State Owned Enterprises in China's Housing Boom: A Case Study of Chengdu, Sichuan

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Abstract

China's property market has been the subject of much media coverage in recent years. Rapid price increases for residential property and the possibility of a price bubble in many cities has led the central government to take a myriad of regulatory measures to cool housing markets. Scholarly attention has focused either on inter-city analyses or case studies of the high-GDP coastal cities like Shanghai and Beijing, and too little is known about the property market dynamics of more typical Chinese cities. Moreover, there is a dearth of research on the role of State Owned Enterprises (SOE), which play an important role in China's housing boom. This paper uses 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 and assess the differences between housing produced by SOE and other types of developers. The observed reduction in variation in housing prices and sizes, as well as a growing premium for larger units can be plausibly connected to new government regulations. We find that units developed by SOE sell at a discount.

Keywords: Housing Markets; Price Distribution; Spatial Analysis; China

JEL Classification Codes: R21; R23; R52; L22; L74

1. Introduction

China's spectacular pace of urban growth during the 1980s, 1990s, and 2000s has been tightly controlled by government planners, yet since major housing market reforms in the late 1990s; housing development has been mostly undertaken by private companies. Nevertheless, as property prices grew from the mid-2000s, a series of increasingly stringent and unorthodox regulations were implemented by central and local governments to re-exert control. Although there is a growing understanding of China's nascent property market, much of the research is either inter-urban or focused on the large coastal cities of Beijing, Shanghai, and Guangzhou. This paper examines the property market of Chengdu, which is a useful case study because it is an average city in many respects; property price dynamics have mirrored trends across China. Yet it is also expected to grow rapidly in the future; in 2006 *China Daily* named Chengdu as the fourth most livable city in the country (Fu, 2006).

Depending on the methodology used to calculate the price index, residential property prices in Chengdu are estimated to have increased by between six and nine percent annually between 2006 and 2010. Yet urban economists have increasingly recognized that average prices can mask important variation within cities and have begun to more rigorously examine changes in the distribution of prices both and across space (McMillen, 2008; Deng *et al.*, 2012; Monkkonen *et al.*, 2012). Chengdu's property market during the recent boom period provides a greater understanding of the evolution of an emerging housing market system as well as the importance of strict regulations the Chinese government has imposed to control the housing market. This is important not only for academic understanding of housing markets, but also has implications for housing affordability and the question of a bubble, at least in the context of Chengdu.

The focus of this paper is the dynamics of Chengdu's property market during the boom period and specifically the presence of State Owned Enterprises (SOEs). To do this, we first analyze how the distribution of housing prices and unit sizes has changed over the time period in question. We then analyze the characteristics of housing produced during this time period and their market valuation using a hedonic regression model. Finally, we assess the price difference of otherwise similar housing built by different types of companies, responding to the question of whether projects built by SOEs differ as dramatically in Chengdu as they have been reported to in Beijing (Wu *et al.*, 2012).

In order to answer these questions, we model the way in which the influence of different housing price determinants has changed; not only unit characteristics but also location and some neighborhood attributes. To do this, several data sources are employed, starting with transaction data provided by the government. This dataset, similar to that used by Zheng and Kahn (2008) in their analysis of the Beijing property market for one year, covers almost all property transactions in Chengdu from 2004 to 2011; roughly 600,000 sales in about 1,400 residential projects. We create a number of neighborhood indicators based on the location of projects by spatially matching the transactions to census data from the year 2000, 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 paper is structured as follows. The first section after this introduction is an overview of the reforms that have led to China's housing market as it exists today, with a brief discussion of how market-based the housing system in China is as well as some research on bubbles in China's property markets. Then we introduce the instrumental case study city, Chengdu, along with the datasets that are used to analyze the intra-urban dynamics of the housing boom. The fourth section presents the results of analysis of the spatial dynamics of housing prices in Chengdu, and the paper concludes with a discussion of implications for further research.

2. Creating a housing market in the People's Republic of China (PRC)

From the foundation of PRC to the early 1990s, the main sources 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 to government and business and the housing system began to gradually be reformed. In August 1990, promulgated by the State Council, 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 they assigned units to their employees for some small fee (Chen, 1996). This in-kind housing subsidy policy was officially abolished 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*, which is generally regarded as the milestone of the marketization of the Chinese real estate sector (Deng *et al.*, 2011). The development of the Chinese real estate market can be divided into four phases, which we refer to as gradual reform (1978-1997), commercialization (1998-2003), boom (2004-2008) and regulation (2009-2011).

Phase I: Gradual reform, 1978-1997

At the beginning of China's opening in 1978, Deng Xiaoping introduced the issue of housing reform, though reforms until the late 1990s were very gradual. In June 1979, the *National Infrastructure Construction Work Meeting Report Outline* was officially endorsed by the Central Committee of CPC and the State Council, which began increasing rents. A policy of "full-price housing", under which tenants were charged something approximating a market value was implemented in about 160 cities and 300 counties from 1982 to 1985, but was unsuccessful at stimulating the private production of housing. Further reforms in the mid-1990s that created a housing provident fund and promoted rent increases and privatization were also unsuccessful and most housing continued to be produced and allocated by work-units or the government (Huang, 2004). During the gradual reform period, housing prices in China did not increase rapidly, other than a real estate bubble in Hainan Province in the early 1990s. However, this bubble burst after aggressive central government intervention, resulting in a major collapse of financial corporations, for example, the Hainan Development Bank, and it was a large drag on Hainan's economy (Yu, 2010).

