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# State Intervention in Land Supply and Its Impact on Real Estate Investment in China: Evidence from Prefecture-Level Cities

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Abstract: State intervention in land supply can be a powerful tool in shaping real estate investment. Yet, few studies have examined the effect of central state intervention on land supply at the municipal level and the impact of land supply on real estate investment with respect to different tiers of prefecture-level cities in China. Varying central-local dynamics of land supply in different tiers of cities, and the often taken-for-granted relationship between land supply and real estate investment, warrant further investigation. This study aims to fill these gaps. It is found that the multi-purposed central land policy and the varying land leasing strategies adopted by different tiers of cities contribute to the varying land supply trajectories, calling for more nuanced and better-tailored central land policies that focus on the socioeconomic conditions of cities. The general significant and positive correlation between land supply and real estate investment, revealed by a panel regression analysis incorporating 280 prefecture-level Chinese cities, suggests that land supply control can function as a critical tool in governing real estate investment in China, which also sheds light on the governance and promotion of sustainable real estate markets in other parts of the world. This study also reveals a higher possibility of land speculation in first- and second-tier cities than that of low-tier cities. The nuanced correlations between land supply and real estate investment and the varying land development strategies employed in different tiers of Chinese cities imply that the effectiveness of land supply intervention in shaping healthy real estate investment may depend on local contingencies, calling for meticulous and tailored governance on land supply and real estate investment behaviors.

**Keywords:** state intervention; land supply; real estate investment; land speculation; prefecture-level cities; China

# 1. Introduction

Holding a critical position in the economy, the real estate sector is regarded as a pillar industry in China. China has witnessed a tremendous increase in real estate investment, from 361 billion RMB in 1998 to 10,258 billion RMB in 2016, and its contribution to GDP has grown from 4.237% in 1998 to 13.785% in 2016 [1]. Concomitant with the burgeoning real estate development, adverse issues such as overheated real estate investment have emerged, as evidenced by the mushrooming development zones in the 1990s and the "ghost city" phenomenon in the 2000s. Overheated real estate investment leads to detrimental socioeconomic and environmental consequences such as real estate bubbles, financial crisis, loss of farmland, and environmental degradation in China [2]. It is thus imperative to ensure the healthy operations of the real estate market to promote sustainable development.



To alleviate market failures and externalities, state intervention is justified as being indispensable to the real estate industry [3–5]. In China, land supply control has been widely acknowledged as a crucial tool of state intervention in shaping real estate investment [6–8], along with other measures such as fiscal policies [9], credit control, and interest rate adjustments [10–12]. Since urban land is owned by the state, and the state possesses the right to expropriate rural collective-owned land for urban development, the state holds substantial control over urban land supply for real estate development [8], which offers a base for its intervention in the real estate market.

The mechanism and effectiveness of the central state's intervention in real estate investment through the means of land supply lie in the central-local relations of land supply as well as the relationship between land supply and real estate investment. The interactions between central and local governments with respect to land supply reveal an uneasy relationship between the two. It is acknowledged that while the central state is more concerned about national-level issues such as land use efficiency, food security and environmental sustainability, local states possess strong political and financial incentives to boost land development to enhance local fiscal revenue and economic growth [13,14]. Nonetheless, the central and local states do not always hold conflicting views about land supply. The central state utilizes land as a key instrument of macroeconomic regulation to manage economic expansion and contraction [15]. It can also favor land supply for certain regions over others to promote regional economic balance, resulting in varying land supply outcomes among regions [6]. In addition, cities of various sizes and administrative statuses can adopt different land supply strategies. Large Chinese cities may deliberately supply limited amounts of urban land for housing and commercial development in order to boost land prices and increase land revenue, whereas medium- and small-sized cities lease large amounts of residential and commercial land at low prices to attract investment and promote economic development [16].

Nonetheless, in exploring the impact of the central state land policies on land supply outcomes at the local level, much emphasis has been placed on the regional differences (e.g., coastal region vs. inland region; see [6,17], with little attention being paid to different tiers of Chinese cities.

There is no official definition for different tiers of Chinese cities. This study adopts a 2017 classification by *Finance and Economics Daily*, a recognized media in China that specializes in reports on financial and economic analyses (http://www.mrcjcn.com/n/244679.html). The criteria used for this classification include socioeconomic indicators such as GDP, average household income, number of top 500 enterprises, number of top universities, etc. Chinese prefecture-level cities are then classified into five tiers. The higher the tier, the greater the socioeconomic strength the cities hold. First-tier cities include Beijing, Shanghai, Guangzhou, Shenzhen, and Tianjin. Second-tier cities include major capital cities of each province and some other large cities. Third- and fourth-tier cities are usually medium-sized prefecture-level cities, and the fifth-tier cities are usually small prefecture-level cities. Although different classifications exist, the discrepancies between them are limited.

