China's Housing Market: Determinants and Problems

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博 士 論 文

平成 26 年 6 月

神戸大学大学院経済学研究科

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(中国の住宅市場：その決定要因及び問題について)

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ABSTRACT

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With the remarkable economic growth in recent decades, China's housing market has developed rapidly, accompanied by high growth of housing price. The multi-level housing supply system was established as a solution to the resulting problem of housing affordability. However, there exist several problems in multi-level housing markets. In turn, this study illustrates the determinants and problems of China's housing market.

This thesis consists of five chapters. Given the housing economy is closely related with the basic economy and social development, the introduction in Chapter 1 highlights economic and social backgrounds, and shows the importance of the housing market in China's national economy. Because of the special relationship between house and land, this chapter introduces the development of housing and land policies. Based on the development of multi-level housing markets, the chapter summarizes the development status of the housing market to illustrate its current problems, including high growth of housing prices, decreasing construction of affordable housing, and illegal subsidy policy in the public housing market. The following three chapters analyze the related problems.

Chapter 2 analyzes the macroeconomic determinants of housing prices to illustrate why housing prices grow quickly, and the methods that can control housing prices. Housing

prices significantly influence economic activity and financial stability; hence, estimating their determinants is very important. In general, housing prices depend on the fundamental factors affecting the supply and demand of houses. This chapter not only uses the basic variables, such as land price, real estate investment, disposable income, and mortgage rate, but also includes the policy variables of enactment of "Property Law" and "China Banking Regulatory Commission's Notification of Improvement of the Real Estate Credit," to analyze the determinants of China's housing prices. The method used is a fixed effect model with data from 30 provinces and cities from 2002 to 2012. The main results indicate that land prices and disposable income have significant roles in pushing housing prices up, while new housing floor spaces and the mortgage rate would push housing prices down; the enactment of "Property Law" and the raising of the minimum down payment ratio negatively affect the changes in housing prices.

As a program to ease the problem of housing unaffordability, the implementation of the affordable housing program appears to ease the problem of decreasing construction. Chapter 3 analyzes its reason, crowding-out effects of affordable and unaffordable housing, by using panel data from 29 provinces and cities over the period 1999–2010 in China. To examine the dynamic interactions between affordable and unaffordable housing construction, this chapter applies the Dynamic Panel Model with controls for region-specific and time-specific fixed effects. The chapter analyzes whether affordable (unaffordable) housing construction has changed in response to the past and contemporaneous construction of unaffordable (affordable) housing. The empirical results reveal an asymmetric crowding-out pattern between affordable and unaffordable housing. Also, the crowding-out effect of unaffordable housing construction on affordable housing construction is related with the urbanization rate. When the urbanization rate is lower than 57.39%, unaffordable housing construction would crowd out affordable housing construction. Moreover, the crowding-out effect of unaffordable housing on affordable housing decreases with rising urbanization rates.

Although the affordable housing program targets middle- and low-income households to help them afford houses, the lowest-income households cannot even rent houses in the market. As a result, the public housing program complements the affordable housing

program. However, to recover the construction fund as soon as possible, the local governments began to sell public housing units to the lowest-income households. To illustrate the effects of this illegal subsidy method, Chapter 4 compares the effects of this method with another legal method, renting public housing units to households. The analysis of this chapter is based on a survey conducted in the city of Baoji, China. How can we assess the effects of the two subsidy policies? This chapter applies a Cobb–Douglas utility function to measure the extra benefits for households that fall under the sell-oriented policy (SOP) and households that fall under the rent-oriented policy (ROP). The results indicate that while both policies offer benefits to households, ROP households benefit more than SOP households do. In contrast, the lowest-income SOP households have a stronger taste in terms of housing consumption, and so, after buying public housing, they acquire more satisfaction. However, both groups of households are dissatisfied with the public facilities supplied to the public housing units. The main policy conclusions are that although the SOP could improve household utilities, the ROP is the more efficient of the two policies. In addition, public facilities to public housing units should be considered when undertaking new public housing projects. Finally, Chapter 5 summarizes the main results of this study, and presents the limitations and direction for future work.

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Chapter 1

Evolution and Problems of China's Housing Market

1.1 Introduction

China has achieved remarkable economic growth over the past several decades. The annual growth rate of its Gross Domestic Product (GDP) averaged 9.14% from 1989 to 2014, with an expansion of 7.4% in the first quarter of 2014 over the same quarter of the previous year[1]. In particular, Kim (2014) pointed out that in 2011, China's GDP of US$7.3 trillion rendered China's economy the second largest in the world. With the high growth of the economy, the population and urbanization rate grew fast as well. In 2011, China's total population was 1.35 billion, and the urbanization rate was 51.27%[2]. As housing is one of the fundamental demands for living, the growing population and urbanization raise the demand for housing, thus boosting construction work as well. In 2011, the contribution of construction, a kind of housing activity, to GDP was about 6.75%, which indicates a bright future for China's housing market. In fact, China's housing market started to develop after a series of reforms that began in 1978. The housing market has flourished, particularly since the reform of housing monetization in 1998, and housing prices have grown as a result. With the higher housing prices, housing affordability has become a serious problem for households, especially for low- and middle-income households (Ren, 2012; Shen, 2012; Chen et al., 2006). Given this situation, this research investigates the determinants and problems of China's housing market.

This chapter serves as an introduction. First, the basic economic and social backgrounds are described, showing the importance of the housing market to China's economy. Based on a brief history of China's housing and land policy, this chapter then

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[1] Data source: Trading Economics, 2014, available at http://www.tradingeconomics.com/china/gdp-growth-annual.
[2] Data are from the China Economic Information Network (CEINET) Database. Urbanization rate refers to the proportion of the urban population in the total population.

summarizes the status of the housing market development to illustrate the current problems.

1.2 China's development since 1978

1.2.1 China's economic and social development

Since 1978, China has undergone tremendous market-oriented economic reform, known as the "Reform and Opening-up" policy. Deng Xiaoping[3], the chief designer of this reform, presented the main goals of the economic development as follows: (1) to double China's GDP from 1981 to 1990 to ensure there is enough food and shelter for its citizens; (2) to double the GDP again during the 1990s to ensure citizens live a moderately prosperous life; and (3) to achieve modernization by 2050, raising income to the level of medium-sized developed countries. Under this guidance, the GDP and household income increased rapidly. As Figure 1.1 shows, the GDP annual growth rate reached the highest value of 14.20% in the fourth quarter of 1992, and the lowest value of 3.80% in the fourth quarter of 1990. Figure 1.2 shows that the year-on-year per capita GDP, urban household per capita disposable income, and the growth rate increased rapidly.

In addition, Deng Xiaoping also presented the policy of "letting some people get rich first, who then help others get rich." However, this introduced a level of inequality between urban and rural households. As Figure 1.2 shows, for rural households, the per capita net income[4] increased more slowly than that of urban households. The annual growth rate of urban households' per capita disposable income averaged at about 13.45%, which is higher than rural households' per capita net income of 12.96%. In addition, the income gap between urban and rural households increased year by year. The proportion of rural household income to urban household income was 38.91% in 1978, reaching its highest value of 54.87% in 1983, and then dropping to 33.00% in 2013. According to a report by the Chinese Academy of Social Sciences, the income gap between urban and rural households in 2011 was about 26% higher than that in 1997, and 68% higher than

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[3] Deng Xiaoping (1994–1997) was a Chinese politician who served as the Paramount leader of the People's Republic of China from 1978 to 1992. He was also the chief designer of the Reform and Opening-up policy.
[4] Per capita net income of rural households is equal to total income less expenses for taxes, depreciation, operating, and transferring. This concept corresponds to per capita disposable income of urban households.

that in 1985 (Duggan, 2013).
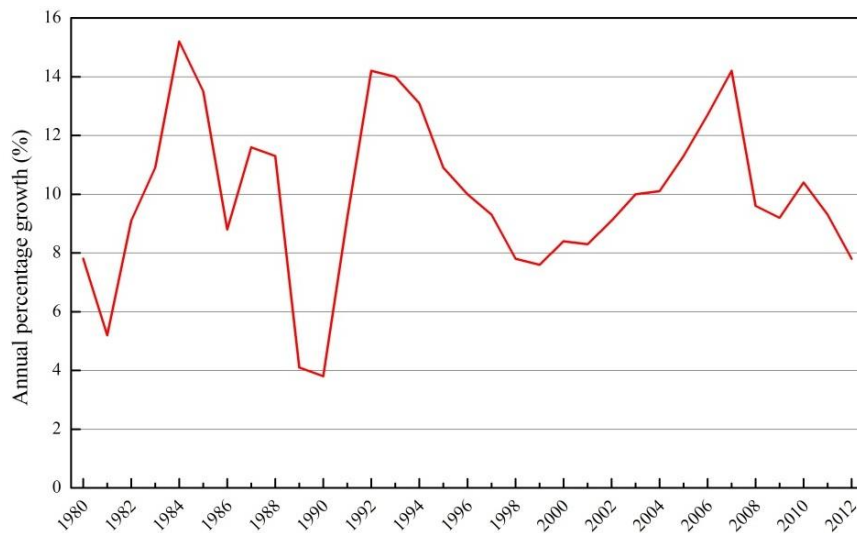
Figure 1.1 The annual growth rate of GDP from 1980 to 2012

Source: The Word Bank[5] (2014)

   The inequality in income resulted in surging numbers of migrants from rural to urban areas, thus promoting the urbanization rate, which reportedly reached 53.73% in 2013 after growing for years (see Figure 1.2). The increase in the urbanization rate also positively affects housing demand. Trend of income and wealth inequality widened continuously during the economic transition is the essence of the housing affordability problem (Chen et al., 2006).

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[5] Available at the website: http://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS/countries.
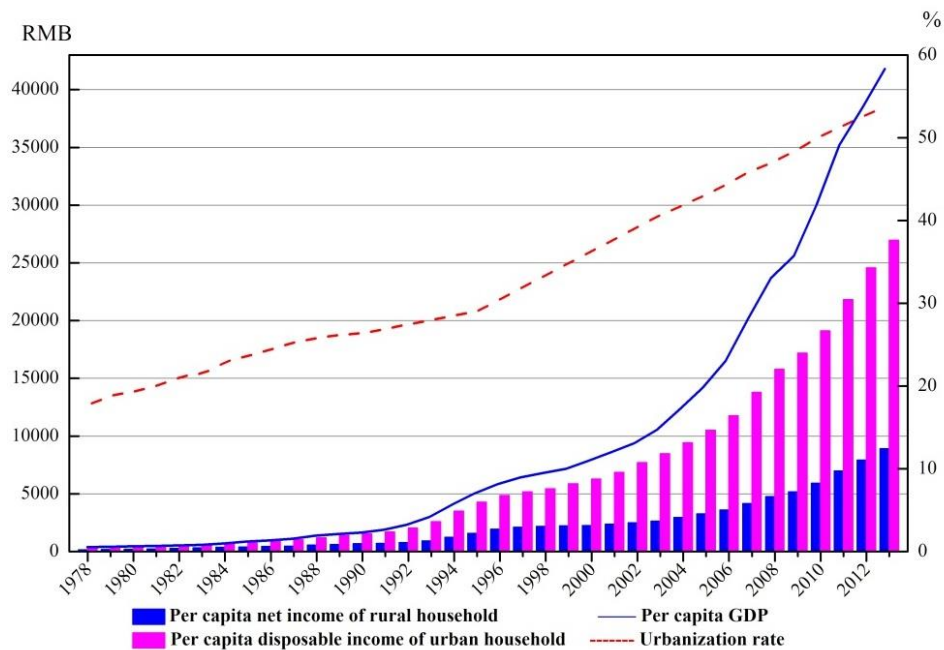
Figure 1.2 Per capita GDP, household disposable income, and urbanization rate from 1978 to 2013.

Source: China Economic Information Network (CEINET) Database.

1.2.2 The importance of housing economy in China's economy

With the improvement in the GDP, China began its housing market in 1987, focusing on land and housing reform. From then on, housing and land was no longer granted for free to state-owned enterprises and government sectors. As a result, housing construction works developed significantly, promoting the development of the housing economy. Hilbers et al. (2008) showed that for many countries, the proportion of housing activities such as trading services, construction and renovation, to GDP should be estimated to be between 5% and 10%. As shown in Figure 1.3, the ratio of construction to GDP in China varied from 3.54% in 1980 to 6.86% in 2013. Since 1992, this proportion has remained above 5%. More specifically, the proportion of total construction to GDP averaged 4.30% from 1978 until 1986, improving to 5.53% from 1987 to 1997, and then reaching almost 6% after 1998. Hence, China's housing industry plays an important role in economy.

In addition, as leading indicators for real activity and inflation, housing prices can

serve as an indicator of where the real economy is heading (Stock and Waston, 2003). Figure 1.4 shows the trends for the Consumer Price Index (CPI), Retail Price Index (RPI), Producer Price Index (PPI), and House Price Index (HPI). The curvilinear shapes of these indices are similar, but the trends for the CPI, RPI, and PPI lag behind that of the HPI. This indicates that housing prices could be a leading indicator of the real economy. In summary, the housing industry plays an important role in China's real economy, resulting in increased interest in the industry by researchers (Barth et al., 2012; Dreger and Zhang, 2013).
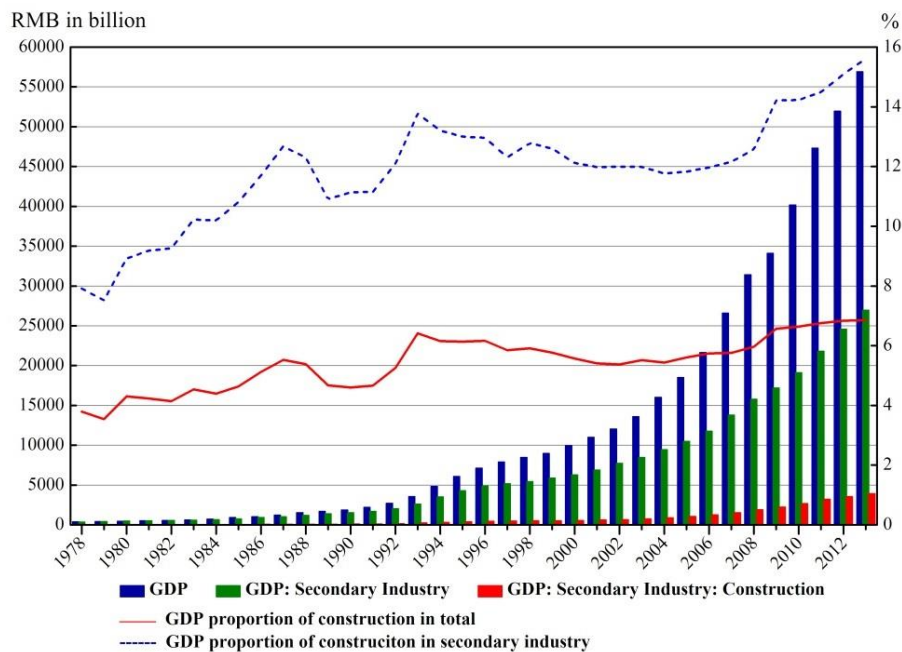
Figure 1.3 The importance of construction work in China's economy

Source: China Economic Information Network (CEINET) Database.
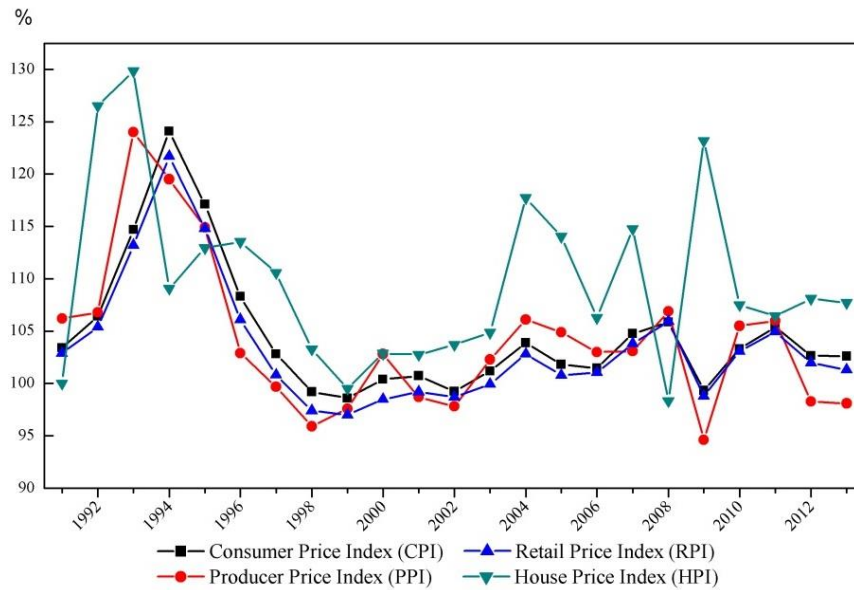
Figure 1.4 The chains of CPI, RPI, PPI, and HPI.

Notes and Source: There are no reported data of housing prices from 1991 to 1994, and 1996. Hence, housing prices are calculated by dividing housing areas with respect to housing sales. Then, the chain of house price index is computed from these housing prices. Related data of housing sales, housing area sold, CPI, RPI, and PPI are collected from the China Economic Information Network (CEINET) Database.

1.3 Development of China's housing and land policy: A brief history

1.3.1 The transformation of China's housing system

This section reviews the transformation of China's housing system. Many studies have documented this transformation and assessed its impacts. This section only summarizes them by discussing several major milestones in China's housing reform.

The development of China's housing market has been a gradual and on-going process. In China, during the era of the plan-oriented economy, from 1949 to 1978, housing was deemed as a welfare good instead of a commodity (Chen et al., 2010). During this period, most people in urban areas were supplied housing units according to the welfare housing

system, under which the state-owned enterprises, also known as work units, produced and allocated housing units almost for free (Chen et al., 2010). Under the welfare housing system, the rent was substantially lower than the cost, and thus was unable to cover the cost of housing maintenance and management. The management of state-owned housing units caused an additional financial burden on work units and the government. Thus, they had little incentive for housing investment and improvement. Before 1978, the government spent on average RMB 25 billion on new housing construction and RMB 10 billion on maintenance, but only received RMB 1 billion from rent, which indicated that investment in welfare housing was incredibly low (Cui, 1991). Therefore, under the old system, China's urban households experienced a widespread housing shortage and continuously deteriorating living conditions (Deng et al., 2009). For example, in the early 1950s, the per capita living space of urban households was 4.5 square meters[6], which declined to 3.6 square meters until the late 1970s; and about 47.5% families faced a lack of housing in 1978 (Li, 1998). In addition, the average ratio of residential housing consumption expenditure to total household expenditure was 2.3% in 1975 (Li, 2007; Wang, 2014). Hence, the housing market developed slowly during this period, and the system was not economically sustainable.

Within the three decades of housing reform, China's housing supply system shifted from a planned-oriented and state-owned housing system to a market-oriented system. From the start of 1979's economic reforms, it took almost two decades to move from a government allocation of housing to a co-existence of a market-oriented allocation and government allocation, and finally to a market allocation of housing (Ye et al., 2006). In 1982, four cities, Zhengzhou, Changzhou, Siping and Shashi implemented a new housing subsidy policy named "Three-thirds System," a subsidy policy for housing sales, under which the government, work units and individual could each afford one third of the housing cost. However, this policy was terminated in 1985. In 1986, the housing reform leading group set up by State Council proposed to increase the housing rent, which indicated the beginning of the national housing reform (Wang, 2014). For example, the three cities, Bengbu, Yantai, and Tangshan, increased the per month rent per square meter

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[6] One square meter is about 10 square feet.

rent from RMB 0.07–0.08 to over RMB 1, the proportion of which to housing cost was about 75%. Besides, they sold the state-owned housing units at standard prices, charging only for construction costs, land compensation fees and relocation compensation fees. Then in 1988, the State Council convened a meeting and proposed that urban areas all across the country should try to implement the housing reform system. However, serious inflation in the second half of 1988 raised the retail price index by 18.5% and foiled the implementation of the housing policy reforms. In 1993, about 3 million square meters of floor space in old state-owned housing units were sold for only RMB 130 per square meter. Especially in July 1994, the State Council issued 'The Decision of Deepening the Reform of the Urban Housing System' to promote housing commercialization and socialization, housing construction and improvement in living conditions. After 1994, the housing development industry and construction developed rapidly. However, instead of being sold to individual families, most of the houses were purchased by work units, which then resold them to their employees at deeply discounted prices (Deng et al., 2009). Hence, in 1997, about 80% of urban housing was in the public sector (Wang, 2007).

In 1998, an important milestone of housing reform was the issuance of the 23rd Decree by the State Council, which ended the policy of purchasing houses from work units (Li and Wu, 2013). Instead, work units would have to provide their employees with monetary subsidies to help them buy housing units on the market. Therefore, the majority of urban households were encouraged to purchase housing units from the housing market. This 1998 reform was characterized as the monetization of the housing allocation system (Deng et al., 2009). Since 1998, there has been widespread housing privatization in urban China. This policy finally paved the way to develop a market-oriented housing market in China's urban area. From 1998 to 2003, the government initiated all sorts of policies to stimulate housing market development. For example, the government reduced many house-related taxes such as sales tax and property tax (Zhang et al., 2012). Consequently, the Chinese housing market experienced rapid expansion since 1998 and housing prices rapidly grew since 2003. Ye et al. (2006) pointed out that in China, annual investment in real estate averaged about RMB 746 billion[7] from 2000 to 2004, and accounted for

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[7] As of February 2014, the U.S. dollar-Chinese RMB exchange rate was 1:6.11 (CEINET Database). To

almost 7% of the national GDP. With the development of the housing market, the living conditions of urban households have also improved significantly. For example, the per capita living space increased from 18.7 square meters in 1998 to 24.97 square meters in 2004 (Deng et al., 2009). However, the government implemented policies, such as raising interest rates, to control housing prices from 2004 to 2008. From September of 2008 to 2009, housing policies aimed at stimulating economic growth were implemented to ease the economic crisis. This caused a continuous growth in housing prices. Since 2010 until now, the government has been initiating policies to curb this rapid rise in housing prices. In April 2010, the State Council issued 'The Notice about Curbing Rapid Rise of Housing Prices in Some Cities', which proposed improving the housing supply and increasing indemnificatory housing construction, such as affordable housing.

