary market. However, rural collective land is not allowed to be developed, except by converting it to state-owned land through government-led land expropriation. Local governments can expropriate land from farmers for very low compensation (Ding and Lichtenberg, 2011; Tao et al., 2010; Wang et al., 2012). Then, **local governments convert rural land to urban land and lease it out to commercial users at a high price, which is usually 20 times or more the compensation paid to farmers** (Wang et al., 2012).

The huge price differential between rural collective-owned land and urban land has become a main source of extra revenue (Tao et al., 2010).² It greatly helps local governments to relieve the fiscal gap that has been increasing since the fiscal centralising reform in 1994, and to finance the construction of urban infrastructure. **Local governments tend to expropriate cheap rural land in the city outskirts and occupy expensive urban land through administrative allocation** (Cai, 2011).

Local governments' industrial land supply behaviour

Urban state-owned land can be leased to commercial users through four mechanisms. One is by transferring land through negotiation with potential users (*xieyi*), which is a non-market transaction method. Local governments usually lease out industrial land by

negotiating as this allows them to bargain with potential industrial investors individually, and to control the land price (Lin and Ho, 2005). The other three mechanisms are tender (*zhaobiao*), auction (*paimai*) and listing (*guapai*), which are more transparent and competitive market transactions. The competitive means of land leasing usually raises land price and generates high price premiums.

Financial and promotional incentives have shaped local governments' industrial land leasing behaviour (Kung and Chen, 2014; Lichtenberg and Ding, 2009). Since the 1990s, local governments are incentivised to attract investments and economic growth in their jurisdictions for two reasons. First, fiscal reform in 1994 changed the central–local fiscal relationship and induced local governments to pursue extra revenue for balancing their expanding local spending (Jin et al., 2005; Lin and Yi, 2011; Tao et al., 2010). They quickly discovered the potential related to land. Leasing out land not only provides extra revenues, but also attracts investments and promotes local economic growth. Second, investment and economic growth are key indicators for local officials' performance evaluations, which are judged by higher-level governments to determine promotions (Su et al., 2012). Under the current land leasing system, local governments prefer to lease out more land to industrial sectors for attracting investments and promoting local economic growth (Tian, 2015).

For promoting local industry development and economic growth, local governments must compete hard with each other for attracting investments from domestic and foreign investors. Regional competition for investments forced local governments to trap in a 'race to the bottom' on industrial land leasing prices. They have no choice but to lease out industrial land at a lower price

when facing competition for attracting investments. Although the Ministry of Land and Resources of China published a document on the Implementation of Leasing Industrial Land by Means of Tendering, Auction and Listing (Document no. 78) in April 2007, which was referred as marketisation reform of industrial land leasing. It demanded that local governments lease industrial land through market transaction, but local governments still prefer one-on-one negotiations in industry land leasing.

Local governments deal with two kinds of investors through different strategies: (1) industry enterprises, which are mainly manufacturing enterprises; and (2) commercial and residential investors, including retailers, offices and residential developers. From a fiscal revenue perspective, although commercial and residential business tends to generate large one-time revenue for local governments, industrial enterprises provide much longer-term tax revenue once the factories are built. Moreover, the manufacturing industry has large spillover effects on the service industry, as manufacture workers need a variety of services.

However, manufacturing investments are non location-specific, because they are mobile and can easily set up new factories in other areas. As a result of this mobility, local governments race to offer more attractive industrial land leasing policies. Offering low- or even zero-priced land by the non-market negotiating process is popular among local governments. Since assembling land for development is costly, local governments must raise the price of commercial and residential land in the open competitive market to compensate for the deficit in industrial land leasing.³ Thus, rational local governments can intentionally monopolise local land supply and lease industrial land to manufacturing enterprises at a low price.

Table 1. Land leasing in China for 2003–2012.

Year	Non-market transaction			Market transaction			Price ratio (3)/(6)
	(1) Revenue (10 ⁸ yuan)	(2) Area (ha)	(3) Price (yuan/m ²)	(4) Revenue (10 ⁸ yuan)	(5) Area (ha)	(6) Price (yuan/m ²)	
2003	2349.9	139,433.7	168.5	3071.4	54,170.3	567.0	0.3
2004	2862.9	129,083.1	221.8	3549.3	52,427.3	677.0	0.3
2005	1687.9	108,367.7	155.8	4195.9	57,218.4	733.3	0.2
2006	2282.7	161,871.4	141.0	5794.9	71,146.5	814.5	0.2
2007	2141.9	117,662.8	182.0	10,074.9	117,297.8	858.9	0.2
2008	731.1	26,634.4	274.5	9528.7	139,225.3	684.4	0.4
2009	883.9	33,594.3	263.1	16,295.6	187,219.6	870.4	0.3
2010	1101.1	34,206.9	321.9	26,363.4	259,510.9	1015.9	0.3
2011	1307.8	30,116.8	434.2	30,818.3	304,968.3	1010.5	0.4
2012	1388.9	30,802.8	450.9	26,653.4	301,629.5	883.6	0.5

Note: These data were not available for the years prior to 2003.

Source: China Land and Resources Statistical Yearbook (2004–2013).