Although there are some correlations between regions and hierarchies of Chinese cities (e.g., most first- and second-tier cities are located in the coastal region, and the inland region is the home to many low-tier cities), such correlations are not predetermined or fixed. The broad-brush regional policy orientations bear the risk of overlooking various socioeconomic conditions of cities within the region, which may impede the delivery of sustainable and effective land governance. Consequently, the dynamics and complexities in central-local relations regarding land supply and their impact on different tiers of cities call for more investigation.

The relationship between land supply and real estate investment seems self-evident, as land is a prerequisite for any real estate project. Nonetheless, increased land supply does not necessarily boost real estate investment in severe land speculation, a noteworthy issue in many Chinese cities [18]. Additionally, restricted supply of new construction land may not restrain real estate investment when redevelopment prevails. Consequently, the relationship between land supply and real estate investment should not be taken for granted and deserves scrutiny, and could offer empirical evidence for state intervention in real estate investment via the control of land supply. Moreover, the impact of

land supply on real estate investment may vary among different Chinese cities, since developers in developed regions are more inclined to participate in land speculation than their counterparts in less developed regions [19]. Yet, empirical evidence of land speculation in different tiers of Chinese cities is lacking in the existing literature. The study of the impact of land supply on real estate investment in different tiers of cities can shed critical light on this issue.

This study explores the impact of central state intervention on land supply at the local level and its influence on real estate investment in prefecture-level cities in China. Due to data limitations in specific types of land supply (e.g., residential, commercial, industrial, etc.) in prefecture-level cities, some studies employ total land supply as a proxy for residential land supply in studying the relationship between land supply and housing investment (e.g., [17]). To overcome data limitation, this study investigates the relationship between overall real estate investment and the total amount of land supply, at the expense of the subtleties of different land types (e.g., residential, commercial, industrial; see references [20,21]) and land leasing means (e.g., negotiation, listing, auction, tender; see references [22]). Such broad-brush treatment to real estate investment and land supply may not well capture one specific type of real estate investment (e.g., residential, commercial, etc.), yet it offers a fundamental attempt to explore the relationship between land supply and real estate investment from which future studies can develop.

The remainder of this article proceeds as follows. The next section offers a conceptual framework for state intervention in land supply and its impact on real estate investment. It is followed by empirical analysis that examines the central state's land supply interventions, land supply outcomes and their impact on real estate investment in different tiers of prefecture-level Chinese cities. The final section summarizes the findings, makes policy recommendations, highlights the limitations of this study, and reflects theoretically on state intervention, land supply, and real estate investment.

## 2. State Intervention in Land Supply and its Impact on Real Estate Investment

State intervention in the land market has generated various discourses. On the one hand, state interventions in the land market are considered essential in reducing externalities and negative social consequences, as well as providing public goods [3–5]. On the other hand, studies argue that state intervention may distort the land market and reduce market efficiency [23,24]. To these researchers, although government intervention is important for the land market, land policies, no matter how well intended, may cause problems such as unintended resource misallocation and productivity loss [25]. Coase contends that state intervention will lead to resource misallocation if state actions are not subject to market rules [26]. Public choice scholars regard government as a self-interested strategic player that attempts to maximize its own revenue and political support (e.g., reference [27]). Nonetheless, the necessity of state intervention in the land market is generally acknowledged among scholars. The question is not about making a choice between the state and the market, but how to ensure effective governance.

In the Chinese context, state intervention in the land market is an indispensable means to stabilize real estate investment. Functioning as a regulator, market builder, planner, developer, and owner of urban land, the state is a predominant, ubiquitous and inextricable player in the land market [28]. The state holds substantial control over urban land supply for real estate development, making land supply a critical tool of the state in shaping real estate investment and urban development [8]. Given its multiple roles in the land market, the state can shape urban land supply through a variety of means such as land use policies and regulations (e.g., references [7,29–32]), direct investment in land development (e.g., references [33–35]), urban and regional planning (e.g., references [36–39]), and land leasing (e.g., references [22,40]).

The impact of the central state's intervention in land supply on municipal levels in China warrants a proper comprehension of the central-local relations in land supply. The Chinese central state holds mixed attitudes toward land development, in which land leasing revenue and property-led economic growth are welcomed, but national-level issues associated with land development such as land use efficiency, food security, agriculture related expenditures, environmental sustainability, and social stability are of serious concern [13,14]. As a result, government departments at national and provincial levels are more involved in formulating policy and supervision than their local counterparts [8]. The Chinese Communist Party also uses land as a key instrument of macroeconomic regulation to manage economic expansion and contraction, to restrain land supply when the economy is overheated, and to promote land supply when the economy becomes stagnant [15]. In addition, the central state can allocate more land supply quota toward less-developed regions to achieve regional economic balance [6]. More importantly, for the Chinese central state, control over land is an essential element of socialism that should never be compromised or abandoned [13].