From 1978 to 1997, together with privatization, to enhance housing affordability, two principal policy instruments were developed (Chen et al., 2010). To accumulate the initial capital for workers to purchase a home, the Housing Provident Fund (HPF), based on Singapore's Central Provident Fund (CPF) system, was introduced in Shanghai in 1991, then across all urban areas after 1994 (Chen et al., 2010). The HPF is supported by tax-free payroll contributions from employees, matched by those of employers, and provides various forms of assistance, including subsidized mortgages, in return (Chen et al., 2010). In addition, the "affordable housing" program was implemented to enhance housing affordability. In this program, supply-side subsidies are provided, which employ instruments such as allocating land at zero cost combined with profit caps on developers (Chen et al., 2010). Hence, the prices of affordable housing fall within agreed thresholds to prevent developers from capturing the subsidy (Chen et al., 2010). This program was aimed originally at households in urban areas, but its target has been narrowed to the middle- and low-income households since 2003 (Chen and Hao, 2007). The monetization reform in 1998 called for establishing a social security housing system for those who could not afford to purchase "affordable housing" units or to rent market housing units (Deng et al., 2009). The targeted groups include people with disabilities, lonely seniors,

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convert Chinese RMB accounts to U.S. dollars, divide the RMB amount by 6.11. Thus, RMB 746 billion would be about 122billion U.S. dollars.

and lowest-income households (Deng et al., 2011). Ye et al. (2006) pointed out that rents in these social housing units should be heavily subsidized. In addition, the Ministry acknowledged that the main housing problem in China is that of urban poverty, in which people may not even be able to rent a house in which to live. Hence, in 2004, the Chinese central government implemented the "public housing/cheap-rent housing" program (hereafter, the "public housing" program), which employed instruments such as expanding the public housing supply and the demand-subsidy approach. However, because of the funding problems, this program has understandably grown very slowly (Han, 2008). Before 2006, about 550,000 lowest-income households benefited from the "public housing" program, which produced only about 1% of the total housing units built during the same period. Until 2006, some big cities, such as Beijing, officially implemented this program.

After over 30 years of reform in the housing market, China now has a more-or-less complete policy system with multi-level housing supply, including general housing, affordable housing, public housing, and so on. The involved parties include the enterprises, consumers, socially vulnerable groups, service agencies, and the government (Ye et al., 2006). Hence, a housing policy is one of the most basic, yet complex policies that concerns everyone's livelihood. Figure 1.5 shows the management of the multi-level housing system.

Table 1.1 The process of China's urban housing reform

Period	Main Content
1948–1978	Welfare housing system (planned state-owned housing system): state-owned enterprises (work units) produced and allocated houses almost free of charge.
1979–1985	"Three-thirds System," a subsidy policy for housing sales, under which the government work units and individual could each afford one third of the housing cost.
1986–1991	Stimulate housing purchases by increasing the rent of state-owned housing to the cost, including maintenance fees, management fees and depreciation charges.
1991–1994	Co-existing of the rent and the sales of state-owned housing units, expanded the form of housing investment, and established HPF program.
1994–1998	Prioritized selling state-owned housing units; established a multi-level housing supply system, including the affordable housing program.
The second half of 1998	Ended the old housing allocation system; set up the policies of privatization and monetization; proposed a multi-level urban housing supply system and housing security system.
2003–Present	Adjusted the housing supply structure, enabling most families to purchase or lease commodity housing units in the free market (affordable housing program and public/cheap-rent housing program).

Source and notes: Wang (2012); periods from 1949 to 1978 are summarized by author.
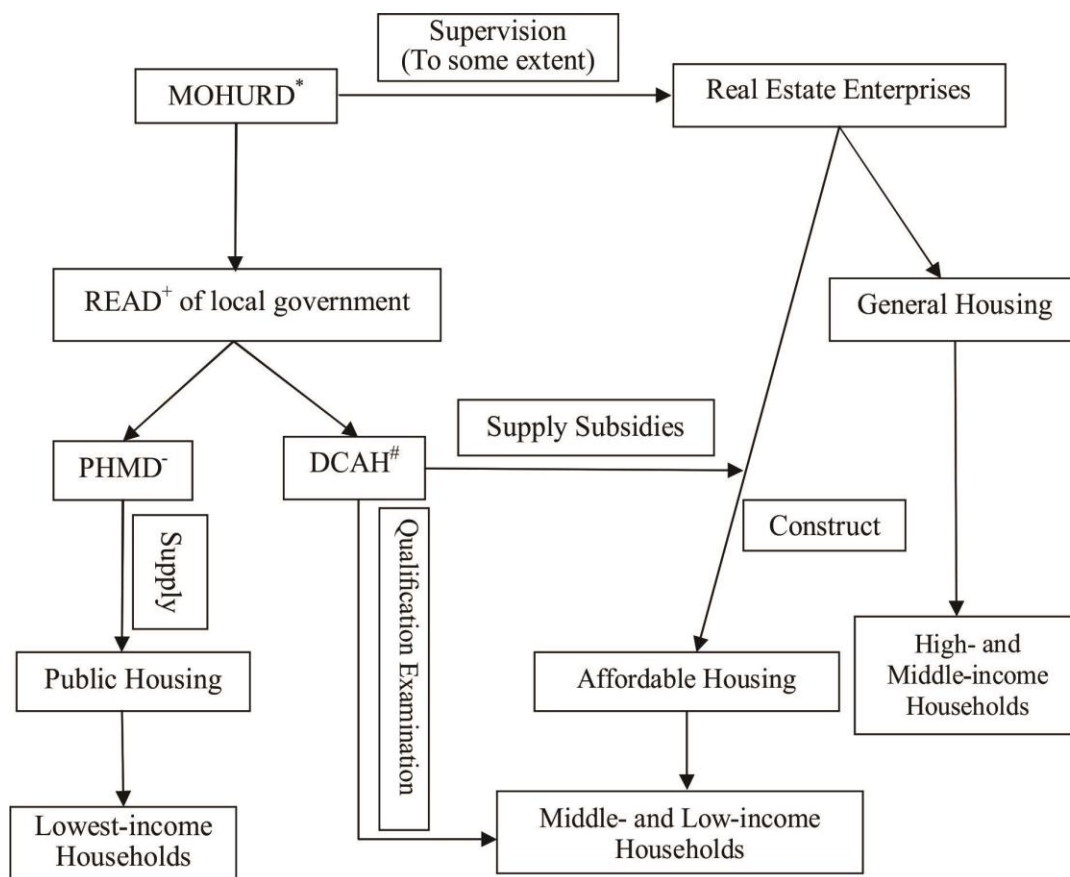
Figure 1.5 The management of the multi-level housing system in China.

Source and notes: Summarized by author; [*]MOHURD: Ministry of Housing and Urban-Rural Development of the People's Republic of China; [+]READ: Real Estate Administration Department; [-]PHMD: Public Housing Management Department; [#]DCAH: The Department in Charge of Affordable Housing.

1.3.2 Relationship between house and land

Housing and land prices are closely related. According to the Ricardian rent theory (Ricardo, 1911), the demand for land is derived from the housing demand in a city. If the land market is efficient, land prices are determined primarily by property prices. In contrast, neoclassical rent theory states that a product's price is determined by its costs (Needham, 1981). Since land costs are the main component of housing prices, rising land prices will increase the long-run supply costs of housing, thus pushing up housing prices (Bostic et al., 2007; Potepan, 1996).

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Especially in China's case, governments were essentially the only land supplier after 2004, enabling them to control land prices by arbitrarily controlling land supply (Du et al., 2011). In addition, a new land granting system, discussed in the next section, has greatly changed the land price formation mechanism, as well as the dynamic relationship between land and housing prices in China (Du et al., 2011). In China, the relationship between housing and land become stronger, a trend already analyzed by many researchers, including Wen and Goodman (2013), Zhang et al. (2013), Du et al. (2011), and Wu et al. (2012). Zhang (2008) points out that the land supply policy implemented by the government had a significant impact on housing prices. Furthermore, by using panel data from four cities[8] in vector error correction models, Du et al. (2011) examined the impact of land policy on housing prices, and found that there exists a long-run equilibrium between the Chinese urban housing and land markets. In other words, land prices are the Granger causes of housing prices, while the reverse does not exist. In addition, they also show that the housing and land markets became less efficient since adopting the new land granting system in 2004, as housing and land markets responded to market disequilibrium more slowly than before. However, Wen and Goodman (2013) pointed out that the impact of housing prices on land prices is almost the same or greater than the impact of land prices on housing prices. To examine the interact effects between land prices and housing prices, they apply a simultaneous-equations model with sample data from 21 provincial cities from 2000 to 2005. They assume that housing prices and land prices have an endogenous interrelationship, and their results show that housing prices have a greater influence on land prices. In addition, Zhang et al. (2013) examined the effect of land use control[9] on housing prices. They apply the production model of three sectors (housing, agriculture, and others) to analyze the effects of an artificial constraint on land use. Their results argue that the policy of restricting land use causes high housing prices. Furthermore, Wu et al. (2012) suggested that much of the housing price increase in large Chinese cities (especially in Beijing) in recent years is driven by the increase in land values. Based on these previous studies, there exists a strong relationship between the

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[8] The four cities are Beijing, Shanghai, Tianjin, and Chongqing (Du et al., 2011).
[9] Land use control includes the policy of restricting land use, in particular, the maintenance of a minimum overall agricultural acreage (Zhang et al., 2013).

housing and land markets. Hence, the next section discusses China's land policy.

1.3.3 China's land policy

China's land does not exist private ownership. On December 4, 1982, the Chinese Communist Party amended the "Constitution," in which Article 10 stipulated that all land is only belong to the collectives or state, and the ownership of land is managed under a system of central control. Hence, the Chinese government owns the rights to controlling and using the land. The local governments are the agents of the country (Deng et al., 2009). Therefore, they take charge of expropriating rural land use for urban use and allocating it among users (Deng et al., 2009). Subject to the requirements of the central government, local governments can decide what can be built in their jurisdiction by controlling both the land supply and the zoning regulations (Deng et al., 2009). For instance, the China's Premier Wen Jiabao (2002–2012) made it clear that a minimum acreage of 1.8 billion mu (120 million ha) for agricultural use must be maintained. Apart from limiting the total amount of land for non-agricultural use, the Chinese government has, over time, developed a system for managing urban land use.

China's land policy comprises two components. One is the land reserve system, and the other one is the granting system of land use rights (Du et al., 2011). Over the last three decades, the two systems have experienced great changes with profound implications for China's housing market. This section reviews the evolution of the land policy and land market.

The land reserve system was set at the national level on April 30, 2001, at which time "A Notice on Strengthening State-Owned Land Management" was also published by the Chinese State Council. On November 19, 2007, the "Land Reserve Regulation" was officially taken effect, which indicated a fully developed land reserve system in China. The urban land reserve system is the system that the land use rights are recycled from the existing land owners by municipal governments through kinds of market-oriented methods, such as repurchase, exchanges and acquisitions (Du et al., 2011). Then, the previous development tasks on land are completed by the governments, after which they can put land back on the market on the basis of the land use and its developing plan.

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Under Chinese land reserve system, the municipal governments are able to monopolize the primary land market. As a result, in the secondary land market, the traded quantity of land use rights is reduced. Therefore, the urban land supply is completely controlled by Chinese municipal governments.

There are three major policy periods in the evolution of the Chinese land use rights granting system: the period from 1982 to 1988, the period from 1988 to 2001, and the period from 2002 onwards. During the first period, the land demanders, such as individuals, organizations, and companies, only could acquire land use rights that cannot be transferred under the allocation system of plan-oriented. The government controlled the land quantity and the timing of the development, thus monopolizing the land market under this policy. In addition, the governments proposed that the maximum durations of land use rights should be difference relying on the purpose and type of land usage. For example, the period was70 years for residential use, 50 years for industrial use, and 40 years for commercial use.

The Article 10 of the "Constitution Amendment Act" on April 12, 1988 stated that land use rights might be transferred on the basis of the law. To be transferable, in the primary land market, the land use rights should be separated from its ownership (Du et al., 2011). To obtain land use rights, there are two main ways as follows. First, land use rights could be negotiated with a municipal government, with an agreement that included a substantial granting fee payable in full and upfront. Alternatively, the existing use rights owners, who were state-owned or collective-owned enterprises, could sell land use rights in the land secondary market. Under the circumstances, the sellers and purchasers could get a negotiate price of land. The negotiate system refers to that demanders could negotiate land price with either state-owned firms or the governments. Because of the barriers in negotiating with the local government, the other land demanders, such as private-owned enterprises, who wanted to enter China's housing market, faced several difficulties.

However, other land developers, especially private-owned enterprises and foreign entities, faced serious difficulties entering China's housing market, mainly owing to various barriers in dealing with local governments. Although Chinese land reserve system did not fully develop, from 1988 to 2001, numerous land rights were still traded in the

market, and especially in the secondary market, most of the land demand could be satisfied. As a result, during this period, urban land prices were dominated by the land transaction in the secondary market, which reflected the land demand and supply, as pointed out by Peng and Thibodeau (2012).

As a result of the lack of transparency in the land trade before 2002, governments lost revenue from land transactions (Du et al., 2011). To promote transparency, on July 1, 2002, China's Ministry of Land and Resources began to implement a new land policy regarding the three main methods of granting land use rights: invitation to tender, auctions, and listings[10]. By August 31, 2004, this policy was fully implemented. Under this policy, land developers could obtain land use rights from a fair competition market, and entering China's real estate market become easier. Hence, these policies bring more transparency to the land market and lower the entry threshold (Du et al., 2011). This granting method was completely adopted in 2004, which was a major milestone in the development of China's real estate market. First of all, the total number of real estate developers increased dramatically from 37,123 in 2003 to 59,242 in 2004 (Du et al., 2011). Secondly, land developers were more diverse than before. For example, in 2004, the number of investment developers from Hong Kong, Macau, and Taiwan, as well as foreign and foreign investment developers increased by 79.25%. Hence, after the complete adoption of this land policy, China's land market structure improved significantly.

1.4 Problems with China's housing market

1.4.1 China's housing market development since 1995

After the enactment of "The Decision of Deepening the Reform of the Urban Housing

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[10] Here, the three new granting methods are introduced in compliance with the study by Du et al. (2011). "Invitation to tender" – after the public announcements of the local governments, the invited organizations or individuals will bid a price on a given land. Based on the bidding results, land use rights are granted.

"Auctions" – after the local governments' announcements, bidders can participate in the auction at a given time and place. Prices are publicly quoted by bidders. The bidder who quotes the highest price could get the land use right.

"Listings" – local governments place a notice at the given location of land exchange. The terms and conditions must be opened by the grantor for the granting of land use rights. As soon as the bidder's quotations are accepted, the listed notice is updated accordingly. The granting of land use right is determined by the quotation with no less than 10 working days.

System" in 1994, some cities began to sell houses in the market. In July 1998, China's housing market started the monetization reform officially (Zhang *et al.* 2012).

A dramatic increase in residential selling prices accompanied housing policy reforms. In 1995, the residential selling price was RMB1710 per square meter. This value reached 6237.3 in 2013. Figure 1.6 shows the trend of residential selling price since 1995. From 1995 to 1997, residential selling price was under RMB 2000 per square meter and this trend was almost consistent. Although housing commercialization reform was implemented gradually during this period, the housing policy of physical distribution was also operational. As a result, the residential selling price did not change greatly. However, the comprehensive implementation of housing monetization reform caused rapid increase in residential selling price. Prices rapidly increased from 2001 until 2013, with a period of brief price drop in 2008. Increase in interest rate on loans from 6.12% to 7.47% by the state to control housing prices might have caused this price decrease.
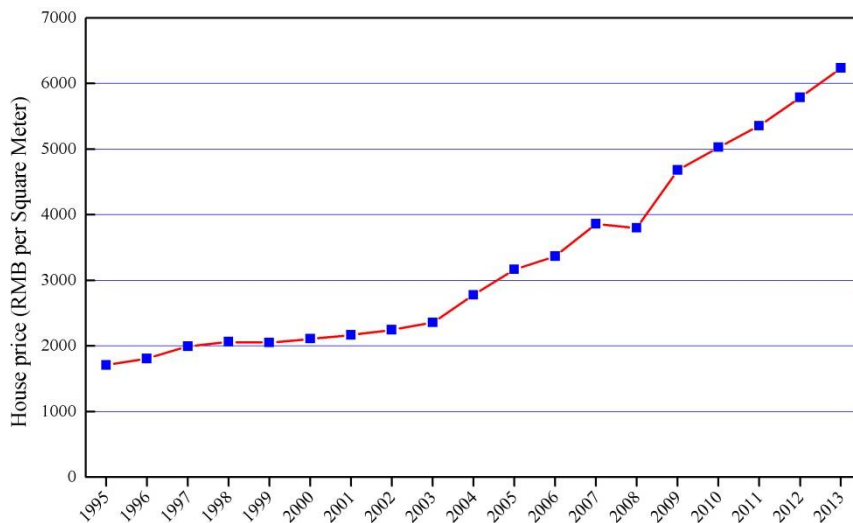
Figure 1.6 Trend in housing selling price since 1995

Source: China Premium Database in the CEIC Database

With an increase in housing price, more and more households could not afford housing units by themselves (Liu et al., 2008; Chen et al., 2010). Deng et al (2009) pointed out to improve housing affordability for its citizen, affordable housing program and public housing program are the two main housing policies in China's current housing market

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(See Section 1.3.1).

   To assist these middle- and low-income households own houses, the Chinese government implemented the affordable housing program which was first proposed in June 1994. In 1997, per meter price of affordable and residential housing were RMB 1097 and RMB 1790, respectively. With increasing residential housing price, affordable housing price also increased year over year (see Figure 1.7). Affordable housing price stood at RMB 2495 per square meter in 2010, recording an increase of 127.44% compared to 1997 prices. This growth was primarily led by the high growth rate of residential housing price, which recorded an increase of 163.97% over 1997 prices. However, the price ratio of affordable housing to residential housing dropped from 0.61 in 1997 to 0.53 in 2010. The lowest price ratio of 0.48 was recorded in 2009. Therefore, it can be observed that although residential housing prices influence affordable housing prices, the latter increases at a relatively slower rate than the former. Moreover, the declining price ratio shows that the price of affordable housing is comparatively reasonable.

Figure 1.7 Residential and affordable selling prices, 1997–2010

Source: China Premium Database in CEIC Database.

   Although the affordable housing program was proposed in 1994, construction progressed at a slow speed from 1994 to 1995. Since 1996, other cities, such as Beijing and Zhengzhou, began construction of affordable houses. Floor spaces of the newly

started, under construction and completed affordable and unaffordable housing are shown in Table 1.2.

Table 1.2 Floor spaces of newly started, under construction and completed affordable and unaffordable housing

| | Floor spaces newly-started | | Floor spaces under construction | | Floor spaces completed | |
| | Affordable housing | Unaffordable housing | Affordable housing | Unaffordable housing | Affordable housing | Unaffordable housing |
Year						
1996	14287 (13.89%)	88583	30946 (9.72%)	287547	14373 (11.75%)	107953
1997	17206 (15.65%)	92760	37643 (12.39%)	266104	19029 (15.27%)	105618
1998	34664 (20.83%)	131711	57464 (15.86%)	304766	23522 (16.65%)	117735
1999	39704 (21.12%)	148275	81680 (19.18%)	344223	40635 (23.03%)	135772
2000	53133 (21.77%)	190879	102159 (20.23%)	402824	53721 (26.07%)	152312
2001	57960 (18.89%)	247367	109495 (17.78%)	506335	58013 (23.56%)	188241
2002	52797 (15.21%)	294396	106816 (14.59%)	625271	54100 (18.97%)	231147
2003	53306 (12.16%)	385233	101395 (11.09%)	812510	45385 (13.44%)	292361
2004	45889 (9.37%)	444084	98744 (8.73%)	1032446	44017 (10.33%)	382180
2005	35134 (6.37%)	516717	81157 (6.29%)	1209627	32128 (7.35%)	404701
2006	43790 (6.80%)	600248	94012 (6.20%)	1423415	32720 (7.20%)	421997
2007	48103 (6.10%)	739852	110129 (5.90%)	1757755	34429 (6.91%)	463884
2008	56219 (6.72%)	780202	126892 (5.69%)	2102026	32198 (5.93%)	511143
2009	53547 (5.74%)	879437	129460 (5.15%)	2383828	34462 (5.78%)	561825
2010	49095 (3.80%)	1244498	134397 (4.27%)	3013204	32019 (5.05%)	602412

Source: All data are from the China Premium Database in the CEIC Database.

Notes: Measurement units of the values are thousand square meters. The numbers in parentheses denote the ratio of affordable housing construction to residential housing construction. The data on newly-started, under construction, and completed unaffordable housing floor spaces are derived by subtracting the corresponding values for affordable housing from that of residential housing.

