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Does developers' ownership structure shape their market behavior? Evidence from state owned enterprises in Chengdu, Sichuan, 2004–2011

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ABSTRACT

Real estate development is a complex speculative endeavor and developer firms take a variety of forms throughout the world. State run development companies are relatively common and China is no exception. State Owned Enterprises (SOEs) have played a major role in China's transition to a market-based real estate sector, yet we know relatively little about the housing they build relative to private companies currently. To assess how their performance differs from private companies, we use a comprehensive set of georeferenced housing transactions, joined with remote sensing data and data on neighborhood amenities and transportation infrastructure, to analyze the dynamics of the Chengdu housing market from 2004 to 2011. We observe a drop in the variation in housing price and size, as well as a growing premium for larger units that we connect to changes in government regulations. Importantly, we find that units developed by SOE sell at a discount of roughly 7%. To explain this discount, we draw on literature and examine pricing strategy, difficult to measure quality elements, preferred treatment by local governments, and efforts to fulfill social goals related to housing provision. The study outlines directions for future research and we recommend the Chinese government formalize the relationship between SOEs in national housing policy to facilitate the production of lower-cost housing in a more consistent and equitable manner.

1. Introduction

Real estate development is a complex speculative endeavor. As a result, successful developers tend to have strong connections to local governments and financial institutions, and their ownership structures differ from many similarly sized firms (Ball, 2006). Additionally, most countries have a subsidized housing construction program, which incentivizes firms of varying ownership structures to build housing "outside of the market" (Groves, Murie, & Watson, 2007). China is no exception. State Owned Enterprises (SOEs) have played a major role in China's transition to a market-based real estate sector, although their role in the country's various housing subsidy programs varies greatly. Their approach to business differs from private companies for a number of reasons, such as greater access to the government, different kinds of resources, different business motivations, and greater inefficiency. As we show in this paper, they sell housing for less than privately run companies do, and this behavior warrants further attention.

This paper examines the property market of Chengdu and the role of State Owned Enterprise developers. We first analyze how the distribution of housing prices and unit sizes has changed from 2004 to 2011.

Then, we assess the changing market value of different characteristics of housing produced during this using a hedonic regression model. Finally, we examine the price difference between similar housing built by different types of companies, asking whether projects built by SOEs differ as dramatically in Chengdu as they do in Beijing (Wu, Gyourko, & Deng, 2012). Chengdu is a useful case study because it is an average city in many respects. Less scholarly attention has focused on medium-sized cities compared to large cities like Beijing or Shanghai.

Our empirical models draw on several data sources, starting with transaction data provided by the government. This dataset, similar to that used by Zheng and Kahn (2008) for Beijing, covers almost all property transactions in Chengdu from 2004 to 2011; roughly 600,000 sales in about 1400 residential projects. We create measures of neighborhood characteristics based on the location of projects using census data, data on the transportation network, indicators of urban growth estimated based on remote sensing data, and the proximity of publicly provided amenities such as post offices and schools. The data also indicate the name of the developer, and we identify the SOEs and other categories of developer.

We find that, after controlling for unit, project, and neighborhood

characteristics, SOE developers sell housing at a discount of roughly 7%. We outline and discuss several potential reasons for this discount, and test some of them empirically. This is a fruitful area for future work on the structure of developer firms.

The two central dimensions of lower housing unit sales prices are as a strategic move – because of their closer connection to local government – or an indicator of low-profitability. We did not find that in the data there was a significant difference in time-to-sale by developer type. SOE often have existing land reserves and connections to local government, which could subsidize their new developments. As prior work asserts, local regulations and relationships with governments may compel them to meet social goals (Zhang & Rasiah, 2014). It is likely that some unobserved housing characteristics correlate with the type of developer, such as the quality of property management or interior finishing, though it is not likely that this accounts for the large price differences we find. Future work testing these hypotheses explicitly is important.

Our study site also provides a greater understanding of the evolution of an emerging housing market system in China during a boom period, as well an assessment of the importance of strict regulations the Chinese government has imposed to control the housing market.

We begin the paper with a brief discussion of how the ownership structure of developers shapes the housing they build. Then, we review the existing literature on SOEs in China, and contrast them with private companies in various ways. Then we introduce the instrumental case study city, Chengdu, along with the datasets we use to analyze the intra-urban dynamics of the housing boom. The fifth section presents the results of analysis of the spatial dynamics of housing prices in Chengdu, and we conclude with a discussion of implications for further research.

2. Who builds housing?

The complexity and high capital requirements of speculative real estate development have led developers to have strong connections to local governments and financial institutions (Ball, 2006). The ownership structure and business model of real estate developers also differs from similarly sized firms in other industries, and most countries have or have had some form of state-owned or heavily subsidized housing construction industry to build housing for government employees or low-income households (Groves et al., 2007). It is an understudied aspect of scholarship focused on housing and the built environment. Given the importance of urban housing for human life, the way the real estate development industry organizes itself in rapidly urbanizing countries should be a prime research concern (Dipasquale, 1999).

