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How did industrial land supply respond to transitions in state strategy? An analysis of prefecture-level cities in China from 2007 to 2016

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ABSTRACT

Industrial land supply has long been a powerful tool for local economic growth and government competition in China. Based on Chinese prefecture-level cities' panel data from 2007 to 2016, our study investigates how industrial land supply responded to two key transitions in state strategy: the "Fiscal Stimulus Package" of 2008 and the "New-type Urbanization" and "Innovation Driven Development" of 2012. The results show that: (1) a response bifurcation of cities occurred in the four economic-geographical regions (eastern, central, western, and northeastern). The response in eastern and central regions was led by urban agglomerations, with neighbors mimicking one another. In the western region, most of the cities demonstrated an active and strong response to the two transitions. Nonetheless, it showed the characteristic of siphon effect, and local governments interacted in a zero-sum game. Meanwhile, the response of the northeastern region was not sensitive to state strategic transitions, and there was no strategic interaction among its cities. (2) We find various responses of cities at different levels of socioeconomic development. In traditional industrial land (TIL) supply, cities with higher socioeconomic levels were more adaptive to state strategic transitions. In high-tech industrial land (HIL) supply, most cities paid more attention to attracting investment in high-tech industries during the second transitional period. Among them, the smaller the economic strength of the city, the more willing it was to supply more land for high-tech enterprises. The paper concludes with implications for state strategies and regional industrial land supply policies.

1. Introduction

With rapid urbanization and industrialization, land-centered development has been a common phenomenon in many developing countries (Heikkila, 2007; Lin, 2007; Wang et al., 2019; Ye and Wu, 2014). Land not only is the spatial foundation of socioeconomic activities but also can bring continuous benefits for local development. Moreover, land is distinguished from goods and services in that its supply is more or less fixed and closely tied to government intervention (Tian and Ma, 2009). Since the early 1990s land reforms, China has extensively adopted the tool of land supply to achieve its goals of increasing state revenue and controlling land use (Zhu, 1999; Zhang, 2000; Tian and Ma, 2009; Xu and Yang, 2019). Among various land use types, industrial land supply has played a significant role in promoting the growth of the manufacturing industry and local development. From 2007 to 2016, China's industrial land supply had reached 1.29 million ha, accounting for 28.34% of the total land supply[1], far more than other land types such as commercial and residential land.

Industrial land supply in China is basically controlled by local governments. A wealth of studies have documented the industrial land supply behavior of China's local governments from a variety of perspectives, including strategic interaction among local governments' land hoarding (Du and Peiser, 2014; Zhang et al., 2015), local governments' industrial land supply patterns (Yang and Yang, 2016; Huang

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and Du, 2017a), and government intervention in land misallocation (Huang and Du, 2017a). Numerous scholars have attempted to explain the socioeconomic consequences of industrial land supply such as housing price increases (Liang et al., 2016; Shen et al., 2018), urban sprawl (Deng and Huang, 2004; Liu et al., 2018), and air pollution (Xu and Zhang, 2016; Zhang and Xu, 2017). However, to the best of our knowledge, there have been few studies which examine how local governments apply the tool of industrial land supply in response to strategic state transitions.

In China, as the agent of the central government, local governments are expected to actively respond to state strategies and make timely adjustments in land supply policies. In reality, due to the central-local fiscal arrangement and diversity of local contexts, local governments may not react to state strategies in similar ways. Based on industrial land supply data of Chinese prefecture-level cities from 2007 to 2016, this paper investigates how local governments adjusted their industrial land supply policies in response to two key state strategic transitions from 2008 to today; namely, the 2008 “Fiscal Stimulus Package” and the 2012 “New-type Urbanization” and “Innovation-driven Development,” and explores policy implications of more reasonable state strategies and regional industrial land supply policies. We address the following two questions:

(1) How and to what extent have state strategic transitions affected industrial land supply in China over the past decade?
(2) How did local governments differ in their responses to state strategic transitions in the four economic-geographical regions of China?

2. Industrial land supply as a tool of local economic growth and government competition

In general, each successful phase of industrial land supply has brought new investments to fixed assets by introducing new enterprises to local governments, bringing long-term tax revenue to cities, and providing a positive spillover effect for local economies (Tao et al., 2010). In general, studies have discussed the role of industrial land supply in local economic growth and government competition from two different perspectives (Cao et al., 2008; Tian and Ma, 2009; Pan et al., 2015; Cai, 2017; Zheng and Shi, 2018). The first of these perspectives is the low-price supply strategy (Zhang, 2017). Some scholars believe that industrial land and commercial/residential land are the two profitable land types to which local governments attach the most attention (Tao et al., 2010; Huang and Du, 2017a). Industrial land supply provides a sustainable benefit stream for a long period, while commercial and residential land provides a sizable and immediate benefit stream for a short period (Cai, 2017). Meanwhile, industrial businesses are often not location-specific. In response to this mobility, local governments have had to offer attractive packages to compete with other cities to attract investment. Since the total amount of land supply is limited, local governments often supply commercial and residential land at a high price to alleviate fiscal pressure; this, in turn, allows them to supply industrial land for low prices to attract industrial investment (Tao et al., 2010; Huang and Du, 2017a). Tian and Ma (2009) and Zhang et al. (2017) suggested that local governments often deliberately drive down the price of industrial land to enhance competition in attracting investment. Fang et al. (2018) argued that in the face of financial pressure, local governments prefer to supply more land to state-owned enterprises at a lower price to stabilize their economy.

The second perspective examines the relationship between political cycles and industrial land supply. In China, the GDP-based promotion criterion triggers inter-regional competition among government officials for better economic and political performance, directly inspiring local governments to supply industrial land to attract more industrial investment to spur local economic growth (Tao et al., 2010; He et al., 2016). Yu and Gong (2015) investigated the political periodic supply of industrial land and found that the supply is often reduced before the provincial party congress and then quickly rebounds after the meeting. They argued that government officials prefer to make favorable targeted investments and economic development decisions immediately before or after the party congress in order to obtain better career opportunities, a behavior which dramatically affects land supply. Cai (2017), Huang and Du (2017a,2017b) and Fang et al. (2018) found that more industrial land is supplied when government officials have an incentive to improve economic performance in the early years of their service terms in order to achieve a leader’s political trust. On the contrary, Yang and Yang (2016) found that for cities with higher economic growth pressure, government officials who have served more than three years tend to supply more industrial land because economic growth performance toward the end of their service terms will have a more significant impact on their promotion opportunities.

Previous research has developed a deep understanding of the economic and political efficacy of industrial land supply. As a tool of local economic growth and government competition, it generates significant impacts on urban and regional economic development. Few studies, however, have discussed the spatio-temporal characteristics of industrial land supply, in particular, the attitudes and behavior of local governments towards state strategies. This research is among the first to fill that gap by exploring different regional responses of industrial land supply towards transitions in state strategies.

3. A brief review of the two key transitions in state strategy in China since 2008

As noted above, there have been two key transitions in state strategy since 2008 taken in response to different developmental challenges. One transition was the “Fiscal Stimulus Package” of 2008, and the other was the “New-type Urbanization” and “Innovation-driven Development” after the 18th CPC national congress of 2012.

In 2008, the world witnessed the most serious global financial crisis since the 1930s, and the Chinese economy was hit with a huge blow. Not only did the Chinese economic growth rate drop rapidly, but the total value of imports and exports even showed negative growth by the end of the year. In response to the economic downturn, China’s central government released a 4 trillion Yuan stimulus package in November 2008 (Naughton, 2009; Li and Zhang, 2014) and introduced a revitalization plan for ten traditional industries which included the steel, automobile, petrochemical industries, etc., along with supporting policies, such as encouraging exports, mergers, and reorganization, credit support, and preferential taxes. Meanwhile, a series of flexible land supply policies was also released. For instance, the central government relaxed control over industrial land use quotas and lowered the minimum standard of land supply prices, while many cities also introduced industrial land supply preferential policies. Driven by this state fiscal stimulus strategy, China's economy recovered rapidly over the next several years.