Phase II: Commercialization, 1998-2003

In 1998, with the formal promulgation of the *Notice on Further Deepening Urban Housing Reform and Accelerating the Housing Construction*, the welfare housing allocation policy was totally abolished, and the commercialization of housing was implemented. During this period of commercialization, various national ministries have issued a notifications and regulations to structure the market, including the *Several Opinions on Vigorous Development of Affordable Housing*, the *Notice on Further Implementation of Existing Public Housing Reform*, and the *Central Government and State Agencies' Implementation Scheme of Further Deepening the Housing Reform*. With the deepening and improvement of housing reform, since 2002, private sector production has grown steadily across China and in 2003 it was officially listed as one of the pillar industries of national economic development. At that time, investment in real estate accounted for around 33 percent of the overall fixed assets investment increase in China, and accounted for roughly two percent of GDP growth and 9 percent of overall GDP. During this period of time, in spite of increasing commercialization of real estate, property prices still did not rise sharply. From 1998 to 2003, the real property price is estimated to have increased at 4.2 percent per year on average in 31 administrative areas of China (Liu *et al.*, 2012).

Phase III: Boom, 2004-2008

By 2004 it was clear that a private real estate industry had been successfully stimulated in China, but significant and rapid increases in property prices were seen, especially in the major coastal cities. In response, the Central Government began to introduce regulations in order to cool the real estate market. The *Notice on Continuing the Supervision and Law Enforcement Work on Bidding, Auction, Listing and Transferring of the Rights of Use for Operating Land* in 2004, commonly recognized as the turning point when the Chinese government started to use the monetary policy to regulate the real estate market. Since then, monetary policy has become the most commonly used method to attempt to control the real estate market. The notice prompted the People's Banks of China to raise the benchmark deposit and lending rates, and lift the restrictions on the floating range of the lending rates. In 2005, the State Council's *Notice on a Feasible Way of Stabilizing the Property Price*, again highlighted the importance of regulating real estate markets through monetary policy.

In spite of policy efforts, property prices continued to rise in 2006, especially in major coastal cities. In respond to the continued increase, new policies were more frequently introduced though to no avail. According to a survey by the National Bureau of Statistics, prices increased by 5 percent on year-over-year basis in the 70 big-and-medium-sized cities in China in December 2006. Thus, in the middle of 2006 (24th in May, 2006), a supply-side policy, *Adjustment the Housing supply Structures and stable the housing prices*, was introduced that specified that more than 70 percent of every city's new housing unit area must be comprised of units smaller than 90 square meters. This policy would prove to have a strong impact, at least in Chegndu.

Attempts to control the property boom through financing continued in 2007, with the *Notice on Reinforcing the Credit Management of Commercial Real Estate*, which increased down payment requirements and lending rates, and the reserve requirement for banks was raised ten times, from

9 to almost 15 percent. Just as these began to show their effectiveness, the global financial crisis hit. After May 2008, real estate policy took a sharp turn from restriction to support; down payment requirements were eased and there were a 30 percent discount on mortgage rates. Most local governments also introduced unconventional measures such as property deed tax refunds and property income tax refund in order to stimulate the market.

Phase IV: Regulation, 2009-2011

Since 2009, regulatory measures introduced by the Chinese government have been frequently modified, aggressive, and inconsistent, interrupting expectations in the real estate market. For example, the 2009 *Notice on Higher Level of Risk Management of Mortgage Loans* placed rigid restrictions on local commercial banks in their lending practices and in 2010, the General Office of the State Council issued the *Notice on Promoting the Stable and Healthy Growth in Real Estate Market* (referred to the State Council's Eleven Regulations), which limited families from purchasing more than two housing units. However, as prices continued to rise rapidly in 2010, further action was taken. In January 2011, the Premier of the State Council Wen Jiabao, issued the Updated State Council's Eight Regulations, which penalized local governments that did not implement regulations such as increased transaction tax and down payments of 60 percent for second homes. Further efforts to cool the market included three increases in deposit and loan rates during 2011, an increase in the housing provident fund mortgage interest rate, an increase of the reserve requirement to 21 percent. These measures seem to have limited speculation in real estate, increased the cost of purchasing property, and reduced liquidity in the market, leading many developers to begin cutting prices in the end of 2011 (McMillan, 2011).

Is there a housing bubble? Is there a housing market?

Much debate over China's housing market has focused in part on identifying the reasons for the steep increase in property prices and analyzing whether this price appreciation is a real estate bubble. Researchers in China have proposed several causes for the run up in housing prices, including speculation, the appreciation of the Yuan, demographic shifts, and foreign investment in luxury property (Jiang, 2005; Du and Liu, 2007; Liu, 2008; Xu *et al.*, 2012). Yet even diagnosing a bubble in a property market that has only existed for about two decades - the first land auctions were in Shenzhen and Shanghai in 1987 and 1988 (Zhu, 1999) – is a challenge, especially since the two decades in question have seen such rapid economic and urban growth. Analysis of price-rent ratios using the user cost of capital model does suggest that expectations about growth in the large markets are higher than observed growth during the past two decades (Wu *et al.*, 2012) but that income growth has outpaced that of housing prices in many markets, including Chengdu.