Compared with the central state, local states in China favor leasing more land since spending on agricultural-related and food supply programs are less of a local responsibility [8]. As the *de facto* owners of urban land that possess monopolistic power over land development, China's local states have strong financial (i.e., land leasing fees as a means to promote local fiscal revenue and economic development) and political (i.e., local leader's career advancement through impressive economic growth) incentives to promote land supply and real estate development, which gives rise to the "Chinese land-driven growth machine" [37] and the regime of "land finance" [41–43]. Similar notions of "state entrepreneurialism" [39], "local developmental state" [44], and "state-led urbanization" [45] have highlighted the pro-growth nature and active role of China's local states in promoting land development and urbanization. The entrepreneurial nature of the local state [39] has meant that it is not a disinterested regulatory third party with regards to land and economic development. Although the central state has gradually strengthened its regulatory power in land supply since the late 1990s [31,46], its rules and regulations (e.g., land use quotas) have often been circumvented or violated by the local state in order to pursue growth [32].

It is significant to note that cities in China may employ different land leasing strategies, thus affecting the effects of the central state's land supply interventions. For instance, to maximize land revenue, local governments in first- and second-tier cities often deliberately release a limited amount of urban land for residential and commercial development in order to boost land prices [47], hoping to compensate for low industrial land revenue [20]. Li finds that, compared to first- and second-tier cities, low-tier cities have more difficulties in achieving economic restructuring and upgrading, due to the lack of qualified professionals and high technological sectors [16]. Consequently, low-tier cities generally apply a less strict land control policy than first- and second-tier cities to promote economic development by releasing a large amount of residential and commercial land with moderate-to-low land prices [16]. The fact that overbuilding (e.g., the 'ghost city' phenomenon) mostly occurs in low-tier Chinese cities is a case in point [16]. Consequently, varying land supply outcomes may be witnessed among different tiers of Chinese cities.

Among many forces affecting real estate investment, land supply is a crucial factor because land is a prerequisite for real estate development and investment. Yet, while increased land supply supposedly leads to rising real estate investment in a normal land market, this may not be the case when developers hold undeveloped land for appreciation in the future instead of immediately building on the land. Although the Chinese central government has strengthened its monitoring of the leased idle land, land speculation is still a severe issue in China [18]. Presently, despite the fact that land supply has been widely acknowledged as a critical tool by the state to manage real estate investment in China (e.g., references [7,8]), few studies have incorporated land supply as an independent variable in explaining the dynamics of real estate investment in econometric analysis. Based on their study of 35 major Chinese cities, Deng and Chen find that land supply has a statistically significant and positive effect on housing investment [17]. However, a comprehensive investigation of the impact of land supply on real estate investment in all prefecture-level cities has not been conducted. It is also worth noting that many studies focus on a small sample of cities or provincial-level data in studying China's real estate market (e.g., references [48–53]). Although these studies shed crucial light on the comprehension of the real estate market in China, they may offer an inadequate picture of China's real estate market given the varying socioeconomic conditions of Chinese cities. This study expands the data sample by incorporating all tiers of prefecture-level cities, which yields more comprehensive and accurate empirical evidence.

# 3. Empirical Analysis

## 3.1. The Chinese Central State's Intervention in Land Supply and its Impact on Prefecture-Level Cities

In this study, land supply is defined as the amount of urban land that has been leased from the local state to developers. The Chinese central state constantly devises land policies to restrain land supply when the economy is overheated, or to boost land supply in economic downturns. Four phases of the central state's land supply interventions can be summarized from 1999 to 2016 (see also [7,29]) for up-to-date reviews on the central state's land policies).

Phase I: 1999–2003

This phase marked the beginning of China's housing commercialization after the allocation of welfare housing from state work units was terminated in 1998 [28]. Land supply was increased by the central state to stimulate domestic consumption demand and economic development to cope with the 1997 Asian financial crisis aftermath [15]. The central state's determination to strictly preserve cultivated land and control developed land intensified the conflicts between accelerated urbanization and cultivated land protection [29]. Government organizations, partnered with private developers and some state work units, illegally leased land to developers for real estate development. During this period, numerous development zones, industrial parks, and urban residential districts were developed, and a large amount of rural land was converted to urban uses without appropriate procedures from upper-level governments [51]. The central state's intervention in land supply was fragmented and ineffective, leading to pervasive and chaotic land development nationwide during this period.

• Phase II: 2004–2008

During this phase, the central state strengthened its control over land [14] to reign in the overheated real estate market by employing measures such as cracking down on land speculation, limiting the supply of residential and commercial land, prohibiting the negotiation approach in residential, commercial and industrial land leasing, and imposing more stringent regulatory constraints on rural-urban land conversion. The central state created a 180 million *mu* "red line" for arable land as the baseline for food security. Land quotas were crucial tools to stabilize real estate investment and preserve sufficient amount of cultivated land during this period [15]. At the same time, since 2003, the central state favored allocating more land quotas toward the inland regions, hoping to promote economic balance [6].