Countries vary in the extent to which developers operate as purely private companies or fully state-owned and managed. Singapore is a relatively extreme case, as the vast majority of housing is publicly built (Phang, 2007) In many countries of Western Europe, a large share of households live in social housing built by non-profit housing associations or the government directly (Scanlon, Fernández Arrigoitia, & Whitehead, 2015). In the United States, a tax-credit programs funds the construction of hundreds of thousands by mostly non-profit housing developers (Bratt, 2008). Even in Latin America, where private developers build social housing, the incentive structures of mortgage finance systems shape their business models considerably (Libertun de Duren, 2018).

In China, SOEs no longer build housing for their employees through the work-unit system. Rather, they are profit-focused enterprises with an organizational culture that resembles foreign companies (Ralston, Terpstra-Tong, Terpstra, Wang, & Egri, 2006). Although, in some cases their connections through local governments coerce them to provide inexpensive housing (Zhang & Rasiah, 2014). The channels through which local governments are expected to build affordable housing in China, however, are unevenly applied across companies and cities (Wang, Wang, & Bramley, 2005), and understudied empirically.

The case of Chinese SOE housing developers is illustrative within the international literature on SOE performance. Research from other countries still show that SOEs have poorer performances due to structural reasons. In Norway, private firms perform much better than SOEs in the market because SOEs tend to have weaker management due to their less effective means to instruct/direct managers (Goldeng, Grünfeld, & Benito, 2008). A global database on SOEs show that SOEs have lower profits than private firms. However, SOEs' inefficiency is mainly attributable to structural reasons instead of ownership itself, especially their high labor intensity and leverage (DeWenter & Malatesta, 2001).

Although there is some empirical evidence on the way SOEs background, internal management structure, and market powers shape their market behavior, these studies focus on manufacturing (Chen & Lin, 2009; Dai & Zhang, 2013) and the financial sector (Yin & Lu, 2009). The present study contributes to a limited but growing body of work focusing on SOE developers (Wang et al., 2005; Zhang & Rasiah, 2014), which has not yet seen the systematic study of price differences between housing developed by different kinds of developers that we provide.

3. State owned enterprises in China's real estate sector

From the founding of the People's Republic of China until the early 1990s, the main source of housing were formerly private housing units or national welfare housing distributed through the *danwei* or work unit system. After China's opening in 1978, work-based welfare housing began to impose a significant financial burden on the government and the housing system began to gradually be reformed. In August 1990, the *Urban State-Owned Land Use, Sale and Transfer Provisional Regulation* came into force. This enabled state-owned land to be mortgaged, leased, transferred and sold, effectively creating a private market for land and housing (Zhu, 1999).

Until 1998, however, housing allocation continued to operate through employment; government or state-owned enterprises bought or built housing and then assigned units to their employees for some small fee (Chen, 1996). The government officially ended the in-kind housing subsidy policy in 1998 and the State Council introduced the *State Council Circular on Further Deepening the Reform of Urban Housing System and Speeding up Housing Construction*. Scholars generally regard this latter reform as the milestone of the marketization of the Chinese real estate sector (Deng, Shen, & Wang, 2011).

Partly because of their dominant role in housing development in prior decades, but also because of the booming housing market, State Owned Enterprises (SOE) from non-real estate sectors play an important role in real estate development across China. With the deepening of housing market reform, the role of private enterprises have gradually increased, and as recently as 2004, SOE represented roughly 40% of the 100 largest real estate enterprises (Feng, 2006) and roughly a third of SOE activities was real-estate related (Zhang & Rasiah, 2014). Some of the decreased presence of SOEs in the real estate sector is the result of government intervention. In 2010, the State-owned Assets Supervision and Administration Commission (SASAC) of China required 78 State-owned companies of China to withdraw gradually from the housing market.

SOEs not traditionally engaged in housing development have over the years established real estate development subsidiaries, buoyed in many cases by access to land and political connections. This expansion has occurred, in spite of the fact that scholars and the mass media have consistently argued that SOEs are inefficient and unprofitable (Schuman, 2012; Perkowski, 2013; Hsu, 2014). Ferri and Liu (2009), for example, find that the existing profits of SOEs would completely disappear if they were to pay a market interest rate without benefiting from current credit subsidies from the government.

Most of the existing literature on SOEs in China focuses on their non-real estate development activities, with the notable exceptions of
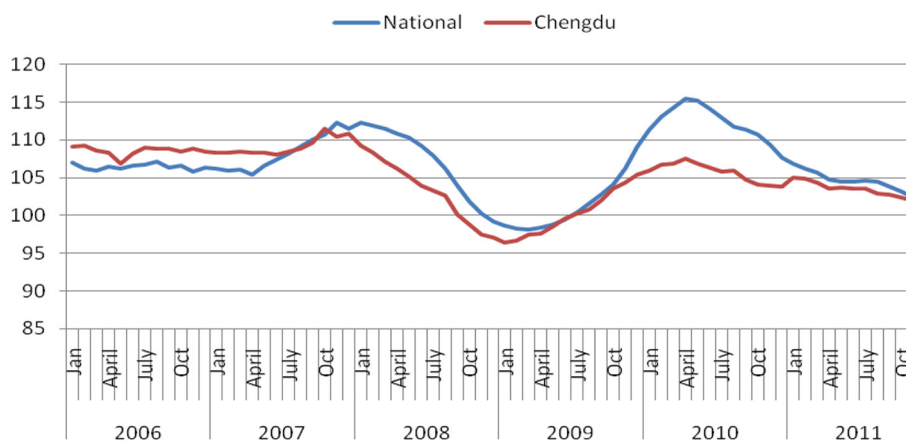
Fig. 1. Average sales price index 70 cities and Chengdu, 2006–2011 (2005 = 100).

