Financial Constraints of Local Governments and Land Supply: Evidence from China

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Abstract: Local governments in China took direct control of the supply of urban land in August 2004, and they came to monopoly suppliers on land markets of China. This paper examines whether the financial constraint of local government is an important determinant of the land supply. We build a two-phase theoretical model of land supply under the precondition of benefit maximization for local governments, and empirically study the effects of the financial constraint on the land supply using quarterly data for 35 major cities in China from 2006Q1 to 2013Q3. Our analysis provides the following findings. First, the financial constraints of local governments can significantly affect the land supply. Second, the effects of the financial constraint to the land supply are stronger in the eastern cities, and this means the governments in the eastern cities have stronger control over the land supply. Third, there is no evidence that significant differences exist between the central and western cities. We also find there is no significant effect of the trend of housing price to the land supply, which means the governments supply land without considering whether the housing price is rising or falling.

Keywords: financial constraint; local government; land supply; China

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1. Introduction

The subprime mortgage crisis broke out in 2007, and the cooling of the housing market triggered a recession in US. The housing price in US has not recovered to it in 2006 (Figure 1). At the same time, the housing price in China has kept the trend of increase. The real growth rate of the aggregated index of the 35 major Chinese cities (THUHPI)[1] reaches 161.33% from 2006Q1 to 2013Q3.Some scholars (Chen et al., 2011; Wu et al., 2012) believe that the rapid development of urbanization and the urban population growth lead to the continuous surge of the housing prices in China. The urban population growth causes the housing in short supply for a long time, and the growth of the housing demand triggers the growth of the urban land demand. As a result, China's urban land price and housing price will both keep rising.

While, some media[2] and scholars (Cao et al., 2008; Tian and Ma, 2009) believe the local governments in China are the real manipulators to drive the land price and housing price, since the local governments are the monopolies of the land supply in China. The local governments transfer the land to the developers through invitations to tender, auction or listing, and the land transferring fees (LTF) will be part of the local governments' revenue. So the local governments have the motivation to control the land supply and are willing to make more money from the land transferring. The land prices are soaring, and "Land Kings"[3] have appeared frequently, as the result, the local governments get more and more LTF from land transferring. The national LTF almost kept rising every year from 1999 to 2011 (Figure 2), and reaches 3212.61 billion Yuan in 2011, while it was only 51.43 billion Yuan in 1999, rising as high as 6146.21%. In the same period, the local government budget

[1] Tsinghua University Housing Price Index (THUHPI) is provided by the Hang Lung Center for Real Estate at Tsinghua University, and it is calculated with the hedonic model based on full sample transaction data in the newly-built housing market. More details see Wu et al.(2014).

[2] See CNN: http://edition.cnn.com/2014/02/25/business/nanjing-real-estate/.

[3] "Land King" is an appellation referring to the most expensive plot of land in a city, and it is often used in the media reports, such as China daily (http://www.chinadaily.com.cn/bizchina/2010-03/16/content_9598548.htm).

revenue[1] rose to 5254.71 billion Yuan in 2011 from 559.49 billion Yuan in 1999, and the growth rate is 839.20%, which is far less than that of LTF. This phenomenon caused the attention of the society, and many media[2]and scholars (Guofu and Zhiqiong, 2009; Yang, 2012) name it "land finance" to represent the large amount of revenue of the local governments from the land transferring.

Since China's public financial system arrangement, most of the tax revenues belong to the central government, and the local governments face severe financial constraints: for example, the local governments' budget revenue was 6107.8 billion Yuan in 2012, which was 52.1% of the total budget revenue, and the expenditure was 10718.8 billion Yuan, which was 85.1% of the total expenditure. The huge gap between the budget revenue and the expenditure makes the local governments have to pursue more revenue from the local government-managed funds[3], which include LTF[4], by land transferring. Therefore, scholars think that the local governments might use monopoly power to control land supply, and make the short of land supply to raise the land price, in order to get more revenue. They believe the "land finance" causes the rise of land price and housing prices. Some scholar (Bo, 2009) also thinks "land finance" lead to a direct result of the housing price bubble.