From 1996 to 2001, the construction of affordable houses increased every year. The proportion of affordable housing construction to residential housing construction reached peak values in the year 2000. Especially, the ratio of completed floor spaces in affordable houses to that of residential housing reached 26.07% in 2000. Nevertheless, in 2002, the construction of affordable houses began to decrease because of the following reasons: first, affordable housing sales from 1997 to 2001 did not satisfy the real estate developers.

During this period, the gap between selling prices of affordable and unaffordable housing units was not very evident (see Figure 1.5). The average proportion of selling areas was only 65.56%. Second, the growth rate in price for residential housing reached 4.9% in 2000, the highest value since 1997. To earn more profits, real estate developers decreased construction of affordable houses. In 2003, the Ministry of Construction claimed that the floor space available per affordable house was too large in several cities (e.g., Beijing) in the report "Chinese Affordable Housing Investigation and Analysis in 2003."[11] Thus, the proportion of floor spaces in newly started affordable houses dropped to only 9.37% in 2004. From then onwards until 2010, investments in affordable housing construction reduced year over year.

There is little official data about the development of the public housing program. According to related studies (Huang, 2012; Yao and Gu, 2011), by 2006, 145 of 657 cities had yet to establish this system. By the end of the same year, only 0.55 million units of public housing had been provided, while there were four million households with a "Certification of Minimum Subsistence Security for Urban Residence"[12] who faced housing difficulties (Huang, 2012). In 2007, the public housing program managed to reach 0.95 million households. As of November 2009, the program included 5.65 million households (3.28% of urban households), of which the governments provided 2.73 million units of public housing, as well as cash subsidies for 2.92 million households. According to the 2010 census data, 2.7% of all urban households lived in public housing units. In total, from 2009 to 2011, about 4.35 million units of public houses were constructed.

Table 1.3 The cumulative number of public housing units constructed (Unit: million)

Year	2006	2007	2008	2009	2010
Public housing	0.55	0.95	4.07	4.67	5.80[*]

Source and notes: Studies by Huang (2012).[*]The housing units of 5.80 million include public

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[11] See the following link: http://wenku.baidu.com/view/9e6c53ce05087632311212de.html (accessed on 15 August 2013).

[12] This is a certification to the low priority given to low-income housing in the first few years of the 21st century.

housing, affordable housing, and rebuilt shanty areas.

1.4.2 The current problems

According to the study by Ye et al. (2006), China's current housing market can be divided into three main parts based on different beneficiaries: a general housing market, an affordable housing market, and a public housing market. This section illustrates the problems faced by each of the three markets.

In the general housing market, house prices increased rapidly after 2003 (Ren et al., 2012). The result was a large-scale housing "price bubble," as shown in studies by Barth et al. (2012), Dreger and Zhang (2013), and Vega (2010). This was the motivation for the interest in the determinants of housing prices in this research. As an important policy to improve citizens' ability to buy houses, the affordable housing program was implemented officially in 1997. As Table 1.1 shows, affordable housing construction has decreased since around 2001, and the ratio of affordable to unaffordable housing construction decreased year by year from 2001 to 2010. Huang (2013) argued that the lack of affordable housing threatens China's urban dream. Comparing the construction between affordable and unaffordable housing, it could be supposed that there exist crowding-out effects between their constructions.

To complete the housing market for those in poverty, the government officially started the public housing program in 2006. As a result of the late start, there is little official statistical data available for the public housing market. Therefore, we investigated the public housing market in Baoji in 2010, one of the biggest cities in the northwest that had implemented this program well. The problem we identified was that despite a lack of public housing stock (Huang, 2012), the local government was selling public housing units to the lowest-income households; such sales were supposed to be a subsidy approach. However, there is some controversy about this subsidy approach. Thus, this research evaluates the approach using utility functions.

Table 1.4 Types and problems of China's housing markets

	Providers	Type	Target group	Main problems
General housing market	Real enterprises, individuals, social organizations	Villa, senior apartment, common residence, etc.	High- and middle- income households	Rapid growth of housing price; housing "price bubble" (Ren et al., 2012; Barth et al., 2012; Dreger and Zhang, 2013)
Affordable housing market (started in 1997)	Real enterprises subsidized by the governments	Affordable housing	Middle- and low-income households	Affordable housing construction decreased year by year (Huang, 2013)
Public housing market (started in 2006)	Government	Public housing	lowest-income households	Shortage of public housing stock; local government sells them to households (Huang, 2012; Yao and Gu, 2011)

Source: Summarized by author from related literature.

Chapter 2

Macroeconomic Determinants of House Prices in China

Significant increase in the price of housing in China has received considerable attention in recent years. House prices significantly influence economic activity and financial stability, hence estimating the determinants is very important. House prices generally depend on fundamental factors affecting supply and demand of houses. Using the data from 30 provinces and cities from 2002:Q1 to 2012:Q4, Chapter 2 applies the fixed effect model to examine the key factors affecting house prices. In fact, the empirical results indicate that land price and disposable income have significant roles in pushing up house prices; a higher amount of newly-started housing floor spaces and increased mortgage rate would apparently push house prices down; the enactment of "Property Law" and the raising of the minimum down payment ratio affect changes in house prices negatively.

2.1 Introduction

The determinants of house prices in China have attracted much attention recently, due to the high growth rate of house prices. Over the past two decades, China's house prices have risen rapidly. Ren et al. (2012) pointed out that from 2003 to 2007, house price growth rate reached as high as 14% per year on average; while in some big cities, such as Beijing, an annual increase of 22% was reported. As a result, there has been widespread concern that the rapid increase in China's housing values marks the existence of "price bubble" that will inevitably burst. This fear stems from the collapse that occurred in Japan beginning in the early 1990s (Barth et al, 2012; Dreger and Zhang, 2013). Vega (2010) even argued that China's housing "price bubble" is more serious than the run-up and subsequent crash of US. house prices, which led to the subprime crisis in 2007. Housing market and economic activity have a strong link (Vargas-Silva, 2008), and the

study by McDonald and Stock (2013) agreed that the bursting of the housing "price bubble" leads to the financial crisis and deep recession of 2007 to 2009 in the US. Hence, China's administrators began to be concerned about the potential risks of a bubble-burst in the housing market, which then prompted them to take a number of actions to control the high house price increase. For the past few years, the government has already adopted several policy packages for this purpose, e.g. raising the minimum ratio of credit down payment, and "Five National Regulations" on housing markets. Given this, it is crucial for the Chinese government to thoroughly analyze the main macroeconomic determinants of house prices, which, in turn, would lead to the understanding of the effects of related policies on the housing market at large.

Against this backdrop, this chapter assesses the impacts of the main macroeconomic determinants on real house price growth. The determinants of house prices include factors that drive demand and supply for housing. The major drivers of housing demand are disposable income, GDP, population, urbanization, user costs, availability of mortgage financing, interest rates, and house price growth expectations; while the major drivers of housing supply include land prices, housing stocks, construction costs, central-local fiscal relations, and the availability of financing (Pan and Wang, 2013; Ahuja et al., 2010). However, housing has unique characteristics and the supply side of the real estate market is more rigid due to the shortage of land for housing construction and the time needed for completing new construction (Stepanyan et al., 2010). Therefore, most empirical studied on house price determinants focus on the demand side, such as Apergis et al. (2013), Calomiris et al. (2013), and Pan and Wang (2013). However, in China's case, because of land use control[13], land price is the most important factor determining house prices. The effect of land prices on house prices was enhanced after the adoption of the new granting system for land use rights in 2002 (Deng et al., 2009). Hence, determining factors from both demand and supply sides is a key to understanding housing price increases in China. Actually many studies have investigated the nature and determinants of house prices in China by attempting to consider this, such as Deng et al. (2009), Hua et al. (2012), and

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[13] Land use control refers to the fact that the government, possessor of the land, implements policies for the restriction of land uses, in particular the maintenance of a minimum overall agricultural acreage (Zhang et al., 2013).

Zhang et al. (2012). The main macroeconomic factors they applied are land price, GDP per capita, household disposable income, population, CPI inflation, user costs [14], newly-build supply, housing units sold, unemployment, mortgage rate, broad monetary aggregate, exchange rate, hot money, etc. However, these papers suffer from a limitation that they did not focus on related policies enacted to suppress house prices. However, Zhang et al. (2012) did suggest that dramatic tightening measures such as down payment ratio, transaction tax or administrative matters also play important roles in housing price dynamics. Hence, assessing these policies' effects on house prices is necessary. In addition, because of the statistical approach of house price index change in 2010, the sample periods of these previous studies ended on or before 2010. Since 2010, with the increased development of the housing market and policies related to this, such as monetary policy (Fernald et al., 2014), it is crucial to extend the sample period.

This chapter attempts to fill in the two gaps, policy and sample period, and will complement the literature by identifying important determinants of house prices in China with panel data over the period 2002:Q1 to 2012:Q4. We not only use the basic factors that drive house price fluctuations, but also use policy dummy variables. We will introduce, in addition to the traditional triggers of real house prices, such as real land price, disposable income, and mortgage rate, etc., two main policies are considered, which demonstrate the effects of the enactment of the "Property Act"[15] in March, 2007 and the "China Banking Regulatory Commission's Notification of Improvement of the Real Estate Credit"[16] in September of 2007[17]. The two policies were enacted to suppress house prices. The main objectives here are to assess quantitatively whether the conventional fundamental factors of house prices, in conjunction with related policies,

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[14] Here, user costs refer to the consumers' costs of owning houses, which include the mortgage interest, maintenance cost, and property tax, e.g. (Brunnermeier and Julliard, 2008).

[15] The "Property Act" proposed that that the property tax should be levied to suppress the speculative demand of houses.

[16] In this notification, the minimum down payment ratio for credit was improved, e.g. this ratio for those who buy a second residential house is 40%, but only 20% or 30% for those who buy a first house; if the floor spaces of a first house are no more than 90 square meters, the ratio is 20%; otherwise, it is 30%.

[17] The reason why we consider the two policies are the following: first, the background of the policy implementation is that house price growth rate reached as high as 14% per year on average (2012); second, "Property Act" presented that although the durable years of residential land go to an end, households could continue to use them, which stable the real estate market; "Property Act" also lay a good foundation for levying property tax, which aims to control speculative housing demand; third, as shown in footnote 16, the related policy of down payment ratio in the "Notification" also play an important role in controlling speculative housing demand.

play an important role in the observed house price dynamics. The following three main questions are answered: What are the main factors that push real house prices up? What are the main factors that push house prices down? Were the two main policies effective in suppressing the growth of real house prices?

The remainder of this chapter is organized into five sections. Section 2.2 summarizes the previous studies and existing explanations for China's housing market. Section 2.3 describes the data and methodology. In section 2.4, we report the empirical results. Section 2.5 concludes with the main findings of this chapter. Then, section 2.6 illustrates the housing affordability in China's housing market.

2.2 Literature review

Many researchers have explored the determinants of house prices. Algieri (2013) pointed out that as durable goods, houses have long average lives and construction processes can be drawn out due to things like slow administrative procedures and cumbersome building regulations. This implies that housing supply is relatively rigid in the short term. The existence of supply-side constraints and other market imperfections make house prices, in short run, chiefly demand driven (Algieri, 2013). In the majority of previous studies, the relevance of income and interest rates are confirmed as house price drivers (Vizek, 2010). Other important factors driving housing demand are population growth, unemployment, inflation, credit availability, and household wealth. Iossifov et al. (2008) analyzed residential prices in Asia and 20 advanced countries in Western Europe from 1980 to 2007. They employed real per capita GDP, population, unemployment, interest rates, primary fiscal balance, current accounts and financial deepening as the determinants of house prices. Their results showed that, their sample countries' house prices are aligned with these fundamentals, and the most important one is the short-run real interest rate, with house price elasticity of -3.6. A higher elasticity was found in the study by Gattini and Hiebert (2010) with the Johansen procedure, and a study by Ayuso et al. (2006) using the error correction model (ECM) models. In the US housing market, Pan and Wang (2013) applied the dynamic panel models with quarterly data over 1990:Q2 to 2010:Q4 to analyze this problem. Their results showed that the income elasticity of house prices

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(which is 0.57) is larger than labor growth elasticity of house prices (0.08). However, another study by Schnure (2005) found an opposite result that labor force elasticity is larger than real income elasticity in the US housing market. Besides, Schnure (2005) found that the negative effect of unemployment is stronger than that of real interest rate.

Recently research has begun to analyze house prices' determinants from both the demand and the supply side. Algieri (2013) analyzed the fundamental determinants of house prices in five main European countries and two Anglo-Saxon economies[18] by applying the annual data from 1970 to 2010 to unobserved components model. The results show that for the sample countries, real disposable income, inflation rate and population growth are the main factors that drive up house prices, and that residential investment and long-term interest rate negatively affect changes in house prices. Besides, the magnitudes of population growth and real investment elasticity are highest and lowest respectively. There are similar situations in OECD countries' housing markets. Study by Caldera and Johansson (2013) showed that the magnitude of population elasticity of real house prices is largest, and that of dwelling stock elasticity of real house prices is lowest. Other related research about OECD countries by Madsen (2012) found that income and mortgage rate are the main factors that increase and decrease house prices. In addition, Adams and Füss (2010) examined the long-term impact and short-term dynamics of macroeconomic variables on international housing prices. Their empirical results indicate that house prices increase in the long-term by 0.6% in response to a 1% increase in economic activity, while construction costs and long-term interest rates show average long-term effects of approximately 0.6% and -0.3% respectively. In the study by Gattini and Hiebert (2010), mixed interest rate elasticity of house prices is -6.87. Also, real house investment elasticity of house prices is -2.2 in the same research. However, there are other studies that prove a positive relationship between house prices and housing investment. In the investigating of the behavior of private residential investments of the six largest European economies, Gattini and Ganoulis (2012) pointed out that in France, Germany and Spain, the land price proxy is an important factor in driving investment decisions. The

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[18] The five main Euro area countries are Germany, France, Italy, Spain, and the Netherlands; the Anglo-Saxon economies are the United Kingdom and the United States.

investments tend to react positively to shocks in the cost of production, e.g. raw material, transport, and labor costs. This result is also supported by Égertand Mihaljek (2007), who point out that the material costs and real costs of construction affect house price positively. Their results reflect that in France, Italy, and the United Kingdom, construction costs influence real residential investment positively at statistically significant level. From this point of view, house investments may be seen as a proxy of costs. Therefore, in this situation house investments affect house prices positively.

In China's housing market, Ren et al. (2012) pointed out that to explore the mechanisms behind the rapid increase of house prices further, one must to carefully examine both demand and supply side. Zhang et al. (2012) explored the determinants of China's housing prices by using monthly data from 1999:01 to 2010:06. In paying main attention on the effects of monetary policies, their results mainly identify mortgage rate, real effective exchange rate, and broad money supply as the key monetary variables in interpreting house price dynamics. Zhang et al. (2012) also pointed out that local fundamentals affect the local house prices, and Ren et al. (2012) stated that house capital flows freely across different regions. Incorporating these two points, eliminates any influence of the local economy on house prices requires China researchers to use panel data. Deng et al. (2009) used the panel vector autoregression (PVAR) model to investigate the dynamic effects of significant factors on China's housing prices. The fundamental factors applied to explain house price variations are land prices, newly-started supply, household disposable income, unemployment, and housing units sold. Their results show that among these factors, the most important is land price. Hua et al. (2012) also used panel data of 12 major cities in China during the period from 1999 to 2012 to analyze the determinants of house prices, and find that land price and user costs have the greatest impacts on house prices.

2.3 Data and methodology

2.3.1 Data

We decide to use panel data in this chapter. Because of the data availability, our samples include 30 provinces and cities[19] in China. Data for our samples starts from 2002:Q1 and extends to 2012:Q4. Following the studies by Algieri (2013), Deng et al. (2009), Pan and Wang (2013), and Caldera and Johansson (2013), we are going to apply nine series variables, i.e. real house prices[20] (denoted by hp), real land prices[21] (lp), real disposable income (per capita) (inc), real estate investment ($inve$), employment growth rate (em), inflation rate[22] ($infl$),newly-started housing floor spaces ($nstart$),stock market return ($glsp$) and nominal average mortgage rate (mrm). The nominal average mortgage rate is calculated by averaging the mortgage rates of less than 5 years and that of over 5 years. The variables of $glsp$ and mrm are two common variables. All series are sampled at a quarterly frequency and seasonally adjusted when appropriate. The source of house and land prices and disposable income is from the database of China Economic Information net. All the other data are taken from the CEIC database. Real values have been obtained from the corresponding nominal quantities using the CPI index as deflator. The logarithms of the variables, hp, lp, inc, $inve$, and $nstart$, are denoted as lhp, llp, $linc$, $linve$, and $lnstart$ respectively.

Detailed explanations of the above variables are shown in Table 2.1. From this table, we can see the expected effect of these variables on house prices, the explanations for this, and related research. In the study by Deng et al. (2009), land price is the most important factor to explain house price in China. The variable lp is expected to be positively related to house prices. We use real estate investment as the proxy for construction cost[23].

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[19] All these provinces and cities are Anhui (AH), Beijing (BJ), Chongqing (CQ), Fujian (FJ), Guangdong (GD), Gansu (GS), Guangxi(GX), Guizhou (GZ), Hainan(HN), Hebei (HEB), Henan (HEN), Heilongjiang (HLJ), Hubei (HUB), Hunan (HUN), Inner Mongolia (INM), Jilin (JL), Jiangsu (JS), Jiangxi (JX), Liaoning (LN), Ningxia (NX), Qinghai (QH), Sichuan (SC), Shandong (SD), Shanghai (SH), Shaanxi (SHAX), Shanxi (SX), Tianjin (TJ), Xinjiang (XJ), Yunnan (YN), and Zhejiang (ZJ).

[20] Here, real house prices do not include real land prices, which mean that real land prices can be clearly separated from real house prices.

[21] Land prices equal to the land transaction fees divided by land areas purchased. Data of land transaction fees and land areas purchased are collected from the China Economic Information net.

[22] Inflation rates have been computed from CPI rate.

[23] Another reason why we use real estate as the proxy of construction cost is that there is no direct data to

In our case, real estate investment refers to the sum of costs and investments on housing construction, land development, public construction, and other associated costs. The material costs and real construction costs affect house price positively (Égert and Mihaljek, 2007). Hence, the expected effect of real estate investment on house price is positive. Real disposable income is the proxy for the wealth of household. The variable *inc* is positively related with house prices due to growing income improves housing affordability, which creates more housing demand, which drives up house prices. Higher inflation (*infl*) expectation is likely to be related with increasing housing demand, a shelter against inflation, which indicates an increasing of house prices. Higher employment growth rate should increase disposable income and housing demand, which drive up house price. Hence, expected effect of *em* is positive. Newly-started housing floor space has been used as a proxy of housing supply. More housing supply pushes the supply curve outside, hence house price decreases. Therefore, the variable *nstart* affect house prices negatively. The relationship between *stock market return* and house prices could be negative or positive, because the stocks have wealth effect or substitution effect on houses. If houses are seemed as investment goods, stocks have the substation effect. The higher the return in one market, the lower the investment in the other market. Therefore, the relationship between stock and housing markets is negative. Conversely, if houses are seemed as consumer goods, stocks will express the wealth effect. The higher return of stock market indicates the raising wealth of investors (Koivu, 2012). Hence, the housing affordability and demand are improved. This indicates a positive relationship between housing and stock market. Nominal mortgage rate is used as a proxy of financing cost. Since the main financial source of buying houses is borrowing money from banks, a higher mortgage rate will increase the user (consumer) costs, and thus push house prices down. Nominal mortgage rate is used as a proxy for the cost of mortgage financing. As houses are predominantly financed by borrowing, higher nominal mortgage rates increase the cost of homeownership and push prices down. In other words, the expected relationship between changes in nominal mortgage rate and real house prices are negative.

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proxy the construction cost in China.

Table 2.1 Independent variables used in our research

Fundamentals	Effect on house prices	Explanation	Literature and their results
Real land price	positive	supply side: proxy for the costs of real estate enterprises	Zhang et al.(2012)+
Real estate investment	positive	supply side: proxy for the construction cost	Gattini and Ganoulis (2012)+, Égert and Mihaljek (2007)+;
Real disposable income	positive	demand side: proxy for the wealth of households, making housing more affordable to population	Algieri(2013)+; Pan and Wang (2013)+; Madsen (2012)+; Gattini and Hiebert(2010)+
Inflation	positive	demand side: proxy for the alternative investments and capital gains from houses	Zhang et al. (2012)+; as a proxy of inflation: Algieri(2013)+
Employment	positive	demand side: proxy for increasing demand of houses	Pan and Wang (2013)+; Calomiris et al. (2013)+
Newly-started floor space	negative	supply side: proxy for the stock of houses	OECD (2005)-; McCarthy and Peach(2004)-
Stock market return	positive or negative	supply and demand sides: proxy for substitution effect (-); proxy for wealth effect (+)	Algieri(2013)+;Sutton (2002)+; Ayuso et al. (2006)-
Mortgage rate	negative	demand side: proxy for user costs	Zhang et al. (2012)-; Madsen (2012)-

Source: Summarized from related literatures.

In addition, we are going to use two policy dummy variables which demonstrate the enactment of the "Property Act" (*dum*1) in March, 2007 and the "China Banking Regulatory Commission's Notification of Improvement of the Real Estate Credit" (*dum*2) in September, 2007. The two policies were enacted to control house prices. Before enactment, the values of dummy variables were 0; after, they equaled 1. Hence, the values of *dum*1 equal 0 during the period from 2002:Q1 to 2006:Q4; they equal 1 from 2007:Q2 to 2012:Q4. In the same way, the values of *dum*2 equal 0 over the period from 2002:Q1 to 2007:Q2; they equal 1 from 2007:Q3 to 2012:Q4. After the enactments, the house prices were expected to decrease. Hence, the expected signs of the two dummy variables are negative. Table 2.2 shows us the summary statistics of the selected variables.