There is strong evidence that a housing market equilibrium has been established since privatization began in the mid-1990s (Wang, 2011), and data from the National Bureau of Statistics of China shows that in 2007, the majority of urban housing units are commercial housing or privatized public housing at 32 and 34 percent of stock respectively (Man, 2011). In Chengdu, at least according to official statistics, only about seven percent of the population still resided in collective housing in the year 2000 (National Bureau of Statistics of China, 2000).

Nonetheless, some scholars argue that in fact, preferential treatment by the State still accounts for a great deal of the variation in people's housing quality and a true market has not yet been established (Logan *et al.*, 2009). The idea that the housing market in China is highly distorted is common, as one of its salient features is high levels of investment in second homes for many middle- and upper-income households, due in part to the lack of other investment vehicles. More than six percent of Chinese households were found to own two or more houses according to a 2005 survey, also which rise to thirteen percent in 2010 (China Household Finance Survey, 2010), and an additional five percent were found to rent their primary home but own a second home for investment purposes (Huang and Yi, 2009). The question of overinvestment in housing and high vacancy rates was dramatized by the researcher who estimated there to be 65 million vacant homes across China using data on electricity usage (Powell, 2010).

State Owned Enterprises in China's Real Estate Sector

The prosperity of housing market in China have attracted enterprises of various ownership forms to enter real estate development industry. Among them are State-Owned-Enterprise (SOEs), a legacy of China's former collective economy. Many SOEs that did not traditionally engage in the development of housing have 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). Giovanni Ferri and Li-Gang 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.

Multiple reasons for the inefficiency of SOEs in the different markets within which they operate have been proposed, including "overcapacity, inefficient cost control, slow industrial upgrading", "enormous expense budgets with inadequate performance" and "poor management of investment decisions" (Zhu, 2013; Cary, 2013). There is also evidence of inefficiency among SOE real estate development companies, with some arguing it is because of their expansion into real estate without adequate expertise (Barboza, 2010). Chonglong 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 percent of their total capital. Under the liquidity adjustments imposed by the central government targeting housing development, some SOE developers have are forced to sell their assets to pay off loans.

3. Background and Data on Housing in Chengdu, Sichuan

Chengdu, the capital of Sichuan province in Southwestern China, is an ideal instrumental case study. It exhibited an average house price appreciation and income growth from 2006 to 2010 among the 35 major cities in China, at about 10 percent for both (Wu *et al.*, 2011). Figure 1 shows a simple average property price index for Chengdu and the standard 70 city index[1] from

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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.

2006 to 2011. Unlike the coastal markets, whose prices grew much more rapidly than the rest of the country, analysis of the Chengdu market will better illustrate the general Chinese situation.

<<Insert Figure 1 here>>

Additionally, the majority of prior studies of the real estate markets in China are on the more developed coastal areas and Chengdu is one of the most important Western, inland cities. The geography of the Chinese economy is going through a transition, shifting focus from the coastal developed areas to the west according to the Western Development Plan. As such, 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 percent in 2004, to 15.2 percent in 2011 (Chengdu Bureau of Statistics, 2011). Chengdu scored the highest in its level of economic openness in the western region (Wang *et al.*, 2011) and McKinsey & Company (2010) identified its importance role in China's urbanization, predicting that the growth rate of Chengdu's urban agglomeration will reach 11 percent and exceed the size of coastal urban agglomerations in 15 years. Forbes (Kotkin, 2010) also forecasts Chengdu among the world's fastest-growing cities in the next 10 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 rual districts such as *Longquanyi* , *Pixian* and *Wenjiang*. From the 2000 to 2009, this urbanized area grew from 356 square kilometers to 796. Figure 2 shows this growth, using maps generated from land-use classification of remote sensing data (National Aeronautics and Space Administration, 2000 and 2009).

<<Insert Figure 2 here>>

Figure 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 1,300 establishments in 2000 to almost 4,000 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 kilometers of Chengdu's center. The gradient of -0.19 indicates that for each kilometer a neighborhood is located from the city

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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.

center, its population density decreases by almost 20 percent. This was higher than that of Beijing, which was 12 percent during the same year (Zheng and Kahn, 2007), 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 two percent drop in the percent of people with more than a high school education in that neighborhood. Distance explained more than 20 percent of neighborhood variation in this measure of education.

There are a multitude of challenges to measuring price change in China. Beyond the common problem of data availability and completeness, the housing market itself is quite new and perhaps most 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 and Kahn 2008, Wu *et al.*, 2011; Wu *et al.*, 2012) depend on transaction data obtained from the local government. For the present study, we use equivalent data for Chengdu from 2004-2011. There were roughly 600,000 residential transactions at almost 1,400 addresses[3] inside the six urban districts of Chengdu during this period, and about 100,000 sales in less than 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 percent, are pre-sales. The pre-sale strategy, in which units are sold before construction in order to obtain financing, is common in Asia (Wong *et al.*, 2006). 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 four percent cheaper. There is, however, a strong positive relationship between the price of a unit and the pre-sale discount, so that more expensive properties were cheaper if purchased before construction.