Wang et al. (2005) and Zhang and Rasiah (2014). This work outlines four central differences from typical private companies. SOEs, scholars argue, have different, more socially-oriented goals than private companies, have better relationships with the government, have preferential access to land, and are less efficient. We discuss each of these goals in turn below.

Scholars consider that most SOEs have multiple goals, not only profit-maximization. These include expansion and social stability through employment and housing, maintaining in some cases their previous commitments to providing inexpensive housing (Zhang & Rasiah, 2014). Guan (2014), for example, found that state-owned enterprises tend to focus on large and diverse sets of business activities. Li and Xia (2008) argue that SOEs seek to expand market share as conglomerates more than private companies, which focus more on immediate profits. In another study, Xing and Chen (2016) found that China's local state-owned enterprises are motivated not only by profit, and the maintenance of state-owned assets, but that they also have social goals, such as maintaining social stability though employment and housing. Local governments sometimes also pressure locally listed real estate companies to improve local employment levels.

The second difference proposed by scholars is that SOEs have a better relationship with government. Yang and Deng (2013), for example, found greater political connections among state-owned enterprises due to their natural political relevance, which enables their growth of market share. One manifestation of better relationships is access to credit. Zhang and Chen (2015), using data from listed companies from 2002 to 2012, found that state-owned enterprises are more likely to obtain long-term loans than private enterprises. Another study found they get lower rates on bank loans and better tax rates due to the political association with government (Wei, Yang, & Li, 2014).

This closer connection between local governments and SOE in the real estate industry likely results in preferential regulatory treatment. SOE developers might be more likely to build above the Floor Area Ratio (FAR) limits, which would enable them to sell units at a lower price without necessarily harming their profitability. Cai, Wang, and Zhang (2017) and Deng (2017) note that real estate developers tend to upwardly adjust FAR to increase profitability, especially developers who have special ties with the governments. State-owned status in some cases gives them privileged access to loans and thus SOEs might have a higher debt-to-equity ratio (Yang & Hughes, 2017). As Zhang and Rasiah point out, "SOEs that helped local authorities to provide more affordable houses are often rewarded with better opportunities to acquire prime lands for future commercial projects" (2014: 65).

A final implication of the connection to local governments is a greater potential for corruption. Evidence has shown that corruption exists in Chinese land auction market and housing market (Cai, Henderson, & Zhang, 2013), for example, bureaucrat home buyers

tends to pay a lower price depending on their hierarchical ranks and the importance of their government agencies to the developer (Fang, Gu, & Zhou, 2014).

A third difference between SOE developers and private companies is their land reserves. SOEs often build on land acquired years ago, often converted from industrial uses that SOEs previously engaged in. Additionally, Yang (2009) shows that SOE developers purchased land aggressively at national scale in 2009. One specific case, Poly Real Estate, is a SOE developer with a branch in Chengdu that ranked among the top holder of in land reserves in 2009 and 2010 (China Economic Weekly, 2010).

Finally, scholars posit inefficiency among SOEs. Common arguments include overcapacity, inefficient cost control, slow industrial upgrading, expense budgets with inadequate performance, and poor management of investment decisions (Zhu, 2013; Cary, 2013). One reason for this difference is the profit incentive is not as strong among executives (Hu, Song, & Zheng, 2006). For example, Liao and Sun (2017) find a significant positive correlation between executive compensation and corporate profits in private enterprises, whereas in state-owned enterprises there is none.

There is some empirical evidence of inefficiency among SOE real estate development companies, partially derived from their expansion into real estate without adequate expertise (Barboza, 2010). Ren (2014) argues that compared with private real estate firms that maintain control of risks and do not over-leverage, SOE real estate developers usually have very high loan ratios, some reaching over 80% of their total capital. Under the liquidity adjustments imposed by the central government targeting housing development, some SOE developers have sold their assets to pay off loans. Mao, Ni, and Pu (2014) used investing data and stock market performance data from listed real estate companies and found that SOEs are more likely to make irrational investments.

4. Background and data on housing in Chengdu, Sichuan

Chengdu, the capital of Sichuan province in Southwestern China, is an ideal instrumental case study of role of SOE developers. Among the 35 major cities in China, Chengdu exhibited average growth in both house prices and household incomes from 2006 to 2010, at about 10% (Wu, Deng, & Liu, 2014). Fig. 1 shows a simple average property price index for Chengdu and the standard 70 city index[1] from 2006 to 2011. Unlike the coastal markets, whose prices grew more rapidly than the