Characteristics and facts of industrial land leasing in China

Table 1 reports land leasing revenues, areas and prices by leasing method from 2003 to 2012. In column (3), the price of non-market transactions, which primarily refers to industrial land leasing, is low compared with that of market transactions (commercial and residential land) in column (6). After the marketisation reform of business land (commercial and residential land) in 2004, land leasing by non-market transactions decreased significantly. Column (7) shows that the leasing price of industrial land is half that of commercial and residential land leasing to commercial and residential developers via the open auctions market, which is also confirmed by existing studies (Tao et al., 2010; Yang and Wang, 2008). This indicates that local governments offer cheap industrial land for attracting manufacturing investors.

Stories of local governments offering cheap land to compete for investment have occurred frequently since the 2000s, especially in the east coast areas of China. According to our investigation into Lishui

city, which is a western area of Zhejiang Province, local government offered free land to attract manufacturing investors while it spent huge amounts of money on infrastructure and preparing land for development. The local government also heavily competed for investors. In another example, according to our interviews with local investors, many local governments, such as Hangzhou, Suzhou and Dongguan city, bid down land prices against each other to attract the firm Toshiba, which planned to set up a new factory in China in the early 2000s. Eventually, Hangzhou city offered the lowest price, which was lower than the cost and than other cities' bids, and thereby won the contract.

Spatial pattern of land supply behaviour of local governments

Industrial land leasing prices differs depending on the region. Figure 1 portrays the spatial pattern of the average industrial land leasing price during 2003–2012 in the prefecture cities. In most areas of China, the industrial land leasing price is below 500 yuan/m².

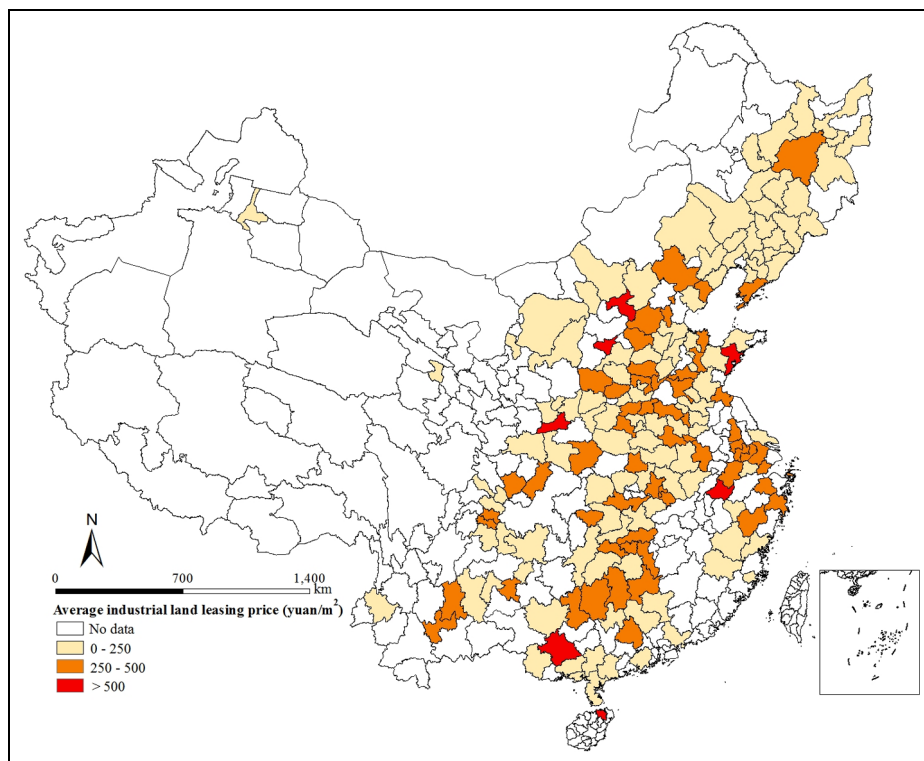


Figure 1. Average industrial land leasing price during 2003–2012.

Source: China Land and Resources Statistical Yearbook (2004–2013).

Figure 1 also shows that the leasing price of industrial land is spatially dependent, especially in the east and middle areas of China, which indicates that there may exist strategic interaction among local governments in industrial land leasing price.

Figure 2 shows the spatial pattern of land price distortion between industry and the service sector. For attracting manufacturing investors, local governments offer lower industrial land price and conduct a race to the bottom. In large areas of China, the leasing price of industrial land is half that of commercial and residential land in open auctions market. This pattern confirms the findings from the existing studies (Tao et al., 2010; Yang and Wang, 2008).

Compared with the service sector, local governments leased too much land to the

industrial sector. Local governments leased out a lot of cheap land to manufacturing firms through negotiating. Figure 3 shows in a large part of east and middle areas, the share of industrial land leasing is much larger than that of commercial and residential land.