<<Insert Table 1 about here>>

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.

<<Insert Table 2 about here>>

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

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 six percent. The dominance of domestic funded enterprises implies that the market for real estate development in Chengdu is still relatively closed to competition from developers outside mainland China. The share of total transactions by type of developer indicates that the real estate market in Chengdu is dominated by domestic funded developers and SOEs and foreign funded developers build slightly larger projects than standard domestic firms.

4. Analysis

Before modeling housing prices, we visualize the change in prices and characteristics of property sold in Chengdu from 2004 to 2011. Figures 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.

<<Insert Figures 3, 4 and 5 here>>

We see in Figure 3 a dramatic concentration of sales of apartments around 90 square meters in 2008 and 2011, possibly because of government regulations around sizes. Figure 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 Figure 5, saw a continuous increase in into 2011, with an increasing variance.

In order 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} : A vector variable, unit level characteristics, including age of the unit, unit size, number of bedrooms and the floor the housing unit locates;
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;

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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 price impacts of differences in fit out are likely captured by the size of the project, as often larger developments have higher quality.

<<Insert Table 3 here>>

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 a higher real housing price for units developed by SOE should be anticipated. Why the lower price then? It is possibly because they have some unobservable characteristics that reduce their value, such as poor property management, inadequate marketing efforts, negative firm reputations, or they simply are selling below market price.

<<Insert Table 4 here>>

Table 4 reports the results of year fixed effects regressions, using the full sample from year 2004 to 2011. Column one 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. We find that the dummy for SOE developers has a strongly significant negative relationship with housing prices. On average, a housing unit developed by SOE sells for seven percent less than an otherwise identical unit developed by non-SOE firms. On the contrary, 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 twenty percent premium respectively. There could be some unobserved housing characteristics that correlate with developers' types, such as the quality of property management and interior finishing. However, it is also likely that some of the price difference is related to the efficiency of different types of developers.

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 six percent. Size also matters a great deal; a ten percent increase in area is associated with a thirteen percent higher price. However, it seems

there is more demand for larger places with fewer bedrooms, as controlling for size, more bedrooms has a negative relationship with price.

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 and Kahn, 2008), the coefficient on distance to the city center is significant and negative. In Chengdu, apartments that are ten percent farther from the city center see a 12 percent drop in price. We use the number of minor roads within a radius of one kilometer 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, the distance is positively related to price. This is expected because of 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.

5. Conclusion

In this paper, we review recent literature on the Chinese housing market and characterize a series of regulations imposed by central and local governments over the past several decades. Then we analyze housing transaction data for the medium-sized city of Chengdu, China, from 2004 to 2011, matching it to a wide variety of other data including GIS data on local amenities and public services. This analysis uncovers several important and heretofore unrecognized facets of China's rapidly developing housing market. We show that there has been 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 that most local amenities have the expected relationship to prices. Some public services, however, do not.

The principal contribution of the analysis is the evidence that SOE developers sell housing at a discount. Their sale performance is worse than the average domestic funded real estate developers, not to mention foreign-funded developers and developers with capital from Hong Kong, Macao and Taiwan, which sell housing at a premium. This fact, combined with prior

evidence that SOE developers tend to overbid during the land acquisition process (Wu et al., 2012), further bolsters the prevailing argument about the low efficiency of SOEs in China.

An important note in relation to the finding about SOE developers is its implication for housing affordability. Housing affordability in the large coastal Chinese cities has become a pressing problem during this period of housing boom (Chen *et al.*, 2010). Consistent with findings reported by Wu *et al.* (2012), however, price-to-income ratios in Chengdu calculated based on averages do not reflect a growing affordability problem. The discount at which SOE developers sell housing benefits consumers and increases affordability.

References

Arraiz, I., D. M. Drukker, H. H. Kelejian, and I. R. Prucha. 2008. A Spatial Cliff-Ord-type Model with Heteroskedastic Innovations: Small and Large Sample Results. Technical report, Department of Economics, University of Maryland.

Chen, A. 1996. China's urban housing reform: price-rent ration and market equilibrium. *Urban Studies* 33(7): 1078-1092.

Chen, Jie, Qianjin Hao, and Mark Stephens. 2010. Assessing Housing Affordability in Post-reform China: A Case Study of Shanghai. *Housing Studies* 25(6): 877-901.

Chonglong, Ren. 2014. How should SOEs developers cope with the housing market adjustment? People.cn, June 17. (In Chinese)

Cliff, A. D., and J. K. Ord. 1973. *Spatial Autocorrelation*. London: Pion.

David, Barboza. 2010. State-Owned Bidders Fuel China's Land Boom. New York Times, Aug 2.

Deng, L. Q. Shen, and L. Wang. 2011. The Emerging Housing Policy Framework in China. *Journal of Planning Literature* 26(2):168-183.

Deng, Yongheng, Daniel P. McMillen, and Tien Foo Sing. 2012. Private residential price indices in Singapore: A matching approach. *Regional Science and Urban Economics* 42: 485–494.