Though people think that China's local governments may control the land supply for the purpose of loosing their financial constraints, the existing literature did not give us strong evidence. Therefore, this paper will focus on the following questions. First, can the local governments get more revenue by controlling the land supply? Second, if so, what are the factors which affect the

[1] The general budget revenue is only a part of the total revenue of the local government, which is composed of the general budget revenue, the revenue of the local government-managed funds (including LTF) and the extra-budget fund. The general budget revenue mainly includes the tax revenues and the non-tax revenue (including special program receipts, charge of administrative and institutional units, penalty receipts and others non-tax receipts) (China Statistical Yearbook 2012).

[2] See Caixinonline: http://english.caixin.com/2010-02-20/100118104.html, and Globaltimes: http://www.globaltimes.cn/business/china-economy/2010-12/606958.html.

[3] The government-managed funds are the fiscal funds which are collected from the citizens, legal persons and other organizations for special purpose such as supporting particular public infrastructure constructions or development of the public utilities (The Interim Measures for the Administration of Government-Managed Funds, 2010).

[4] See "Circular on Further Strengthening the Management of the Revenue and Expenditure of Land Grant", Ministry of Finance, Ministry of Land and Resources, People's Bank of China, Ministry of Supervision and National Audit Office of the People's Republic of China, 2010

land supply decision-making of the local governments? Third, the local governments with more binding financial constraints have less revenue to support their expenditure, and we want to find whether the financial constraint is one of the determinants of land supply.

This paper hopes to make the following contributions to the literature. First, this paper seems the first to analyze the factors which affect the land supply under the condition of the government monopoly. The literature discussed the effects of the land supply restrictions (Johnstone, 1994; Lai and Wang, 1999) or geographic determinants (Rose, 1989; Saiz, 2010) for land supply, but the special institutional arrangement of land market of China -- monopoly supply of local governments will lead some other factors become the determinants of land supply. This paper constructs a two-stage model, and finds the factors that affect China's land supply.

Second, this paper is the first to focus on the effects of local governments' financial constraints for the land supply. We explored the relationship of the financial constraints between the local governments and the land supply under the condition of the monopoly supply, and investigate whether the Chinese local governments will supply more land when they need more money to loose their financial constraints.

Third, this paper empirically analyze the effects of the financial constraint and other factors for the land supply at the city level using the data of Chinese major cities. Controlling other factors (such as the income, the population density and the trend of housing price growth), we investigate the effects of different indicators to measure the financial constraints of local governments for the land supply, and we also investigate the differences between the cities in different regions. This paper provides new empirical evidence for the research of the Chinese housing and land market.

This paper provides the following novel empirical evidence. First, the financial constraints of local governments in China can significantly affect the

land supply. When the local governments need more revenue to support the expenditure, they will transfer more land. Second, the effects of the financial constraint to the land supply are stronger in the eastern cities, and there is no evidence that significant differences exist between the central and western cities. Third, we find that the land supply has positive correlation with the lagged land price and housing price and the per capita disposable income, and has negative correlation with the population density. Finally, there is no significant effect of the trend of housing price to the land supply, which means the governments supply land without considering the housing price is rising or falling.

2. China's Public Financial System and the Land Transferring Fees

In order to investigate the relationship between the land supply and the financial constraints of local governments in China, we must firstly understand the relationship between the local governments' revenue and the land transferring fees.