Phase III: 2009–2011

In this phase, the central state reversed its restrictive land supply policies to pursue pro-growth policies, and to cope with the 2008 financial crisis [15,17]. Along with the four trillion RMB stimulus package from the central state and a series of monetary and fiscal measures (see references [9,10]), land supply was increased for urban construction, and land quotas were loosened so more land was released into the market [15]. Affordable low- to medium-priced and low- to medium-sized apartments were strongly encouraged [7]. In 2011, the central state continued to increase residential land supply, attempting to curb skyrocketing housing prices. During this period, arable land protection and land use efficiencies were still crucial tasks [15].

#### • Phase IV: 2012–2016

The final phase of the study witnessed the resurgence of restrictive land policies, since the central state again became concerned with an overheated economy. To contain speculative investment from the demand side, policies restraining housing mortgages were implemented [7]. Government rigorously controlled the total amount of construction land supply, and continuously emphasized the strict preservation of cultivated land. Meanwhile, there was a shift from land-use quantity to land-use quality and from cultivated land preservation to comprehensive ecosystem protection [29]. Facing skyrocketing housing prices, the central state attempted to increase the supply of affordable housing and stabilize housing prices. Overbuilding became a noteworthy phenomenon in many Chinese cities (e.g., references [2]), and as a response, there was an initiative by the central state to reduce real estate inventory since 2015. Policies and initiatives were implemented to promote residential land supply for affordable housing and limit speculative investments in the market [7], to optimize land spatial patterns and protect natural ecosystems [29], and to assist with the supply-side structural reform and the new mode of urbanization. There was a focus on differentiated regulations and land supplies to accommodate specific demand-supply conditions in different regions [7]. More construction land quotas were continuously planned to be allocated toward the inland provinces to promote regional economic balance [6].

Figure 1 illustrates the dynamics of China's real estate investment and land supply from 1999 to 2016. In this study, real estate investment refers to the investment made by real estate development companies in land development (excluding land purchasing fees). Real estate investment has undergone several phases. From 1999 to 2009, real estate investment witnessed a steady growth. Although restrictive policies were implemented from 2003 to 2008 by the central state to contain the overheated real estate market, the interventions did not effectively restrain real estate investment because local governments had continued their strong interests in land leasing and economic development. Deng and Chen argue that the ineffectiveness of the central state interventions from 2003 to 2008 lies in the fact that the interventions only responded to perceived issues such as housing market stability and housing affordability, without considering major external disruptions such as economic crisis [17]. However, the situation changed tremendously between 2009 and 2013 when real estate investment experienced explosive growth, due to the consensus between the central and local governments in stimulating real estate development, and the dramatic measures by the central state to deal with the 2008 financial crisis. The growth of real estate investment slowed down from 2014 to 2016 due to the termination of the central state's stimulus package, as well as the resurgence of many restrictive real estate policies, and the oversupply of housing stocks in many medium- and small-sized cities.

The effectiveness of the central state's land supply interventions deserves close examination. Figure 1 shows how the land supply dynamics generally reflect the changing land interventions from the central state. Land supply increased rapidly from 1999 to 2004, resulting from the strong demand for real estate development and ineffective land management at the time [17]. After 2004, following the central state's restrictive land policies, the amount of land supply dropped from 2004 to 2006, and then fluctuated until 2009. The situation changed significantly from 2009 to 2011, when the central state actively promoted land supply and implemented pro-growth strategies to overcome the 2008 global financial crisis aftermath. As a result, land supply experienced explosive growth and reached a historic high in 2011. The growth momentum faded away after 2012 when the central state resumed restrictive land and real estate policies to stabilize the real estate market, demonstrated by a sharp decline in land supply from 2012 to 2016. After 2014, accompanied by a relatively slower economic growth compared with the growth in previous years, and the emphasis on the supply-side structural reform, China's real estate market slowed down under the "economy's new normal" [54].



**Figure 1.** Real estate investment and land leased to developers in China, 1999 to 2016. (Source: National Bureau of Statistics of China 2017).