Since November 2012, the “New-type Urbanization” and “Innovation-driven Development” transitions have become the two major state strategies of the central government. The “New-type Urbanization” strategy reviewed problems caused by the rapid urbanization and industrialization, such as the loss of arable land, the phenomenon of “ghost cities,” and inefficient urban expansion, and it was expected to explore a new path toward more sustainable and efficient urbanization (Chen et al., 2018). The goals of this strategy included addressing rural and agricultural problems, facilitating industrial improvements, coordinating urban and rural development, making land use more compact, and promoting more balanced regional development, etc. (Tian, 2016). The “Innovation-driven Development” strategy originated from the important governance philosophy of General Secretary Xi Jinping, that is, scientific and technological innovation is the strategic support for improving social productivity and overall national strength and must be placed at the core of the country's overall development. The purpose of this strategy is to transform the driving force of China's economic development from a traditional labor force, resource, and energy expenditure to scientific and technological innovation, adjusting the industrial structure from the supply side, to resolve overcapacity, to promote the development of high-tech industries, and to enhance the capability of China’s innovation (Sun, 2015; Chen et al., 2017).

4. Data and method

4.1. Study area and data

This paper selects 331 prefecture-level cities in China (including four municipalities, excluding Tibet, Sansha, Hong Kong, Macau, and Taiwan) as cases to examine responses to the transitions in state strategy through industrial land supply. The 331 city samples consist of four types of administrative units: (1) municipalities directly under the Central Government *(zhixia shi)*, (2) prefecture-level cities *(diji shi)*, (3) autonomous prefectures *(zizhizhou)*, (4) leagues *(meng)*.

We collect data for industrial land supply from January 1, 2007 to December 31, 2016 provided by the China Land Market Website (www.landchina.com), and this information includes the area, geographical location and other attributes of each piece of industrial land. According to the high-tech industry and high-tech service industry classification standards formulated by the State Statistics Bureau in 2018, industrial land is divided into traditional industrial land (TIL) and high-tech industrial land (HIL).

High-tech industry is classified into two types of categories: high-tech manufacturing industry and service industry (Table 1), and other types of industry are regarded as traditional industries. In total, the TIL supply has 301,200 cases with an area of 1,203,300 ha, and the HIL supply has 23,800 cases with an area of 94,200 ha.

In order to identify the influence of the two state strategic transitions on industrial land supply behaviors of local governments, we divide the rise and fall of China's industrial land market from 2007 to 2016 into three phases. The first phase is from 2007 to 2008, before the introduction of the “Fiscal Stimulus Package,” the second phase is the period of the “Fiscal Stimulus Package, from 2009 to 2012, and the third phase is the period of the “New-type Urbanization” and “Innovation-driven Development” from 2013 to 2016. We also divide the study area into four economic-geographical regions (Fig. 1): (1) the eastern region, covering Beijing, Tianjin, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong and Hainan provinces; (2) the central region, covering Shanxi, Anhui, Jiangxi, Henan, Hubei and Hunan provinces; (3) the western region, covering Inner Mongolia, Guangxi, Chongqing, Guizhou, Yunnan, Tibet, Shannxi, Gansu, Qinghai, Ningxia and Xinjiang provinces; and (4) the northeastern region, covering Liaoning, Jilin and Heilongjiang provinces.

4.2. Research method

4.2.1. Spatial autocorrelation

The spatial autocorrelation method is used to analyze the spatio-temporal patterns of industrial land supply at the national and regional levels. First, global autocorrelation is used to describe whether there is an agglomeration in the distribution of TIL and HIL supply. The commonly used test statistic is the Global Moran’s I index (Anselin, 1995), which is calculated as follows:

$$Global\ Moran's\ I = \frac{n\sum_{i=1}^{n}\sum_{j=1}^{n} W_{ij}(x_i-\bar{x})(x_j-\bar{x})}{\left(\sum_{i=1}^{n}\sum_{j=1}^{n} W_{ij}\right)\sum_{i=1}^{n}(x_i-\bar{x})^2},\ (i \neq j) \tag{1}$$

where x_i and x_j are industrial land supply areas of city i and city j; n is the number of cities; W_{ij} is the spatial weight matrix, which is established based on the common side or common point of each city using the queen contiguity adjacency standard (Su et al., 2011), i.e.: when i and j are adjacent, $W_{ij} = 1$, otherwise $W_{ij} = 0$; $i = 1, 2,…,n$; $j = 1,2, …,m$, m is the number of cities adjacent to city i; and $\bar{x}$ is the average of x. The value of *Moran’s I* ranges from -1 to 1. When Moran’s I $>$ 0, this indicates a positive spatial correlation, meaning that the land supply pattern has a special agglomeration characteristic. The larger the Moran’s I value, the higher the concentration. Moran’s I $<$ 0 demonstrates a negative spatial correlation, and the closer the Moran’s I value is to -1, the higher the degree of dispersion. Moran’s I = 0 shows there is no spatial correlation and that the land supply level is randomly distributed in each city. The significance of the autocorrelation can be tested by the standardized statistic Z (I), which is calculated as follows:

$$Z\ (I) = \frac{I - E(I)}{\sqrt{Var(I)}} \tag{2}$$

where $E(I)$ is the mathematical expectation of the Global Moran's I value, and $Var(I)$ is the variance of the Global Moran's I value. If $|Z| >$ 1.96, spatial autocorrelation is significant (Zhou et al., 2018).

We then use the local spatial autocorrelation method to measure the association of industrial land supply in each city with its neighboring cities and to identify the specific spatial agglomeration pattern. The formula is as follows:

$$Local\ Moran's\ I = \frac{n(x_i-\bar{x})\sum_{j=1}^{m} W_{ij}(x_j-\bar{x})}{\sum_{i=1}^{n}(x_i-\bar{x})^2},\ (i \neq j) \tag{3}$$

The meanings of the variables in Eq. (3) are the same as those in Eq. (1). The significance level of Local Moran’s I index measured by Z(I), and the significance threshold is also 1.96. Based on the results of the significance test, those statistically significant cities can be classified into four categories. When the Moran’s I $>$ 0 and Z(I) $>$ 1.96, the city is a High-High (HH) city, which has a variable value and an average of the neighboring values above the mean. When the Moran’s I $>$ 0 and Z(I) $<$ -1.96, the city is a Low-Low (LL) city, which has a variable value and an average of the neighboring values below the mean. When Moran’s I $<$ 0 and Z(I) $>$ 1.96, the city belongs to High-Low (HL) cities, which has a variable value above the mean, but average neighboring values below the mean. When the Moran’s I $<$ 0 and Z(I) $<$ -1.96, the city belongs to Low-High (LH) cities, which has a variable value below the mean, but an average of the neighboring values above the mean.

Table 1
The high-tech manufacturing industry and service industry.