Drukker, D. M., I. R. Prucha, and R. Raciborski. 2011. An ML and GS2SLS estimator for the spatial autoregressivemodel. Technical report, Stata.

Du, Minjie, and Xiahui Liu. 2007. The expectations on RMB appreciation and fluctuation in property prices. *The Journal of World Economy* 1: 81-99. (in Chinese)

Eve Cary. 2013. Reforming China's State-Owned Enterprises. The Diplomat, June.

Giovanni Ferri and Li-Gang Liu. 2009. Honor Thy Creditors Beforan Thy Shareholders: Are the Profits of Chinese State-Owned Enterprises Real? Hong Kong Institute for Monetary Research Working Paper No.16/2009

Kotkin, Joel. 2010. The World's Fastest-Growing Cities. *Forbes*, July 10.

Hongyan, Yu. 2010. "Hainan officials rule out bubble burst." *China Daily*, May 10.

Huang, Y. 2004. The road to homeownership: A longitudinal analysis of tenure transition in urban China (1949–94). *International Journal of Urban and Regional Research* 28(4): 774-795.

Jack Perkowski.2013. China's SOEs: Expect More Focus On Profitability. Forbes, Dec 10.

Jiang, Chunmei. 2005. Research on speculative bubble in Chinese real estate market. *Management World* 12: 71-84. (in Chinese)

Fu , Jing. 2006. Beijing drops out of top 10 'best city' list. *China Daily*, January 3.

Liu, Liya. 2008. Did overseas hot money push up the stock index and property prices? *Finance Research Journal,* 10: 48-70. (in Chinese)

Liu, Xueliang, Jing Wu, and Yongheng Deng. 2012.Population shock,marriage and the real estate market. Paper presented at the Global Chinese Real Estate Congress (GCREC), Hangzhou, China, April 3. (in Chinese)

Logan, John R.,Yiping Fang, and Zhanxin Zhang. 2009. Access to Housing in Urban China. *International Journal of Urban and Regional Research* 33(4): 914-935.

Man, Joyce Y. 2011. Affordable Housing in China. *Land Lines* 16-20.

McKinsey & Company. 2010. Beautiful Sichuan, Fairview Tianfu: Sichuan development and the international investment report. (in Chinese)

McMillan, Alex Frew. 2011. "Falling home prices pressure Chinese developers' liquidity, margins." Reuters, November 11.

McMillen, Daniel. 2008. Changes in the distribution of house prices over time: structural characteristics, neighborhood or coefficients? *Journal of Urban Economics* 64: 573–589.

Michael Schuman. 2012. Are China's Big State Companies a Big Problem for the Global Economy? Time, Feb 15.

Monkkonen, Paavo, Kelvin S.K. Wong, and Jaclene Begley. 2012. Economic Restructuring, Urban Growth, and Short-term Trades: The Spatial Dynamics of the Hong Kong Housing Market, 1992-2008. *Regional Science and Urban Economics* 42(3): 396-406.

National Aeronautics and Space Administration. 2000 and 2009. Landsat data.

National Bureau of Statistics of China**.** 2000. Township Population Census with Maps, Sichuan.

National Bureau of Statistics of China. 2009. Statistical Yearbook of China.

Ningzhu, Zhu. 2013. News Analysis: China's SOEs face poor profit prospects. Biz China Weekly Issue No.99, May 24.

Powell, B. 2010. "China's Property: Bubble, Bubble, Toil and Trouble." Time, March 22.

Sara Hsu.2014. China's Changing State-Owned Enterprise Landscape. The Diplomat, June.

Wang, Shing-Yi. 2011. State misallocation and housing prices: theory and evidence from China. *American Economic Review* 101(5): 2081-2107.

Wang, Songtao, Zan Yang, and Hongyu Liu. 2011. Impact of urban economic openness on real estate prices: Evidence from thirty-five cities in China. *China Economic Review* 22: 42–54.

Wong, S.K., C.Y. Yiu, M.K.S. Tse, and K. W. Chau. 2012. Do the Forward Sales of Real Estate Stabilize Spot Prices? *Journal of Real Estate Finance and Economics* 32: 289–304.

Wu, Jing, Joseph Gyourko, and Yongheng Deng. 2012. Evaluating conditions in major Chinese housing markets. *Regional Science and Urban Economics* 42: 531–543

Wu, Jing, Yongheng Deng, and Hongyu Liu. 2014. House Price Index Construction in the Nascent Housing Market: The Case of China. *Journal of Real Estate Finance and Economics* 42: 531–543

Xu, J.W., Xu, Q.Y. & He, F. 2012. The population structure factor of property price increases: International experience and domestic evidence in China. *The Journal of World Economy* 1: 24-42. (in Chinese)

Zheng, Siqi, and Matthew E. Kahn. 2008. Land and residential property markets in a booming economy: New evidence from Beijing. *Journal of Urban Economics* 63: 743–757.

Zheng, Siqi, Matthew E. Kahn, and Hongyu Liu. 2009. Towards a System of Open Cities in China: Home Prices, FDI Flows and Air Quality in 35 Major Cities. NBER Working Paper 14751.

Zheng, S., Wu, J., Kahn, M. E., & Deng, Y. 2012. The nascent market for "green" real estate in Beijing. *European Economic Review* 56(5): 974-984.