Figure 2 depicts average annual land supply in different tiers of prefecture-level Chinese cities from 1999 to 2016. It can be observed that land supply in each tier of cities is affected by the central land policy rhetoric to some extent, but with variations. From 1999 to 2003, all tiers of cities experienced growth in average annual land supply. Nonetheless, the growth rates in first- and second-tier cities surpassed those of third- to fifth-tier cities. From 2003 to 2004, cities at two ends of the hierarchy (i.e., first-, fourth-, and fifth-tier cities) saw an increase in average annual land supply, whereas secondand third-tier cities experienced decreases. When the central state implemented restrictive land supply policies in 2004, the average annual land supply declined precipitously in first- and second-tier cities, whereas the changes were more gentle in third-, fourth-, and fifth-tier cities, with the fifth-tier cities even witnessing steady growth in average annual land supply. All cities experienced fluctuations in average annual land supply between 2005 and 2008, as they responded to restrictive national land policies and the global financial crisis. Average annual land supply dynamics were altered tremendously after 2009 when pro-growth rhetoric was endorsed by the central and local governments to battle the 2008 financial crisis aftermath. From 2009 to 2011, average annual land supply increased in all cities, except for a mild fluctuation in first-tier cities. As the central state resumed its restrictive land policies after 2011, cities in all tiers except the fifth-tier witnessed a decline in average annual land supply. This decline was more prominent in first- and second-tier cities than in third- and fourth-tier cities. There was an increase in average annual land supply for all tiers from 2012 to 2013, when the central state enhanced residential land supply to cool down housing prices. After 2013, under the restrictive land supply policies, as well as a relatively stagnant real estate market, all tiers experienced a continuous decline in average annual land supply.



**Figure 2.** Average annual land supply in different tier prefecture-level Chinese cities, 1999 to 2016. (Source: China Land and Resources Statistical Yearbooks, compiled by the authors).

The analysis reveals the varying land supply dynamics between high-tier (i.e., first- and second-tier) and low-tier (i.e., third-, fourth-, and fifth-tier) cities. The difference reflects the various socioeconomic conditions and local governments' different reactions toward central land policies among cities: high-tier cities were relatively less dependent on land development to generate economic development compared with low-tier cities, which lacked a diversified economic base, but had to depend heavily on land leasing with moderate-to-low prices to stimulate land and economic development [16]. Nonetheless, there was a tendency for all cities to become more responsive to central land policies after 2012, when the central state continued to ameliorate its land management institutions and upgrade the monitoring of land policy implementations at local levels. In addition, the discrepancy in average annual land supply among cities in different tiers can be explained by regional differences in central policy orientations. For instance, since 2003, the central state has intended to allocate more construction land quotas to the inland region [6], which is home to many third-, fourth-, and fifth-tier cities. Given the preferential national policies and the strong desire to promote land development, the average growth rates of land supply in these low-tier cities surpassed those in first- and second-tier cities from 2003 to 2008 under the restrictive central land policies. Finally, land supply dynamics were subject to economic conditions such as a slowing market since 2013.

#### 3.2. The Impact of Land Supply on Real Estate Investment in Prefecture-Level Chinese Cities

This part of the analysis aims to explore the impact of land supply on real estate investment in different-tiers of prefecture-level cities in China. The econometric model adopted in this study is based on previous work on China's real estate investment [11,17,52,55,56], in which several common variables have been employed, such as per capita GDP, average commodity building price, gross floor area of commodity building being sold, interest rates, and land supply. Per capita GDP reflects the possible incentive for real estate investment. Higher per capita GDP would generate demand for real estate properties, thus attracting more real estate investment in the corresponding industries [55,56]. Commodity building prices and sales of commodity building floor area can be viewed as the barometers of the real estate market. A high level of commodity building prices and sales would reinforce the developers' confidence in real estate investment [52,55]. In particular, real estate speculation has been crucial in shaping China's real estate market [57,58], especially under the enhanced capital mobility across Chinese cities and regions that may affect real estate investment outcomes [59]. Consequently, the variable of sold commodity building floor area, induced by both non-speculative and speculative demands for real estate properties, is employed in this study to capture the effect of real estate speculation. In addition, as a key indicator of financial cost, interest rates play a crucial role in real estate investment, albeit with contradictory effects [11,17,52]. Moreover, as previously articulated, land supply could critically affect real estate investment [17].

This analysis established a panel model using annual city-level data for prefecture-level cities from 2000 to 2016. Based on data availability, a total of 280 prefecture-level cities (five first-tier cities, 31 second-tier cities, 84 third-tier cities, 95 fourth-tier cities, and 65 fifth-tier cities) were selected for econometric analysis. The investment in real estate was expressed as a function of current year and one-year lagged land supply, one-year lagged per capita GDP, interest rates, commodity building price, and gross floor area of commodity building being sold. The model was developed in a logarithmic form to interpret a nonlinear relationship between dependent and independent variables, written as the following equation:

$$Ln(REI_{it}) = \lambda_i + \alpha_1 Ln(LS_{it}) + \alpha_2 Ln(LS_{i,t-1}) + \alpha_3 Ln(PGDP_{i,t-1}) + \alpha_4 (IR_{it}) + \alpha_5 Ln(SOLD_{it}) + \alpha_6 Ln(CBP_{it}) + \varepsilon_{it}.$$
(1)