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[1] A discussion of the deficiencies of the 70 city index can be found in Wu et al. (2011), who also describe how it ceased to be reported to a clear difference between the relatively flat trend it displayed and the experience of price booms in major cities.
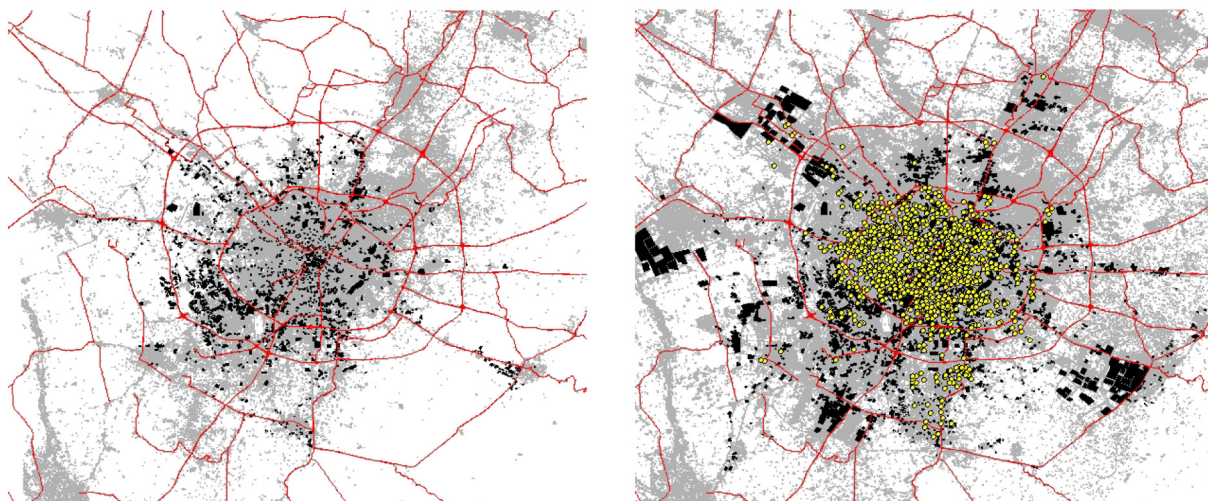
Fig. 2. Maps of the urbanized area of Chengdu in 2000 and 2009 with non-residential land uses and residential transactions from 2004 to 2011.

rest of the country, Chengdu is a typical Chinese city. Moreover, the majority of prior studies of real estate markets in China focus on the more developed coastal areas.

The shift in development in China from the eastern coast to the western cities also makes Chengdu a more interesting case. During the 2000s inland cities experienced a wave capital inflows and a concurrent development in real estate markets. For example, GDP growth in Chengdu increased from 13.6% in 2004, to 15.2% in 2011 (Chengdu Bureau of Statistics, 2011). Chengdu scored the highest in its level of economic openness in the western region (Wang, Zan, & Liu, 2011) and McKinsey and Company (2010) identified its importance role in China's urbanization, predicting that the growth rate of Chengdu's urban agglomeration will reach 11% and exceed the size of coastal urban agglomerations in 15 years.

Chengdu is a sub-provincial city, and as such has an administrative region much larger than the actual urban area. The administrative region had a population of about 11 million in 2009, whereas the six urban districts – *Chenghua, Jinjiang, Jinniu, Qingyang, Wuhou* and *Gaoxin* - that cover the core urbanized area had roughly 5 million residents (National Bureau of Statistics of China, 2009). The contiguous urbanized area extends into some suburban or rural districts such as *Longquanyi, Pixian,* and *Wenjiang*. From the 2000 to 2009, this urbanized area doubled in size. Fig. 2 shows this growth, using maps generated from land-use classification of remote sensing data (National Aeronautics and Space Administration, 2000 and 2009).

Fig. 2 also depicts the location of the residential transaction data used in the present study as well as the non-residential buildings identified through analysis of remote sensing data. It is clear that there is a great deal of urban development beyond the area of residential development, as much of the urban periphery is occupied with non-residential uses. The industrial base of Chengdu grew substantially during the 2000s, from about 1300 establishments in 2000 to almost 4000 in 2009, and comparing the location and size of these establishments in the two years visually shows their decentralization and significant increase in physical size.

Although Chengdu is not located on a completely featureless plain, other than some rivers its urban growth is relatively unhindered by natural geography. Thus, it takes a typical circular shape and, at least in the year 2000, exhibited a monocentric structure. This is demonstrated through the standard density gradient model,[2] which is estimated using

township data from the year 2000 census. There are roughly 90 census areas within 20 km of Chengdu's center. The gradient of -0.19 indicates that for each kilometer a neighborhood is located from the city center, its population density decreases by almost 20%. This was higher than that of Beijing, which was 12% during the same year (Zheng & Kahn, 2008), although the average density of Chengdu, almost 16,000 people per square kilometer, was lower. Also similar to Beijing, more centrally located communities have a higher socioeconomic status. A regression of neighborhood education on distance yielded a negative coefficient, indicating that each kilometer further away from the center leads to a 2% drop in the percent of people with more than a high school education in that neighborhood. Distance explained > 20% of neighborhood variation in this measure of education.

Measuring housing market activity is challenging in China. Beyond the common problem of data availability and completeness, the housing market itself is quite new. Importantly, most property transactions are for new housing units, making the repeat sales method more challenging. A comparison of three price index methods by Wu and colleagues (2011) – the simple average method without quality adjustment, the matching approach with the repeat sales modeling framework, and the hedonic modeling approach – finds that the first two yield downward biased indexes and the hedonic approach is the most robust. Surprisingly, the simple average method yields more comparable results than the matching approach.