We start from the local governments' revenue in China. Generally, the local governments' revenue can be composed of three parts: the general budget revenue[1], the revenue of the local government-managed funds and the extra-budget fund[2]. The general budget revenue mainly includes the tax revenues and non-tax revenues listed in Table 1, and the general budget revenue is the most important part of revenue for the governments. After the tax system reform in 1994[3], the central government got 75% of the value-added tax, which

[1] The general budget revenue mainly includes the tax revenues and the non-tax revenue (including special program receipts, charge of administrative and institutional units, penalty receipts and others non-tax receipts) (China Statistical Yearbook 2012)

[2] The extra-budget fund takes the forms of the extra-budgetary revenue or the off-budget revenue. The extra-budget fund is obtained by governments using coercive power, but is not included in the formal budget system before 2011. It includes various surcharges and service fees charged by government agencies. In theory, extra-budget fund is collected based on regulations promulgated by the central or provincial level governments. (Shen et al., 2006) Various local government departments and organizations collect and manage different extra-budget fund under different names and justifications.(Chen, 2004) Since 1997, the extra-budget fund does not include the intra-budgetary government-managed funds (fees) (China Statistical Yearbook 2012), and all extra-budget fund is managed within budgetary (education charges excluded) from 2011 (Finance Year Book of China 2012)

[3] In the early 1990s, China's central government started a policy of recentralizing the tax revenue collection and public expenditures. The tax system reform was a response to the problems of controlling the tax revenue encountered by the

has the largest amount of all kinds of taxes, and proportion of the local general budget revenue to the national general budget revenue has declined sharply as it is shown in Table 2.

The tax system reform made the local governments lost huge tax revenues from the corporates, and the local governments had to start looking for new channels to make their revenue grow. Unlike the tax revenues, the local government-managed funds can be controlled by the local governments, and the local governments don't need to share the revenue with the central government. So the revenue of the local government-managed funds, most of that is LTF[1], become the most important channel to make more money for the local governments, especially after 2002, when the central government took 50% (60% after 2003) of the income tax (including the corporate income tax and the personal income tax).

According to the laws, most parts of LTF and the related tax of the construction industry and real estate will come into the local governments' financial accounts after 1994. Thus, local governments have two main channels to increase their revenue: (1) expanding LTF or (2) expanding the related tax of the construction and real estate industry through expanding the city. Since 2002, the local governments became highly interested in the land development, infrastructure investment and urbanization, one of their motivations is promoting the local fiscal revenue.

China began the urban housing system reform since the late 90s, and the "Land Administration Law" was published in 1998. Since the 21st century, the urbanization of China was accelerating, and the southeastern coastal areas were developing rapidly. All these factors make the rapid growth of residents' and companies' demand for urban construction land, and the land price is rising with the housing price. LTF become the main source of revenue for local government

central government in 1994. For more details, see Wong(Wong, 1991), Chen (Chen, 1995) and Shen, Jin and Zou (Shen et al., 2006).

[1] 79.41% of the revenue of local government-managed funds is LTF in 2011 (Finance Year Book of China 2012).

as Figure 1 shows. The rate of LTF to the budget revenue of local government came to over 60% (61.14% in 2011) from less than 10% (9.19% in 1999) in twelve years.

According to the "Land Administration Law"[1], only the local governments are authorized to develop the agricultural land, and supply the land in the urban land market. So the local governments are the monopolists of the land supply. Local governments take the agricultural land on low prices, and transfer the land to the developers with high prices through invitations to tender, auction or listing[2]. The cost of developing the agricultural land is far less than the transferring price, and the monopoly of supply and low cost makes the local government can easily get a lot of income in the land market.

The local governments quickly get a large sum of money on the land market. In some cities of the eastern region[3], the scale of LTF is equal to or even greater than the scale of the local budget revenue. The local governments also get a large number of loans for urban construction by financial guarantee and mortgage of LTF. In this way, the circle of land sales, bank loans, urban construction and new land development brings a steady flow of money for the local governments, and the money makes the prosperity of the industrialization and urbanization in China.

Therefore, the land supply is highly correlated with the financial constraints of the local governments in China. When the local governments need money, the most efficient way is transferring land. Local governments will be less constrained if they supply more land and take more transferring fees. We want to test if the financial constraints of the local governments affect the land supply,

[1] Land Administration Law is amended for the second time in accordance with the Decision on Amending the Land Administration Law of the People's Republic of China, and adopted at the 11th Meeting of the Standing Committee of the Tenth National People's Congress on August 28, 2004. More details, see http://www.china.org.cn/china/LegislationsForm2001-2010/2011-02/14/content_21917380.htm.