Table 2.2 Summary statistics of the selected variables

Variables	Measure	Observation	Mean	Min	Max	Std. Dev.
Real house price	RMB	1320	3559.35	1016.38	18730.90	2583.90
Real land price	RMB	1320	1700.55	42.65	49945.80	3402.79
Real disposable income	RMB	1320	8166.44	2902.50	25655.90	4071.70
Real estate investment	RMB in million	1320	47.50	59.00	33.00	54.00
Floor spaces newly-started	Square meter in million	1320	17.60	0.29	89.00	16.10

2.3.2 Methodology

The initial house prices differ across provinces and cities. The standard panel data specification is that there is an individual-specific effect which enters linearly in the regression, which is consistent with the situation in China. The basic function is expressed as follows:

$$lhp_{it} = \alpha + X'_{it}\beta_i + u_i + e_{it} \qquad\qquad (2.1)$$

where lhp is the dependent variable, the logarithm of house price, β is the model parameters, i and t indicate the individual and time variables respectively, and X is a data vector of 10 explanatory variables, i.e., $X = [llp, linve, linc, infl, em, lnstart, mrm, glsp, dum1, dum2]$. u_i shows the unobserved individual effect, and e_{it} is error term across individuals and time. We assume the individuals i are mutually independent, that u_i and e_{it} are independent, and e_{it} is uncorrelated with x_{it}. Table 2.3 gives us the summary statistics of the variables used in our model.

The individual-effects models include the fixed effects and random effects models, in which the individual effects are considered fixed and different across individuals respectively. In other words, when u_i is correlated with X'_{it}, we follow the convention and call (2.1) a fixed-effects model, and when u_i is uncorrelated with X'_{it}, we shall call it a random-effects model. The main testing procedure of fixed- or random-effects model is suggested by Hausman (1978). The null hypothesis of the Hausman test is the estimates of the two models show no significant difference. Hence, if the null hypothesis is rejected, the fixed-effects model is chosen. Model (2.1) includes all possible combinations of the variables. In order to better examine the main determinants of house prices, we report the estimates from 8 equations. Following previous studies, e.g. Zhang et al. (2012), Gattini and Ganoulis (2012), Algieri (2013), Calomiris et al. (2013), changes in real house prices are expected to be positively related with changes in real land prices, user costs, disposable incomes, inflation, and employment growth rates, which are the fundamental forces driving house prices up:

$$lhp = f(llp, linve, linc, infl, em) \qquad\qquad (2.2)$$

We are also interested in examining the fundamental factors that decrease house prices. From Table 2.1, newly-started floor spaces and mortgage rate affect house prices negatively. Stock market return may affect house prices either positively or negatively. The two policies that were enacted to control house prices need to be examined to see if they affected the house prices as expected. To check whether the other five variables

could influence house prices negatively or not, we add them into equation (2.2) one by one:

$$lhp = f(llp, linve, linc, infl, em, lnstart) \qquad (2.3)$$

$$lhp = f(llp, linve, linc, infl, em, lnstart, mrm) \qquad (2.4)$$

$$lhp = f(llp, linve, linc, infl, em, lnstart, mrm, glsp) \qquad (2.5)$$

$$lhp = f(llp, linve, linc, infl, em, lnstart, mrm, glsp, dum1) \qquad (2.6)$$

To check the different effects of the two policies, we then used another function,

$$lhp = f(llp, linve, linc, infl, em, lnstart, mrm, glsp, dum2) \qquad (2.7)$$

Depending on the results of equation (2.2) to (2.7), we drop the factor of em, hence,

$$lhp = f(llp, linve, linc, infl, lnstart, mrm, glsp, dum1) \qquad (2.8)$$

$$lhp = f(llp, linve, linc, infl, lnstart, mrm, glsp, dum2) \qquad (2.9)$$

Table 2.3 Summary statistics of the variables used in the model

Variables	Observation	Mean	Min	Max	Std. Dev.
Log of real house price (*lhp*)	1320	8.0035	6.9240	9.8379	0.5524
Log of real land price (*llp*)	1320	6.7600	3.7531	10.8187	1.0192
Log of real estate investment (*linve*)	1320	23.9064	20.1875	26.5112	1.2905
Log of real disposable income (*linc*)	1320	8.8917	7.9733	10.1525	0.4806
Inflation rate (*infl*)	1320	0.0003	-0.0278	0.0333	0.0076
Growth rate of employment (*em*)	1290	0.0064	-0.0980	0.2381	0.0221
Log of newly-started floor spaces (*lnstart*)	1320	16.2695	12.5763	18.3083	0.9871
Stock market return (*glsp*)	1290	0.0074	-0.3198	0.2981	0.1482
Average mortgage rate (*mrm*)	1320	4.1505	3.6000	4.9950	0.4410
Dummy1 (*dum1*)	1320	0.5227	0.0000	1.0000	0.4997
Dummy2 (*dum2*)	1320	0.5000	0.0000	1.0000	0.5002

2.4 Empirical Results

The standard panel data model requires stationary data, which are assessed by unit root test. Hence, we first test the unit roots. From the Section 2.3, we know that seven variables are collected for all provinces and regions, which means we need to do panel unit root tests for the seven variables (shown in Table 2.4). Panel unit roots based on the Im, Pesaran and Shin (2003) (hereafter IPS) t-bar test is used for more general case when the errors in the univariate time-series representation are serially correlated. Demeaned series for each variable was carried out and the results are shown in Table 2.4[24]. The more general specification of the IPS t-bar test is applied here. For the other two common variables, *glsp* and *mrm*, we apply the Augmented Dickey-Fuller test (1979) (hereafter ADF) to test their stationaries. The findings presented in Table 2.4suggest that all of the examined variables are stationary in levels. This allows us to use the standard panel data model.

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[24] In cases where the errors in the different regressions contain a common time-specific component, IPS proposes the same t-bar test, but with the individual test statistics based on cross-sectional demeaned regressions. In our case, demeaning is more appropriate compared to many other applications of the IPS test, because our group of provinces and cities are regionally connected as well, and could be hit by common shocks.

Table 2.4 Unit root test

Panel unit root test	
Variables	IPS test (t-bar)
Log of real house price (lhp)	-2.7294***
Log of real land price (llp)	-3.5107***
Log of real estate investment ($linve$)	-2.2772***
Log of real disposable income ($linc$)	-2.2049***
Inflation rate ($infl$)	-7.0268***
Growth rate of employment (em)	-6.7324***
Log of floor spaces newly-started ($lnstart$)	-3.1902***
Unit root test for common variables	
Variables	Augmented Dickey-Fuller (z-statistics)
Stock market returns ($glsp$)	-3.5260**
Average mortgage rate (mrm)	-2.7890**

Note: ***, ** refer to the significant at 0.1% and 1% respectively.

The estimated relationship between changes in real house prices and their determinants are presented in Table 2.5. The last two rows show the Hausman tests. The null hypothesizes are all rejected, which reveals that the fixed-effects models are appropriate. Real land prices are highly significant and have the expected positive sign in virtually all equations, indicating that changes in real land prices are strongly positively correlated with changes in house prices. We can conclude from all the equations that real land prices elasticity of real house prices varies from 0.0630 to 0.0785. Land prices capture an important driving force of China's house prices. The reason is that the land monopoly has enabled the local governments to extract the maximum amount of revenues from land leases to businesses and residential land users (Zhang et al., 2012).

Real estate investment coefficients in most cases have the expected positive sign and are statistically significant, indicating that increasing changes in real estate investment is

associated with rising changes in real house prices. Compared with real land prices, real estate investment elasticity of house prices is higher, varying from 0.1059 to 0.1271. One unit increase of real estate investment causes more than 0.10 units of increases of real house prices. Real estate investment may react positively to shocks in the cost of production, e.g. raw material, transport, and labor costs (Gattni and Ganoulis, 2012). With this in mind, real estate investment could be viewed as a proxy of construction costs, which affect changes in real house prices positively.

Changes in real disposable income have a strong positive relationship with changes in real house prices in all equations. Interestingly, estimated real disposable income elasticity is the highest of all factors. The elasticity values vary from 0.6445 to 0.7825, which means that real disposable income is the most important factor driving real house prices up. For instance, in the equation (2.8), if disposable income increases by 1%, real house prices would be raised by 0.7825%. Also in France and Italy, per capita income is the most important factor of the observed components that increase real house prices (Algieri, 2013).

Inflation rate in most equations is significant and has the expected positive sign, and also the second most important factor that increases real house prices. This indicates that higher of inflation rates is associated with increasing real house prices. Keeping other factors constant, a 1% increase in inflation rate causes a rise in real house prices of 0.6169% to 0.7027%. In France, inflation rate is also the second most important factor driving up real house prices (Algieri, 2013).About growth rate of employment, only equations (2.4) and (2.5) show us that it is significant with an expected positive sign. One unit increase in growth rate of employment might raise real house prices by almost 0.30 units.

High and rising prices in China's housing markets have attracted the attention of the scholars and policy-makers. From our analysis, we now know that the main factors driving house prices are real land price and disposable income. We would now like to look at the main factors that decrease house prices. Newly-started housing floor space shows a strong negative relationship with real house prices in all equations, indicating that the more changes in newly-started housing floor spaces, the lower changes in real

house prices. From equations (2.3) to (2.9), the coefficients of *lnstart*, do not show much change. The newly-started housing floor space elasticity of real house prices varies from -0.0791 to -0.0750. In the long-run, the increase in newly-started housing floor space pushes the supply curve outwards, which means the equilibrium price would decrease. In other words, more newly-started housing floor space increases the supply of housing units, hence affecting house prices negatively (Meen, 2002; Caldera and Johansson, 2013).

Nominal mortgage rate coefficients have the expected negative sign and are statistically significant, indicating that increasing mortgage rate is associated with decreasing house price. Increase in mortgage rate is an increase in user costs, hence the demand of housing units decreases, which pushes demand curve inwards. In the long-run, the equilibrium price would decrease also. One unit increase in mortgage rate would decrease real house price by 0.0220 to 0.0270 units[25].

Stock market return coefficients in most equations are statistically significant and have a negative sing. Based on a previous study by Aligeri (2013), the negative relationship indicates that in China the substitution effect dominates the relationship between housing and stock markets, as a high return in one market tends to cause investors to leave the other market. Therefore, the high stock market return would push real house prices down. Stock market return elasticity of real house prices varies from -0.0716 to -0.0577, the magnitudes of which is less than that of newly-started housing floor space.

We also examine the two important policies' effects on real house prices. The estimated coefficients of dummy 1 show that the enactment of the "Property Act" has a strong negative relationship with changes in real house prices in all equations, indicating that after its enactment changes of real house prices tended to decrease. The "Property Act" hoped that when the property tax was levied, it would suppress the speculative demand of houses. As a result, after the enactment, changes in house prices are definitely decreased by about 0.08.

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[25] Klyuev (2008) pointed out that in the U.S., real mortgage rate elasticity of house prices varies from -0.02 to -0.04.

With the enactment of "China Banking Regulatory Commission's Notification of Improvement of the Real Estate Credit," decreases in changes of real house prices were seen as well, as shown in equations (2.7) and (2.9). This notification increased the minimum down payment ratio for credit to prevent from speculation. Therefore, after the enactment, changes in house prices decreased by 0.0641 to 0.0665.These results are different from a study by Zhang et al. (2012), who revealed that the intervention policies, such as down payment ratio, are not effective in controlling house prices. The results of the two policies indicate that the act and notification play important roles in suppressing the high growth of house prices, which was in line with the targets of the regulators.

Table 2.5 Estimation results of fixed-effects models – Dependent variable logarithm of house prices (*lhp*)

Variables	Equ. 2.2	Equ. 2.3	Equ. 2.4	Equ. 2.5	Equ. 2.6	Equ. 2.7	Equ. 2.8	Equ. 2.9
llp	0.0785***	0.0698***	0.0676***	0.0673***	0.0630***	0.0640***	0.0633***	0.0644***
	(0.0213)	(0.0191)	(0.0197)	(0.0198)	(0.0200)	(0.0202)	(0.0199)	(0.0201)
linve	0.0545	0.1233**	0.1271**	0.1263**	0.1059*	0.1118*	0.1063*	0.1123*
	(0.0606)	(0.0573)	(0.0575)	(0.0577)	(0.0612)	(0.0609)	(0.0612)	(0.0610)
linc	0.6673***	0.6445***	0.6467***	0.6498***	0.7803***	0.7515***	0.7825***	0.7545***
	(0.1254)	(0.1194)	(0.1190)	(0.1203)	(0.1505)	(0.1504)	(0.1508)	(0.1509)
infl	0.6169*	0.6743**	0.5578	06941*	0.6775*	0.5283	0.7027*	0.5489
	(0.3323)	(0.3178)	(0.3324)	(0.3871)	(0.3847)	(0.3806)	(0.3856)	(0.3803)
em	0.2159	0.2513	0.2924*	0.2867*	0.2164	0.2270		
	(0.1571)	(0.1592)	(0.1589)	(0.1577)	(0.1480)	(0.1488)		
lnstart		-0.0776**	-0.0783**	-0.0791**	-0.0762**	-0.0773**	-0.0750**	-0.0761**
		(0.0330)	(0.0325)	(0.0324)	(0.0319)	(0.0319)	(0.0320)	(0.0320)
mrm			-0.0230*	-0.0235*	-0.0220*	-0.0270**	-0.0211*	-0.0262**
			(0.0114)	(0.0115)	(0.0118)	(0.0114)	(0.0118)	(0.0114)
glsp				-0.0240	-0.0577*	-0.0688*	-0.0596*	-0.0716*
				(0.0245)	(0.0296)	(0.0354)	(0.0298)	(0.0356)
dum1					-0.0801**		-0.0820**	
					(0.0309)		(0.0312)	
dum2						-0.0641**		-0.0665**
						(0.0312)		(0.0315)
intercept	0.2327	0.1118	0.1217	0.1318	-0.5223	-0.3867	-0.5755	-0.4456
	(0.5586)	(0.5345)	(0.5295)	(0.5324)	(0.4694)	(0.4678)	(0.4637)	(0.4613)
rho	0.7665	0.7471	0.7489	0.7481	0.7286	0.7317	0.7283	0.7313
Hausman test								
Chi(2)	58.86	50.95	50.10	50.10	41.03	42.84	47.76	50.82
p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Note: ***, **, * refer to the significant at 1%, 5%, and 10% respectively. Standard errors are in parentheses.

2.5 Conclusions

Real house prices in China have seen an extraordinary rapid increase in recent years. For this reason, this chapter has analyzed the main macroeconomic factors that drive real house price fluctuations by using panel data from 30 provinces and cities over the period from 2002:Q1 to 2012:Q4 in China. Although previous studies have considered land prices, per capita disposable income, and mortgage rate, etc. as the main determinants of price behavior, this chapter adds two main policy dummy variables to the model. From the empirical results, we summarize the main conclusions as follows.

Because the coefficients of real disposable income and real land prices are significant in all cases, we conclude that they are the two main factors which push real house prices up. The magnitudes of the factors that push real house prices show differences. Real disposable income has largest magnitude that affects real house prices. Real land prices have the smallest magnitude in influencing of real house prices. In a similar fashion, the volume of newly-started housing floor space and increasing mortgage rate decrease real house prices. The magnitude of newly-started housing floor space on real house prices is the highest, while that of mortgage rate is the smallest. The enactment of the "Property Act" and the "China Banking Regulatory Commission's Notification of Improvement of the Real Estate Credit" also affected real housing prices negatively.

The results of our analysis suggest that it remains crucial for regulators to carefully monitor the housing market, given the impact of housing price on economic activity. To restrain the high growth of house prices, regulators should supply more land and encourage real estate enterprises to start more housing floor spaces. Besides, the government could implement appropriate monetary policies, which affect house prices largely by controlling demand for houses through mortgage rates. The other alternative policy related with housing demand is down payment ratio. The gradual changes to down payment ratio can help to restrain long-term growth in house prices. In addition, the fixed effect models used indicate that different regions have different fixed characteristics. Hence, it is advisable to implement different structural policies in different regions, such

as different policies that encourage real estate enterprises to construct more housing units, which can substantially impact the supply side of housing market.

On top of this, our results show that high house prices are mainly driven by real disposable income. In this case, when disposable income increases but house price increases at a greater rate, at what point are households priced out of the market? This is an important consideration that demands further research.

Chapter 3

Problems of Affordable Housing Market: Crowding-out Effects

Before analyzing the problems of affordable housing market, this chapter first illustrates the reasons of implementing affordable housing program. As shown in Chapter 2, to answer the question of at what point are households priced out of the market, the problem of housing affordability should be introduced.

3.1 Housing affordability in China's housing market

Housing affordability is an expression of the social and material experiences of people, constructed as households, in relation to their individual housing situations (Stone, 2006). Affordability expresses the challenges that each household faces in balancing the cost of actual or potential housing and non-housing expenditures within the constraints of its income (Stone, 2006). One of the most important indicators measuring housing affordability is the price-to-income ratio. Chen et al. (2006) pointed out that it is widely believed that a price-to-income ratio with value of over 7 is intolerable. In other words, households cannot afford a home if the price is seven times their annual family earnings. As a result of the substantial increase in housing prices after the reform in 1998, authorities and academics began to be concerned about the buying capability of ordinary households. For example, Chen et al. (2006), Liu et al. (2008), Chen (2012), and Shen (2012) were particularly interested in the big cities (Beijing, and Shanghai). In the Beijing market, Liu et al. (2008) use the price-to-income ratio and the Housing Affordability Index (HAI) model to measure housing affordability. They find that the price-to-income ratio fluctuated from 6.69 to 9.12 over the period 2002 to 2006 (based on an average gross floor space of 60 square meters). Chen et al. (2010) examined the housing affordability in Shanghai, and find that the price-to-income ratio varies from 6.6

to 9.1 over the period from 1995 to 2008 (the ratio reached 9.1 in 2004). During the period 2002 to 2006, the price-to-income ratio in Shanghai varied from 7.9 to 9.1, a little higher than that of Beijing. In addition, Mak et al. (2007) pointed out that in Tianjin in 2000, the price-to-income ratio of commodity housing sized 60 square meters was as high as 17.2. Table 2.6 compares the price-to-income ratios between Beijing and Shanghai over the period 2002 to 2006.

Table 3.1 Price-to-income ratios in Beijing and Shanghai, 2002–2006[26]

	2002	2003	2004	2005	2006
Beijing	7.17	6.82	6.69	7.35	9.12
Shanghai	7.9	8.1	9.1	8.6	8.1

Source: Summaries of the studies by Chen et al. (2010) and Liu et al. (2008)

According to the measure of 7 in 2006, both urban households in Beijing and Shanghai faced the problem of housing affordability. Liu et al. (2008) pointed out that the rapid growth of housing prices is causing the gap between housing prices and income levels to continue widening, which indicates that a large proportion of Beijing households cannot afford housing. In addition, Chen and Hao (2007) argued that the increasing inequality between income and wealth is the essence of the housing affordability problem faced by Shanghai households. Based on the evidence of this increasing inequality, as well as the analysis in Chapter 1, it can be concluded that China's urban households face a problem of housing affordability. Shen (2012) further suggested that measured in terms of the price-to-income ratio, housing affordability in China is very high relative to other developed countries, which further supports our conclusions.

To ease the affordability problem, Liu et al. (2008) argued that the governments should implement new housing provision policies, especially with regard to the affordable housing program. In addition, owing to the affordability problem, many households have to remain in the rental market for many years before being able to buy a home. In the

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[26] There is little literature on the price-to-income ratios of other cities. Hence, we only summarize the two cities mentioned here.

rental market, the lowest-income households cannot even rent housing (Liu et al., 2008). Therefore, it is necessary for the government to implement a public housing program as a supplemental policy to ensure that these lowest-income households are able to rent housing units. From the analysis in Section 1.4, the affordable and public housing markets have several problems. The next two chapters analyze the main problems in these two markets in more detail.

The following sections of this chapter examine the crowding-out effects of affordable and unaffordable housing in China from 1999 to 2010, by using panel data on housing construction. Applying the Dynamic Panel Model allows this chapter to examine the dynamic interactions between affordable and unaffordable housing construction when controlling for region-specific fixed and time-specific effects. This chapter analyzes whether affordable (unaffordable) housing construction has changed in response to the past and contemporaneous construction of unaffordable (affordable) housing. The empirical results reveal an asymmetric crowding-out pattern between affordable and unaffordable housing. We also observe that when urbanization rate is lower than 57.39%, unaffordable housing construction would crowd out affordable housing construction. Moreover, the crowding-out effect of unaffordable housing on affordable housing decreases with rising urbanization rates.

3.2 Introduction

China initiated reforms in 1979 and embarked upon a process of market transition from a state-oriented to a market-oriented economy. Consequently, the state aimed to establish a market-oriented housing system by dispersing housing responsibility among households, individuals and work units. China launched the housing monetization reform in 1998, urging urban residents to satisfy their housing needs in the open market (Mok and Forrest, 2009). Comprehensive implementation of the housing monetization reform has led to rapid increase in residential housing prices. This price increase is disproportionate to the annual income of households. Until 2010, the average selling price of residential housing was RMB 4725 per square meter, and per capita annual incomes for urban and rural households were RMB 21033 and RMB 5919, respectively, for the same year. The per

capita average income for the entire country in 2010 was calculated as RMB 13428.81, based on the urbanization rate of 49.68%. Similarly, per capita living space for the entire country was calculated as 32.86 square meters. By using these data, the house price-to-income ratio of residential housing for 2010 was obtained as 11.56 for the entire country. This massive number indicates that many households could not afford housing.