High-tech manufacturing industry	High-tech service industry
Pharmaceutical industry	Information service industry
Aviation industry	E-commerce service industry
Electronic and communication device industry	Inspection and testing service industry
Computer and office equipment industry	Special technical service industry
Medical equipment and instrument industry	R&D and design service industry
Photographic equipment industry	Scientific achievement transformation service industry
	Intellectual property law and practice service industry
	Environmental service in industry

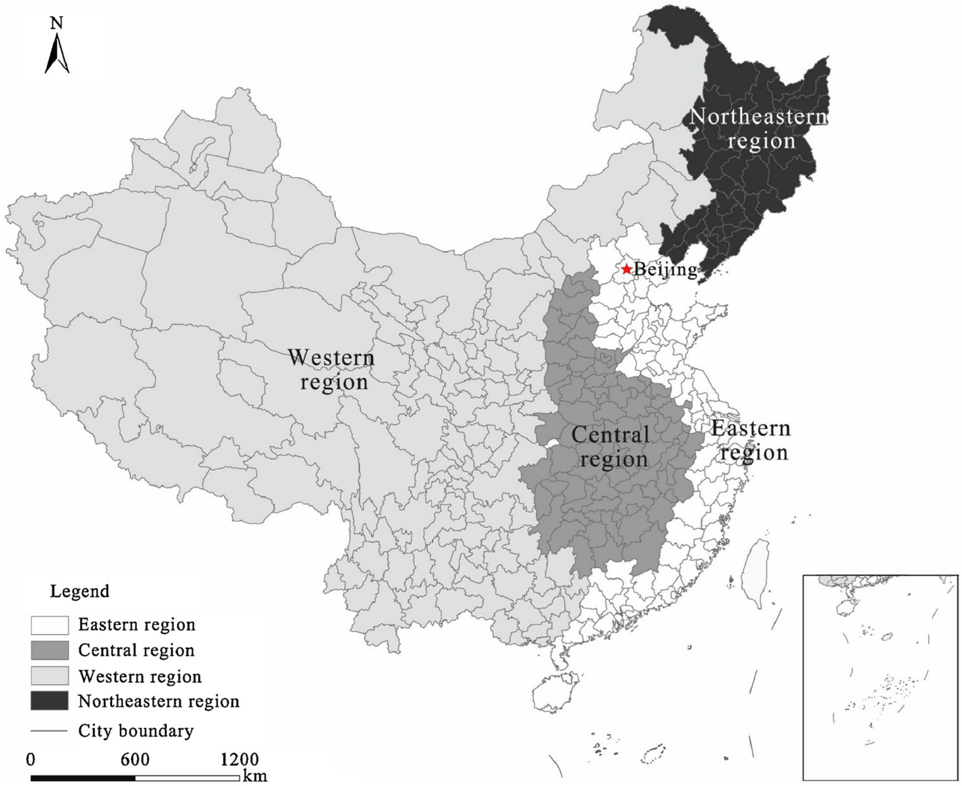

Fig. 1. Four economic-geography regions in China.

4.2.2. Dynamic spatial panel data model

Strategic interaction among local governments, path dependence of land supply, and local socioeconomic development levels are considered by many scholars to influence the decision making of local governments in supplying industrial land. This means that compared with other econometric models, the dynamic spatial panel model can better explain the driving forces of industrial land supply under state strategic transitions (Li et al., 2013; Du and Peiser, 2014; Huang and Du, 2017a; Liu et al., 2018). Specifically, economic and political competition among cities causes their industrial land supply behavior to have characteristics of spatial autocorrelation (Li et al., 2013; Yu et al., 2015; Huang and Du, 2017a). This indicates that the dependence form of the Spatial Autoregressive Model is powerful and can deal with strategic interactions occurring within nearby cities, with these neighboring effects estimated by introducing a spatially lag term of the dependent variable (Anselin, 1995; Yang et al., 2018, [Yang et al., 2019a] 2019a, [Yang et al., 2019b]b). Meanwhile, the land supply behavior of local governments is strongly characterized by path-dependence; i.e., the contemporary supply of industrial land is influenced by contemporary factors as well as by the previous supply of industrial land. Therefore, we employ the dynamic spatial lag panel data model, containing both the time lag term and the time-spatial lag term of the dependent variable besides the spatial lag term (Elhorst et al., 2013). We also include some variables of local socioeconomic development in the model. We control the fixed effects of city individuals to avoid endogeneity, and the maximum likelihood estimation method is applied to estimate the model. The estimating equation is expressed as follows:

$$y_{it} = \rho\sum\nolimits_{j=1}^{n} w_{ij}y_{jt} + \gamma y_{i,t-1} + \tau\sum\nolimits_{j=1}^{n} w_{ij}y_{j,t-1} + \beta X_{it} + u_i + \varepsilon_{it}\ (i = 1,\ ...n;\ t = ,1...T) \quad (4)$$

where y_{it} is the industrial land supply area of city i in year t, which includes TIL supply area (TSR) and HIL supply area (HSR). An element of the spatial contiguity weight matrix W is w_{ij}, which is specified to capture the strategic interaction noted above between cities i and j (Huang and Du, 2017a; Liu et al., 2018). The regressor includes the time lag term $y_{i,t-1}$ to allow for a dynamic effect, which can be considered as a measure of path dependence (Yu et al., 2016). The covariate matrix representing socioeconomic development level is X_{it}, which includes economic strength indicators such as gross domestic product (GDP) and GDP growth rate (GDPGR) (Yang and Yang, 2016; Liu and Alm, 2016); industrial structure indicators such as share of industry in GDP (INDG) and share of services in GDP (SERG) (Tao et al., 2010; Du and Peiser, 2014; Li et al., 2018); labor force indicators such as number of employees (NUME), number of tertiary educated students (NUMS) and average wage of staff and workers (AWS) (Ye and Wu, 2014; He et al., 2016; Huang and Du, 2017a,b); investment indicators such as ratio of investment in fixed assets to GDP (INVG) and number of development zones (NUMZ) (Chen et al., 2017; Huang and Du, 2017a); and financial pressure indicators such as ratio of fiscal expenditure to revenue (FRC) (Du and Peiser, 2014; Zhang and Xu, 2017). ρ, γ and τ refer to the measurement of the spatial dependent effects, the time lag effects, and the time-spatial lag effects, respectively. The coefficient of the socioeconomic variable is β, while u_i is the unobserved individual fixed effect across cities, and ε_{it} denotes the random error. More details of the definition and descriptive analysis of the main variables are presented in Table 2. In addition, three variables, namely, gross domestic product (GDP), number of employees (NUME), and average wage of staff and workers (AWS), are subject to natural-log form transformation before the estimation.

Considering that this paper pays great attention to the industrial land supply by local government during state strategic transitional periods, we only discuss the driving mechanism of land supply in China's prefecture-level cities from 2009 to 2016. Meanwhile, among the 331 cities, socioeconomic information of 39 autonomous prefectures and leagues, and 12 prefecture-level cities which experienced adjustment of administrative division is incomplete and they are removed from the samples. Finally, we kept the information of 280 cities in the panel dataset for the econometric analysis. Since the local governments' industrial land supply plan is formulated in the previous year,

Table 2
Description of variables.

Type	Variables	Definition	Obs.	Mean	Sd
	Dependent Variables				
	TSR	TIL supply area (ha)	2240	401.41	409.84
	HSR	HIL supply area (ha)	2240	34.83	53.89
	Explanatory Variables				
Strategic Interaction	*W*TSR	The spatial lag term of TIL supply area (ha)	–	–	–
	*W*HSR	The spatial lag term of HIL supply area (ha)	–	–	–
	*W*TSR(t-1)	The time-spatial lag term of TIL supply area (ha)	–	–	–
	*W*HSR(t-1)	The time-spatial lag term of HIL supply area (ha)	–	–	–
Path Dependence	TSR(t-1)	The time lag term of TIL supply area (ha)	2240	414.80	419.49
	HSR(t-1)	The time lag term of HIL supply area (ha)	2240	34.30	53.92
Socioeconomic development level	GDP	Gross domestic product (millions yuan)	2240	18.70	25.35
	GDPGR	GDP growth rate (%)	2240	11.46	4.43
	INDG	Share of industry in GDP (%)	2240	50.31	10.33
	SERG	Share of services in GDP (%)	2240	36.47	8.69
	NUME	Number of employees (10^4 person)	2240	52.89	79.55
	NUMS	Number of college students (10^4 person)	2240	7.54	14.24
	AWS	Average wage of staff and workers (yuan)	2240	38599.58	15662.08
	INVG	Ratio of investment in fixed assets to GDP (%)	2240	0.72	0.26
	NUMZ	Number of development zones	2240	1.31	2.29
	FRC	Ratio of fiscal expenditure to revenue (%)	2240	1.52	0.75

we use the socioeconomic data which is collected one year before the land supply data is provided, and all socioeconomic data is collected from China City Statistical Yearbook (2009-2016).