[2] More details about invitations to tender, auction and listing, see Liu et al.(2013).

[3] Such as in 2011, LTF of Yancheng (in Zhejiang Province) was 26.08 billion, and the general budget revenue was 26.90 billion; LTF of Hangzhou (in Zhejiang Province) and Zhuhai (in Guangdong Province) were 106.99 billion and 16.82 billion, and their general budget revenues were 78.52 and 14.34 billion respectively. (Finance Year Book of China 2012 and China Land and Resources Almanac 2012).

and whether the local governments supply land according to their financial constraints. We will build a simple two-stage model of land supply, and make empirical analysis to verify the questions as following.

3. Theoretical Framework

3.1. A Simple Two-Stage Model of Land Supply

We build a simple two-stage model of land supply to investigate the land supply behavior of the local governments under the condition of maximizing LTF. We impose the following six assumptions:

(1) Assume that we are concerned with two periods, t=1 and t=2.

(2) The governments control the land supply, and $Q_{L,1}^S$ and $Q_{L,2}^S$ are the land supply in period 1 and 2. Since the total amount of land supply $Q_{L\max}$ is limited, we have $Q_{L,1}^S + Q_{L,2}^S = Q_{L\max}$.

(3) Housing supply has a linear relationship with the land suppl. Thus $Q_{H,t}^S = \varphi Q_{L,t}^S \ (\varphi \geq 0; t = 1,2)$, and φ is the plot ratio.

(4) The housing demand function is exogenous. We assume the housing demand function is $P_{H,t} = \alpha - \beta Q_{H,t}^D \ (\alpha, \beta > 0; t = 1,2)$. $P_{H,t}$ represents the housing price, and $Q_{H,t}^D$ represents the housing demand. α represents the local economic condition, and α should be stronger when the local economy is better. β represents the price elasticity of demand. Since $\beta > 0$, β should be weaker when the price elasticity of demand is stronger, which means the housing is more scarce.

(5) The housing market is clearing, thus we have $Q_{H,t}^S = Q_{H,t}^D$.

(6) Since the land price is determined by developers' competition through bidding, the land price is determined by the housing price. The land price can be

presented as: $P_{L,i} = P_{H,i} - c_0$, where c_0 represents the construction cost. Since the land price cannot be negative, $P_{L,i}$ is requested to be greater than zero in any condition.

The local government hopes to maximize the total land transfer fee $\pi_{L,0}$, so we have:

$$\begin{aligned} &Max \ \ \pi_{L,0} = Q_{L,1}^S P_{L,1} + \frac{1}{1+r} Q_{L,2}^S P_{L,2} \\ &= Q_{L,1}^S \cdot \left(\alpha - \beta\varphi Q_{L,1}^S - c_0\right) + \frac{1}{1+r} \cdot \left(Q_{L\max} - Q_{L,1}^S\right) \cdot \left[\alpha - \beta\varphi\left(Q_{L\max} - Q_{L,1}^S\right) - c_0\right] \end{aligned} \tag{1}$$

where r is the discount rate for the local government.

To solve Equation (1), we have:

$$\frac{\partial \pi_{L,0}}{\partial Q_{L,1}^S} = \frac{1}{1+r}\left[r\left(\alpha - c_0\right) + 2\beta\varphi Q_{L\max} - 2(2+r)\beta\varphi Q_{L,1}^S\right] = 0 \tag{2}$$

Since $\frac{\partial^2 \pi_{L,0}}{\partial\left(Q_{L,1}^S\right)^2} < 0$, we will get the maximum $\pi_{L,0}$ by solving Equation (2), and we have the optimal decision for the government on period one:

$$Q_{L,1}^{S*} = \frac{r\left(\alpha - c_0\right) + 2\beta\varphi Q_{L\max}}{2(2+r)\beta\varphi} \tag{3}$$