For all variables, subscripts i and t stand for city i and year t, respectively. REI<sub>it</sub> denotes the amount of real estate investment in city i during year t. LS<sub>it</sub> represents land leased to developers in city i during year t, and LS<sub>i,t-1</sub> stands for one-year lag of LS<sub>it</sub>. PGDP<sub>i,t-1</sub> represents one-year lagged per capita GDP in city i during year t. IR<sub>it</sub> is the interest rate in city i during year t. CBP<sub>it</sub> and SOLD<sub>it</sub> denote average commodity building price and gross floor area of commodity building being sold (commodity building includes commodity housing, office buildings, commercial and retail properties, etc.) in city i during year t, respectively.  $\lambda_i$  is unobserved heterogeneity and  $\varepsilon_{it}$  stands for idiosyncratic errors that change across i and t. The same model (Equation (1)) was applied to all prefecture-level cities and each tier of cities. Prior to the regression analysis, unit root test was an essential step to examine the stability of variable sequence to avoid spurious regression [60]. Test results indicated that all variables had unit roots in their level value. However, all variables became stationary in their first difference. Panel co-integration tests were then conducted and the results rejected the null hypothesis of non-co-integration, which was a prerequisite for running the panel regression analysis. Finally, according to the results of the Hausman test [61], fixed effects were adopted for all six models.

## 3.2.1. Data and Variables

Table 1 summarizes the definitions of all variables and their sources. Data for real estate investment, per capita GDP, gross floor area of commodity building being sold, and commodity building price were from *China Regional Economic Statistical Yearbooks* (2001–2014), *China City Statistical Yearbooks* (2001–2017), *Provincial Statistical Yearbooks* (2015–2017), and corresponding Statistical Yearbooks of individual cities if their data were missing in the aforementioned data sources. Land supply data and interest rates were from *China Land and Resources Statistical Yearbooks* and *People's Bank of China*, respectively. Similar to Deng and Chen's analysis of housing investment in China [17], we used nominal values instead of real values for all variables.

#### 3.2.2. Discussion of Results

Table 2 reports the empirical results of all six econometric models. All models have high adjusted R square, indicating strong explanatory power of the results. Although there is a gentle decline of R square from second-tier to fifth-tier cities that may be caused by more noise contained in the data of low-tier cities than that of high-tier cities, the discrepancies remain limited given the overall high level

of R square. The results show that both the same-year and one-year lagged land supply have a positive and statistically significant impact on real estate investment in all cases, except for the same-year land supply in first- and second-tier cities. In first- and second-tier cities, although the one-year lagged land supply has a statistically significant and positive correlation with real estate investment, the coefficients for the same-year land supply are not statistically significant. This suggests that developers in first- and second-tier cities may purchase land ahead of time and hoard it for development/resale at a better time, which is in accordance with existing studies [18,62]. Furthermore, the coefficient for the same-year land supply generally increases from second-tier cities to fifth-tier cities, meaning that the possibility of land hoarding decreases with city size. Developers have great profit motivations to hoard raw land in large cities and wait for land value appreciation [18]. Indeed, recent studies find that compared with rampant land speculation in first- and second-tier cities, third-tier cities have just begun to see increasing land speculation, whereas land speculation in fourth-tier cities is not common [62]. The present study also indicates that land speculation is closely associated with the socioeconomic conditions of cities.

Variable		Definition	Data Source		
Dependent Variable	Real Estate Investment (REI)	Investment made by real estate development companies in land development (excluding land purchasing fees; Unit: million Yuan)	China City Statistical Yearbooks; Provincial Statistical Yearbooks		
Independent Variables	Land Supply (LS)	Area of land leased to developers by local governments (Unit: square kilometers)	China Land and Resources Statistical Yearbooks		
	Per Capita GDP (PGDP) Per capita Gross Domestic Prod (Unit: Yuan)		China Regional Economic Statistical Yearbooks; China City Statistical Yearbooks		
	Interest Rate (IR)	Six-month interest rates for loans	People's Bank of China China Regional Economic Statistic		
	Commodity Building Floor Area Sold (SOLD)	being sold, including commodity housing, office buildings, commercial and retail properties, etc. (Unit: m <sup>2</sup> )	Yearbooks; Provincial Statistical Yearbooks; Statistical Yearbooks of certain individual cities China Regional Economic Statistic		
	Commodity Building Price (CBP)	Average price of commodity building (Unit: Yuan/m <sup>2</sup> )	Yearbooks; Provincial Statistical Yearbooks; Statistical Yearbooks of certain individual cities		

Table 1	. De	finitions	and	data	sources	of	all	varia	bles.
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Table 2 illustrates the relationships between real estate investment and other variables. As Model 1 indicates, when calculated in a single model, both prices and sales of commodity building have statistically significant and positive impacts on real estate investment. Nonetheless, these impacts are not significant in first-tier cities. In contrast, both prices and sales of commodity building are significantly and positively correlated with real estate investment (at the 1% level) in second-, third-, fourth-, and fifth-tier prefecture-level cities. This implies a somewhat unique real estate investment mechanism in China's first-tier cities compared with other tiers of cities. Whereas in second-, third-, fourth-, and fifth-tier prefecture-level cities, developers and investors may take commodity building prices and sales as the barometers in their real estate investment decisions, they may be less sensitive to short-term changes in commodity building prices and sales in first-tier cities because they are confident that the real estate market will always be lucrative in the long-term in first-tier cities.