Empirical framework and data

If there exists strategic interaction, city i 's industrial land leasing price depends not only on its own factors, but also on the land price chosen by neighbouring cities. City i 's reaction function could be described as:

$$P_i = R(P_{-i}, X_i) \quad (1)$$

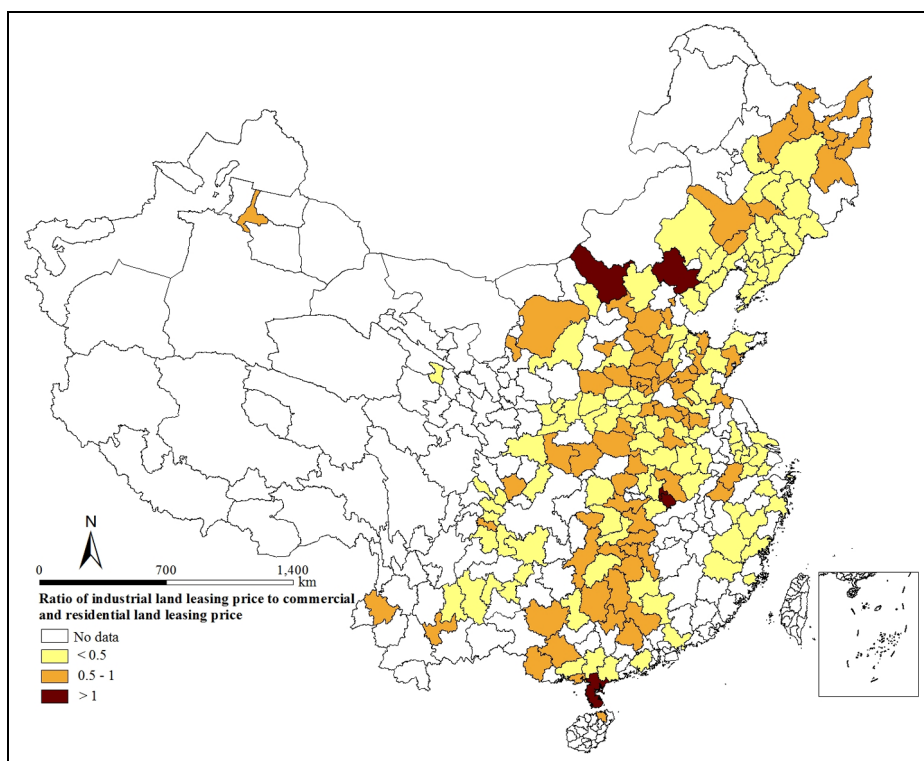


Figure 2. Average ratio of industrial land leasing price to commercial and residential land leasing price during 2003–2012.

Source: China Land and Resources Statistical Yearbook (2004–2013).

where P_i is industrial land leasing price in jurisdiction i ; P_{-i} is neighbouring cities' industrial land leasing price; and X_i is city i 's own characteristics (including economic, demographic and other characteristics). This model generates an industrial land leasing price reaction function similar to the tax competition model, and can be referred to as the land competition model. The sign of correlation in the local industrial land leasing price level depends on whether the neighbouring jurisdictions follow a mimicking or substituting land leasing strategy.

To test the existence of strategy interaction in industrial land leasing price among local governments, we employ spatial

econometrics models. The basic estimating equation can be expressed as follows:

$$P_{it} = \rho \sum_{j \neq i} w_{ij} P_{jt} + X_{it} \beta + \mu_i + \varepsilon_{it} \quad (2)$$

where P_{it} is the industrial land leasing price of city i in year t . w_{ij} , spatial weight, is specified to capture the interaction between city i and j . ρ is the slope of the reaction function, which is the main interest of our empirical work. X_{it} is a set of control variables, including the characteristic variables of the cities. μ_i is the spatial fixed effect controlling for unobserved heterogeneity across cities. We use a time trend instead of time dummies for

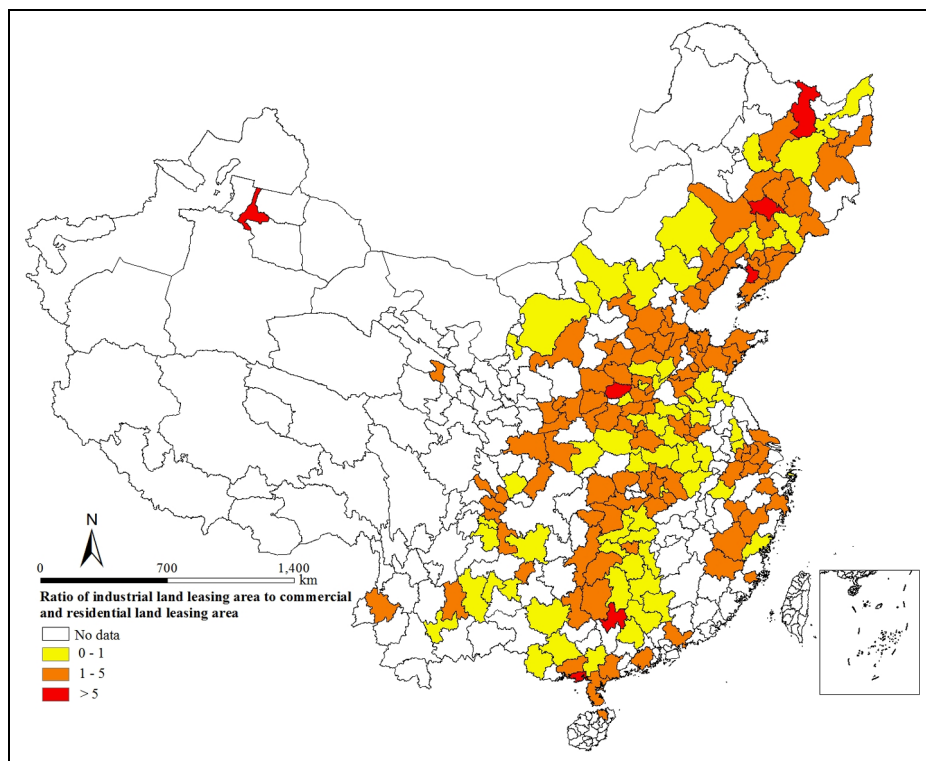


Figure 3. Average ratio of industrial land leasing area to commercial and residential land leasing area during 2003–2012.