These indexes and other recent work on residential property markets in China (Zheng & Kahn, 2008, Wu et al., 2014; Wu et al., 2012) depend on transaction data obtained from the local government. For the present study, we use equivalent data for Chengdu from 2004 to 2011. There were roughly 600,000 residential transactions at almost 1400 addresses[3] inside the 6 urban districts of Chengdu during this period, and about 100,000 sales in < 100 addresses in the suburban and rural districts outside the urban core. All the transactions are for new properties. This is not a limiting factor for their representativeness of the property market in Chengdu, as any substantial resale market for housing in Chinese cities has not yet emerged.

The vast majority of sales in the dataset, roughly 90%, are pre-sales. The pre-sale strategy, in which units are sold before construction in order to obtain financing, is common in Asia (Wong, Yiu, Tse, & Chau, 2012). Pre-sale units are sold at discount, although the discount in the Chengdu data is not too large. In projects at the median price, pre-sale units were 4% cheaper. There is, however, a strong positive relationship

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[2] The natural log of population density for different parts of the city is regressed on the distance of each part to the center. In the case of Chengdu, the model had an R-squared of 0.55.

[3] Some of the addresses are single residential buildings whereas others are residential estates; collections of buildings developed by the same developer.

Table 1
Summary characteristics of transactions by year, 2004–2011.

Year	Transactions (thousands)	Average real sales price[a]	Average real price per m² [b]	Average unit size (m²)	Average # bedrooms	Average floor #
2004	60	409	4049	101	2.6	7.3
2005	64	467	4473	103	2.4	7.5
2006	80	561	5063	108	2.5	9.1
2007	119	610	5981	102	2.4	12.0
2008	63	569	6007	95	2.2	12.8
2009	162	593	6291	93	2.1	13.6
2010	92	740	7785	93	2.0	13.6
2011	57	801	8420	98	2.1	13.5

Notes: There are sales for 641 projects in 2004 but no indication of project start date.
Source: Chengdu transaction data.
[a] In thousands of 2011 Yuan.
[b] In 2011 Yuan.

between the price of a unit and the pre-sale discount, so that more expensive properties were cheaper if purchased before construction.

Table 1 reports a summary of the transaction data for the years 2004 to 2011 in Chengdu. The average real price per square meters has been consistently rising since 2004 and the price in 2011 is over two times higher than it was in 2004. Meanwhile, the average unit size declines and average floor of the transactions increases, indicating more high-rise residential complexes and an increasing residential density in Chengdu.

Table 2 displays the distribution of the registration status of real estate developers in the sample. The National Bureau of Statistics of China has classified all business entities in China into three categories based on their funding source: domestic funded enterprises (CHOE), enterprises with funds from Hong Kong, Macao and Taiwan (HMTOE) and enterprises with foreign investment (FOE). In Table 2, we see that CHOE make up the largest share by far with SOEs accounting for a non-trivial portion of those companies. Enterprises with foreign investment or funds from Hong Kong, Macao and Taiwan occupy a much smaller percentage, around 6%. The share of total transactions by type of developer indicates that domestically funded developers and SOEs dominate the real estate market in Chengdu. Foreign funded developers build slightly larger projects than standard domestic firms do.

5. Analysis

Before modeling housing prices, we visualize the change in prices and characteristics of property sold in Chengdu from 2004 to 2011. Figs. 3, 4, and 5 show the distribution of housing units by size, the log of total sales price, and the log of sales price per square meter for transactions in 2004, 2008, and 2011 to assess the changes in the composition of the housing stock sold over time.

We see in Fig. 3 a dramatic concentration of sales of apartments around 90 square meters in 2008 and 2011, possibly because of government regulations around sizes. Fig. 4 shows a similar, though less dramatic concentration of sales prices in 2008, with an uptick in 2011. In contrast, the average unit price per square meter, presented in Fig. 5,
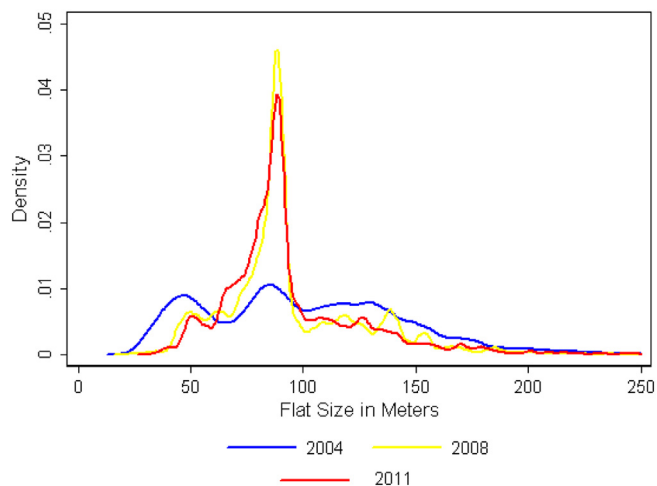

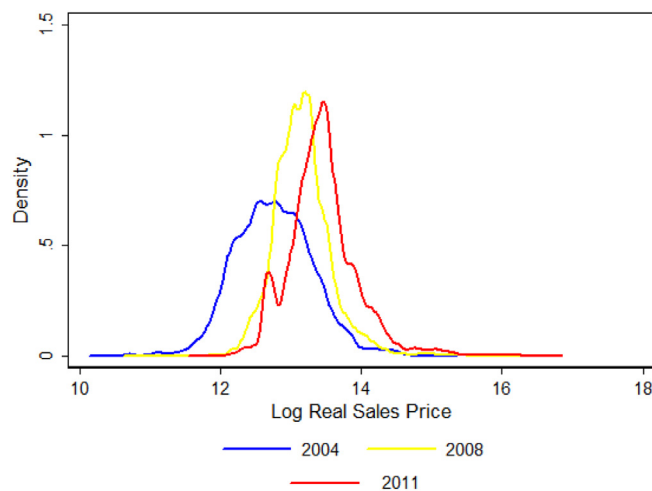**Fig. 3.** Distribution of units by size, 2004, 2008, & 2011.