In addition, one-year lagged per capita GDP has statistically significant and positive impacts on real estate investment in all tiers, highlighting the critical role of demand in shaping real estate investment. However, the coefficient for one-year lagged per capita GDP in first-tier cities is larger than those of other tiers of cities, meaning that the stimulatory effect of the previous year's economic prosperity on real estate investment is higher in first-tier cities than in other cities. Moreover, the coefficients for short-term interest rates vary across different tiers. First-tier cities witness a statistically significant and negative correlation between interest rates and real estate investment, indicating that financial

cost has been a key concern for real estate investment in first-tier cities. In contrast, interest rates have statistically significant and positive correlation with real estate investment in second- and third-tier cities, suggesting that financial costs may not be a decisive factor in developers' decisions in real estate investment in these cities, as the real estate sector is so lucrative that developers become less sensitive to rising costs. Additionally, increase in interest rates is regarded as the signal for a more restrictive real estate market that may actually consolidate potential purchasers' "buy now or lose later" mindset, further favoring the market [17]. Furthermore, there are no statistically significant correlations between interest rates and real estate investment in fourth- and fifth-tier cities. These differences in real estate investment mechanisms among different tiers of prefecture-level cities call for more nuanced real estate governance to achieve sustainable development in China.

	Dependent Variable: Natural Log of Real Estate Investment Ln(REI)						
Independent variables	Model 1: All prefecture-level cities	Model 2: First-tier cities	Model 3: Second-tier cities	Model 4: Third-tier cities	Model 5: Fourth-tier cities	Model 6: Fifth-tier cities	
Constant	0.1721	2.8396 ***	-0.2778	-0.0470	-0.4520 **	0.1399	
	(0.1198)	(0.5604)	(0.2627)	(0.1893)	(0.2063)	(0.3343)	
Ln(SOLD <sub>it</sub> )	0.6229 ***	-0.0541	0.6273 ***	0.5740 ***	0.6337 ***	0.6371 ***	
	(0.0109)	(0.0832)	(0.0324)	(0.0206)	(0.0179)	(0.023)	
Ln(CBP <sub>it</sub> )	0.4775 ***	0.1269	0.5691 ***	0.4630 ***	0.3834 ***	0.5723 ***	
	(0.0221)	(0.1324)	(0.0474)	(0.0351)	(0.035)	(0.0626)	
Ln(PGDP <sub>i,t-1</sub> )	0.5368 ***	1.0993 ***	0.5343 ***	0.5890 ***	0.5850 ***	0.4388 ***	
	(0.0207)	(0.1566)	(0.0507)	(0.0351)	(0.0325)	(0.0508)	
IR <sub>it</sub>	1.6994 *	-13.0451 ***	5.4811 ***	3.4859 **	0.8140	-0.6408	
	(1.0687)	(3.5879)	(1.9757)	(1.4853)	(1.6004)	(2.8117)	
Ln(LS <sub>it</sub> )	0.0532 ***	0.0732	0.0107	0.0437 ***	0.0641 ***	0.0691 ***	
	(0.0086)	(0.0449)	(0.0221)	(0.0139)	(0.0137)	(0.0216)	
$Ln(LS_{i,t-1})$	0.0526 ***	0.0817 *	0.0636 ***	0.0552 ***	0.0456 ***	0.0577 ***	
	(0.0084)	(0.0464)	(0.0209)	(0.0134)	(0.0135)	(0.0207)	
Observations	4760	85	527	1428	1615	1105	
Adjusted R <sup>2</sup>	0.961	0.961	0.965	0.953	0.946	0.903	

Table 2. Estimated results of regression analysis.

Note: \* Significant at 10% level. \*\* Significant at 5% level. \*\*\* Significant at 1% level.

# 4. Conclusions and Discussion

This study explores the central state's intervention in land supply and its impact on real estate investment in prefecture-level cities in China. The central state's intervention in land supply has experienced several phases between 1999 and 2016—from a period of fragmented and ineffective land supply policies (1999–2003), to a period of restrictive yet still less effective land policies (2004–2008), then to a phase of pro-growth land supply policies (2009–2011) to cope with the 2008 financial crisis aftermath, and finally to the period of 2012–2016 with more restrictive and comprehensive land policies. There has been a gradual shift in land governance from land-use quantity to land-use quality, and from single-minded cultivated land preservation to comprehensive ecosystem protection. The phases of the central state's land supply policies in this study echo Rithmire's argument that the Chinese central state uses land supply as a critical tool in managing the national economy to ensure a healthy macroeconomic environment [15].