5. Results

5.1. The spatio-temporal characteristics of industrial land supply

5.1.1. General characteristics of industrial land supply

Figs. 2 and 3 present the supply curves of TIL and HIL which show a distinct inverted u-shape. After the 2008 "Fiscal Stimulus Package," the supply area of industrial land rose rapidly, and the average increase in TIL was close to 20% from 2009 to 2012, reaching 174,700 ha in 2012. The supply area of HIL also grew exponentially. Since 2013, after the launch of the "New-type Urbanization," the industrial land market rapidly cooled and demand for TIL decreased dramatically. As a result, supply in 2016 was only 37.25% of that in 2012. The similar inverted u-shaped curves also appeared in the eastern, central, and western regions. However, the supply curve of the northeastern region was relatively flat.

Fig. 4 shows the ratio of HIL supply to TIL supply increased from 7.19% in 2007 to 10.10% in 2016. Due to the "Innovation-driven Development" strategy, the ratio grew the quickest after 2013. Moreover, this ratio in the eastern, central, and western regions shared similar paths, but with varying degrees. In the northeastern region, there was no continuous increase in the ratio of HIL supply to TIL supply.

5.1.2. Spatio-temporal pattern changes of industrial land supply

Table 3 shows there was a continuous positive spatial autocorrelation across Chinese prefecture-level cities of the two types of industrial land supply during the different periods. All of the Global Moran' s I values are between 0.15 to 0.30 and Z(I) > 1.96, indicating that whether in traditional or high-tech industry, the land supply levels tended to cluster spatially, high (low) supply cluster areas near other

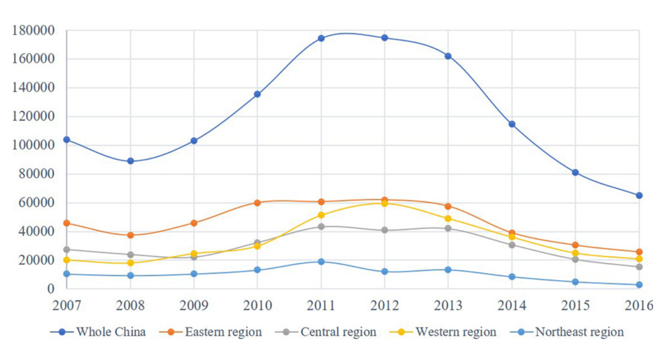

Fig. 2. TIL supply in national and regional levels from 2007 to 2016.

Fig. 3. HIL supply in national and regional levels from 2007 to 2016.

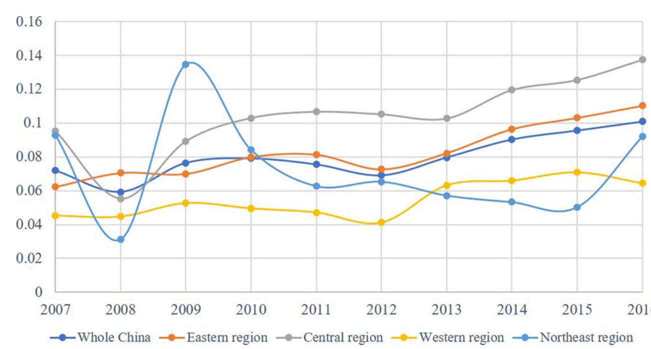

Fig. 4. The ratio of HIL supply to TIL supply in national and regional levels from 2007 to 2016.

Table 3
Global Moran's I values of TIL and HIL supply during different periods.

Years	2007-2008		2009-2012		2013-2016	
Land types	TIL	HIL	TIL	HIL	TIL	HIL
Moran's I value	0.26	0.17	0.30	0.21	0.27	0.15
Z(I) value	7.59	5.36	8.86	6.31	7.97	4.78

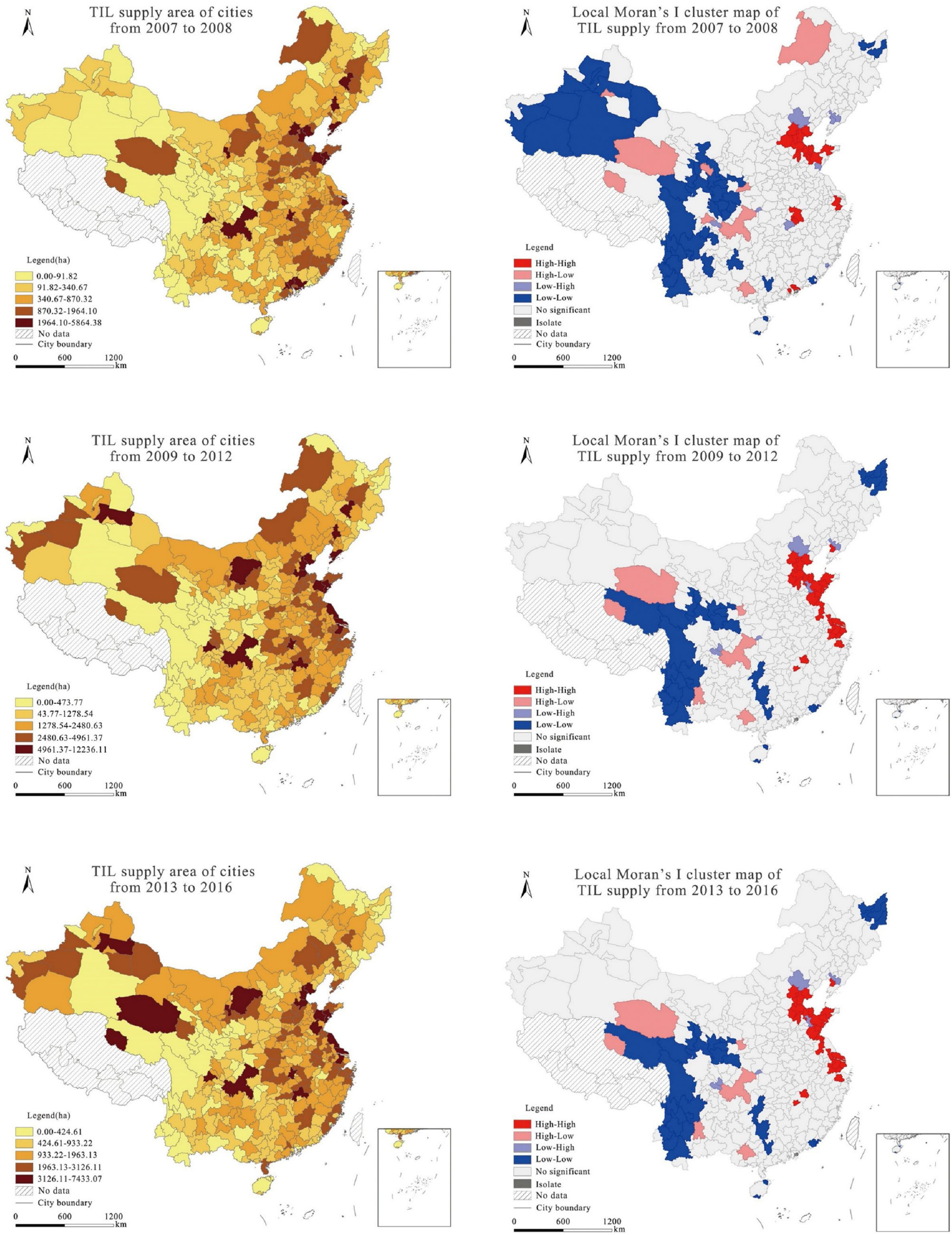

Fig. 5. Spatio-temporal patterns of TIL supply during different periods.

high (low) supply areas.

5.1.2.1. TIL supply. From 2007–2008, in the eastern region, the TIL market in the Beijing-Tianjin-Hebei (BTH) and the Shandong Peninsula (SDP) was active, forming an HH city cluster that included 13 cities. In contrast, in the two major developed urban agglomerations, the Pearl River Delta (PRD) and the Yangtze River Delta (YRD), the supply of TIL was lower, and HH cities appeared only in megacities such as Shanghai, Guangzhou, and Shenzhen. In the central, western and northeastern regions, the land supply in provincial capitals and municipalities was apparently more than in other cities; demonstrating a siphon effect (Fig. 5).