To address the housing problem, the Chinese government implemented the affordable housing program, wherein commercial housing, deemed affordable to households with low and moderate incomes, was provided at lower prices as a kind of social security. Under this program, the government sponsored real estate enterprises for construction of affordable housing of reasonably adequate standards in some demarcated locations at reasonable prices. The price ratio of affordable housing to commercial residential housing was 0.5280 in 2010. Some other enterprises were directed to construct a certain proportion of affordable housing as part of their commercial residential housing construction projects. Under the program of affordable housing, the government urged the real estate enterprises to construct affordable housing units by subsidizing other taxes and fees and exempting land transaction costs, in addition to the regular construction of unaffordable housing, including ordinary commodity residential housing at market prices, high-end flats and villas. Supply of both affordable and unaffordable housing by the real estate enterprises gives rise to the problem of crowding out. Such enterprises fund both affordable and unaffordable housing projects from a fixed stock of gross capital, which necessitates them to scale back one project at the cost of the other. Hence, an increase in affordable (unaffordable) housing leads to a corresponding reduction in unaffordable (affordable) housing.

Several researchers have focused on studying crowding-out effects in the housing market. Murray (1983) used time series data of subsidized and unsubsidized housing from 1961 to 1977 for estimating crowding-out effects, and applied a standard demand-supply model and estimated it using the two-stage least squares method. The conclusions revealed that unsubsidized housing starts significantly offset the effect of the stock of subsidized housing starts (Murray, 1983). Later, Murray (1999) applied econometric tools of co-integration to analyze crowding out of the stock of subsidized and private housing

units and found a long-run equilibrium relationship between unsubsidized housing and subsidized housing in the period from 1935 to 1987. This research further estimated an error-correction model and testes crowding out with restrictions on the error-correction terms. The conclusions clearly indicated that low-income subsidized housing does not crowd out private housing. Increase in real income and urbanization have spurred increase in both public and private housing (Murray, 1999). Sinai and Waldfogel (2005) differed from Murray (1999) in that they consider cross-sectional data for examining whether the housing markets with more subsidized housing units will have more total stocks of housing units. Their conclusions showed that there is less crowding-out effects in more populous markets and more crowding-out effects in markets with an excess demand for subsidized housing (Sinai and Waldfogel, 2005). Eriksen and Rosenthal (2010) also considered cross-sectional data for studying the crowding-out effects of the Low Income Housing Tax Credit (LIHTC) program on low-moderate income housing construction. Their estimations revealed that the LIHTC program does not have a significant impact on the number of newly developed rental housing units. Besides, instrumental variables' estimates yielded substantially greater crowding out than ordinary least squares in their linear models (Eriksen and Rosenthal, 2010). This shows the importance of proper estimation methods. Additionally, Lee (2007) advanced the research of crowding out in housing markets by using panel data, and employed panel vector autoregressive (VAR) models to examine the effects of public rental housing investment on private housing investment, and vice versa. The findings revealed that public and private housing investments affect each other and the crowding-out effect rises with the housing availability ratio (Lee, 2007).

Researchers have studied crowding-out effects in the context of housing starts, stock and investments in the housing market. However, to the best of our knowledge, limited research has been undertaken on the newly constructed housing units.[27] For studying crowding out, researchers prefer using cross-sectional data (e.g., Sinai and Waldgogel, 2005; Eriksen and Rosenthal, 2010) and time-series data (Murray, 1983; Murray, 1999).

[27] For example, newly constructed housing units in 2010 refer to the floor spaces of housing units completed by the real estate enterprises in that particular year for the entire country.

Only Lee (2007) applied panel data for undertaking such a study. The panel data have several advantages over cross-sectional or time-series data in that they contain more accurate inference of model parameters and greater capacity for capturing complexity in behavior and simplifying computation and statistical inference (Cheng, 2007). Besides, panel data provides the strongest test for the "crowding-out" hypothesis (Van and Arts, 2005). Chinese researchers have paid limited attention to the study of crowding-out effects in the housing market. Although the affordable housing program was implemented in 1995, to the best of our knowledge, until now only two studies have mentioned the crowding-out effect. Zhao *et al.* (2013) pointed out that by crowding out business investment, affordable housing investments do not promote GDP growth. Chen and Wang (2011) indicated that the affordable housing supply does not crowd out commercial housing (Chen and Wang, 2011). However, both these studies did not clarify the reason and process of crowding out. China's experience in the past decade provides a good case study for examining crowding-out effects in housing markets. This chapter applies the panel data to analyze crowding-out effects of newly constructed housing units in China from 1999 to 2010. Specifically, crowding-out effects between affordable and unaffordable housing is studied. Our analysis contributes to existing literature and advances the context examined by previous studies in this area in three main ways. First, we provide a case study on crowding out in the Chinese housing market. China's affordable housing program began a little later than that of the other developed countries, and there are few studies in this area. Second, this chapter applies Dynamic Panel Model, including both region-specific and time-specific effects, for affordable and unaffordable housing construction.[28] To the best of our knowledge, little previous study in this area uses the Dynamic Panel Model to estimate crowding-out effects in the housing market. This model helps in focusing on dynamic interactions between affordable and unaffordable housing. Third, before we start our analysis, we provide a brief account of the history of Chinese housing policy development since the establishment of the People's Republic of China in 1949. Although the pace of development of the housing market was

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[28]Affordable and unaffordable housing are hereafter referred to as affordable and unaffordable newly completed housing units.

slow before 1998, some housing policies were adopted even then. Few researchers have outlined such a detailed summarization to the best of our knowledge.

Using Dynamic Panel Model, we first explore whether affordable housing construction would change in response to unaffordable housing construction, and vice versa. We mainly focus on the crowding-out effects between affordable and unaffordable housing in China. Our results reveal that (i) affordable housing and unaffordable housing constructions crowd out each other with an asymmetric pattern; (ii) the crowding-out effect of unaffordable housing on affordable housing decreases with increase in urbanization rate: if the urbanization rate is lower than 57.39%, crowding out occurs; otherwise, filling-in effect is detected; and (iii) unaffordable housing construction responds to affordable housing during the same period. Moreover, the estimated coefficient shows that a unit increase in affordable housing leads to a decrease by 1.460 units in unaffordable housing.

The remainder of this chapter is organized as follows. Section 3.2 summarizes the history of China's housing policy development since 1949 and housing market development since 1995. Section 3.3 describes the Dynamic Panel Model and data used for analysis. Section 3.4 presents the empirical results and Section 3.5 concludes.

3.3 Problems of affordable housing market

In Section 1.4, we illustrate that the current problem of affordable housing market is the decreasing construction of affordable housing. Besides, there was significant variation in implementation of the affordable housing program across different provinces and regions. Shanghai implemented this program only in the years 1999 and 2009, and Tibet did not take up this program in 2004, 2005 and 2010. Because of these inconsistencies in implementation timeframes, we do not include Shanghai and Tibet in our analysis, and select the other 29 provinces and regions as our sample[29]. Moreover, although these provinces and regions implemented the affordable housing program, they present different trends and results because of difference in population, urbanization rate and

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[29] Although Table 3.2 shows that Hainan province did not complete any floor spaces of affordable housing in 2010, during the other periods over 1999 to 2009, it completed affordable housing floor spaces as well. Therefore, we include Hainan province in our sample.

regional GDP. Basic information about these 29 provinces and regions for the year 2010 is provided in Table 3.2. As shown in the table, the proportion of completed floor spaces in affordable housing of Tianjin is the highest of all samples. However, the regional GDP of Tianjin is the second lowest. The urbanization rate of Tianjin is 61.11%, the second highest value after Beijing. The population proportion is only 0.99%. Hainan province does not construct affordable housing units. Beijing has the highest urbanization rate and its floor spaces in completed affordable housing constitute of 4.54% of all the samples. Although Jiangsu province has the highest regional GDP, the floor spaces of completed affordable housing are 3019.40 thousand square meters. Therefore, we can say that regional variations exist in implementation of the affordable housing program.

Table 3.2 Basic Information about the 29 provinces and regions in 2010

Region	Population		Urbanization rate (%)	GDP		Floor spaces of completed affordable housing	
	Million	%		Billion	%	Thousand square meters	%
Beijing	19.62	1.50	78.71	1411.36	3.37	1446.30	4.54
Tianjin	12.99	0.99	61.11	150.10	0.36	4889.00	15.33
Hebei	71.94	5.50	31.79	2039.43	4.86	645.54	2.02
Shanxi	35.74	2.73	50.88	920.09	2.19	672.97	2.11
Inner Mongolia	24.72	1.89	50.77	1167.20	2.78	962.87	3.02
Liaoning	43.75	3.35	30.94	1845.73	4.40	1983.90	6.22
Jilin	27.47	2.10	33.95	866.76	2.07	1063.80	3.34
Heilongjiang	38.33	2.93	40.25	1036.86	2.47	670.08	2.10
Jiangsu	78.69	6.02	52.15	4911.03	11.71	3019.40	9.47
Zhejiang	54.47	4.16	38.33	2772.23	6.61	997.58	3.13
Anhui	59.57	4.55	32.95	1235.93	2.95	1026.10	3.22
Fujian	36.93	2.82	45.29	1473.71	3.51	587.33	1.84
Jiangxi	44.62	3.41	48.39	945.13	2.25	865.71	2.71
Shandong	95.88	7.33	22.71	3916.99	9.34	1662.30	5.21
Henan	94.06	7.19	27.04	2309.24	5.51	1438.80	4.51
Hubei	57.28	4.38	21.96	1596.76	3.81	901.56	2.83
Hunan	65.70	5.02	35.89	1603.80	3.82	1364.10	4.28
Guangdong	104.41	7.98	22.38	4601.31	10.97	507.43	1.59
Guangxi	46.10	3.52	40.86	956.99	2.28	463.02	1.45
Hainan	8.69	0.66	19.34	206.45	0.49	0.00	0.00
Chongqing	28.85	2.21	33.51	792.56	1.89	2441.80	7.66
Sichuan	80.45	6.15	26.16	1718.55	4.10	386.22	1.21
Guizhou	34.79	2.66	16.14	460.22	1.10	1090.20	3.42
Yunnan	46.02	3.52	16.56	722.42	1.72	435.65	1.37
Shaanxi	37.35	2.86	34.13	1012.35	2.41	584.62	1.83
Gansu	25.60	1.96	25.85	412.08	0.98	393.77	1.23
Qinghai	5.63	0.43	30.09	135.04	0.32	193.65	0.61
Ningxia	6.33	0.48	37.70	168.97	0.40	493.94	1.55
Xinjiang	21.85	1.67	42.66	543.75	1.30	700.46	2.20
Total	1307.81	100.00		41932.99	100.00	31888.10	100.00

Source: China Premium Database in CEIC Database; China Population and Employment Statistics Yearbook (2000-2011).

Note: The ratio equals the proportion of each region in the national total.

3.4 The dynamic panel model and data specification

We use provincial panel data to address the crowding-out effects in housing construction in China. Panel VAR models, such as those employed by Lee (2007), are used to explain evolution of variables based on their own lags and the lags of other model variables. Hence, they cannot reflect contemporaneous effects among the variables. We primarily focus on the interaction between affordable and unaffordable housing. Not only past values, but also contemporaneous values of unaffordable housing construction may influence affordable housing. Additionally, affordable housing construction could be affected by other variables such as urbanization rate, total construction and GDP. Thus, we apply the Dynamic Panel Model for avoiding the problems of panel VAR model and to properly reflect our emphasis.

3.4.1 Theoretical framework

This section offers several theoretical explanations in support of the following two points. First, why does urbanization play an important role in housing construction? We assume that the housing market in China can be divided into urban housing market and rural housing market. Population flow, business flows and housing consumption are unrestricted between the two partial markets. The overall housing market would reach equilibrium only if housing prices are equal in these two markets. If there is more migration from rural to urban areas, the demand for housing decreases in the rural area and increases in the urban area, increasing housing prices in the latter and bringing down prices in the former. In this situation, to earn more profits, the real estate enterprises would transfer to the urban housing market. Hence, urban housing construction increases and rural housing construction decreases. We can conclude that if this trend of urbanization persists, the housing demand in the urban area will be greater than rural area, making it difficult to achieve market equilibrium. Even if the urban and rural housing markets are in equilibrium, the high house price-to-income ratio prevents poorer families from affording houses. In this situation, the government has to interfere in the housing market to help the poor families solve their housing problems. Thus, urbanization trends

play an important role in housing construction and government interference in housing markets.

Second, what causes crowding out to occur between affordable and unaffordable housing construction? In our case, the government exempts land transaction costs and subsidizes other taxes and fees to encourage real estate enterprises to construct affordable housing. The government extends several project-based subsidies to real estate enterprises for facilitating reduced housing costs. Suppose the costs are fixed, the subsidies could be considered as raising the selling price indirectly[30]. When the indirect price of affordable housing is higher than the price of unaffordable housing, it is in the interest of real estate enterprises to supply more affordable housing for substituting unaffordable housing. On the contrary, when the price of unaffordable housing is higher, the estate enterprises supply more unaffordable housing. The substitution effect ceases to occur only if the indirect price of affordable housing equals the price of unaffordable housing.

We now consider Figure 3.1, which portrays the crowding-out effects between affordable and unaffordable housing construction. When more affordable housing units are built, they would crowd out the amount of unaffordable housing units built. Conversely, unaffordable housing units are constructed more, and then amount of affordable housing constructed will be crowded out. From Figure 3.1, the magnitudes of crowding out effects between their construction change depending on different situations. Actually, the crowding out effect of unaffordable on affordable housing construction is higher than that of affordable housing construction.

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[30] If a household buys a house with subsidies, real selling price should equal to the money paid to real estate enterprises plus the subsidies, which raise selling price indirectly.
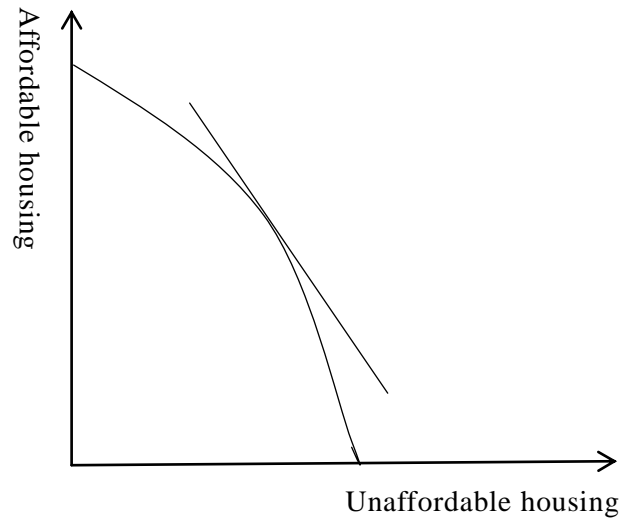
Figure 3.1 Crowding-out effects of affordable housing construction

3.4.2 Dynamic panel model

Explanatory variables in the dynamic panel model we have used include not only the lags of dependent variables, but also the lags of some explanatory variables. A simple form of Dynamic Panel Model with first order lagged term and exogenous variables are shown as follows:

$$y_{it} = \beta_{11}y_{it-1} + \beta_{20}x_{it} + \beta_{21}x_{it-1} + \sum_{l=3}^{l}\beta_{l0}z_{lit} + \alpha_i + \gamma_t + \varepsilon_{it} \qquad (3.1)$$

where y_{it} refers to the dependent variable for region i in year t, and if $|\beta_{11}| < 1$, it is stationary; x_{it} is the explanatory variable whose first order lag is a regressor; z_{it} represents the other exogenous variables; α_i is region-specific fixed effect and γ_t is time-specific effect; and ε_{it} is idiosyncratic error. Furthermore, we assume that all explanatory variables are independent of ε_{it}.

We intend to explain the crowding-out effects between affordable and unaffordable housing construction. However, housing construction could also be affected by regional urbanization levels, income and the overall housing market situation. This chapter reflects these influence factors by using the variables of urbanization rate, GDP, total construction and price ratios of affordable housing to residential housing. First, urbanization rate is an important factor affecting both demand- and supply-side of housing construction. Regions with high levels of urbanization may cause an increase in

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demand of affordable housing, thus, driving up housing prices. Moreover, high prices of commercial residential housing prevent migrants from affording houses by themselves. In this situation, the government would encourage real estate enterprises to build more affordable housing units. However, to pursue higher profits, real estate enterprises prefer constructing more unaffordable housing. The amount of subsidies given to real estate enterprises determines the outcome of this "game." Second, regional GDP reflects the level of household income to some extent. This is the expression of household purchasing capacity and effective demand of houses. Third, the level of total construction, referring to floor spaces of houses constructed by real estate enterprises and individuals, could report the overall housing market situation. A high value of total construction illustrates that the housing market supplies more houses, including affordable houses. Fourth, price ratios of affordable housing to residential housing would influence the housing market situation. A high value of this ratio indicates a relatively higher price of affordable housing for a region, implying that real estate enterprises would be willing to construct more affordable housing units. Additionally, we control for the region-specific fixed and time-specific effects. The variable specifications are shown in Table 3.3.

Table 3.3 Explanations and data source of the variables

Variable	Explanation	Data source
af_{it}	The floor spaces of completed affordable housing in region i at time t	China Premium Data in CEIC the Database
uaf_{it}	The floor spaces of completed unaffordable housing in region i at time t; the values are calculated by subtracting floor spaces of completed afforable housing from completed residential housing in region i at time t	The data on affordable and residential housing floor spaceces are collected from China Premium Data in the CEIC Database.
ru_{it}	The urbanization rate in region i at time t	China Population and Empolyment Statistics Yearbook
$ru_{it} \cdot af_{it}$	The interaction between urbanization rate and affordable housing construction in region i at time t	China Premium Data in the CEIC Database
$ru_{it} \cdot uaf_{it}$	The interaction between urbanization rate and unaffordable housing construction in region i at time t	China Premium Data in the CEIC Database
$total_{it}$	The floor spaces of completed residential housing for the entire region in region i at time t	China Premium Data in the CEIC Database
$lgdp_{it}$	The natural logarithm of regional GDP in region i at time t	China Premium Data in the CEIC Database
pr_{it}	The price ratio of affordable housing to residential housing in region i at time t	China Premium Data in the CEIC Database

We intend to apply Dynamic Panel Model to analyze the interaction between affordable and unaffordable housing construction. Accordingly, we consider the explained variables of affordable housing and unaffordable housing construction as af_{it} and uaf_{it}, respectively. Our Dynamic Panel Model contains the lags of explained and explanatory variables, as well as the current values of explanatory variables. Additionally, since urbanization rate plays an important role in determining housing construction, we control for the interaction terms between urbanization rate and affordable/unaffordable housing construction. Before modelling the models, we have to ascertain the lag lengths for the variables of affordable housing construction, unaffordable housing construction and the interactions of urbanization rate and affordable/unaffordable housing construction. By the Akaike and Schwarz information criteria (Akaike, 1974; Schwarz, 1978), we conclude that the best lag length for all the three variables is one. Thus, the affordable housing construction equation takes the following empirical form:

$$af_{it} = \beta_{11}af_{it-1} + \beta_{20}uaf_{it} + \beta_{21}uaf_{it-1} + \beta_{31}ru_{it-1} \cdot af_{it-1} + \beta_{40}ru_{it} \cdot uaf_{it} +$$
$$\beta_{41}ru_{it-1} \cdot uaf_{it-1} + \beta_{50}ru_{it} + \beta_{60}total_{it} + \beta_{70}lgdp_{it} + \beta_{80}pr_{it} + \alpha_i + \gamma_t + \varepsilon_{it}$$
(3.2)

where the variables af_{it}, uaf_{it}, $ru_{it} \cdot uaf_{it}$, ru_{it}, $total_{it}$, $lgdp_{it}$, pr_{it}, have the same specification as that in Table 3.3; the variables uaf_{it-1}, $ru_{it-1} \cdot uaf_{it-1}$, and $ru_{it-1} \cdot af_{it-1}$ refer to the first order lagged terms of corresponding variable; α_i is the region specific intercept, which represents the unobserved region-specific fixed effects and i =Beijing (BJ), Tianji (TJ), Hebei (HEB), Shanxi (SX), Inner Mongolia (IM), Liaoning (LN), Jilin (JL), Heilongjiang (HLJ), Jiangsu (JS), Anhui (AH), Fujian (FJ), Jiangxi (JX), Shandong (SD), Henan (HEN), Hubei (HB), Hunan (HUN), Guangdong (GD), Guangxi (GX), Hainan (HN), Chongqing (CQ), Sichuan (SC), Yunnan (YN), Shaanxi (SAX), Qinghai (QH), Ningxia (NX) and Xinjiang (XJ); γ_t is the year specific intercept; $t = 1999, \cdots, 2010$; and ε_{it} is the idiosyncratic error term.

We use the following controlled Equation (3.3) for Equation (3.2) to compare the effects of urbanization on affordable housing construction. Urbanization levels represent both demand- and supply-side of affordable housing. Equation (3.3) is expressed as follows:

$$af_{it} = \beta'_{11}af_{it-1} + \beta'_{20}uaf_{it} + \beta'_{21}uaf_{it-1} + \beta'_{30}ru_{it} + \beta'_{40}total_{it} + \beta'_{50}lgdp_{it} + \beta'_{60}pr_{it} + \alpha'_i + \gamma'_t + \varepsilon'_{it}$$

In Equation (3.3), we do not consider the variables that reflect the interaction between urbanization rate and affordable/unaffordable housing construction as our explanatory variables. The other variables in this equation have the same specification as in Equation (3.2).