Zhu, J. 1999. Local Growth Coalition: The Context and Implications of China's Gradualist Urban Land Reforms *International Journal of Urban and Regional Research* 23(3): 534-548.
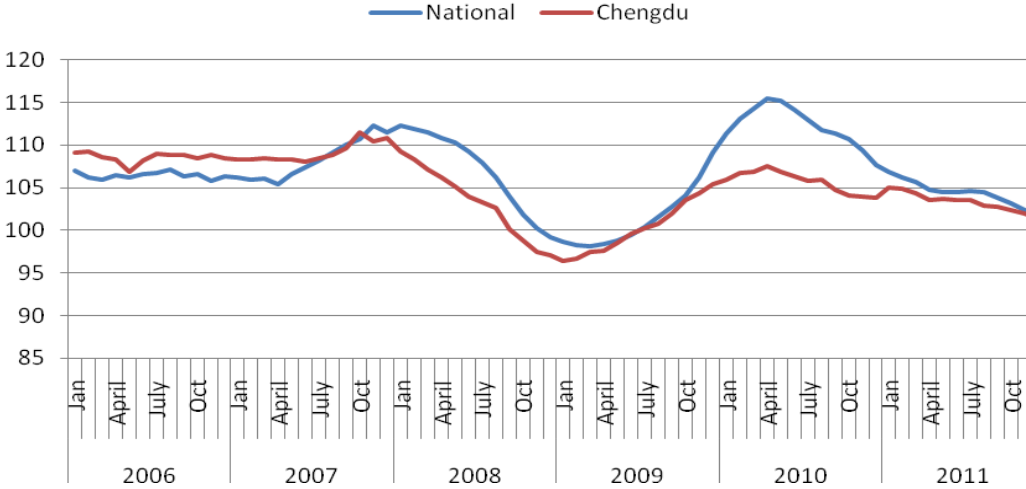
Figures:

Figure 1. Average sales price index 70 cities and Chengdu, 2006 – 2011 (2005=100)
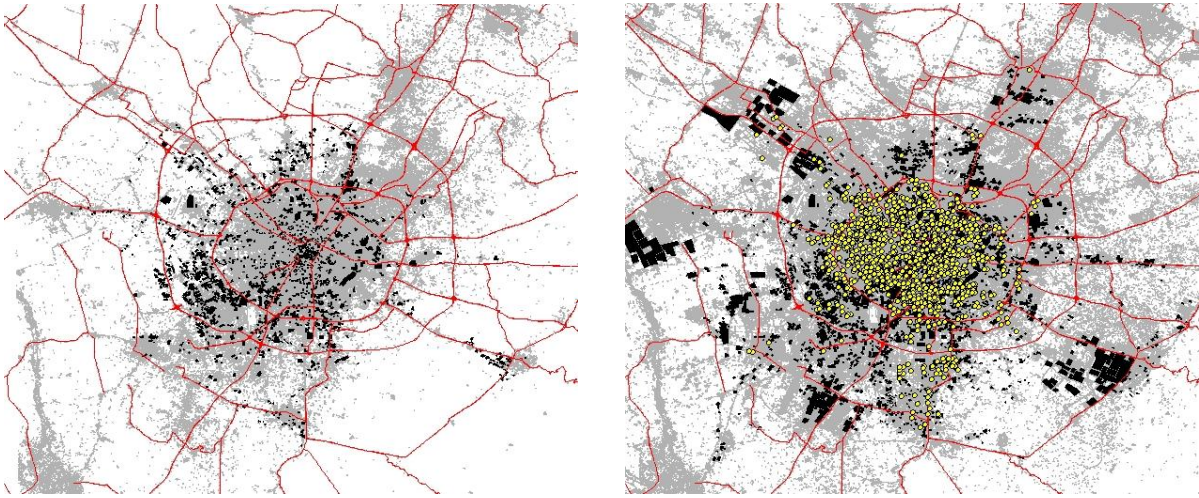
Figure 2. Maps of the urbanized area of Chengdu in 2000 and 2009 with non-residential land uses and residential transactions from 2004-2011
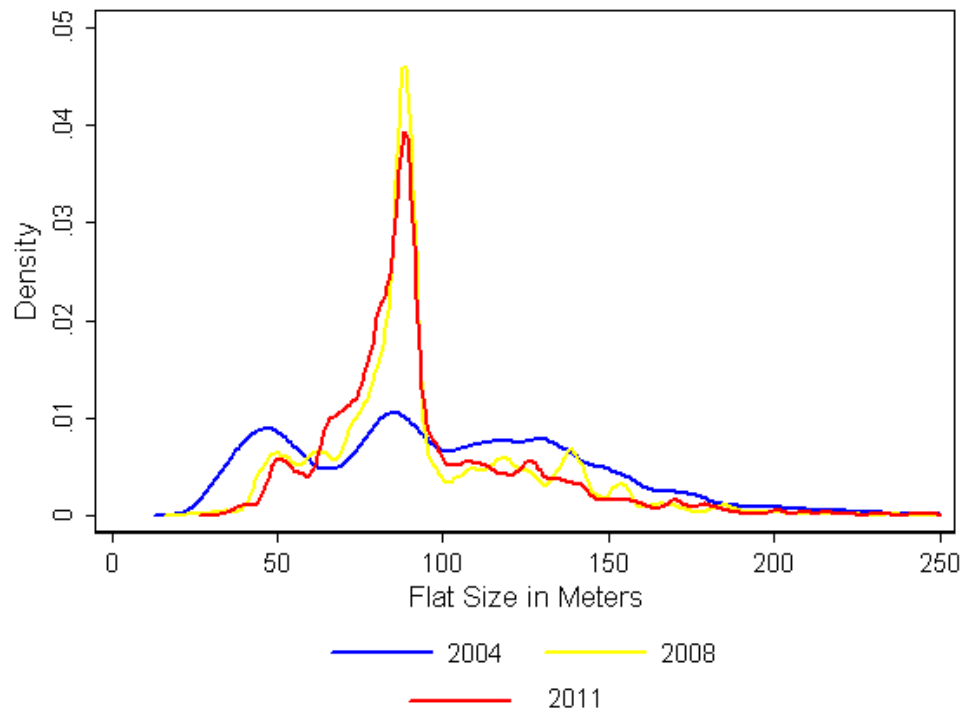
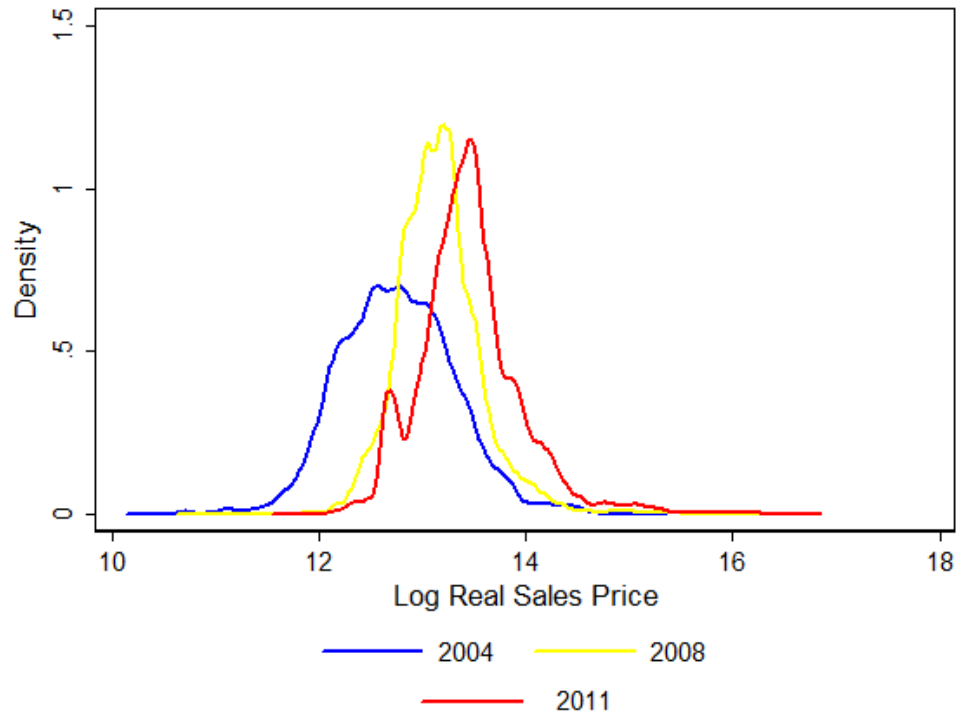**Figure 3. Distribution of units by size, 2004, 2008, & 2011**

Figure 4. Distribution of units by total sales price, 2004, 2008, & 2011
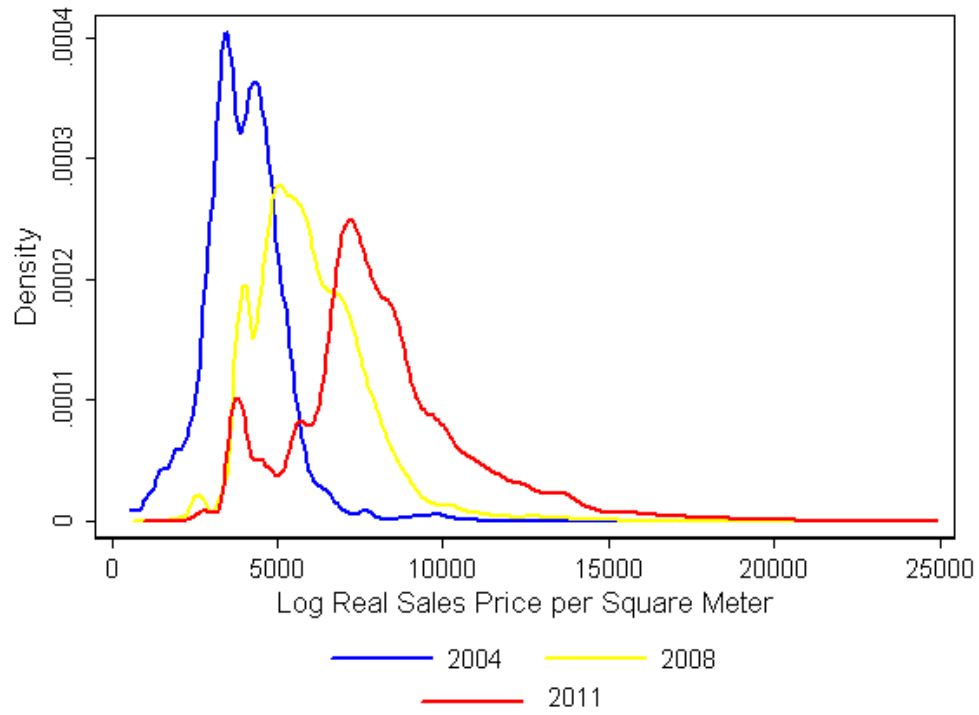
Figure 5. Distribution of units by sales price per square meter, 2004, 2008, & 2011