Fig. 4. Distribution of units by total sales price, 2004, 2008, & 2011.

saw a continuous increase in into 2011, with an increasing variance.

To better understand the changes in housing stock in Chengdu during the boom years, and to test the hypothesis that different types of developers sell units at a different price *ceteris paribus*, we run a hedonic price model with per square meter sales price as the dependent variable. We pool data on all housing units transacted in Chengdu from 2004 to 2011 and incorporate year fixed effects. The model is as follows:

$$Ln\ (HP_{it}) = \beta_i + \beta_1 X_{1it} + \beta_2 X_{2it} + \beta_3 X_{3it} + \beta_4 X_{4it} + \beta_5 X_{5it} + \varepsilon_{it}$$

where HP_{it}: Real sale price per square meter (yuan) for housing unit i in year t;

X_{1it} X_{1it}: A vector variable, unit level characteristics, including age of the unit, unit size, number of bedrooms and the floor the housing

Table 2
Number and Importance of Developers by Category.

Variable	Definition	Number of firms	Percent of firms	Number of transactions	Percent of transactions
CHOE	Domestic, private firms	523	87	543,021	89
SOE	State-owned enterprise	42	7	67,293	11
FOE	Enterprises with foreign investment	17	3	29,418	5
HMTOE	Enterprises with funds from Hong Kong, Macao and Taiwan	20	3	38,503	6
Total		602	100	610,942	100

Note: This table only includes transactions whose type of developers can be identified.
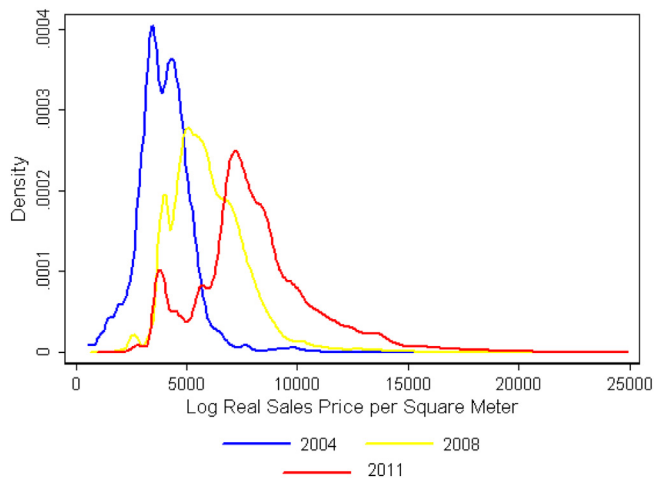
Fig. 5. Distribution of units by sales price per square meter, 2004, 2008, & 2011.

unit is on;

X_{2it}: Neighborhood level characteristics, including percentage of green area and size of the neighborhood;

X_{3it}: Accessibility to urban amenities, including the distance to urban center, major roads, minor roads, post office, police station, government office, primary school, college, university, transit stations and river.

X_{4it}: Geographic location, *i.e.* the quadrant in which the unit is located;

X_{5it}: Type of real estate developers, whether it is a SOE, FOE, HMTOE, or other domestically funded enterprise.

Table 3 reports summary statistics by developer type. As Zheng and Kahn (2008) note, variables describing individual unit characteristics in this dataset are limited, only the size, floor number, and number of bedrooms. However, this is less of a concern in the contemporary Chinese context as all the units are in multi-unit buildings, which are quite similar in building structure and initial materials. The size of the project likely captures the price impacts of differences in fit, as larger developments have higher quality amenities.

In Table 3, we see that housing units developed by SOEs generally sell at a lower price per square meter. This is surprising given that these units are newer, have more bedrooms and more green areas in the neighborhood than units sold by other types of developers. Moreover, compared with the average, units developed by SOEs are closer to the urban center and major roads; they also locate more proximately to transit, post offices, police station, government office, primary schools and university. Intuitively, all these factors except for distance to police station are positive amenities for property values. Therefore, we anticipate a higher real housing price for units developed by SOE, but do not find one.

Table 4 reports the results of year fixed effects regressions, using the full sample from year 2004 to 2011. The first column displays the result of the null model without considering the type of developer. In columns two, three and four, we add the dummy variables for SOE, FOE and HMTOE, as well all three types respectively to examine the effects of developers' types on real housing sale price per square meter. The price discount for SOE developers persists, with a strongly significant negative coefficient even controlling for all observable features.