Similarly, for unaffordable housing construction, we can obtain a function of the lagged values as follows:

$$uaf_{it} = \hat{\beta}_{11}uaf_{it-1} + \hat{\beta}_{20}af_{it} + \hat{\beta}_{21}af_{it-1} + \hat{\beta}_{31}ru_{it-1} \cdot uaf_{it-1} + \hat{\beta}_{40}ru_{it} \cdot af_{it} +$$
$$\hat{\beta}_{41}ru_{it-1} \cdot af_{it-1} + \hat{\beta}_{50}ru_{it} + \hat{\beta}_{60}total_{it} + \hat{\beta}_{70}lgdp_{it} + \hat{\beta}_{80}pr_{it} + \hat{\alpha}_i + \hat{\gamma}_t + \hat{\varepsilon}_{it}$$

(3.4)

The controlled equation for Equation (3.4) is the following,

$$uaf_{it} = \hat{\beta}'_{11}uaf_{it-1} + \hat{\beta}'_{20}af_{it} + \hat{\beta}'_{21}af_{it-1} + \hat{\beta}'_{30}ru_{it} + \hat{\beta}'_{40}total_{it} + \hat{\beta}'_{50}lgdp_{it} + \hat{\beta}'_{60}pr_{it} + \hat{\alpha}'_i + \hat{\gamma}'_t + \hat{\varepsilon}'_{it}$$

(3.5)

Using Equations (3.2) and (3.3), we can calculate the effects of unaffordable housing on affordable housing construction. We know that construction of the former at time t and $t-1$ could affect the latter at time t.

From Equation (3.2), the effects could be calculated as follows:

$$\frac{\partial af_{it}}{\partial uaf_{it}} = \beta_{20} + \beta_{40}ru_{it} \quad \text{and} \quad \frac{\partial af_{it}}{\partial uaf_{it-1}} = \beta_{21} + \beta_{41}ru_{it-1}$$

(3.6)

If the values of partial derivatives are negative, we consider that unaffordable housing construction would crowd out affordable housing construction. On the contrary, if these values are positive, we infer that unaffordable housing construction would induce affordable housing construction. Similarly, if the estimated coefficients, β_{40} and β_{41}, are negative, we conclude that there would be serious crowding-out effects in regions with low levels of urbanization.

From Equation (3.3), crowding-out effects are expressed as follows:

$$\frac{\partial af_{it}}{\partial uaf_{it}} = \beta'_{20} \quad \text{and} \quad \frac{\partial af_{it}}{\partial uaf_{it-1}} = \beta'_{21}$$

(3.7)

The explanations of the values of partial derivatives in Equation (3.7) are the same as those in Equation (3.6).

Similarly, for Equation (3.4) and (3.5), the effects of affordable housing on

unaffordable housing construction could be calculated as follows:

$$\frac{\partial uaf_{it}}{\partial af_{it}} = \hat{\beta}_{20} + \hat{\beta}_{40} ru_{it} \quad \text{and} \quad \frac{\partial uaf_{it}}{\partial af_{it-1}} = \hat{\beta}_{21} + \hat{\beta}_{41} ru_{it-1} \qquad (3.8)$$

$$\frac{\partial uaf_{it}}{\partial af_{it}} = \hat{\beta}'_{20} \quad \text{and} \quad \frac{\partial uaf_{it}}{\partial af_{it-1}} = \hat{\beta}'_{21} \qquad (3.9)$$

If the values of partial derivatives shown in Equations (3.8) and (3.9) are negative, we can infer that affordable housing construction would crowd out unaffordable housing construction. However, if these values are positive, we consider that affordable housing construction would induce unaffordable housing construction, which is referred to as the "filling-in" effect. If the estimated coefficients of $\hat{\beta}_{40}$ and $\hat{\beta}_{41}$ shown in Equation (3.8) are negative, we infer that crowding-out effects would be serious in regions with high levels of urbanization.

3.4.3 The estimation method

Choosing an appropriate estimation method is essential for proper estimation of our Dynamic Panel Model. We choose the 29 provinces and regions of China as our sample and 1999 to 2010 as our study period. Since the different regions vary substantially, as seen from Table 3.2, our Dynamic Panel Model includes region-specific effects. Besides, the length of time period is 12. On presenting the affordable housing construction for this period, we find that this variation includes the time trend as well. Therefore, our models include time-specific effects. When estimating coefficients, we first eliminate the region-specific effects by using differencing method. For time-specific effects, we use time dummy variables. Moreover, in the case of "large N and small T," the common estimators ignore the presence of time-specific effects and are inconsistent. Nevertheless, the panel dynamic generalized method of moment (GMM) estimator, proposed by Arellano and Bond (1991), is consistent and asymptotically normally distributed, whether region-specific effects are treated as fixed or random, since it eliminates the effects from the specification (Cheng, 2007; Cheng and Tahmiscioglu, 2008). This method is as follows: take the first differences of each model to eliminate fixed effects and then apply GMM to the first difference models using valid instruments. The GMM estimator

optimally exploit all the linear moment restrictions that follow from the assumption of no serial correlation in the error, and uses the level of lagged variables as the instruments for first difference explanatory variables[31] (Arellano and Bond, 1991). We can deal with the endogeneity problem by using GMM estimator. Besides, since substantial variation among the sampled regions causes the problem of heteroskedasticity, robust standard errors are estimated. The estimation results show that the estimated coefficients of the lagged independent variable are in the expected range, so we use the one-step difference GMM estimators (Roodman, 2009).

3.4.4 Data specifications

As mentioned earlier, this chapter uses panel data including 29 provinces and regions, and a 12-year period. Data has been collected from various databases related to housing construction. We collected data relating to floor spaces in completed affordable housing and residential housing constructed by real estate enterprises from the China Premium Data in the CEIC database. We then calculated the floor spaces of completed unaffordable housing by subtracting floor spaces of completed affordable housing from completed residential housing. The urbanization rates for all regions from 1999 to 2010 are collected from the China Population and Employment Statistics Yearbook. The floor spaces of total construction refer to houses constructed by both real estate enterprises and individuals. These values, regional GDP and prices of affordable and residential housing, were collected from the China Premium Data in the CEIC database. Price ratio was obtained by dividing affordable housing by the price of residential housing. The total sample size, including all collected data, is 348. Table 3.4 shows the descriptive statistics of the variables considered for this study. Hainan province did not construct affordable housing in 2010 (see Table 3.2). Hence, the minimum value of af_{it} and $ru_{it} \cdot af_{it}$ is zero.

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[31] For instance, the instruments for $\Delta af_{i,t-1} = af_{i,t-1} - af_{i,t-2}$ are $af_{i,t-2}, af_{i,t-3}, \cdots$, because these level variables will remain orthogonal to the first-differenced error term $\Delta \varepsilon_{it} = \varepsilon_{it} - \varepsilon_{i,t-1}$ as long as ε_{it} is serially uncorrelated.

Table 3.4 Descriptive statistics

Variable	Mean	SD	Min	Max	Observations
af_{it} (in 10^6 Sq.m)	1.4124	0.9666	0.0000	4.8890	348
uaf_{it} (in 10^6 Sq.m)	11.7166	10.9981	0.1598	63.1802	348
ru_{it} (in %)	32.6969	13.5437	14.4600	78.7100	348
$ru_{it} \cdot af_{it}$ (in 10^6 Sq.m)	0.4799	0.4464	0.0000	2.9877	348
$ru_{it} \cdot uaf_{it}$ (in 10^6 Sq.m)	4.0249	4.5640	0.0280	32.9121	348
$total_{it}$ (in 10^6 Sq.m)	16.1581	14.2348	0.2865	90.6580	348
$lgdp_{it}$	26.8198	1.0385	23.9013	29.2203	348
pr_{it}	0.6947	0.1565	0.2464	1.0538	348

Notes: Detailed variable descriptions are given in Table 3.3.

3.5 Empirical results

Before we get to empirical results, we present the various relationships between affordable and unaffordable housing construction. Figure 3.2 displays the floor spaces of affordable and unaffordable housing completed since 1996. The floor spaces completed of affordable housing are always at lower levels compared with unaffordable housing. Nevertheless, at the beginning of the affordable housing program, the ratio of affordable housing construction to unaffordable housing construction was at slightly higher values. This value kept on rising until 2000, when it reached its highest value at 35.27%.[32] From 2001 to 2010, this ratio decreased year over year; in 2010, it stood at only 5.32%. Although it is not an obvious inference, it can be observed that affordable housing construction decreased with rapid growth in unaffordable housing construction since 2001. This implies that they demonstrate an opposite moving tendency, thus, indicating the existence of crowding-out effects. This inference has been proved by the following econometric analysis.

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[32] Refer to subsection 2.2 on housing market development in China since 1995 for reasons that caused affordable housing construction to decrease in 2002.
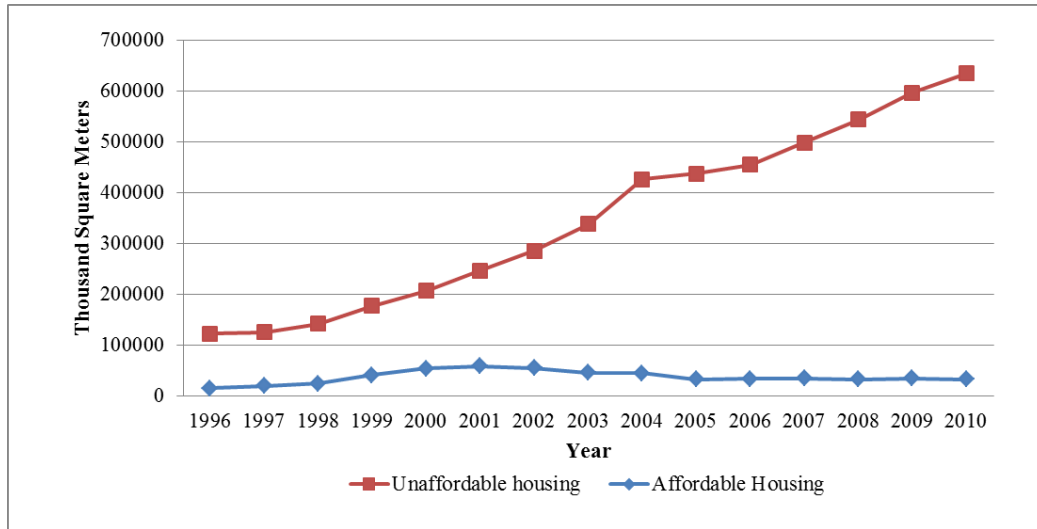
Figure 3.2 Floor spaces of affordable and unaffordable housing completed in China since 1996

Source: China Premium Database in CEIC Database.

We estimated Dynamic Panel Model for affordable and unaffordable housing construction. The use of the GMM method to estimate Equations (3.2) to (3.5) would eliminate the region-specific effects. For incorporating the time-specific effects, we use "$yeart$" as time dummy variables. For the first-difference estimation, we need to drop an additional year dummy variable (Lee, 2007). As a result, we have 290 estimation samples. Table 3.4 reports the estimation results. All specifications that control for the year-specific dummy variables are supported by the Wald test at 0.1% significance level. This is evidence in support of our Dynamic Panel Model. In addition, the GMM approach is based on the assumption of no residual autocorrelation, and at least no second-order correlation based on residual (Arellano and Bond, 1991; Dang, Kim, and Shin, 2014). In theory, the conditions can be evaluated by using AR(1) and AR(2) tests (Arellano and Bond, 1991). AR(1) and AR(2) denote Arellano–Bond tests for the first- and second-order autocorrelation in first-differenced error terms, respectively. The null hypothesis of AR(2) test is there are no second order autocorrelations of error term in the first order difference equations. Since the p-value of AR(2) in each equation is greater than 5%, it denotes no second order autocorrelation in first order difference equation. This is another supportive evidence of our models.

First, we examine crowding-out effects of unaffordable housing construction on affordable housing construction. The Case 1 in Table 3.5 shows the estimated results of Equation (3.3), which does not control for the interaction terms of urbanization rate with affordable/unaffordable housing construction. The results show that the current and lagged values of unaffordable housing construction do not appear to be the causes of affordable housing construction, since their coefficients are small and weak in statistical significance. The estimated coefficient of the lagged value of affordable housing construction is 0.636 at the 0.1% significance level, which implies that if affordable housing construction in the previous period increases by 1 square meter, current affordable housing construction would increase 0.636 square meters. When unaffordable housing construction is the dependent variable, Case 3 does not control for the interaction of affordable housing and unaffordable housing construction. The results indicate that affordable housing construction affects unaffordable housing construction during the same period. The coefficient of affordable housing construction at time t is -0.624 at 0.1% significance level. If the current affordable housing construction increases 1 square meter, current unaffordable housing construction would decrease 0.624 square meters. This indicates that affordable housing construction would crowd out unaffordable housing construction. This can be easily understood by the following explanation. Since the gross capital of real estate enterprises is fixed, they construct more affordable housing units at the cost of unaffordable housing units. Furthermore, unaffordable housing construction is positively related to total construction. This shows that residential houses are mainly constructed by the real estate enterprises.

When controlling for the interaction terms of urbanization rate with affordable and unaffordable housing construction, we obtain different results. From the estimated coefficients shown in Cases 2 and 4 in Table 3.5, we find that the interaction terms[33] are highly statistically significant. In Case 2, the estimated coefficients for interaction terms $ru_{it-1} \cdot af_{it-1}$ and $ru_{it} \cdot uaf_{it}$ are at the 5% and 0.1% significance levels, respectively. The coefficients of uaf_{it} are also significant at 0.1% level. From the coefficients of

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[33] The reason why we use the interaction terms is that we want to examine the relationship between the crowding-out effect changes and the urbanization rates.

$ru_{it} \cdot uaf_{it}$ and uaf_{it}, we can infer that the crowding-out effect of unaffordable housing on affordable housing, for the same period, would decrease with rise in urbanization rates. When urbanization rate is below 57.39%[34], unaffordable housing construction would crowd out affordable housing construction. On the contrary, if this value is over 57.39%, unaffordable housing construction induces affordable housing construction, resulting in a "filling-in" effect. Similarly, Case 4 shows the results when controlling for the interaction terms and dependent variable is uaf_{it}. From the coefficients of af_{it}, we find that the effects of affordable housing construction on unaffordable housing construction during the same period is -1.460, indicating that affordable housing construction crowd out unaffordable housing construction. The estimated coefficients represent that the lagged value of interaction term $ru_{it-1} \cdot uaf_{it-1}$ is -0.861 at 0.1% significance level. Besides, the coefficients of uaf_{it-1} become significant at 0.1% significance level compared with the results without controlling for interaction terms.

Results from the above analysis indicate that interaction between affordable and unaffordable housing construction during the same period exists when controlling for the interaction terms of urbanization rate with affordable and unaffordable housing construction. This reflects the asymmetric crowding-out pattern between affordable and unaffordable housing construction, which implies that construction of one particular type responds to the current value of the other type. However, the crowding-out effect from affordable housing to unaffordable housing is greater than the opposite effect from unaffordable to affordable housing. Besides, the interaction term of unaffordable housing with urbanization rate has a negative effect on affordable housing construction. However, the interaction term of affordable housing with urbanization rate would not affect unaffordable housing construction. These results indicate the existence of a competitive relationship between affordable and unaffordable housing construction. This is easily

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[34] Actually, this result is robust in both short run and long run. Here, we considered the effects in the short run. Substituting the estimated coefficients into $\frac{\partial af_{it}}{\partial uaf_{it}} = \beta_{20} + \beta_{40} ru_{it}$, we obtained the critical value of urbanization rate as 57.39%. When considering the long-run crowding-out effects, affordable and unaffordable housing construction are assumed to be constant. Then, we know the long-run effects would be $\frac{\partial af_{it}}{\partial uaf_{it}} = \frac{(\beta_{20} + \beta_{21}) + (\beta_{40} + \beta_{41}) ru_{it}}{1 - \beta_{11} - \beta_{31} ru_{it}}$. Using the estimated coefficient, we then compute the critical value of urbanization rate, which is also 57.39%.

understood given the reasoning presented before. Both types of housing are constructed by real estate enterprises and the prices of affordable housing are lower than unaffordable housing. The mean value of price ratio between affordable and residential housing is only 0.6947. Hence, real estate enterprises would obtain less benefit from investing in affordable housing. They are less likely to construct affordable housing units. This might be the reason for year over year decrease in floor spaces of completed affordable housing.

Overall, our empirical evidence indicates crowding-out effects between affordable and unaffordable housing. Crowding-out effects would be serious when the urbanization rate is lower than 57.39%. This occurs because high affordable housing demand in regions with high level of urbanization prompts local governments to implement policies encouraging affordable housing construction to solve the housing problem, which, in turn reduces crowding-out effects. Among the provinces and regions studied, the urbanization rate of only Beijing and Tianjin are higher than this critical value. Therefore, crowding out is the primary problem when implementing the affordable housing program in China. One could be concerned about possible problems of nonstationary in estimated results for the level data. The first-difference regressions are an option to get around the nonstationary problem. We have applied this method to examine whether the level data analysis is robust enough. Table 3.6 shows the first difference regression results for checking robustness. The p-value of AR(2) test in Table 6 shows no second order autocorrelation in first order difference equation, which supports our models. Case 6 in Table 3.6 shows that the difference of affordable housing construction responds to that of unaffordable housing construction and the interactive term $d\_ru_{it} \cdot uaf_{it}$. The estimated coefficients of d_uaf_{it} and $d\_ru_{it} \cdot uaf_{it}$ show that the crowding-out effect of the difference of unaffordable on affordable housing construction would decrease with increase in the urbanization rate. Case 8 in Table 3.6 shows that difference of affordable housing construction would crowd out that of unaffordable housing construction, although the estimated results in Case 8 are a little different from that in Case 4. We conclude that the results shown in Table 3.6 support the results obtained from Table 3.5. In the two tables, "$yeart$" is the year t-specific effect, where $t = 2001, \cdots, 2010$; for example, time dummy variable "year2001" refers to the dummy of year of 2001. If a

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province has a number in one year, the time dummy variable for the year is equal to 1, or else 0. For each equation, instrumental variables include two parts: the vector of $\left(y_{i1}, \cdots, y_{i,t-2} \right)$ are GMM instruments, and ΔX_{it} are the other standard instruments for the first-differenced equations. For example, in Case 1, the following instrumental variables for GMM are used: dynamic panel instruments are af_{it-2} and af_{it-3}; other instruments are Δuaf_{it}, Δuaf_{it-1}, Δru_{it}, $\Delta total_{it}$, $\Delta l\,g\,dp_{it}$, Δpr_{it}, $\Delta year2001$, $\Delta year2002$, $\Delta year2003$, $\Delta year2004$, $\Delta year2005$, $\Delta year2006$, $\Delta year2007$, $\Delta year2008$, $\Delta year2009$, and $\Delta year2010$. AR(1) and AR(2) denote Arellano–Bond tests for the first- and second-order autocorrelation in first-differenced error terms, respectively. The results of AR(2) denote no second-order autocorrelation in first-differenced errors.

Table 3.5 Interactions between affordable and unaffordable housing construction by specification: level regression

X	Dependent variable = af_{it}		Dependent variable = uaf_{it}	
	Case 1	Case 2	Case 3	Case 4
af_{it-1}	0.636^{***}	0.882^{**}	0.023	-0.461
	(0.106)	(0.285)	(0.173)	(0.430)
af_{it}	---	---	-0.624^{***}	-1.460^{*}
			(0.170)	(0.572)
$ru_{it-1} \cdot af_{it-1}$	---	-1.844^{*}	---	1.884
		(0.908)		(1.512)
$ru_{it} \cdot af_{it}$	---	---	---	2.378
				(1.871)
uaf_{it}	-0.104	-0.198^{***}	---	---
	(0.060)	(0.051)		
uaf_{it-1}	0.017	-0.006	0.152	0.505^{***}
	(0.022)	(0.036)	(0.159)	(0.138)
$ru_{it} \cdot uaf_{it}$	---	0.345^{***}	---	---
		(0.077)		
$ru_{it-1} \cdot uaf_{it-1}$	---	-0.024	---	-0.861^{***}
		(0.086)		(0.225)
ru_{it}	-12695.5	-85234.0^{*}	-54791.0	-65498.3
	(35065.2)	(33757.0)	(70731.6)	(72922.1)
$total_{it}$	0.077	0.069	0.586^{***}	0.590^{***}
	(0.048)	(0.036)	(0.128)	(0.101)
$lgdp_{it}$	-274270.9	-277595.7	1252894.2	1331296.9
	(240947.8)	(375580.6)	(693017.5)	(836823.6)
pr_{it}	379688.0	761251.0^{*}	1548714.7	91302.0
	(286472.8)	(314812.2)	(1401073.6)	(704862.2)
year2001	-120531.4	95103.7	244201.8	48498.3
	(108321.9)	(106836.4)	(132008.5)	(108012.1)
year2002	-310202.7^{*}	84355.3	363672.2	-69930.0
	(131873.7)	(121042.0)	(286456.2)	(163357.3)
year2003	-452219.0^{**}	43790.8	591154.8	-23027.9
	(174888.1)	(172404.1)	(393777.9)	(270725.9)
year2004	-250774.6	274659.1	785719.0	-105687.2
	(229569.9)	(244732.3)	(633001.8)	(417323.4)
year2005	-521002.4^{*}	104303.5	889228.9	-165907.1
	(208524.1)	(241286.6)	(919441.5)	(612490.4)
year2006	-213346.1	409904.9	778274.6	-117933.1
	(247274.4)	(285618.0)	(1039904.3)	(745977.1)
year2007	-67970.8	577728.3	1066410.0	-15692.2
	(321770.9)	(388991.8)	(1134501.6)	(791107.0)
year2008	-194227.5	555056.7	550873.9	-625942.2
	(343028.0)	(472367.8)	(1421411.6)	(1150187.9)
year2009	34087.9	764385.9	1514003.8	169394.1
	(386159.0)	(560078.8)	(1277760.7)	(868242.0)
year2010	-90309.0	808213.7	1124722.7	-485440.8
	(443507.5)	(681634.4)	(1664526.2)	(1094185.7)
No. of instruments	71.	74.	71.	74.
Serial correlation test				
AR(1) (p-Value)	0.0001	0.0010	0.3343	0.2989
AR(2) (p-Value)	0.5400	0.5391	0.3262	0.5125

Notes: Robust standard errors are in parentheses. *, **, *** denotes significance at 5%, 1%, and 0.1% respectively.