After the introduction of the “Fiscal Stimulus Package,” TIL supply increased significantly, and regional patterns underwent dramatic changes (Fig. 5). In the eastern region, the largest HH city cluster expanded south to the YRD, and the number of cities in this cluster increased to 28, including six cities with a supply area above 5000 ha from 2009 to 2012. However, in the southeastern coastal areas, especially around the PRD, land supply declined sharply. In the central and western regions, the siphon effect was still significant, and supply in the northwest inland cities rose remarkably. The former large-scale cluster of LL cities disappeared during this period. The response in the northeastern region was weak, and the original pattern did not change during the transitional period.

From 2013–2016, with the implementation of new state strategies, the TIL supply market tightened rapidly, but the supply pattern showed little difference as compared with that during the previous phase. However, the TIL market was still relatively active in the western region, especially in the northwest, in stark contrast to other regions.

5.1.2.2. HIL supply. From 2007–2008, more than 80% of HIL was supplied in the eastern and central regions. In the western and northeastern regions, only a few cities, such as Chongqing, Guiyang, and Changchun, supplied a large amount of industrial land, and they were all HL cities according to the spatial autocorrelation analysis (Fig. 6).

From 2009–2012, the HIL supply pattern underwent more significant changes (Fig. 6). In the eastern and central regions, the large HH city cluster in the BTH, the SDP, and the YRD had not yet appeared. In the BTH, only Beijing and Tianjin were classified as HH cities, and the land market in other cities was sluggish. In contrast, the supply area of cities in the middle reaches of the Yangtze River (MYR) and the YRD had increased rapidly, and two large-scale HH city clusters were observed, indicating the preference of local governments towards supplying high-tech industrial land. The western and northeastern regions continued to display characteristics of the previous period.

From 2013–2016, many cities responded to the “Innovation-driven Development” strategy undertaken by the central government. In the eastern and central regions, the supply strength of cities in the MYR and the YRD continued to be robust, and more cities entered the HH city cluster category. In the PRD, a new HH city cluster also emerged. In general, an HIL supply belt consisting of the PRD, the MYR, and the PRD was gradually taking shape while the supplied land in the BTH and the SDP continued to decline. In the western region, the HIL supply market was active in many undeveloped cities, but the siphon effect was significant. By contrast, the response in the northeastern region was not positive, and an LL city cluster emerged that included many cities (Fig. 6).

5.1.2.3. Ranking changes of TIL and HIL supply before and after transitions. To evaluate the impact of the two transitions on industrial land supply, we further investigate the ranking changes of cities' TIL and HIL supply before and after transitions (Fig. 7). After the implementation of the “Fiscal Stimulus Package, the degree of ranking changes in the western region was greater than that in the other three regions. Most of the cities witnessed a surge in the supply of TIL, with the ranks of 10 cities climbing more than 150 places. However, in terms of HIL supply, the ranking of western cities declined significantly. It was interesting to find that some cities even saw a decline of more than 100 places while their TIL supply rose by more than 100 places.

After 2013, the ranking of cities changed dramatically, especially in the western and northeastern regions. As Fig. 7 shows, the supply rankings of TIL in western cities continued to rise. Meanwhile, many cities' rankings of HIL supply rose significantly, which was completely opposite from the previous phase. For example, four northwestern cities' supply ranking rose more than 150 places, while in the southwest, there was an “urban agglomeration” of HIL supply across different provinces, and 10 cities rose in their rankings by more than 50 places. However, in the northeastern region, the HIL supply experienced a cliff-like decline, even in provincial capitals and sub-provincial cities.

5.2. Driving forces of industrial land supply under the state strategic transitions

In general, the two key transitions in state strategy had significant impacts on the supply patterns of TIL and HIL. More importantly, regional differences were notable among the four economic-geographical regions. Therefore, it is necessary to study the driving forces of industrial land supply at the regional level. Tables 4 and 5 present 16 estimation results of the four regions during the two transition periods. As noted above, our discussion focuses on the three driving factors: strategic interaction, path dependence, and socioeconomic development level.

5.2.1. Strategic interaction

Tables 4 and 5 show that the spatially lagged dependent variables are statistically significant in 11 models, but the time-spatial lagged dependent variables are statistically significant in 13 models, indicating that local governments formulating their industrial land supply plans paid more attention to the contemporaneous behavior of neighboring cities than their historical behavior. Specifically, nearly all of the spatially lagged dependent variables are statistically significant in the eastern, central, and western regions, suggesting that strategic interaction with respect to industrial land supply occurred in most Chinese cities. Moreover, the coefficients for the variables are positive in the eastern and central regions, but negative in the western region during different periods. Cities in the eastern and central regions tended to adopt similar industrial land supply strategies, but in the western region, the strategic interaction among local governments had the characteristic of the adage that “The more there is of mine, the less there is of yours.” Surprisingly, there was no strategic interaction in the northeastern region, indicating that local governments did not consider inter-regional competition when formulating their industrial land supply plans.

5.2.2. Path independence

The path independence between the two types of industrial land supply is different. In terms of TIL supply, the coefficients of all time-lagged dependent variables are significantly positive during the two transitions in the eastern, central, and western regions. This discovery shows that in cities with large TIL supplies, the cities were inclined to see a rise of supply during the next phase due to the “inertia,” even under the “New-type Urbanization” and “Innovation-driven Development” scenarios, during which supply fell sharply. However, the regression results are quite different in the northeastern region where a negative path dependence opposite of what was found during the “Fiscal Stimulus Package” period appeared. In terms of HIL supply, there is a discrepancy in the path dependencies in the four regions. During the “Fiscal Stimulus Package” period, the coefficients of the time-lagged dependent variables are significantly positive in the central and western regions but negative in the northeastern region. During the