We want to investigate the effects of exogenous variables for the government decision-making, in other words, the effects of α, β and r for $Q_{L,1}^{S*}$. According to the Equation (3), we know:

$$\frac{\partial Q_{L,1}^{S*}}{\partial r} = \frac{\alpha - c_0 - \beta\varphi Q_{L\max}}{(2+r)^2 \beta\varphi} > 0 \tag{4}$$

$$\frac{\partial Q_{L,1}^{S*}}{\partial \alpha} = \frac{r}{2(2+r)\beta\varphi} > 0 \tag{5}$$

$$\frac{\partial Q_{L,1}^{S*}}{\partial \beta} = -\frac{r(\alpha - c_0)}{2(2+\mathrm{r})\varphi\beta^2} < 0 \tag{6}$$

Since $\frac{\partial^2 \pi_{L,0}}{\partial\left(Q_{L,1}^S\right)^2} < 0$, we know that the governments can maximize LTF by controlling the land supply, and we can draw the following hypotheses according to the Equation (4), (5) and (6):

(i) $\frac{\partial Q_{L,1}^{S*}}{\partial r} > 0$ means the governments with higher discount rate are willing to supply more land.

(ii) $\frac{\partial Q_{L,1}^{S*}}{\partial \alpha} > 0$ means in the more developed cities, the governments are willing to supply more land.

(iii) $\frac{\partial Q_{L,1}^{S*}}{\partial \beta} < 0$ means in the cities that housing is scarcer, the governments are willing to supply less land, in order to obtain the higher earnings in the future.

3.2. Further Inference

3.3.1. The Minimum Land Transferring Price

In this section, we will introduce the minimum land transferring price $P_{L\min}$. The government requires the land transferring price shall not be less than $P_{L\min}$. If the price offered by the developers is less than $P_{L\min}$ ($P_{H,i} - c_0 < P_{L\min}$), the government will make $P_{L,i}$ equal $P_{L\min}$, and the developers can choose to reduce the demand for land to maximize their own profits. So there will be a Q_L^*: $Q_L^* = \frac{1}{\beta\varphi}\left(\alpha - c_0 - P_{L\min}\right)$. When $Q_{L,i}^{S*} = Q_L^*$, we will have $P_{L,i} = P_{L\min}$.

Condition 1: If $P_{L\min} \le \frac{\left(4+r\right)\left(\alpha - c_0\right) - 2\beta\varphi Q_{L\max}}{2\left(2+r\right)}$, we have $Q_{L,1}^{S*} \le Q_L^*$ and $Q_{L,2}^{S*} \le Q_L^*$. The model is not different with those in Section 3.2.

Condition 2:If $P_{L\min} > \frac{(4+r)(\alpha - c_0) - 2\beta\varphi Q_{L\max}}{2(2+r)}$ (that is $\alpha < \frac{2(2+r)P_{L\min} + 2\beta\varphi Q_{L\max}}{4+r} + c_0$), there will be $P_{L,1} = P_{L\min}$ .The developers will choose $Q_{L,1}^S = Q_L^* = \frac{1}{\beta\varphi}(\alpha - c_0 - P_{L\min})$ and $Q_{L,2}^S = Q_{L\max} - \frac{1}{\beta\varphi}(\alpha - c_0 - P_{L\min})$. We will have $\pi_{L,1} = Q_{L,1}^S P_{L\min} + \frac{1}{1+r} Q_{L,2}^S P_{L,2}$ and $\frac{\partial \pi_{L,1}}{\partial P_{L\min}} < 0$.

Therefore the government should not make $P_{L\min}$ too high. Since $\frac{\partial \pi_{L,1}}{\partial P_{L\min}} < 0$, higher $P_{L\min}$ will reduce the total revenue in Condition 2, so the government will get more land transfer fee in Condition 1. But if the economy goes into recession, and there comes a time that $\alpha < \frac{2(2+r)P_{L\min} + 2\beta\varphi Q_{L\max}}{4+r} + c_0$, the government should make the $P_{L\min}$ as low as possible to get a larger $\pi_{L,1}$.