On average, a housing unit developed by SOE sells for 7% less than an otherwise identical unit developed by a private company does. On the other hand, housing developed by FOE and HMTOE are more expensive than housing units developed by other types of firms. Compared with non-SOE domestic funded real estate developers, developers with foreign funding and funding from Hong Kong, Macao and Taiwan sell their units at a nine and 20% premium respectively.

As outlined in the literature review, there are a number of possible explanations for the SOE discount. One possibility is that developers adopt different sales strategies; either selling fast with lower prices or selectively releases their units at different times and prices. However, we did not find that in these data there was a significant difference between the time to sale by developer type. Many SOE real estate enterprises have land reserves that could subsidize their new developments, but we are unable to test that in this case. Another suggested cause is that, under an older system of employment, the salaries of SOE employees were lower than other firms were. We do not have data specific to the Chengdu case, but Liu (2015) does find evidence that salaries of SOE developer employees are lower than average.

Other explanations derive from the closer connection between SOE developers and local governments, and their role in the mandate to provide affordable housing. For example, projects built by SOE developers might benefit from regulatory variances and thus built above FAR limits. Similarly, SOE developers might have easier access to credit and therefore selling at a lower price will not hinder profitability. Finally,

Table 3
Descriptive statistics for housing units characteristics by developers' type from 2004 to 2011.

Variables	SOE developers		Non-SOE developers		FOE and HMTOE developers	
	Mean	SD	Mean	SD	Mean	SD
Real price (per m²)	5231.4	2087.9	5674.6	2291.3	6803.7	2666.1
Age (year)	0.4	0.7	0.5	0.7	0.5	0.8
Unit size (m²)	98.2	31.0	97.4	37.3	104.4	40.8
Bedrooms	2.3	0.8	2.2	0.9	2.4	1.0
House floor	12.0	7.9	11.9	7.9	12.0	8.0
Percentage of greening area	3.1	2.9	2.6	3.4	4.4	6.3
Total transactions	2800.0	3150.2	2447.4	2594.1	3789.7	3089.9
Distance to center (km)	5.9	2.3	6.7	3.2	6.5	2.8
Distance to major roads (meters)	314.0	257.9	366.0	368.8	318.7	351.8
Number of minor roads within 1 km distance	473.6	155.6	475.6	192.9	461.0	168.2
Distance to post offices (meters)	913.2	524.0	1156.5	920.5	1288.2	1073.9
Distance to police station (meters)	676.0	391.0	829.5	696.2	910.1	958.7
Distance to government offices (meters)	591.4	345.9	726.6	559.3	843.9	590.1
Distance to primary school (meters)	556.8	273.4	778.2	658.4	834.8	428.0
Distance to college (meters)	1906.4	1329.2	2040.7	1460.9	1902.0	1211.2
Distance to university (meters)	1305.6	1353.4	1579.6	1418.9	1543.1	1087.2
Distance to transit (meters)	1660.2	1035.9	1796.8	1246.7	1767.8	1370.1
Distance to river (km)	0.5	0.4	0.8	0.9	0.7	0.7

Note: SD refers to Standard Deviation.

Table 4
Fixed-year effects regression results from 2004 to 2011.

Dependent variable	Ln (real price per m²)			
	(1)	(2)	(3)	(4)
Age	−0.060***	−0.059***	−0.059***	−0.060***
	(−143.33)*	(−140.23)	(−142.78)**	(−143.77)
Ln(unit size)	0.139***	0.135***	0.126***	0.126***
	(95.38)	(92.82)	(87.83)	(87.73)
Bedrooms	−0.051***	−0.050***	−0.050***	−0.049***
	(−87.18)	(−84.32)	(−86.36)	(−85.09)
House floor	0.003***	0.003***	0.003***	0.003***
	(76.86)	(69.43)	(72.30)	(72.88)
Percentage of green area	0.003***	0.003***	0.001***	0.001***
	(27.35)	(23.30)	(6.18)	(8.17)
Ln (total transactions in project)	0.019***	0.023***	0.016***	0.017***
	(59.84)	(73.45)	(51.75)	(52.21)
Ln (km to center)	−0.132***	−0.123***	−0.117***	−0.116***
	(−132.30)	(−122.56)	(−118.24)	(−118.41)
Ln (meters to major roads)	−0.027***	−0.014***	−0.029***	−0.024***
	(−17.92)	(−8.84)	(−18.99)	(−15.73)
[Ln (meters to major roads)]²	0.003***	0.002***	0.003***	0.003***
	(20.24)	(10.78)	(22.28)	(19.36)
Ln (minor roads in 1 km)	0.011***	0.004***	0.013***	0.011***
	(9.21)	(3.30)	(11.03)	(9.83)
Ln (distance to post office)	0.030***	0.030***	0.031***	0.030***
	(55.83)	(55.90)	(59.03)	(55.88)
Ln (distance to police station)	0.017***	0.021***	0.031***	0.031***
	(37.98)	(46.88)	(67.59)	(68.74)
Ln (distance to government office)	−0.023***	−0.022***	−0.033***	−0.033***
	(−43.08)	(−42.27)	(−62.14)	(−63.76)
Ln (distance to primary school)	−0.026***	−0.033***	−0.034***	−0.035***
	(−49.78)	(−63.40)	(−66.11)	(−69.46)
Ln (distance to college)	−0.027***	−0.027***	−0.026***	−0.024***
	(−45.16)	(−43.80)	(−42.39)	(−39.77)
Ln (distance to transit)	−0.032***	−0.035***	−0.028***	−0.027***
	(−61.36)	(−65.64)	(−53.27)	(−52.04)
Ln (distance to river)	−0.015***	−0.018***	−0.015***	−0.016***
	(−44.05)	(−49.82)	(−41.97)	(−45.79)
SOE		−0.072***		−0.059***
		(−70.80)		(−58.87)
FOE			0.094***	0.087***
			(60.23)	(55.65)
HMTOE			0.193***	0.188***
			(144.91)	(141.19)
Fixed year effect	Yes	Yes	Yes	Yes
Constant	8.229***	8.297***	8.246***	8.252***
	(600.17)	(598.82)	(604.38)	(606.58)
R-squared	0.60	0.60	0.62	0.62
Adjusted R-squared	0.60	0.60	0.62	0.62
N	625,730	593,876	593,879	593,876
F-statistics	34,011.65	31,394.89	31,935.99	31,197.46