Tables

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	4,049	101	2.6	7.3
2005	64	467	4,473	103	2.4	7.5
2006	80	561	5,063	108	2.5	9.1
2007	119	610	5,981	102	2.4	12.0
2008	63	569	6,007	95	2.2	12.8
2009	162	593	6,291	93	2.1	13.6
2010	92	740	7,785	93	2.0	13.6
2011	57	801	8,420	98	2.1	13.5

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

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.

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

Variables	SOE Developers		Non-SOE Developers		FOE and HMTOE Developers	
	Mean	SD	Mean	SD	Mean	SD
Real price (per m^2)	5,231.4	2,087.9	5,674.6	2,291.3	6,803.7	2,666.1
Age (year)	0.4	0.7	0.5	0.7	0.5	0.8
Unit size (m^2)	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	2,800.0	3,150.2	2,447.4	2,594.1	3,789.7	3,089.9
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 one km distance	473.6	155.6	475.6	192.9	461.0	168.2
Distance to post offices (meters)	913.2	524.0	1,156.5	920.5	1,288.2	1,073.9
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)	1,906.4	1,329.2	2,040.7	1,460.9	1,902.0	1,211.2
Distance to university (meters)	1,305.6	1,353.4	1,579.6	1,418.9	1,543.1	1,087.2
Distance to transit (meters)	1,660.2	1,035.9	1,796.8	1,246.7	1,767.8	1,370.1
Distance to river (meters)	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 2004-2011

Dependent Variable	Ln (real price per m²)			
	(1)	**(2)**	**(3)**	**(4)**
Age	-0.0598***	-0.0593***	-0.0594***	-0.0597***
	(-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	-0.0508***	-0.0495***	-0.0499***	-0.0490***
	(-87.18)	(-84.32)	(-86.36)	(-85.09)
House floor	0.00315***	0.00287***	0.00294***	0.00296***
	(76.86)	(69.43)	(72.30)	(72.88)
Percentage of greening area	0.00296***	0.00253***	0.000686***	0.000905***
	(27.35)	(23.30)	(6.18)	(8.17)
Ln (total transactions in project)	0.0187***	0.0234***	0.0164***	0.0165***
	(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)	-0.0267***	-0.0135***	-0.0285***	-0.0235***
	(-17.92)	(-8.84)	(-18.99)	(-15.73)
[Ln (meters to major roads)]²	0.00309***	0.00168***	0.00342***	0.00297***
	(20.24)	(10.78)	(22.28)	(19.36)
Ln (minor roads in one km)	0.0108***	0.00394***	0.0130***	0.0116***
	(9.21)	(3.30)	(11.03)	(9.83)
Ln (distance to post office)	0.0299***	0.0302***	0.0313***	0.0296***
	(55.83)	(55.90)	(59.03)	(55.88)
Ln (distance to police station)	0.0170***	0.0213***	0.0306***	0.0311***
	(37.98)	(46.88)	(67.59)	(68.74)
Ln (distance to government office)	-0.0225***	-0.0223***	-0.0325***	-0.0333***
	(-43.08)	(-42.27)	(-62.14)	(-63.76)
Ln (distance to primary school)	-0.0256***	-0.0328***	-0.0337***	-0.0354***
	(-49.78)	(-63.40)	(-66.11)	(-69.46)
Ln (distance to college)	-0.0271***	-0.0271***	-0.0259***	-0.0242***
	(-45.16)	(-43.80)	(-42.39)	(-39.77)
Ln (distance to university)	-0.0330***	-0.0397***	-0.0363***	-0.0368***
	(-65.88)	(-75.57)	(-69.14)	(-70.32)
Ln (distance to transit)	-0.0323***	-0.0349***	-0.0281***	-0.0274***
	(-61.36)	(-65.64)	(-53.27)	(-52.04)
Ln (distance to river)	-0.0153***	-0.0176***	-0.0146***	-0.0159***
	(-44.05)	(-49.82)	(-41.97)	(-45.79)
SOE		-0.0723***		-0.0593***
		(-70.80)		(-58.87)
FOE			0.0943***	0.0871***
			(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	0.603	0.605	0.617	0.620
Adjusted R-squared	0.603	0.605	0.617	0.620
N	625,730	593,876	593,879	593,876
F-Statistics	34011.65	31394.89	31935.99	31197.46

Notes: Control variables indicating quadrant of the city in which the housing unit is located. t statistics in parentheses. * $p<0.1$, ** $p<0.05$, *** $p<0.01$