Source: China Land and Resources Statistical Yearbook (2004–2013).

spatial interaction effects cannot be separated from the time fixed effects (Devereux et al., 2008; Elhorst, 2010).

There are two main econometric issues in estimating equation (2). First, the spatially lagged dependent variable is endogenous as local governments' and their neighbours' industrial land leasing price decisions are interacted. As ordinary least squares estimation method is inconsistent in this case, maximum likelihood or the IV method is commonly used for the estimation (Brueckner, 2003). Second, when the dependent variable is persistent, a dynamic spatial panel data model using the GMM method should be introduced as the previous estimators are inconsistent (Costa et al., 2015;

Radoano, 2007). We use the maximum likelihood estimation method for basic estimation results, and the GMM method for the dynamic spatial panel data model and IV method in the robust analysis section.

Specification of the weight matrix

The choice and criterion of adequate spatial weight matrices has not reached a consensus (Costa et al., 2015). The specification of a spatial weight matrix implicitly imposes a certain spatial pattern of interaction. Following the literature (Caldeira, 2012; Costa et al., 2015), we consider different spatial weight schemes according to the geographic proximity, economic proximity and

Table 2. Definition and descriptive statistics of major variables in Chinese prefecture cities for 2003–2012.

Variables	Definition	Obs.	Mean	Std. dev.
<i>P</i>	Industrial land leasing price (yuan/m ²)	1800	199.75	180.88
<i>PINV</i>	Per capita fixed asset investment (10 ⁴ yuan)	1800	11,451.88	11,045.51
<i>PFDI</i>	Per capita FDI (yuan/person)	1800	540.08	1017.83
<i>PLR</i>	Per capita land revenue (yuan/person)	1800	836.25	1371.35
<i>FP</i>	Ratio of budgetary expenditure to revenue (%)	1800	2.52	1.29
<i>PGDP</i>	Per capita GDP (10 ⁴ yuan)	1800	20,079.01	17,511.78
<i>INDRAT</i>	Share of second industry production in GDP (%)	1800	48.69	10.75
<i>POPDEN</i>	Population density (inhabitants per sq. km)	1800	426.27	260.77

a hybrid of geographic and economic proximity, which may affect interaction. The geographic proximity weight, which is most common in the empirical literature, is based on the Euclidean distance between cities (weight is given by $w_{ij}^G = 1/d_{ij}$ for $j \neq i$, where d_{ij} is the Euclidean distance between centres of cities i and j). The economic proximity weight is based on the inverse of distance between per capita GDP of cities i and j (weight is given by $w_{ij}^E = 1/abs(PGDP_i - PGDP_j)$, for $j \neq i$). Finally, the hybrid of the geographic and economic proximity weight, is given as $w_{ij}^{GE} = w_{ij}^G \times w_{ij}^E$. All the weight matrices are row-normalised.

Data source and variable description

We use Chinese panel data from 2003 to 2012 for prefecture-level cities. Except for the land data sourcing from the *China Land and Resource Yearbook*, all other data are sourced from the *China City Statistical Yearbook*. Table 2 presents the definitions and summary statistics of the main variables.

As each city decides to lease out industrial land at a certain price according to the decisions of neighbouring governments' industrial land leasing behaviours and its own city characteristics (Brueckner, 2003; Revelli, 2006), we used city characteristics as control variables. Drawing on the existing literature (Caldeira, 2012; Ye and Wu, 2014;), we

selected several cities' economic and fiscal factors. These are per capita fixed investments (*PINV*), per capita foreign direct investments (*PFDI*), per capita land revenue (*PLR*), fiscal pressure (ratio of budgetary expenditure to revenue, *FP*), per capita GDP (*PGDP*), industrial structure (ratio of second industry production to GDP (*INDRAT*) and population density (*POPDEN*) as control variables. All the nominal variables are deflated using 2003 as the base year. More details of the definition and descriptive analysis of the main variables are presented in Table 2.

All variables, except for the fiscal pressure ratio and industrial structure, are subject to natural-log form transformation before the estimation.

Empirical results

Basic spatial regression results

Table 3 reports the basic estimation results. The most important results are the estimation of the spatially lagged dependent variable (*WLogP*), and the spatial interaction or reaction function slope parameter. Interestingly, the spatial interaction parameters are positive and statistically significant under three different spatial weight matrices. These results suggest that there exists strategic interaction among Chinese local governments in relation to industrial

Table 3. Basic estimation results for different weight matrices.