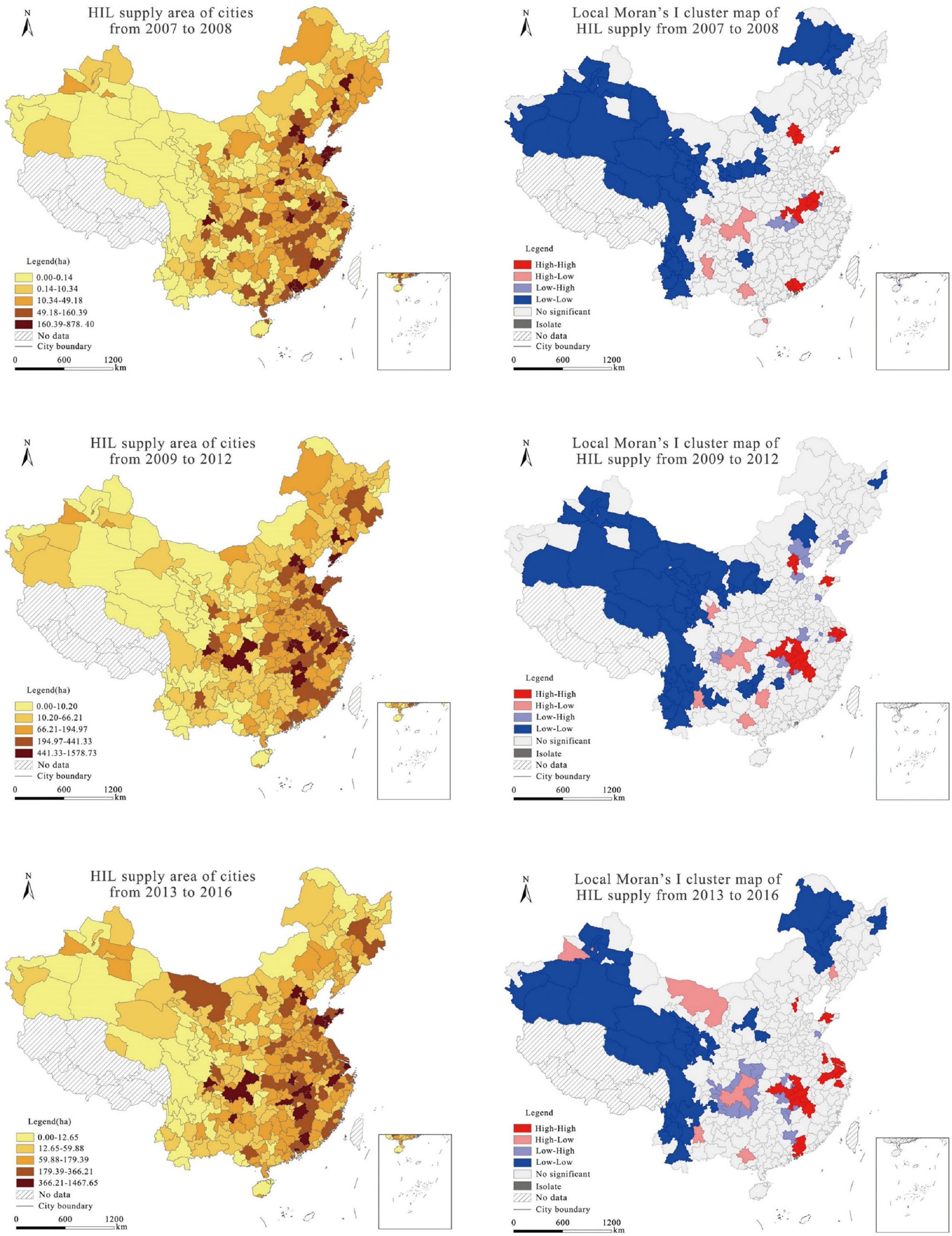

Fig. 6. Spatio-temporal patterns of HIL supply during different periods.

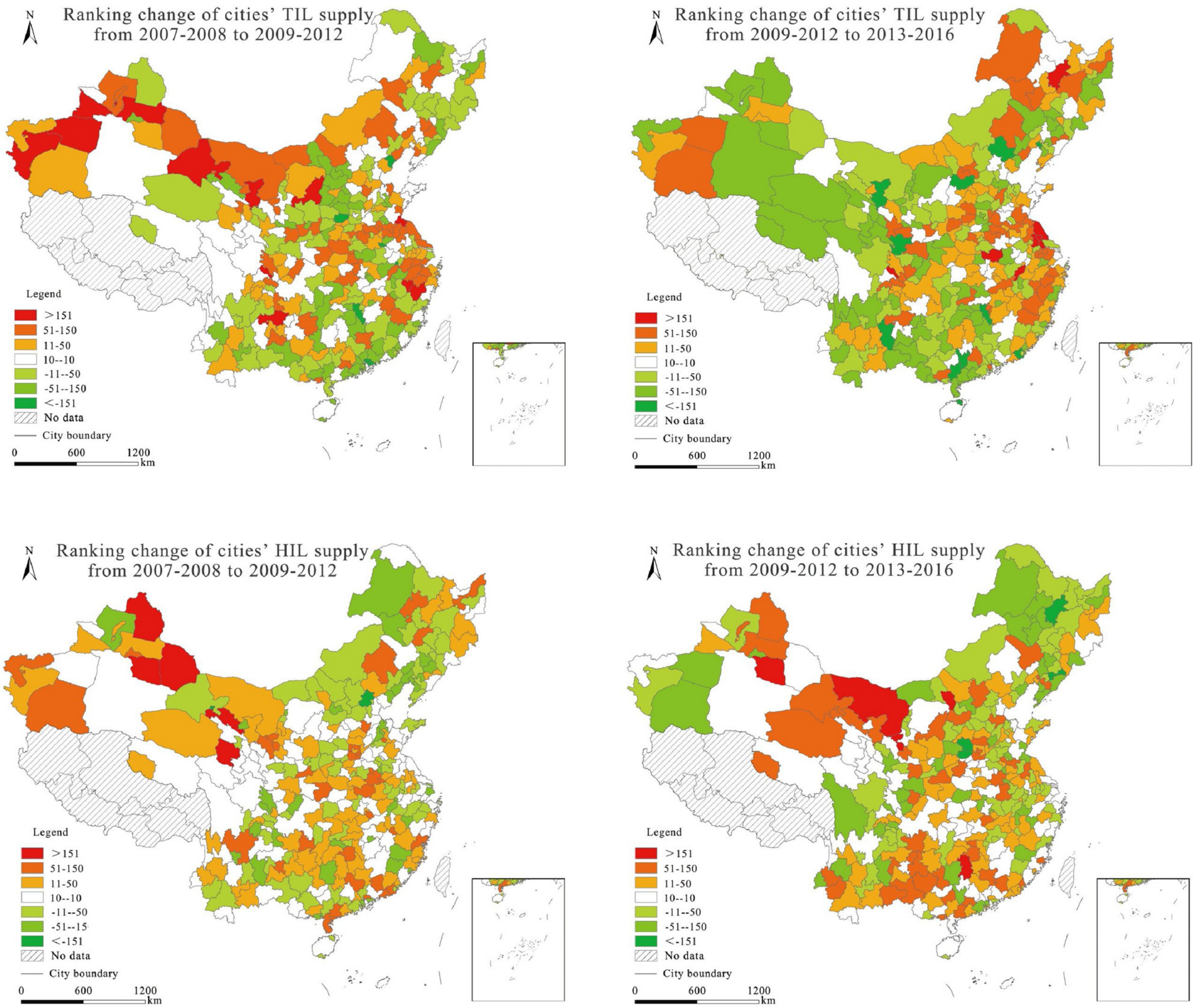

Fig. 7. Ranking changes of cities' TIL and HIL supply before and after transitions.

Table 4
Estimation results of TIL supply.

Variables	TIL supply							
	Eastern region		Central region		Western region		Northeastern region	
	2009-2012	2013-2016	2009-2012	2013-2016	2009-2012	2013-2016	2009-2012	2013-2016
W	0.23^{***} (0.07)	0.30^{***} (0.06)	0.20^{***} (0.07)	0.31^{***}(0.07)	-0.24^{***}(0.07)	-0.18^{***}(0.07)	0.18(0.11)	0.25^{**}(0.10)
W_{t-1}	0.11(0.09)	-0.17^{**}(0.08)	−0.12(0.11)	0.04(0.09)	0.10(0.12)	0.23(0.18)	0.25(0.22)	0.32^{*}(0.19)
Y_{t-1}	0.17^{***}(0.05)	0.49^{***}(0.05)	0.27^{***}(0.06)	0.12^{**}(0.06)	0.14^{**}(0.07)	0.10^{**}(0.05)	-0.46^{***}(0.10)	0.10(0.09)
ln GDP	−374.58(294.95)	-663.24^{*}(401.48)	36.95(139.96)	−244.83(153.10)	356.68^{*}(198.15)	-253.72^{**}(105.94)	169.27(264.48)	-679.07^{**}(323.36)
GDPGR	−4.53(10.58)	0.83(2.31)	5.48(4.57)	0.26(4.16)	6.44(5.89)	−4.13(3.04)	6.39(7.75)	1.91(3.41)
INVG	353.64^{*}(200.82)	−39.99(279.65)	379.41^{***}(102.40)	-269.72^{**}(123.39)	−83.45(119.21)	18.60(56.93)	443.96^{**}(184.98)	−0.26(1.10)
FRC	405.85(318.55)	865.21^{**}(433.04)	−100.54(145.08)	53.67(78.81)	−90.57(65.44)	−18.73(35.69)	−88.25(126.07)	44.87(94.32)
ln NUME	426.13^{*}(259.83)	44.59(76.05)	109.48(74.94)	47.46(53.33)	70.59(132.76)	-125.29^{**}(54.95)	−92.24(231.19)	-384.17^{**}(180.48)
ln AWS	685.98^{**}(311.79)	112.91(305.16)	27.12(136.97)	-204.77^{*}(111.89)	−103.73(265.97)	−55.33(42.37)	179.74(363.33)	32.28(204.99)
INDG	48.84^{**}(22.71)	41.07(30.09)	7.73(9.84)	−13.18(12.19)	−4.39(11.20)	17.27^{**}(8.76)	23.91(20.11)	11.12(14.26)
SERG	14.89(26.58)	70.91^{**}(35.45)	−5.85(14.06)	−2.97(12.94)	−10.43(13.80)	10.53(10.12)	24.73(19.09)	0.88(2.12)
NUMZ	31.94^{*}(18.68)	22.75(23.97)	4.74(16.96)	−47.90(25.04)	22.95(34.78)	-68.27^{**}(33.07)	−59.91(54.61)	122.54^{**}(62.23)
NUMS	−3.60(14.17)	−0.88(1.54)	28.82^{***}(10.19)	3.20^{***}(0.99)	0.02^{*}(0.00)	0.07^{***}(0.02)	−19.75(42.27)	3.90(2.59)
N	340	340	316	316	332	332	132	132
R^2	0.21	0.45	0.40	0.63	0.22	0.44	0.36	0.46

Note: Standard errors are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table 5
Estimation results of HIL supply.