Table 3.6 Interactions between affordable and unaffordable housing construction by specification: first difference regression results

X	Dependent variable = d_af_{it}		Dependent variable = d_uaf_{it}	
	Case 5	Case 6	Case 7	Case 8
d_af_{it-1}	0.005	0.901*	0.108	-0.164
	(0.066)	(0.364)	(0.190)	(0.298)
d_af_{it}	---	---	-0.608***	-1.088*
			(0.136)	(0.518)
$d\_ru_{it-1}{\cdot}af_{it-1}$	---	-2.912**	---	0.780
		(1.115)		(0.593)
$d\_ru_{it}{\cdot}af_{it}$	---	---	---	1.398
				(1.512)
d_uaf_{it}	-0.066	-0.160***	---	---
	(0.034)	(0.048)		
d_uaf_{it-1}	0.016	-0.017	-0.069	0.167
	(0.036)	(0.044)	(0.069)	(0.157)
$d\_ru_{it}{\cdot}uaf_{it}$	---	0.225**	---	---
		(0.086)		
$d\_ru_{it-1}{\cdot}uaf_{it-1}$	---	0.090	---	-0.688
		(0.093)		(0.482)
d_ru_{it}	-1765.6	-54218.6	17324.5	-47085.3
	(24238.0)	(29037.3)	(43445.4)	(50610.0)
d_total_{it}	0.048	0.073	0.467**	0.474**
	(0.035)	(0.041)	(0.172)	(0.168)
d_lgdp_{it}	1762867.4	1957560.7	14337812.2	14488685.5
	(951645.5)	(1178910.6)	(7582659.9)	(8351527.8)
d_pr_{it}	345252.2	299693.6	237802.0	66296.5
	(288667.2)	(322429.9)	(536733.4)	(570831.8)
year2001	357416.9*	---	733481.1*	742936.7
	(143941.9)		(373141.0)	(381694.2)
year2002	54870.4	-225173.5	713911.5	723484.0
	(155202.2)	(164386.6)	(438490.3)	(454790.0)
year2003	-177407.6	-439446.1**	377624.5	404831.7
	(111432.2)	(142063.1)	(211294.1)	(218770.8)
year2004	---	-328128.0*	---	---
		(162086.1)		
year2005	-287126.5	-591595.4***	120651.5	256537.7
	(149209.1)	(135514.9)	(184511.8)	(205097.1)
year2006	105543.9	-246701.8	-217700.8	6677.5
	(162888.6)	(140514.8)	(268919.2)	(254961.1)
year2007	112940.3	-314422.1*	-499673.8	-536307.6
	(104726.8)	(153847.8)	(473179.8)	(545199.4)
year2008	-66399.2	-451534.3**	-783814.2	-754178.1
	(102394.2)	(168726.8)	(527774.8)	(604971.7)
year2009	329753.1**	-80941.6	1769085.8	1755253.9
	(123620.0)	(163736.6)	(965029.2)	(975769.9)
year2010	-80552.7	-426511.5*	-594944.9	-589858.7
	(148318.4)	(166779.6)	(452985.7)	(486010.5)
No. of instruments	60.	63.	60.	63.
Serial correlation test				
AR(1)	0.0002	0.0004	0.1465	0.1348
AR(2)	0.6446	0.3943	0.1639	0.2639

Notes: The prefix "d" denotes the first-difference value of the variable. Robust standard errors are in parentheses. *, **, *** denotes significance at 5%, 1%, and 0.1% respectively.

3.6 Conclusions

This chapter analyzed crowding-out effects between affordable and unaffordable housing construction in China by using province-level panel data. We chose 29 provinces and regions in China as our sample. The data include floor spaces of completed affordable and unaffordable housing construction, urbanization rate, total floor spaces of completed residential housing, regional GDP and prices of affordable and residential housing. We applied Dynamic Panel Model, including region-specific and time-specific effects, to examine the interaction between affordable and unaffordable housing. The GMM estimator is a useful and valid estimator of dynamic panel data (Ahn and Schmidt, 1997; Cheng and Tahmiscioglu, 2008). Our results reveal an asymmetric crowding-out pattern between affordable and unaffordable housing construction. This implies that each is offset by the current value of the other and there are no lagged values. Our findings also indicate that affordable housing construction, besides being related with unaffordable housing construction, is also related with urbanization rate. When urbanization rate is lower than 57.39%, unaffordable housing construction would crowd out affordable housing construction. Moreover, crowding out effect of unaffordable housing on affordable housing decreases with a rise in urbanization rate. Additionally, unaffordable housing construction only responds to affordable housing construction during the same period, as revealed by the estimated coefficient of current value of affordable housing construction. This indicates that affordable housing construction crowds out unaffordable housing construction.

Overall, crowding out renders the affordable housing program less efficient. To address this, the government should take measures to encourage real estate enterprises to construct more affordable housing by supplying more subsidies and further reducing transaction taxes for selling affordable housing. Besides, the government could also explore other sources for expanding the supply base of affordable housing through methods such as selling second-hand housing units for addressing the housing problem. A combination of such methods would prove to be more efficient for successful implementation of the affordable housing program aimed at solving housing problems in

China.

One limitation of this study is that it considers data pertaining to only 12 years of housing construction. The lack of data reporting about the subsidies provided to real estate enterprises is another limitation. Provision of subsidies would affect the preference of enterprises for construction of affordable housing. This chapter could be used as a foundation for further research to investigate how affordable housing programs in China should be developed to respond effectively to the requirements of households with low and moderate incomes.

Future research could also explore the possibility of combining affordable housing provision with voucher programs[35], which would be more efficient for households with low and moderate incomes when housing markets realize a long-run equilibrium (see Lee, 2007). In addition, Eriksen and Rosenthal (2010) pointed out that LIHTC development may help low and moderate income families gain access to higher quality local schools and other local public services. In our case, many households are not satisfied with the provision of infrastructure around affordable housing. Hence, how to raise the quality of services offered in the vicinity of affordable housing for the convenience of residents could be an area of future research. Hence, how to raise the convenience of affordable housing is an area of future research.

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[35] Voucher program refers to the government's program for providing housing assistance to help lowest-income households, the disabled people, and elderly to afford housing units in the open market.

Chapter 4

Problems of Public Housing Market: Sell-Oriented Policy

This chapter conducts a comparative analysis on the main public housing policies implemented in the city of Baoji, China. In addition to supplying rental public housing, the local government of Baoji sells public housing to lowest-income households. To understand the effects of the public housing program, it is necessary to measure the feasibility of the sell-oriented policy (SOP) and to compare the effects of the SOP and rent-oriented policy (ROP). The data in this chapter come from a survey conducted in 2010 in Baoji. This chapter applies a Cobb-Douglas utility function to measure the extra benefits for households that fall under the SOP and households that fall under the ROP. The results indicate that while both policies offer benefits to households, ROP households benefit more than SOP households do. In contrast, the lowest-income SOP households have a stronger taste in terms of housing consumption, and so after buying public housing, they acquire more satisfaction. However, both groups of households are dissatisfied with the public facilities supplied to the public housing units. The main policy conclusions are that although the SOP could improve household utilities, the ROP is the more efficient of the two policies. In addition, public facilities to public housing units should be considered when undertaking new public housing projects.

4.1 Introduction

The Chinese Ministry has acknowledged that the main housing problem in China is unaffordability of urban poverty (Deng et al. 2009). Given increasing concerns about urban poverty and how it might threaten social stability and economic prosperity, the Chinese government has developed the public housing[36] program, which had its official

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[36] Public housing is usually called "cheap rent housing" in China, but is similar to public housing in other countries. In the whole country, public housing is managed by Ministry of Housing and Urban-Rural

origin in *Ways to Provide Public Housings for the Poorest Urban Residents* in 2004 with the goal of strengthening the social rental housing system and renaming it the public housing program (Deng et al. 2009). Via the public housing program, the government provides housing or housing subsidies to lowest-income households to help them improve their housing conditions or to obtain houses in which to live (Xie, 2011). Until 2006, few local governments had officially used the program, but by 2010, almost all local governments in China had constructed public housing units.

When a public housing program is implemented, the subsidy method is one of the most important aspects (Gilbert, 2012). According to the public housing program laws, there are two main public housing subsidy policies: a rent-oriented policy (ROP) and a rent subsidy policy[37]. Housing subsidies have been able to solve the housing problem effectively in Chile, Colombia, and South Africa, but only by having adequate funding (Gilbert 2004). Besides, when central government urged local governments to establish the public housing program, it did not dedicate funding for this purpose (Deng et al. 2009). Although the central government might provide some support from its annual budget, such funding was not guaranteed and often very limited (Deng et al. 2009). Hence, local governments were responsible for carrying out the construction programs[38]. Therefore, to obtain the funding they needed, some local governments began selling public houses, which they had constructed, to lowest-income households at a very low price. In this way, local governments were able to ensure there were sufficient funds for the construction assignments being implemented in the next period. In this study, we refer to this method of subsidizing lowest-income housing as a "sell-oriented policy (SOP)."

Thus, public housing constructed by local governments is subject to two main subsidy

Development of the People's Republic of China (MOHURD). In local, it is managed by local governments' Housing Security Centers. In this chapter, we use the term "public housing" for the purpose of comparison and understandability.

[37] When implementing the ROP, lowest-income households rent public housing constructed by the governments. The rent subsidy policy enables a government to give rent subsidies to lowest-income households to help them to rent housing in the normal rental market.

[38] Funding for these housing units came from various sources. The central government provided about 33.33% of the funds, and the provincial government provided about 16.67% of the funds. The remaining 50% came from the local government itself. In China, governments can be classified into five main administrative levels: the first level is the central government, which sits above the other four; second is the provincial government; third is the city government; fourth is the county government; and the fifth level is the township government. A higher level of government can overrule lower ones, to a certain extent. Public housing projects are typically constructed by a city government. Therefore, in this chapter, 'local government' refers to a city government.

policies: the SOP and ROP. However, there are no rules or laws governing the SOP public housing programs. Several officials from local governments, such as those in Baoji city, believe that the SOP helps governments to recycle construction funds rapidly, and so are in favor of it. On the other hand, some officials at the central government level insist that, in the case of a public housing shortage, the policy is counter to the goal of helping as many lowest-income households to obtain housing. Their reasoning is that, if public housing is sold to lowest-income households, those houses exit the market immediately, and can no longer be used for renting, so should take the ROP. The debates between SOP and ROP make it crucial to discuss their wealth effects on lowest-income households. This is the main objective of this chapter.

4.2 Literature review[39]

When it comes to public housing programs, rent subsidies are widely adopted around the world. Rent subsidies and public housing programs have a social benefit, but also contain both economic effects and welfare effects for the society (Tiwari and Hasegawa 2001; Koning and Ridder 1997). In particular, lowest-income households receive more benefits. However, one difficulty with these subsidies is how to calculate the benefits distribution between different kinds of lowest-income households. Kraft and Olsen (1973) measured the distribution of direct benefits to different households by using a general equilibrium model. They found that the mean benefits first rise and then fall, depending on the household income; for households with the lowest income levels, there are almost no benefits. Another study by Murray (1975) indicated that the distribution of consumers' surplus depends mainly on individuals' characteristics, such as level of income, the age of the head of the household, race, and family composition. This study used a Cobb-Douglas utility function and a Constant Elasticity of Substitution (CES) utility function to analyze the effects on different households. Even though there was not much difference in average benefits, the results showed that, in the Cobb-Douglas case, the coefficients of non-housing goods and the age of the head of the household are positive and significant,

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[39] In fact, much of the references are very dated in this chapter. Because many countries have been implementing the public housing program for many years, e.g., US begun it in 1930s, Hong Kong is 1953, British is 1920s, the researchers study the related problems are dated (China begun it in 2006).

while the coefficient of income is positive, but not significant. Wong and Liu (1988), using a Cobb-Douglas utility function, found that the public housing program is inefficient in Hong Kong, because poor public housing tenants obtain more benefits than the rich, and because many of the poor are not covered by the public housing program.

In our case, the sell-oriented policy is similar with the privatization of public housing, which is a flat-for-sale scheme mainly for public rental housing tenants as well as those eligible private rental tenants. This policy was launched in 1978 in Hong Kong – Home Ownership Scheme (Ho, 2004); and in US the launch of the privatization of public housing[40] was in 1988 (Schill, 1990). Some studies suggested that privatization of public housing would be an alternative policy for public housing program. Ho (1995) pointed out that in Hong Kong, privatization of public housing is economic efficiency, "policy efficiency," and equity. In further, Ho (2004) discussed methods of privatizing public housing, and used the sequential model to examine every stage of the privatization process. The results indicated that the government should not ignore numerous mistakes in the privatization process, and do something to replace market interventions with market mechanisms. According to Kirwan (1984), whatever the motives of individual tenants and whether through choice or constraint, privatization "must be seen as one component of a more general trend towards the reconstitution of public housing as market or economic rent housing." However, there are major problems with this strategy that the selective effect of the policy filters out relatively advantaged households and properties, leaving behind the least advantaged household in the worst accommodation, incapable and unwilling to pay increased rents (Flynn, 1988). Hence, Schill (1990) pointed out that the privatization of public housing units remains at the forefront of the housing policy debates.

Research on the public housing program in China is still characterized by controversy on which kind of subsidy policy should be adopted. Several researchers point out that, when there is a shortage of housing stock, the ROP should be chosen (Jiang, 2007; Liu, 2004). Zhang (2009) suggested that, in the short term, the ROP is more efficient. Then, in

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[40] The Commission on Privatization recommended that Congress direct the United States Department of Housing and Urban Development ('HUD') to sell public housing units to tenants at discounted prices (Schill 1990).

the long term, this policy should transition to a rent subsidy policy. The effects of the public housing subsidy policy were analyzed by Zhou (2008, 2010). Zhou (2008) compared households receiving rent subsidies to those who are not subsidized, and found that there are some problems, for example, in Shanghai, there is a level of inequity and insufficiency when the rent subsidy policy is used. In further, Zhou (2010) established a logistic model to analyze the factors that influence the policy effects. The results showed that household size, location, and people's willingness to purchase in future seem to influence the policy effects.

In summary, to the best of our knowledge, little studies in China have investigated the wealth effects of SOP and ROP on lowest-income households in public housing programs. Therefore, it is worth comparing the effects of the SOP and ROP in China. The rest of this chapter is organized as follows. Section 4.3 outlines the Cobb-Douglas utility function and suggests possible extra benefits. Section 4.4 describes our data and summarizes households' characteristics. Section 4.5 discusses our empirical results on the extra benefits to each household group. Then, Section 4.6 concludes the paper by summarizing our main findings.

4.3 The utility function and benefits

This study assumes there are only two kinds of goods in the market: a housing service and non-housing goods. The market is assumed to be perfectly competitive and in equilibrium in the long run. This means that in the long run, the supply curves of the two goods are perfectly elastic. Housing services are measured by several attributes, including floor area, number of bedrooms, whether the house has a bathroom, and orientation.

The prices of housing services and non-housing goods are P_H and P_C, respectively. Under the public housing program, a family is offered " H " units of housing services. Households under the SOP have to pay $H \cdot P_H^s$ to buy a public housing unit, and consume C_b units of non-housing goods by using their surplus income. Similarly, families under the ROP need to pay a rent of $H \cdot P_H^r$ to rent the public housing unit, and consume C_r units of non-housing goods using their surplus income. Since these are

public housing units, the prices, P_H^s, and rents, P_H^r, are lower than in commercial housing units in the open market. Therefore, participants in the public housing program obtain benefits and welfare from this program. Do households under the SOP and ROP obtain the same benefits and welfare? If not, which of the two obtains more? To answer these questions, assessing these benefits is necessary.

The benefits to eligible households in public housing programs are equivalent to receiving an unrestricted cash grant, B. For households under the SOP, this is B_s; for households under the ROP, this is B_r. Here, B refers to the difference between the market value and the real expenditure on the goods consumed by households under the public housing program. To calculate the value of the cash grants, B, this study adopt the Cobb-Douglas utility function[41] to estimate households' benefits.

A simple form of this function is as follows:

$$U = H^\alpha C^{1-\alpha} \tag{4.1}$$

where U is a household's utility; H refers to the consumption of housing services; C represents the consumption of non-housing goods. In addition, α is the proportion of income spent on housing by a consumer facing the following budget constraint:

$$H \cdot P_H + C \cdot P_C \leq Y \tag{4.2}$$

where the variables are defined as they were before the consumer became part of the housing program. Subject to the budget constraint (4.2), the consumer will maximize his or her utility. We solve the utility maximization problem for the consumer by using a Lagrangian function. The optimal solutions are as follows:

$$H = \alpha Y / P_H \quad \text{and} \quad C = (1-\alpha) Y / P_C \tag{4.3}$$

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[41] Similar previous studies have mainly used three utility functions: the Cobb-Douglas utility function (Kraft and Olsen 1973; Murray 1975; Wong and Liu 1988.), the Constant Elasticity of Substitution (CES) utility function (Murray 1975), and the Stone-Geary utility function (Johnson and Hurter 2000). Murray (1975) compared the parameters of the generalized CES and Cobb-Douglas utility functions when estimating the distribution of benefits in public housing programs. The author suggested that the Cobb-Douglas utility function may be useful for computing aggregate benefits. One of our important objectives is to compute the aggregate benefits of subsidized low-income households. In addition, Murray (1975) pointed out that the CES utility function would be the better option when studying structural characteristics, such as the correlation between income or age and the benefits. In our case, households are eligible if they have special certifications, such as the "Certification of Minimum Subsistence Security for the Urban Residence," "Certification of Five Guarantees Family," and the "Certification of Disabled People." This means that the policy does not depend only on income or age. The Stone-Geary utility function could be used to solve problems that involve subsistence levels of consumption (Johnson and Hurter 2000). In our case, the households are the lowest income households, which means all consumption of housing services and non-housing goods are at or below subsistence levels. Hence, the Cobb-Douglas utility function is the most appropriate for our study.

In addition, by the first-order condition, optimal solutions need to satisfy the condition:

$$H \cdot P_H + C \cdot P_C = Y \tag{4.4}$$

This implies that the income of the consumer is used completely. Here, $H \cdot P_H$ is the housing expenditure. Therefore, the consumption of non-housing goods (all non-housing goods being represented here by a composite commodity) is

$$C = Y - H \cdot P_H / P_C \tag{4.5}$$

Next, we suppose that the consumer participates in the public housing program. Then, with an income of Y_1, the consumer obtains H_1 housing units and C_1 units of non-housing goods. He or she may obtain these under either the SOP or ROP. The two options do not affect the analysis. Then, the utility level of the consumer is

$$U_1 = H_1^{\alpha} C_1^{1-\alpha} \tag{4.6}$$

Suppose the consumer's taste in housing does not change. This means the value of α remains constant while the consumer participates in the public housing program. To obtain U_1 in the open market, how much income is necessary for the consumer?

For a given income, Y_1, the consumer participating in the public housing program would consume the following quantity of non-housing goods:

$$C_1 = Y_1 - H_1 \cdot P_{H_1} / P_C \tag{4.7}$$

In this case, P_C is constant because, in the short term, the market price of non-housing goods does not change. By minimizing $H \cdot P_H + C \cdot P_C$, subject to $U_1 = H_1^{\alpha} C_1^{1-\alpha}$, to obtain U_1 in the open market, the necessary income is

$$Y_1' = \left(H_1 \cdot P_H^e / a \right)^a \left\{ \left(Y_1 - H_1 \cdot P_{H_H} \right) / (1-a) \right\}^{(1-a)} \tag{4.8}$$

where P_H^e is the market price of the housing service, which is not affected by the public housing program. In our case, P_H^e contains the market selling price, P_H^{es}, for the SOP and the market rent price, P_H^{er}, for the ROP. In addition, $\left(Y_1' - Y_1 \right)$ is the benefit the consumer obtains from the public housing program. Hence, the total benefit value for the consumer participating in the public housing program is given by:

$$B = Y_1' - Y_1 \tag{4.9}$$

Substituting the average values into equation (4.9) could obtain the average benefits. To compare the benefits obtained by households under the SOP and ROP, it is needed to

calculate B_s for SOP and B_r for ROP, respectively. If $B_s > B_r$, the benefits obtained by the households under the SOP are higher, and SOP is more effective. Otherwise, ROP is more effective.