Variables	(1)	(2)	(3)
	W^G	W^E	W^{GE}
<i>WLogP</i>	0.51*** (0.07)	0.10*** (0.03)	0.11*** (0.03)
<i>LogPINV</i>	-0.10 (0.08)	-0.14* (0.08)	-0.14* (0.08)
<i>LogPFDI</i>	0.002 (0.02)	0.004 (0.02)	0.004 (0.02)
<i>LogPLR</i>	0.23*** (0.04)	0.23*** (0.04)	0.23*** (0.04)
<i>FP</i>	-0.06* (0.04)	-0.07** (0.03)	-0.07* (0.03)
<i>LogPGDP</i>	-0.01 (0.26)	-0.04 (0.25)	-0.03 (0.25)
<i>INDRAT</i>	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)
<i>LogPOPDEN</i>	1.32*** (0.50)	1.34*** (0.50)	1.34*** (0.50)
Time trend	0.02 (0.04)	0.07** (0.04)	0.07** (0.04)
City fixed effect	Yes	Yes	Yes
<i>N</i>	1800	1800	1800
<i>R</i> ²	0.213	0.215	0.214

Note: Standard errors clustered at the city level are reported in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

land leasing price. The upward sloping reaction function suggests that city i 's best response to the decrease of its neighbours' industrial land leasing price for attracting investments is to decrease its own industrial land leasing price accordingly. Our findings indicate that the industrial land leasing prices between neighbouring cities are strategic complements, which is similar to tax competition studies, such as Brueckner and Saavedra (2001).

The coefficients of the spatially lagged dependent variable ranged from 0.10 to 0.51 under different spatial weight matrices: a 1% decrease of neighbouring cities' industrial land leasing price would induce local governments to decrease their industrial land

leasing price by 0.51% under the geographic distance weight matrix; 0.10% under the economic distance matrix; and 0.11% under the hybrid matrix. The coefficient of spatially lagged variables under the geographic distance weight matrix is larger than that under the economic distance weight matrix or the hybrid matrix (columns 2 and 3), which indicates that local governments react more to neighbours located in closer geographic proximity. The range of the interaction effect is consistent with other studies, 0.20 (tax setting interaction effect) indicated by Besley and Case (1995); 0.28 (welfare spending interaction effect) estimated by Elhorst and Freret (2009); 0.35 (property tax interaction effect) offered by Allers and Elhorst (2005); 0.6 (non-tax revenue interaction effect) estimated by Schaltegger and Kuttel (2002); and 0.8 (expenditures interaction effect) estimated by Caldeira (2012).

Regarding the coefficients of the cities' characteristics, the sign of the variables conforms to our expectation, although some coefficients are not significant. As expected, the coefficient for FDI (*LogPINV*) is statistically significant and negative, which indicates that cities with large investments tend to lease out industrial land at a lower price, reflecting their incentives for attracting more investments. Fiscal pressure has a statistically significant and negative effect, implying that cities which experience more fiscal pressure are aggressive regarding the supply of industrial land and lease out industrial land at a lower price in order to balance their fiscal budget. The coefficient on *LogPLR* is statistically significantly and positive, suggesting that cities which have more demand for industrial land lease out this land at a higher price. City's population density also has a significantly positive coefficient. Cities in which the population density is larger have higher industrial land leasing prices. It is likely that cities with a larger population

Table 4. Estimation results for different regions.

Variables	Eastern area		Middle area		Western area	
	(1)	(2)	(3)	(4)	(5)	(6)
	W ^G	W ^E	W ^G	W ^E	W ^G	W ^E
<i>WLogP</i>	0.21 [*] (0.11)	0.09 ^{***} (0.03)	0.39 ^{***} (0.08)	-0.01 (0.04)	0.02 (0.14)	0.04 (0.08)
<i>LogPINV</i>	-0.31 [*] (0.16)	-0.33 [*] (0.16)	0.07 (0.11)	0.05 (0.11)	0.03 (0.16)	0.03 (0.17)
<i>LogPFDI</i>	-0.00 (0.04)	0.00 (0.04)	-0.01 (0.03)	-0.01 (0.03)	0.03 (0.04)	0.03 (0.04)
<i>LogPLR</i>	0.16 ^{***} (0.05)	0.16 ^{***} (0.05)	0.17 ^{***} (0.06)	0.17 ^{***} (0.06)	0.32 ^{***} (0.06)	0.32 ^{***} (0.06)
<i>FP</i>	-0.07 (0.13)	-0.09 (0.13)	-0.08 [*] (0.04)	-0.09 ^{**} (0.04)	-0.03 (0.06)	-0.02 (0.05)
<i>LogPGDP</i>	-0.36 (0.52)	-0.41 (0.51)	-0.80 ^{***} (0.29)	-0.87 ^{***} (0.28)	0.62 (0.45)	0.63 (0.45)
<i>INDRAT</i>	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	-0.02 (0.01)	-0.02 (0.01)
<i>LogPOPDEN</i>	0.71 (1.69)	0.74 (1.68)	0.90 [*] (0.50)	0.92 [*] (0.49)	2.54 ^{**} (1.09)	2.56 ^{**} (1.07)
Time trend	0.15 ^{**} (0.07)	0.18 ^{***} (0.06)	0.10 ^{**} (0.05)	0.16 ^{***} (0.05)	-0.08 (0.06)	-0.08 (0.06)
City fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i>	640	640	750	750	410	410
<i>R</i> ²	0.244	0.230	0.194	0.192	0.172	0.170

Note: Standard errors clustered at the city level are reported in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

density have advantages from agglomeration economics, which leads to higher land rent.