Variables	HIL supply							
	Eastern region		Central region		Western region		Northeastern region	
	2009-2012	2013-2016	2009-2012	2013-2016	2009-2012	2013-2016	2009-2012	2013-2016
W	0.11**(0.05)	0.18***(0.07)	0.01(0.08)	0.20***(0.08)	−0.18**(0.08)	0.11(0.13)	0.11(0.12)	−0.08(0.12)
W_{t-1}	0.17*(0.09)	−0.12(0.10)	0.14(0.11)	0.04(0.09)	−0.05(0.12)	−0.01(0.08)	0.08(0.17)	−0.02(0.12)
Y_{t-1}	0.07(0.06)	0.28***(0.06)	0.34***(0.06)	0.01(0.05)	0.30***(0.07)	−0.12**(0.05)	−0.38***(0.08)	0.51***(0.06)
ln GDP	−36.46(41.43)	−157.90***(56.19)	−29.37(30.66)	−29.60*(16.65)	15.87(20.82)	−46.51**(17.38)	−27.97(47.89)	−26.03(24.39)
GDPGR	−0.11(1.52)	−0.06(0.33)	0.60(1.50)	−0.81(0.92)	−0.93(0.63)	−0.12(0.52)	1.50***(0.31)	0.20(0.25)
INVG	31.03(27.96)	−27.40(39.42)	65.22***(23.55)	−7.38(26.11)	8.69(12.68)	13.53(9.83)	−17.62(35.81)	−13.41***(4.49)
FRC	94.12**(44.31)	−18.03(60.31)	13.63(34.07)	−1.58(16.99)	−0.28(0.96)	4.23(6.06)	13.28(24.60)	2.11(6.82)
ln NUME	18.65(36.22)	31.39***(10.67)	7.21(16.92)	−8.96(11.48)	−12.55(14.18)	−17.95*(9.46)	−50.37(44.58)	−2.31(12.92)
ln AWS	33.58(43.23)	69.41*(41.94)	1.52(31.75)	−24.93(23.74)	−1.17(2.92)	18.14**(7.18)	44.33(71.28)	7.36(14.00)
INDG	1.67 (3.15	5.45(4.21)	0.90(2.29)	−3.69**(1.83)	0.94(1.22)	−1.16(1.50)	1.24(3.99)	0.67(1.02)
SERG	8.40**(3.66)	3.60(4.94)	1.42(3.22)	−3.63**(1.82)	0.31(0.83)	−1.61(1.69)	2.53(3.72)	0.12(1.32)
NUMZ	−1.15(2.63)	9.67***(2.63)	−0.88(3.85)	−8.03**(3.80)	2.60(3.84)	4.23(5.66)	14.16(10.66)	−3.03(0.49)
NUMS	−4.46**(1.97)	0.29**(0.13)	9.49***(2.59)	0.13(0.21)	0.00(0.00)	0.03**(0.00)	−12.03(8.35)	−0.21(4.47)
N	340	340	316	316	332	332	132	132
R^2	0.16	0.18	0.26	0.29	0.10	0.26	0.33	0.41

Note: Standard errors are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

second transition, there is positive path independence in the eastern and northeastern regions but negative path dependence in the western region.

5.2.3. Socioeconomic development level

Our results show that cities at different levels of socioeconomic development had various responses to the two state strategic transitions. In terms of TIL supply, cities with higher levels of socioeconomic development were more responsive to the transitions. Under the "Fiscal Stimulus Package," such cities had a significant role in promoting TIL supply. For instance, in the eastern region, for every increase of 1% in the number of employees, the proportion of fixed asset investments to GDP, and average wages increase TIL supply by 4.27 ha, 3.54 ha, and 6.85 ha, respectively. After 2013, this promotion effect quickly turned into a suppression effect. For example, for every 1% increase in GDP, a given city's supply drops by 6.63 ha, 2.45 ha, 2.53 ha, and 6.79 ha in the eastern, central, western, and northeastern regions, respectively.

In terms of HIL supply, Table 5 shows that during the period of the "New-type Urbanization" and "Innovation-driven Development," the HIL supply was more closely related to the socioeconomic development level of cities, and there was an increase in the number of significant socioeconomic variables across the country, especially in the central and western regions, which increased from 2 to 4 and 0 to 5, respectively. At the same time, the GDP variable was not statistically significant from 2009 to 2012, but was significant and negative from 2013 to 2016 in the eastern, central, and western regions, indicating that the smaller the economic volume of the city, the more willing it was to supply more industrial land under the second transition in state strategy. It is noteworthy that when compared with the other three regions, there are few significant socioeconomic development variables in the northeastern region, especially in the supply of HIL.

6. Discussion

6.1. Divergence of response model in the four regions in China

6.1.1. The eastern and central regions

In the eastern and central regions, the response of cities was led by urban agglomerations, and two distinct large-scale belts with a high supply of industrial land emerged gradually with the two transitions (Fig. 8). One was the TIL supply belt, located in the BTH, the SDP, and the YRD. The other was the HIL supply belt, consisting of the YRD, the

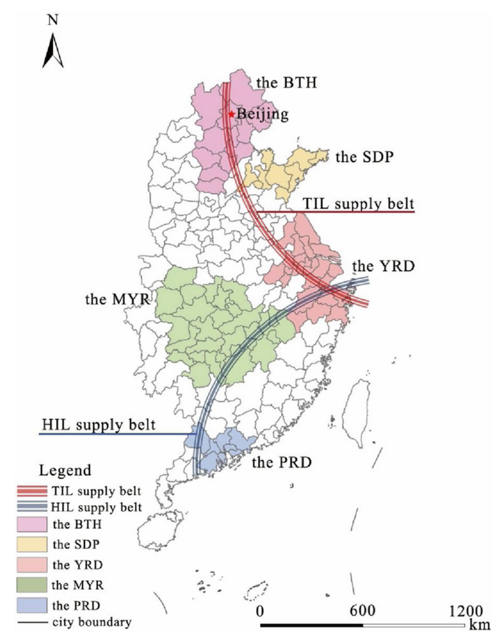

Fig. 8. Two distinct large-belts of TIL and HIL supply in the eastern and central regions.

MYR, and the PRD. Meanwhile, regardless of TIL or HIL supply, the actions of local governments were significantly impacted by their neighbors, and they adopted similar land supply policies during different transitional periods.

In the BTH and the SDP, the development of most cities depended on resource-based industries, on which the financial crisis in 2008 had a severe influence. (Naughton, 2009; Li and Zhang, 2014). After the introduction of the "Fiscal Stimulus Package," the heavy pressure of bailouts forced local governments to stimulate the re-emergence of traditional industries which stimulated the large-scale supply of TIL. After the 18th CPC national congress in 2012, cities in these two urban agglomerations began to adjust their industrial policies and land supply plans. Whether aimed at resource endowment or the business environment, the seeds of traditional industry had been deeply instilled in these areas (Liu et al., 2016).