Notes: Control variables indicating quadrant of the city in which the housing unit is located are included but not reported. *t* statistics are in parentheses.
* p < 0.1.
** p < 0.05.
*** p < 0.01.

individuals connected to the local government are more likely to buy properties developed by SOE, price collusion and corruption might yield lower prices. Unfortunately, we are unable to test the significance of these hypotheses with available data.

The question of SOE's better access to land is also worth further study. We did not find a database for Chengdu, but anecdotally SOE developers have paid less in many cases. The "Pan Cheng Gang Zone", for example, is an old industrial area that developers have converted into housing. A well-known SOE developer, Greenland Group, was an early developer in this area. They acquired land at a considerable discount and sold units for less than private developers in the area.

Table 4 also reveals interesting information about the housing market in Chengdu, with variables describing individual units, local amenities, access to the transportation network, and local public goods. The age of a housing unit has significant and important negative impact

on housing prices; with one year of age lowering prices by around 6%. Size also matters a great deal; a 10% increase in area is associated with a 13% higher price. When controlling for size, the number of bedrooms has a negative relationship to price, possibly because large units with fewer bedrooms correlate to unmeasured features of luxury units, whereas units with smaller bedrooms might target lower-income families.

In terms of local amenities, having more green space in the neighborhood has a positive impact on the sale price. As expected, given prior empirical work confirming monocentricity in Chinese cities (Zheng & Kahn, 2008), the coefficient on distance to the city center is significant and negative. In Chengdu, apartments that are 10% farther from the city center see a 1.2% drop in price. We use the number of minor roads within a radius of 1 km of a housing unit as an indicator of urban density. Results in Table 4 indicate that higher density, *i.e.*, more minor roads in the neighboring area, is associated with higher housing price.

When measuring accessibility to transportation networks, we find that the distance to major roads have the expected quadratic relationship to housing price. Housing units located very close to major roads sell at a discount, but as they move slightly further, prices go up. This results from the tradeoff between noise and pollution on the one hand, and better transportation accessibility on the other. We also measure the distance to transit stations, in this case bus stops, which is significantly, and negatively associated with housing prices reflecting the benefits of access.

Finally, we examine the role of local public goods in housing prices. Real housing prices decrease as the distance to primary school, college and university grows, although the underlying mechanism for these relationships is likely different. We hypothesize that being located near primary schools adds value for the convenience it implies for parents, whereas housing in neighborhood near universities is more valuable because of spillover effects of activities. Other public services have somewhat unexpected relationships to housing prices. The distance to police stations and post offices is slightly but significantly positively related to housing prices. This is possibly because these public services are more concentrated in older neighborhoods and associated with worse neighborhood environmental quality.

6. Conclusion

In this paper, we analyze housing transaction data for the medium-sized city of Chengdu, China, from 2004 to 2011, matching them to local amenities, public services, and the type of developer. We uncover several important and heretofore unrecognized facets of China's rapidly developing housing market, such as a standardization of housing sizes and total price, in spite of an increase in average price per square meter. We find that the monocentric model holds in Chengdu, and most amenities have the expected relationship to price. Some public services, however, do not.

The principal contribution is the evidence that SOE developers sell housing at a discount. Their sale performance is worse than that of domestically funded developers, not to mention foreign-funded developers. This is an important finding, especially in light of existing work shows SOE developers tend to overbid on land (Wu et al., 2012). Questions remain as to why they sell housing at a discount, though a primary reason is that they work with local governments to fulfill mandates to provide affordable housing. An additional argument is that SOEs in China are inefficient, but this finding opens other avenues for research. Unobserved housing characteristics, such as the quality of property management or interior finishing, likely contribute to but do not fully explain the price difference. Further work on the operations of SOE developers is warranted, to address the question of whether they are less profit focused than private companies, and interested in achieving social goals.

The broad policy implication of the present analysis is that the

government should formalize the relationship between SOEs and national housing policy goals. Using successful cities' programs as models, SOEs can be encouraged and subsidized to build affordable housing more aggressively. Since the housing boom in China is a big part of current economic growth, it does make sense that SOEs should bear a social responsibility to cooperate with the government's goals of affordable housing production, especially as they receive other kinds of preferential treatment in local regulations and access to financing. This should occur in a transparent manner that is equitable across cities and companies.

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