Table 4 presents the estimation results according to the eastern, middle and western areas of China. Interestingly, the coefficients for the spatially lagged dependent variable are statistically significant and positive in the eastern and middle areas of China, but insignificant in the western areas of China, which suggests that strategic interaction in industrial land leasing prices occurs in the eastern and middle of China, but not in the western area. The slope coefficient under the geographic distance weight matrix is larger in the middle than in the eastern area. This is because the middle area of China has location disadvantages compared with the eastern area, and local governments must compete heavily and offer a lower

industrial land price to attract investments. In addition, the context of national development strategy of carrying out industry transfer from the east coast of China to middle and west regions in recent years induced local governments in the middle area to compete fiercely to attract investments.⁴ However, as the western area's investment environment and location condition is worse than that of the middle area, it could not easily attract outside investments.

To investigate whether the institutional reforms, marketisation reform of industrial land leasing in 2007, impact local governments' industrial land supply policy, we create a time dummy variable (*Reform2007*) for the 2007 reform and then let it interact with the weighted average of neighbouring cities' industrial land leasing price. Table 5

Table 5. Estimation results of industrial leasing policy reform.

Variables	W^G	W^E	W^{GE}
	(1)	(2)	(3)
<i>WLogP</i> *	0.43***	0.65***	0.64***
<i>Reform2007</i>	(0.14)	(0.13)	(0.13)
Time trend	Yes	Yes	Yes
City fixed effect	Yes	Yes	Yes
<i>N</i>	1800	1800	1800
<i>R</i> ²	0.223	0.226	0.226

Note: Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. All regressions include the same set of control variables.

presents the estimated results. The coefficients on the interacted term are statistically significant and positive, which suggests that marketisation reform of industrial land leasing in 2007 induce the more fierce competition among local governments in industrial land leasing price. According to our interviews with local governments, most industrial land still leased by the non-market approach after the marketisation reform of industrial land leasing in 2007. None of the local governments have an incentive to raise industrial land leasing price in the open market, for they have concerns about losing outside investments. Local governments even faced greater pressure to attract investments after 2007 and in the following economic stimulus plan period, so they must compete harder with each other.

Robustness analysis

To ensure the robustness of these results, we proceed to conduct additional analyses and run several more regressions.

First, we employ spatial panel two-stage least squares regression models to address potential endogeneity problems. Such problems may result from the spatially lagged dependent variable. For example, decreased industrial land leasing price may also

Table 6. Estimation results for spatial panel two-stage least squares regression models.

Variables	(1)	(2)
	W^G	W^E
<i>WLogP</i>	0.95***	0.41**
	(0.17)	(0.20)
<i>LogPINV</i>	-0.06	-0.10
	(0.08)	(0.08)
<i>LogPFDI</i>	-0.0001	0.01
	(0.02)	(0.02)
<i>LogPLR</i>	0.22***	0.23***
	(0.03)	(0.03)
<i>FP</i>	-0.05*	-0.06**
	(0.03)	(0.03)
<i>LogPGDP</i>	0.01	-0.05
	(0.15)	(0.16)
<i>INDRAT</i>	-0.01*	-0.01*
	(0.04)	(0.004)
<i>LogPOPDEN</i>	1.33***	1.56***
	(0.50)	(0.52)
<i>Constant</i>	-7.68**	-5.21
	(3.43)	(3.63)
Time trend	-0.03	0.04
	(0.03)	(0.03)
City fixed effect	Yes	Yes
<i>N</i>	1800	1800
<i>R</i> ²	0.56	0.55

Note: Robust standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

decrease neighbours' land leasing price. To tackle such endogeneity problems, we employ a generalised spatial two-stage least squares method, which was developed by Kelejian and Prucha (1998, 2010). We regress the spatially lagged dependent variables $WLogP$ on X , WX and W^2X , and then employ the fitted value of $WLogP$ as instrument for $WLogP$. The fitted value of $WlogP$ is asymptotically uncorrelated with the error term. Table 6 presents the instrumental variable estimation results. The coefficient on the spatially lagged dependent variable is still significantly positive, and is larger than that shown in Table 3. In addition, the coefficient patterns of the other variables remain the same.

Table 7. Estimation results for the dynamic spatial panel data models.

Variables	(1)	(2)	(3)
	W^G	W^E	W^{GE}
$LogP_{t-1}$	0.09*** (0.03)	0.11*** (0.03)	0.11*** (0.03)
$WLogP$	0.70*** (0.14)	0.21*** (0.08)	0.20** (0.08)
Time trend	Yes	Yes	Yes
City fixed effect	Yes	Yes	Yes
N	1800	1800	1800
R^2	0.31	0.30	0.30

Note: Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. All regressions include the same set of control variables.

Second, we employ a dynamic spatial panel model using lagged variables as instruments and use the GMM procedure to address possible endogeneity problems and time persistence of dependent variables. Owing to restrictions on space in the paper, we only present the estimated coefficients for the lagged dependent variable ($LogP_{t-1}$) and the weighted average of neighbouring cities' industrial land leasing price ($WLogP$) (see Table 7), including the same set of control variables. The lagged dependent variable ($LogP_{t-1}$) is statistically significant and positive, which justifies the use of the dynamic spatial panel data model. This also indicates that industrial land leasing price has some persistence or is influenced by historical factors. The spatial interaction effect is significantly positive under the three different weight schemes. The estimated coefficient (0.7) in column (1) is larger than that reported in columns (2) and (3), which still suggests that local governments seem to react more to their geographically close neighbours. The results for the dynamic spatial panel model confirm the strategic interaction of industrial land leasing among local governments.