In contrast, the MYR and the PRD were given great importance to industrial transformation after the financial crisis. For example, in the MYR, the Wuhan metropolitan area and the Changsha-Zhuzhou-Xiangtan metropolitan area were designated in 2008 as resource-friendly and environmentally friendly demonstration areas by the central government. This designation encouraged the two areas to pay more attention to industrial transformation. As the forerunner of China's high-tech industrial economy, the PRD began to implement a policy of promoting the outward transfer of labor-intensive and resource-based industries in 2008. Beginning in 2008, the policy resulted in 84,000 traditional industrial enterprises being transferred or eliminated, and 18,000 high-tech enterprises were introduced over the next three years. Accordingly, the supply structure of industrial land changed dramatically (Jiang et al., 2014). With the implementation of the "Innovation-driven Development" strategy, these two urban agglomerations further increased their proportion of HIL supply from 2013 to 2016.

The YRD is the intersection of two large-scale industrial land supply belts. As the urban agglomeration with the largest economic volume in China, this urban agglomeration's industrial (should this be "industries" or some other word? added value accounts for more than 20% of the national total, and both traditional industries and high-tech industries have helped form the backbone of China's economy (Sun and Du, 2010). A solid industrial foundation and favorable geographic conditions have equipped the YRD to better seize the opportunities provided by state strategic transitions and to effectively distribute the development of the two types of industries.

In terms of mimetic strategy interaction among cities, we believe this is the result of the super-positioning of the relatively developed industrial economy and the political-economic mechanism by which China's economic performance is linked to the "career advancement of public officials" (Tian and Ma, 2009; Pan et al., 2015; Tian, 2015).

6.1.2. The western region

In the western region, most cities, whether provincial capitals, municipalities or small and medium-sized cities, demonstrated an active and strong response to the two transitions, but showed the characteristics of a siphon effect. Meanwhile, local governments interacted in a zero-sum game in the western region, which was quite different from the eastern and central regions.

As a developing region, why the western region demonstrated an active response to the two transitions is worthy of exploring. First, most western cities hope to facilitate urban development through a top-down administrative intervention. Therefore, industrial land becomes an important tool. Second, a series of preferential policies was provided for the western region. For example, during the "Fiscal Stimulus Package" period, the central government issued an official document which emphasized that major infrastructure construction funds, such as those geared towards railways, airports and power grids, should be guided toward the western region. As a consequence, significant investment promoted the development of traditional industries such as the steel, metallurgy and building materials industries, leading to the large-scale expansion of industry and land (Li et al., 2018). As "Innovation" became the keyword of China's development, investment in innovation in the western region increased substantially, with an actual growth rate from 2013 to 2016 (68.6%) that outpaced that of the eastern region (67.3%) (Li et al., 2018). The new version of the China Western Development plan emphasized that all cities should actively respond to the "Innovation-driven Development" and enhance their level of high-tech industrial development. The zero-sum competition can be explained by the fact that market resources were limited in the western region, and the increase in high-tech enterprises in some cities was made at the cost of a decrease in other cities.

6.1.3. The northeastern region

Compared with the other three regions, the industrial land supply in the northeastern region was not sensitive to the two transitions, and there was no strategic interaction among cities during the different periods. Over the past decade, the industrial economy in the northeastern region had been in a state of comprehensive decline, which had a direct impact on the supply of industrial land and the response of cities. There are two reasons for the decline. First, the proportion of resource-based industry in this region was very high, and state-owned enterprises dominated the economy. These two features led to many enterprises experiencing serious development shortages, such as overcapacity, low-end products, and insufficient investment in research and development (Golley, 2002; Hong et al., 2014). Second, population outflow was a serious problem. According to the 6th Population Census, the net population migration in the northeastern region reached 2.19 million in 2010 alone. Therefore, regardless of the type of industry, the distorted and rigid economic market was not attractive to enterprises. Coupled with the booming development of the other three regions, the northeastern region was not sensitive to business concerns, and sometimes even contradicted state strategic transitions.

6.2. Various responses from cities with different levels of socioeconomic development

This research indicates various responses of cities at different levels of socioeconomic development. In terms of TIL supply, cities with a higher socioeconomic development level were more responsive to the two transitions. When it came to the "Fiscal Stimulus Package," they would supply more TIL, but in response to the "New-type Urbanization" and "Innovation-driven Development," they preferred to reduce land supply. In terms of HIL supply, the influence of the socioeconomic development level was significantly enhanced during the second transitional period. Among them, the smaller the economic volume of the city, the more willing it was to supply industrial land for high-tech industrial enterprises.

As the engine of China's rapid industrialization, traditional industry has played an important role in the socioeconomic development of most cities. It has had a significant positive correlation with GDP, fixed asset investment, employment and other indicators (Jefferson et al., 2008; Hong et al., 2014). The critical factor is that the higher the socioeconomic development level of a city, the more experience its local government will have had with traditional industrial operations (Thun, 2004; Jiang et al., 2014). Therefore, in the face of a sharp transition in state strategy, such governments could shape a more flexible supply plan in order to improve their political and economic performance. Since the 18th CPC national congress, "Innovation" has become the new core of China's development and most cities now pay more attention to attracting investment in high-tech industries. At the same time, as a key driving force of China's economic transformation, high-tech industry remains an emerging industry, lacking experience in attracting investment and operations in most local governments. This unstable industrial development had provided new opportunities for some cities with smaller economies. They had sought a head start in innovative development during the transitional period, aiming to attract more investment from high-tech industrial enterprises.

7. Conclusion

As a powerful tool for local economic growth and government competition, industrial land supply plays a pivotal role in China's urban and regional development. Based on Chinese prefecture-level cities' panel data from 2007 to 2016, this paper investigates how industrial land supply responded to two key transitions in state strategy in China: the "Fiscal Stimulus Package" of 2008 and the "New-type Urbanization" and "Innovation-driven Development" of 2012. The results show that a response bifurcation of cities occurred in the four economic-geographical regions in China. In the eastern and central regions, the response was led by urban agglomerations, and two distinct large-scale supply belts of TIL and HIL gradually emerged. Local governments' supply behavior tends to mimic that of their neighbors. In the western region, most cities demonstrated an active response to the two transitions, and there existed a zero-sum competition among local governments. In the northeastern region, regardless of the TIL of HIL supply, the response was not sensitive, and there was no strategic interaction among its cities. Secondly, we find varied responses from cities of different socioeconomic development levels. In terms of TIL supply, cities with higher socioeconomic levels were more adaptive to the transitions. In terms of HIL supply, cities all across China paid more attention to attracting investment in high-tech industries during the second transitional period. Among them, the smaller the economic volume of the city, the more willing they were to supply more land for high-tech enterprises.

Given the diverse responses of cities in China to the two state strategic transitions, some cities were able to adjust and optimize their industrial land supply paths, while some cities' responses to the transitions were static. Therefore, when formulating major state strategies, the central government should develop gradient path guidance for cities in different regions and socioeconomic development levels, which would help cities understand how to maximize the positive effects of these transitions (Su et al., 2017).

Based on the bifurcated responses of the four regions, the following implications of the various regional industrial land supply policies are proposed. In the eastern and central regions, local governments in the BTH and the SDP could attach importance to the supply of HIL, and increase investment in related industries. In the western region, most cities benefited significantly from the two transitions, but the siphon effect of municipalities and provincial capitals was still very significant. In order to enhance the implementation of state strategies, the central and local governments are encouraged to promote inter-regional coordinated development policies and support ordinary cities with carrying capacity to more actively connect inter-regional industries. In the northeastern region, local governments should improve their cities' investment environment, seize new opportunities for the development of high-tech industries, and try to establish industrial transfer relations with more developed provinces like Guangdong and Zhejiang. In general, different policies based on the socio-development level of various regions, rather than "one-size-fits-all" policies, are beneficial for national and regional comprehensive development.

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