To obtain the average benefits, it is needed to calculate the value of α first. In the short term, this study supposes that the consumer's preference does not change, which means α remains constant before and after participation in the public housing program. Thus, α could be calculated from the values of $H \cdot P_H$ and Y from before the consumer participated in the public housing program. The value of α is the proportion of income spent on housing by a consumer. Hence,

$$\alpha = \left(H \cdot P_H \right) / Y \tag{4.10}$$

4.4 Data

This empirical study is based on cross-sectional data originating from a survey conducted in the city of Baoji in July 2010. Baoji is one of the biggest cities in northwest China, and began constructing public housing in 2006[42]. By the end of 2010, the local government of Baoji had constructed 4,110 public housing dwellings, with a combined building area of 205,500 square meters. By September 2010, 1,361 dwellings were in use. Of these, 1,148 dwelling units had been bought, and only 213 dwelling units were rented. Thus, the proportion of lowest-income households under the SOP was about 84.35%. By the end of 2010, the main public housing areas were the XFY area, the CSL area, and the LFY area[43]. There were 984 lowest-income households living in the XFY area, which is about 72.30% of the lowest-income households subsidized by a public housing policy. The sample in this chapter comes from the XFY area of Baoji. We successfully interviewed 75[44] households. Our sample size is rather small[45]. When Kraft and Olsen (1973) estimated the relationship between the rent-income ratio and family characteristics, they used 168 observations. They divided these observations into four groups. Three groups contained

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[42] In China, 2006 is when public housing officially began to be constructed.
[43] XFY, CSL, and LFY are the name of different areas.
[44] We used the method of random sampling to do the questionnaire.
[45] We have tried to enlarge our sample and did this investigation again in 2012. Because there are no rules or laws governing the sell-oriented policy, local government of Baoji city was criticized in 2012. Most households were not willing to be interviewed for fear of criticism or punishment. Hence, we were not able to achieve a bigger sample size.

40 observations, with the remaining group containing 48 observations. However, the small number of observations did not affect their analysis. Hence, although our sample size is relatively small, this will affect our analysis. Of the 75 lowest-income households, 63 bought public housing units under the SOP. The remaining 12 households rented their property, thus falling under the ROP. Therefore, in our survey, the proportion of households under the SOP is 84%, which is close to the proportion of Baoji's overall figure of 84.35%.

Our survey data includes detailed information on each house characteristic, including the housing area, expenditure on housing services, the living conditions, and the distance from the city center. For all households[46], data on annual disposable income[47], as well as other important household characteristics, such as the household size, number of children, age and years of schooling of the head of the household, were also collected. The survey collected data on the household before and after moving into the public housing. Table 4.1 summarizes the characteristics of surveyed households.

Table 4.1 Summary characteristics by type of subsidy

Variables	All	Households in SOP	Households in ROP
Number of households	75	63	12
Age of head of household	51.55	52.03	49
Proportion of age 18-30 (%)	2.67	1.59	8.33
Proportion of age 31-45 (%)	34.67	39.68	8.33
Proportion of age 46-60 (%)	45.33	39.68	75
Proportion of age over 60 (%)	17.33	19.05	8.33
Years of schooling of head of household	9.53	9.34	10.5
Household size	3.11	3	3.75
Number of Children	41	37	4
Proportion of age 0-9(%)	24.4	24.32	25
Proportion of age 10-18(%)	75.60	75.68	75.00

Source: Summarized by the author from the survey conducted in Baoji in 2010

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[46] A household in this study refers to a family, including all family members who are in the same Residence Registration Booklet, which is a certification that a person belongs to a family in an administrative region.
[47] Annual disposable income refers to the amount of money that households have available to spend and save after deducting income tax.

Local governments have flexibility in determining who is eligible and what types of units should be provided (Deng et al. 2009). According to the laws of the public housing program, eligible households need to hold a special certification, such as the "Certification of Minimum Subsistence Security for the Urban Residence," "Certification of Five Guarantees Family," and the "Certification of Disabled People." These all certify that a person is eligible to be subsidized by the public housing program. In our sample, 89.33% of the households hold these certifications. Table 4.1 shows that the average education level of a head of a household is only 9.53 years of schooling. Besides, only 9.3% of the heads of households in our sample had received college education. The low average education level makes it more difficult for a household to find work as technology develops. In addition, the heads of the households with the average age of 51.55 are mostly the workers who were laid off during the reformation of the state enterprises. Those households are easier to obtain special certifications, as well as the disabled people. Another criterion used to judge eligibility is annual disposable income. The annual disposable income per capita for urban households in Baoji was RMB 13225 in 2008 and RMB 16346 in 2009[48]. In contrast, this value for the households in our survey was RMB 4089.84 in 2008 and RMB 4562.84 in 2009, or 30.93% and 27.91% of the urban average, respectively. Therefore, the disposable income of subsidized households is lower than that of the average urban household.

Households who satisfy the above criteria have priority when it comes to receiving a subsidized dwelling unit. In our sample, the local government provides dwelling units to lowest-income households in two ways: SOP and ROP. Table 4.2 compares the characteristics of households under the SOP and ROP, as well as the differences before and after the implementation of the policies.

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[48] The data come from "Shanxi Statistical Yearbook in 2009."

Table 4.2 Characteristics of households surveyed in Baoji

Variables (unit)	SOP			ROP		
	Before	After	Difference	Before	After	Difference
Annual disposable income (RMB)	12097.01	14122.78	2025.77	13951.13	15858.50	1907.37
Average expenditure for housing service per area per year (RMB)	90.72	15.72	-75.00	50.64	14.64	-36.00
Highest expenditure for housing service per area per year (RMB)	240.00	18.72	-221.28	60.00	27.60	-32.40
Lowest expenditure for housing service per area per year (RMB)	12.00	10.56	-1.44	29.16	9.96	-19.20
Average expenditure for non-housing goods (RMB)	8373.04	10871.29	2498.26	6542.66	14081.62	7591.29
Housing area per capita (m^2)	11.93	23.18	11.25	5.99	12.21	6.21
Highest value of housing area per capita (m^2)	40.00	37.62※	-2.38	8.10	22.00	13.90
Lowest value of housing area per capita (m^2)	3.33	11.50	8.17	4.00	5.50	1.50
Average distance from the city center (m)	1.57	3.62	2.05	1.86	3.55	1.69
With kitchen and bathroom (%)	31.75	100.00	68.25	25.00	100.00	75.00
Without kitchen and bathroom (%)	52.38	0.00	-52.38	75.00	0.00	-75.00

Source: Summarized by the author from the data of a survey conducted in Baoji city in 2010

Notes:

1. For the SOP, after buying public housing, the expenditure for housing services per area per year is calculated by purchase price, housing area, and usage year. Housing expenditure per area per year equals to purchase price divided by the multiplier of housing area and usage year. In China, the legal limit for the usage year of residential land is 70 years, and as such, here, the usage year is set as 70.

2. ※ Here, the highest value of housing area per capita has decreased. The main reason is that the housing area per capita is calculated by dividing the overall housing area by the total population. In the actual calculation, total population means the census register population, which changed in the time before and after buying public housing. For example, the household with the highest housing area per capita before buying public housing contains one census register population. However, there are actually four people living in the house. Their housing area is 40 square meter. Then, by the function and policy standard, the housing area per capita is 40. However, after buying public housing, the census register population of the household would have changed to 4, with a housing area of 74 square meters. Therefore, the value of housing area per capita would have changed to 37.62.

From Table 4.2, the annual disposable income of those who choose to buy public housing is lower than those who choose to rent them. The reasons why there are more households preferring to buy public housing are as follows. First, the prices of public housing units are lower than the prices of commodity housing, although they provide similar conditions. The average price of public housing units is RMB 1100.4[49] per square meter. However, the average market price for commodity houses is RMB 2711.3[50]per square meter, which is as 2.46 times greater than that of public housing units. Second, the prices of public housing units are lower than their costs. In 2006, the average costs of public housing units were RMB 1180 per square meter in Baoji. The prices had increased to RMB 1500 per square meter by 2010. In our sample, the lowest-income households bought the public housing units after 2007, when the price was RMB 1100.4 per square meter. The fact that prices are lower than costs encourages lowest-income households to buy public housing units. Third, in the traditional view, households favor buying public housing units. According to the survey, owning the fixed usage rights of public housing units brings more happiness and sureness to the households. The fixed usage rights indicate that they do not need to move frequently and could live in the houses for 70 years. Hence, most lowest-income households want to buy public housing units. Fourth, lowest-income households could borrow money without interest from relatives. Although most of the lowest-income households could not afford houses by themselves, with the funds borrowed from relatives, they were able to do so. In the survey, there is no interest when households borrow money from their relatives, which encourages lowest-income households to borrow money and buy public housing units. The reasons why households choose to rent public housing units are the following: first, in their opinion, the infrastructure is not enough in the public housing community; second, they intend to move to other better houses when they have enough money.

After participating in the public housing program, the annual disposable income of households under both the SOP[51] and ROP increased, although the figures for the SOP

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[49] This information comes from the survey conducted in Baoji.

[50] This information comes from the China Premium Database in the CEIC Database, a database of comparative economic data for over 120 countries.

[51] The disposable income shows us that the average disposable income of SOP is lower than that of ROP. However, those a bit lower income households could buy public housing units. The reason can be explained

households showed a greater increase. Most of the households who buy public housing units have to return the borrowed money. They might do many types of work to earn enough to do so. Besides, expenses for non-housing goods increased for all households after participating in the public housing program. This is partly because of the increase in annual disposable income, but also because the housing expenses decreased.

4.5 Empirical results

4.5.1 Estimating α

To obtain the benefits, B, for households participating in the public housing program, this study first use equation (4.10) and the average household data before participating in the public housing program to calculate α.

For households under the SOP, before participating in the public housing program, the average housing area per capita is 11.93 square meters. In addition, Table 4.1 shows us the average household size is three persons. Therefore, the average housing area per household is 35.79 square meters[52] (H^s). The average price of a house is RMB90.72 per square meters (P_H^s). Hence, the average expenditure on housing services is RMB 3246.8688. The average value of the annual disposable income is RMB 12097.01[53] (Y^s). Therefore:

$$\alpha_s = H^s \cdot P_H^s \big/ Y^s = 35.79 \times 90.72 / 12097.01 = 0.2684 \qquad (4.11)$$

In the same way, for households under the ROP, the average housing area per capita is 5.99 square meters. Table 4.1 shows that the average household size under the ROP is 3.75 persons. Hence, the average housing area per household is 22.4625 square meters (H^r). The average rent is RMB50.64 per square meter (P_H^r). Hence, the average housing expenditure is RMB 1137.5010. The annual disposable income of households under the

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as follows. Huang (2012) points out that the local governments have been unwilling to allocated public housing units by renting out, since they are more concerned about economic goals without paying attention to the income levels of applicants. Therefore, to some extent, it is the responsibility of the local governments.

[52] This chapter uses the housing area as a proxy for the consumption of housing services.

[53] Actually, the expenditure on non-housing goods (shown in table 4.2) is 8373.04 RMB. The total expenditure for housing services and non-housing goods is equal to 11619.9088 RMB. The difference between total expenditure and annual disposable income is savings.

ROP is RMB 13951.13 (Y^r). Therefore,

$$\alpha_r = H^r \cdot P_H^r / Y^r = 22.4625 \times 50.64 / 13951.13 = 0.0815 \qquad (4.12)$$

From the above values, $\alpha_s > \alpha_r$, which reveals that households under the SOP have a stronger taste in housing than households under the ROP. A lowest-income household who values houses would most likely buy a public house. We can now derive the utility functions for households under the SOP and ROP, as follows:

For households under the SOP, the utility function is

$$U_s = H^{0.2648} C^{0.7316} \qquad (4.13)$$

For households under the ROP, the utility function is

$$U_r = H^{0.0815} C^{0.9185} \qquad (4.14)$$

Because the sample is selected from one city, the two functions only represent the utilities of lowest-income households in Baoji who participated in the public housing program. Although our sample size was small, this could still illustrate some problems with the program. Using the utility functions, this study then calculates the profits/benefits for households under the SOP and ROP.

4.5.2 Comparison of benefits

Based on Equations (4.8) and (4.9), the benefits could be obtained from the public housing program. First, this study applies Equation (4.8) to calculate the necessary income for the households after participating in the public housing program. For households under the SOP, after buying public housing units, the per capita housing area is 23.18 square meters. This study assumes that household size is constant before and after participating in the public housing program. Hence, the average household size is three persons, and per household housing area is 69.54 square meters (H_{s1}). The market price of commercial residential housing per square meter was RMB 2711.3 in Baoji in 2009. Since the usage years for commercial residential housing is limited to 70 years, the housing price per year per square meter is RMB 38.7 (P_H^{es}). However, the selling price of public housing units per year per square meter is RMB 15.72 ($P_{H_1}^s$), as shown in Table 4.2. After moving into public housing units, the annual disposable income, Y_{s1}, is RMB 14122.78 (see Table 4.2). Based on Equation (4.8), necessary income for households

under the SOP is as follows.

$$Y'_{s1} = \left(69.54 \times 38.7/0.2684\right)^{0.2684} \left\{\left(14122.78 - 69.54 \times 15.72\right)/0.7316\right\}^{0.7316} = 15268.34$$

(4.15)

The extra benefits obtained by households under the SOP are

$$B_s = Y'_{s1} - Y_{s1} = 15268.34 - 14122.78 = 1145.56 \qquad (4.16)$$

In the same way, the benefits for households under the ROP could be calculated as well. After renting public housing units, the per capita housing area is 12.21 square meters. Given 3.75 persons per household, the average housing area is 45.79 square meters (H_{r1}). The average market rent of housing per square meter is RMB 87.6 (P_H^{er}) (Shu, 2012). The average rent for a public housing unit per square meter per year is RMB 14.64 ($P_{H_1}^{r}$, shown in Table 4.2). The average annual disposable income for households under the ROP is RMB 15858.5 (Y_{r1}, shown in Table 4.2). Therefore, the necessary income for households under the ROP is as follows:

$$Y'_{r1} = \left(45.79 \times 87.6/0.0815\right)^{0.0815} \left\{\left(15868.5 - 45.79 \times 14.64\right)/0.9185\right\}^{0.9185} = 18073.68$$

(4.17)

Based on Equation (4.9), the extra benefits of households under the ROP are

$$B_r = Y'_{r1} - Y_{r1} = 18073.68 - 15858.5 = 2215.18 \qquad (4.18)$$

From the outcomes shown in Equation (4.16) and (4.18), all households benefit from participating in the public housing program. As $B_r > B_s$, the benefits obtained by households under the ROP are greater than those of households under the SOP.

As out study only uses data from two years, it is difficult to ascertain the benefits to these households in the long term. In addition, the sample is only from Baoji. Other cities may show different results. Thus, we conclude that the SOP in Baoji also brings households extra benefits in the short term. However, the ROP appears to be the more effective public housing program. Therefore, the Baoji government should first adopt the ROP. The implementation of the SOP should be more careful.

4.5.3 The satisfaction on the public housing

In the questionnaires, we surveyed 56 families' satisfaction with the public housing program. The proportion of households under the SOP who felt there was a great improvement in wellbeing was 80%. However, this same proportion under the ROP was 75%.Hence, those under the SOP were more satisfied that those under the ROP. In addition, households evaluated the living conditions of the public housing units, such as floor space, orientation, distance from the city center, public facilities, and traffic conditions. Since the surveyed households were in the same district, there was no need to distinguish them again. The evaluations are shown in Table 4.3. A higher value means a greater level of satisfaction. There were five levels of satisfaction: "completely satisfied"= 5, "satisfied"= 4, "neutral"= 3, "dissatisfied"= 2, and "completely dissatisfied"= 1.

Table 4.3 Evaluation of the public housing program

Item	Evaluation	Item	Evaluation
Floor spaces	3.73	Children's education	2.48
Structure	3.52	Public facilities	3.24
Floor	3.53	Sports center	3.14
Orientation	3.64	Traffic condition	3.38
Distance from city center	3.23	Community plan	3.56
Distance from work place	3.06	Green belt	3.65
Distance from supermarket	3.03	Social security	3.17

Source: Summarized by the author from the survey conducted in Baoji in 2010

All households are most satisfied with the floor space in the public housing units. In our survey, most public housing units are 66 square meters. From Table 4.2, after participating in the public housing program, the per capita housing area increased, especially for households under the SOP. However, after moving into public housing units, the distance from schools increased, which hinders children's education and increases transportation costs. Hence, when the local government of Baoji constructs public

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housing units, they need to consider the location more carefully. This is not just because they need to consider the wellbeing of those living in the houses, but also because the distances could mean extra subsidy costs (Johnson and Hurter, 2000).

4.6 Conclusions

This chapter analyzes the benefits and satisfaction of households who participated in the public housing program in Baoji. To evaluate the effects of the SOP, this study divides the surveyed lowest-income households into two groups: households under the SOP and households under the ROP. We estimate the utility function for each group, based on which we calculate and compare the benefits of the households. Lastly, we summarize the level of households' satisfaction on the public housing program. The main conclusions are as follows:

Households joining under the SOP have a stronger taste in houses than households joining under the ROP. Using the survey data from Baoji, the α of households under the SOP is 0.2684 and that of households under the ROP is 0.0815. These results reveal that households under the SOP value housing consumption more than those under the ROP. This is one important reason why the households under the SOP prefer to buy public housing units, even though their incomes are lower than households under the ROP.

Both SOP and ROP offer benefits to the households participating in the public housing program. However, the ROP brings greater benefits to lowest-income households than the SOP. After participating in the program, households under the SOP obtain an extra benefit of 1145.56 RMB, while households under the ROP obtain 2215.18 RMB. As a result, the ROP appears to be more efficient than the SOP. When the local government of Baoji implements the public housing program, they should first adopt the ROP, and control the units of public housing sold, as this is the less efficient policy. To achieve policy efficiency, restricting resale by the purchasers is the key point (Ho 1995).

Both SOP and ROP households are dissatisfied with the public facilities supplied to the public housing units, in terms of children's education, because the public housing units are a little too far from the schools. Therefore, the local government should carefully consider where they will build the public housing units. The public facilities around

public housing units need to be improved.

That this study only had 75 households in our sample poses some limitations. In addition, the lack of data from other regions of China is another limitation. This chapter could be used as a foundation for further research into the effects of the SOP and ROP for the entire country. Another possible area for future research would be to explore the effects of the public housing program from the point of view of society as a whole, rather than just lowest-income household.

Chapter 5

Conclusions

5.1 Summary of main results

This study illustrates the main problems of China's housing market. According to previous studies (Ren et al., 2012; Barth et al., 2012; Zhang, 2011), the growth rate of China's housing prices have resulted in high prices; as a result, urban households face the problem of being unable to afford housing units (Chen, 2012; Shen, 2012; Liu et al., 2008). Liu et al. (2008) argued that an affordable housing program could ease the affordability problem for middle- and low-income households. For the lowest-income families, renting houses is not even an option in the market (Liu et al., 2008), which is why the public housing program is also necessary. Therefore, a multi-level housing market system was established in China, including a general housing market, an affordable housing market, and a public housing market. Based on the previous literature and analysis of markets, the current problems of China's housing markets are the high growth rate of housing prices, decreasing construction of affordable housing, and the selling of public housing units to the lowest-income households although under a case of a shortage of stock. Given these problems, this study illustrates the macroeconomic determinants of housing prices, the crowding-out effects of affordable housing construction, and the utility effects of the sell-oriented policy on households. The main conclusions of this study are summarized in the following.

The main factors that push real housing prices up are real land prices and real disposable income. Owing to the negative effects of the mortgage rate, in order to ease the problem of the high growth rate of housing prices, the central bank could take the measure of raising the mortgage rate. Another method of decreasing housing prices is encouraging developers to supply more housing, for which decreasing the construction costs of developers is an option. Therefore, it could be concluded that reducing land prices and its related transaction costs is the effective method.

Although real disposable income is an important factor in pushing housing prices up, income and wealth inequality render middle- and low-income households unable to afford housing units. The affordable housing program aims to help those households afford houses, by supplying real estate enterprises subsidies to construct affordable housing units. However, affordable housing construction is crowded-out by unaffordable housing construction, and the crowding-out effects are related to the urbanization rate. To address this, the government should take measures to encourage real estate enterprises to construct more affordable housing by supplying more subsidies and further reducing transaction taxes for selling affordable housing.

As a supplement to the affordable housing program, the public housing program targets the lowest-income households that cannot even rent houses in the market. This program started officially in 2006 and the major providers are the local governments, who should be responsible for at least 50% of the construction fund. Therefore, the development of this program is slow, resulting in a shortage in the stock of public housing units. However, to recover the fund rapidly, the local governments began to sell public housing units to the lowest-income households, which was not permitted in the related law. According to our results, the sell-oriented policy could offer benefits to the households as well, but the rent-oriented policy would offer more benefits. Hence, the local government should be more careful to opt for the sell-oriented policy.

5.2 Limitations and future work

Shortage of data for the affordable housing market and a small sample size for the public housing market are the two main barriers to analyzing the problems of the two-level housing markets. Both affordable and public housing programs are subsidy policies on the basis of the supply side. Policy aimed at the demand side is also implemented, which is known as the "Housing Provident Fund" program. This program is a compulsory housing savings program, under which both employers and their employees contribute a certain percentage of the employees' wages, at least 5%, to "Housing Provident Fund" accounts that are administered by the China Construction Bank (Deng et al., 2009). In return, when employees purchase houses, they could get low-interest mortgage loans

from the Housing Provident Fund. This program also greatly helps households afford houses. However, this study does not analyze the problems of the Housing Provident Fund program, which is another limitation.

Future research should explore the effects and problems of the "Housing Provident Fund" program, which would be a complementary study of China's housing market. Future work should also include enlarging the data and sample sizes to complete the related research.

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