Third, following Lockwood and Migali (2009) and Caldeira (2012), we consider placebo weights, which are randomly assigned

without any consideration of geographic or economic proximity.⁵ This placebo scheme is used as a benchmark to discern whether the spatial interaction effect results from a statistical artifact or omitted common shocks. The results (available from the authors upon request) suggest that there is no spatial interaction using the random weight matrix.

In sum, the above empirical findings confirm the existence of strategic interaction among local governments in industrial land leasing price, and it seems that endogeneity is unlikely to be a major concern in our empirical framework.

Additional sources of strategic interaction

For exploring the possible sources of strategic interactions among local governments in industrial land leasing price, additional tests are performed. We first interact the spatially lagged dependent variable with a set of dummy variables for political cycle. Then, we employ alternative weighting matrices based on industrial structure similarity.

First, according to the yardstick competition hypothesis, local governments react more strongly to neighbouring cities' industrial land leasing policies during political cycles because provincial leaders compare city leaders' performances during these periods. To test this prediction, two kinds of political cycle dummy variables are created.⁶ First, we create time dummy variables for the Provincial Communist Party Congress (PCPC), including one year before the PCPC ($PCPCPre1$), the year of PCPC ($PCPC$), and the first year after the PCPC ($PCPCPost1$). Second, considering that changes to local officials is another political event, we create a time dummy variable for local officials' tenure, including the first year of tenure ($Tenure1$), and the second year of tenure ($Tenure2$).⁷ These two kinds of political dummy variables are then interacted with

Table 8. Estimation results for the yardstick competition model.

Variables	(1)	(2)	(3)	(4)
	W^G	W^E	W^G	W^E
<i>WLogP</i>	0.18 (0.13)	0.02 (0.04)	0.44*** (0.08)	0.09*** (0.03)
<i>WlogP*PCPCPreI</i>	0.15 (0.11)	0.20** (0.10)		
<i>PCPCPreI</i>	-0.82 (0.53)	-1.11** (0.49)		
<i>WlogP*PCPC</i>	0.22** (0.11)	0.28*** (0.09)		
<i>PCPC</i>	-1.22** (0.54)	-1.57*** (0.45)		
<i>WLogP*PCPCPostI</i>	0.23* (0.13)	0.30** (0.12)		
<i>PCPCPostI</i>	-1.27* (0.68)	-1.60** (0.62)		
<i>WLOGP*TenureI</i>			0.10 (0.09)	0.15* (0.09)
<i>TenureI</i>			-0.53 (0.46)	-0.80* (0.45)
<i>WLogP*Tenure2</i>			0.08 (0.09)	0.14 (0.09)
<i>Tenure2</i>			-0.37 (0.47)	-0.68 (0.47)
Time trend	Yes	Yes	Yes	Yes
City fixed effect	Yes	Yes	Yes	Yes
<i>N</i>	1800	1800	1750	1750
<i>R</i> ²	0.220	0.221	0.211	0.211

Note: Standard errors clustered at the city level are reported in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. All regressions include the same set of control variables.

the weighted average of neighbouring cities' industrial land leasing price, and the estimated results are shown in Table 8. The results reported in columns (1) and (2) indicate that local governments react more to their neighbouring cities during the PCPC period, especially during and after the first year of the PCPC. In columns (3) and (4), the results suggest that local governments react more to their neighbouring cities after the first year of local officials' tenure. The reason for this is that local officials aggressively lease out more industrial land to attract investments after taking office to signal their high performance and try for a promotion. These results indicate that after the

PCPC or local officials taking office, local officials compete aggressively with neighbouring cities to signal their own competence and performance by attracting more investments at a lower land price.

Second, according to the resource flow hypothesis (Brueckner, 2003), local governments compete with each other for a particular mobile resource. They would react more to their neighbouring cities' industrial land leasing prices in more investment (resource) or industrial output dependent areas, because they are more inclined to care about attracting investments for promoting local industrial development. To test this prediction, a set of dummy variables for the

Table 9. Estimation results for resource flow models.

Variables	W^G	W^E	W^G	W^E	W^G	W^E
	(1)	(2)	(3)	(4)	(5)	(6)
$WLogP*INVRATD$	0.18* (0.10)	0.66*** (0.10)				
$WLogP*FDIRATD$			0.33*** (0.10)	0.76*** (0.09)		
$WLogP*INDRATD$					0.22** (0.09)	0.65*** (0.09)
City fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
N	1800	1800	1800	1800	1800	1800
R ²	0.181	0.153	0.202	0.161	0.159	0.138

Note: Standard errors clustered at the city level are reported in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. All regressions include a dummy variable for fixed investment dependent area, foreign direct investment dependent area or industrial output dependent area and a spatially lagged dependent variable.

investment or industrial output-dependent area, including fixed investment dependent area ($INVRATD = 1$ if the ratio of fixed investment to GDP is over the 50th percentile), foreign direct investment depended area ($FDIRATD = 1$ if the ratio of FDI to GDP is over the 50th percentile), and industrial output depended area ($INDRATD = 1$ if the ratio of industrial output to GDP is over the 50th percentile), were created and then interacted with the weighted average of neighbouring cities' industrial land leasing prices ($WLogP$). Table 9 presents the estimated results, suggesting that cities do react more strongly to their neighbours in investment or industrial output dependent area for attracting more outside investments. The results reported in columns (1) and (2) show that cities in more investment dependent area are inclined to react more to their neighbouring cities' industrial land leasing behaviour. In columns (3) and (4), the results suggest that cities in more FDI (foreign direct investment) dependent areas are more aggressive to lease out industrial land, and react more strongly to their neighbours. Results in columns (5) and (6) indicate that cities with a high reliance on industrial outputs react most strongly to their neighbours.