The central state's interventions in land supply have affected land supply outcomes in prefecture-level cities, with variations. High-tier (i.e., first- and second-tier) cities seem to be more responsive to the central state's restrictive land policies than low-tier (i.e., third-, fourth-, and fifth-tier) cities. Variations in land supply may also be affected by regional differences in central policy orientations and varying land supply strategies adopted by different tiers of cities. Concurrent with the central

state's effort to allocate more land supply quotas toward the inland region (home to many low-tier cities) to tackle the coastal-inland regional imbalance since 2003, low-tier cities are more dependent on land leasing to generate local fiscal revenues and promote economic development than high-tier cities,

which possess a more diverse economic base. Additionally, the fact that China's land regulations are often better implemented and monitored in developed regions than in underdeveloped regions [19] could also contribute to land supply outcomes among different tiers of cities.

This study also finds that land supply has a positive and statistically significant impact on real estate investment in third-, fourth-, and fifth-tier cities, and a less pronounced effect on firstand second-tier cities, where the coefficients for same-year land supply are statistically insignificant. Coupled with the fact that the coefficient for same-year land supply generally increases from secondto fifth-tier cities, there is a greater possibility of land speculation in large cities, especially in firstand second-tier cities. In large cities, due to the continuous demands for land and real estate as well as the ever-rising land prices, developers may purchase land and hoard it for a more lucrative development agenda, a practice that has been noted by others (e.g., [18,63]). Although the possibility of land speculation is lower in low-tier cities, it has been a growing concern in third-tier cities in recent years [62].

The findings illuminate several policy implications. First, central land policies need to consider the dynamics of central-local relations, given different local circumstances. The different land supply outcomes and land leasing strategies in different tiers of cities call for more nuanced and better-tailored national land policies. The emergence of ghost cities as a nationwide phenomenon since the 2000s suggests that land oversupply is not only a regional issue, but also relates to the socioeconomic conditions of cities and the politico-institutional architecture in China. This warrants more effort to reform existing land institutions and to formulate more nuanced policies that pay attention to the subtle socioeconomic conditions of different tiers of cities, in addition to the current emphasis on regional differences (e.g., coastal region vs. inland region). Second, due to the varying land supply outcomes in different tiers of cities, differences in real estate stocks have been witnessed among cities, where high-tier cities have moderate real estate stocks but many low-tier cities suffer surplus of real estate inventory (i.e., overbuilding), and these excessive housing stocks may not necessarily benefit moderateand low-income households [64]. It is thus imperative for the central state to adopt nuanced land policies to promote housing affordability in different tiers of cities. Third, the significant and positive correlation between land supply and real estate investment in most cities implies that land supply can be employed as a crucial tool in governing real estate investment in China. Nonetheless, the enhanced possibility of land speculation with large cities necessitates the central state's strengthening governance in restraining land speculation and promoting sound and rational real estate investment, as well as leaving sufficient room for local authorities to address the nexus between land supply and real estate development. If managed properly, land supply can function as an essential tool for governments to stabilize real estate markets.

The reoccurrence of real estate cycles in the capitalist system has been well documented [65], where the state's intervention in real estate markets is limited. The minimalist approach of state intervention has been proven ineffective in preventing real estate bubbles. Although the state is not an entirely benevolent actor that can always ensure public interests to the maximum, this study highlights the significance of the state's capability in manipulating land supply to sustain a functional real estate market. Through the means of public ownership of urban land, strong state capacity in land supply control, and timely state intervention for sustainability, the Chinese state uses strategies in promoting sustainable real estate markets.

This study has several limitations. First, due to data constraints, the wholesale treatments of land supply and real estate investment overlook subtleties in and interactions between real estate submarkets, such as residential and non-residential investments [66]. Residential and non-residential investments may have different mechanisms. For instance, households' speculative investment in residential properties may directly drive up residential investments, but may not result in equivalent

increase in non-residential investment. Regarding interactions between real estate submarkets, on the one hand, it is claimed that industrial investment can have a spillover effect on residential and commercial developments—industrial development will generate not only long-term tax revenues but also demands for housing and consumption [20]; on the other hand, residential investment may not necessarily favor nearby industrial investment, since the mixture of residential land with industrial land has long been deemed as negative [21]. Merging all types of real estate investments in one model bears the risk of overlooking the off-setting effects of real estate submarkets. Furthermore, although land hoarding has been acknowledged in residential, commercial, and industrial sectors in Chinese cities, their magnitudes vary. Consequently, the impact of land supply on real estate investment may differ among real estate submarkets. With enhanced data availability for land supply and real estate investment, future studies can explore and compare the mechanism between land supply and real estate investment in different real estate submarkets, which will yield more accurate evidence for effective real estate governance.

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