Third, besides the geographic and economic definitions of neighbourhood, we further considered an alternative spatial weight matrix based on industrial structure similarity between neighbourhood cities. Cities with more similar industrial structure may be more probable to mimic each other's industrial land leasing behaviour. That is, the more similar they are, the more fierce competition they will face. This is because a productive firm will have more options to choose where to locate, so the cities have to offer much lower land price to attract it. We use industrial structure similarity (ISS) weight based on the inverse of distance between second industrial output ratio of cities i and j (weight is given by $w_{ij}^{ISS} = 1/abs(INDRAT_i - INDRAT_j)$, for $j \neq i$). The results in Table 10 indicate that local governments imitate those with similar industrial structure in industrial land leasing price.

In sum, the empirical findings for the source of strategic interaction among local governments in industrial land leasing support both the yardstick competition and resource flow hypothesis. In order to attract mobile manufacturing investments, local officials compete with each other and lease out land at a lower price. The political cycle

Table 10. Estimation results based on industrial structure similarity weight.

Variables	MLE	IV	GMM
	(1)	(2)	(3)
WLogP	0.11*** (0.04)	0.38*** (0.09)	0.14* (0.08)
Time trend	Yes	Yes	Yes
City fixed effect	Yes	Yes	Yes
N	1800	1800	1800
R ²	0.30	0.46	0.30

Note: Standard errors clustered at the city level are reported in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. MLE, GMM, IV stands for maximum likelihood estimation, generalised method of moment system estimation and instrumental variable estimation, respectively.

influences the interaction of local governments in relation to the industrial land leasing price, whereby local governments react more to their neighbours during and after the first year of the provincial-level communist party congress and in the first year of local officials' tenure. In addition, cities imitate those with similar industrial structure in industrial land leasing behaviour.

Conclusions

This study confirms existing theory, and provides new evidences that strategic interaction occurs among local governments in industrial land supply in the context of centralised government without local autonomous tax policy, based on panel data of Chinese prefecture cities for 2003–2012. Local governments' industrial land leasing prices are significantly and positively affected by the action of neighbouring cities. We further attempted to indentify the sources of this strategic interaction and found that both the yardstick competition and resource flow and hypotheses have explanatory power. Local governments mimic each other to attract and compete for outside investments. They react

more to their neighbours' industrial land leasing prices during political cycle periods, in order to demonstrate better performance.

This study provides some policy implications. As local governments compete with each other to lease industrial land at a lower price for attracting investments, this would cause land use inefficiency and resource misallocation. Land is a key input and is used as an important tool for local governments to promote economic growth in China. When industrial land is underpriced, the manufacturing investment is higher than is socially optimal. This leads to overheated investments and excess production capacity problems and lower returns on industrial investment. The low price also leads to the extensive use of industrial land and associated excessive investment problems in China. In addition, the reason cheap industrial land is leased to manufacturing investors lies in the fact that local governments dominate and manipulate land supply, whereby they expropriate farmers' land with very low cost and lease it to investors at cut prices. Such a 'race to the bottom' in industrial land supply promotes local industrial development and economic growth in the short term, but sacrifices economic efficiency, social harmony and long-term sustainable economic growth.

To reconcile the dilemma of this socially irrational outcome due to local governments' rational behaviour regarding the strategic interaction of industrial land supply, the central government should reform the current land leasing system. In addition, the central government should adjust the central–local fiscal relationship and reform local officials' governance system, and provide appropriate incentives for local governments to attract investments by providing more efficient public goods and services. These reforms would not only help to improve land use efficiency and income equity under the rapid industrialisation and urbanisation process, but would

also contribute to transforming the country's current extensive economic growth model.

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Notes

1. Some scholars have suggested that local officials' career incentive significantly influences land supply (Kung and Chen, 2014).
2. Land leasing revenue accounted for 33.7% of local general budget revenues during 2007–2012 according to the *China Land and Resources Statistical Yearbook* (2008–2013), and *China City Statistical Yearbook* (2008–2013).
3. Since the service sector is location-specific, local governments can transfer the high land price to consumers.
4. Chinese central government encouraged industry transfer from east China to middle and west regions after the 11th Five-Year Program (2006–2010), which set goals to move labour intensive industry to middle and west areas.
5. We generate a random number between 0 and 1 as the distance between city i and city j . The value of 1 is assigned if the distance is larger than 0.5, and 0 otherwise.
6. There are two kinds of political events reflecting the political cycle in China: (1) the Communist Party Congress, which is held every five years; and (2) changes to local officials' office, which is decided by the higher-level government.
7. Data on the PCPC events and prefecture-level officials were sourced from official websites. We provide estimated results for local city secretaries, as they have greater political power. The results are robust to local city mayors.

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