3.3.2. Housing Price Growth

In this section, we will change the Assumption (4) of Section 3.2 and introduce the condition of housing price growth. The Assumption (4) will be changed as:

(4*)The housing demand function is exogenous, and we assume housing price is rising, or some exogenous factors make the housing price rise in stage two. So the housing demand function is changed to $P_{H,1} = \alpha - \beta Q_{H,1}^D; P_{H,2} = g\alpha - \beta Q_{H,2}^D$ where g represents the trend of the housing price. $g > 1$ means the housing price is rising, and $g < 1$ means the housing price is falling.

Now we maximize the total land transfer fee $\pi_{L,0}$ by solving:

$$
\begin{aligned}
Max\ \ \pi_{L,0} &= Q_{L,1}^{S} P_{L,1} + \frac{1}{1+r} Q_{L,2}^{S} P_{L,2} \\
&= Q_{L,1}^{S} \cdot \left(\alpha - \beta\varphi Q_{L,1}^{S} - c_0\right) + \frac{1}{1+r} \cdot \left(Q_{L\max} - Q_{L,1}^{S}\right) \cdot \\
&\quad \left[g\alpha - \beta\varphi\left(Q_{L\max} - Q_{L,1}^{S}\right) - c_0\right]
\end{aligned} \tag{7}
$$

We have:

$$
\frac{\partial \pi_{L,0}}{\partial Q_{L,1}^{S}} = \frac{1}{1+r}\left[(1-g)\alpha + r\left(\alpha - c_0\right) + 2\beta\varphi Q_{L\max} - 2(2+r)\beta\varphi Q_{L,1}^{S}\right] = 0 \tag{8}
$$

And we have the optimal decision for the government on period one:

$$
Q_{L,1}^{S*} = \frac{(1-g)\alpha + r\left(\alpha - c_0\right) + 2\beta\varphi Q_{L\max}}{2(2+r)\beta\varphi} \tag{9}
$$

and

$$
\frac{\partial Q_{L,1}^{S*}}{\partial g} = -\frac{\alpha}{2(2+r)^2 \beta\varphi} < 0 \tag{10}
$$

Then we can get another hypothesis:

(iv) when the housing price is rising (or the governments expect it will rise), the governments are willing to supply less land, since the rising housing price may make the land more valuable in the future.

4. Data

4.1. Variables

According to the analysis in Section 3, we focus on ten quarterly time series for 35 major cities[1] in China from 2006Q1 to 2013Q3. They are the local per capita land sales (*pLandS*), three indicators to measure financial constraints of local governments (*BRate*, *TIG* and *AIG*), the lagged housing price index (*HPI(-1)*), the lagged average land price (*LandP(-1)*) ,the per capita disposable income (*INC*), the population density (*POPD*) and the trend of housing price growth

[1] The 35 major cities in China include Beijing, Tianjin, Shijiazhuang, Taiyuan, Hohhot, Shenyang, Dalian, Changchun, Harbin, Shanghai, Nanjing, Hangzhou, Ningbo, Hefei, Fuzhou, Xiamen, Nanchang, Jinan, Qingdao, Zhengzhou, Wuhan, Changsha, Guangzhou, Shenzhen, Nanning, Haikou, Chongqing, Chengdu, Guiyang, Kunming, Xi'an, Lanzhou, Xining, Yinchuan and Urumqi.

(*TrendHP*) in Table 3.We choose the local per capita land sales (*pLandS*) as proxy for the land supply to be the dependent variable, and the independent variables we choose are as following.

We think the financial constraints of local governments will be the most important determinant of r .The local governments with higher financial constraints will want to get LTF as soon as possible, so they may have higher discount rate (r). We use the rate of the local government budget expenditure to the budget revenue (*BRate*), the average proportion of the tertiary industry in the *GDP* (*TIG*) and the local government investment to the GDP (*AIG*) to measure the financial constraints of the local governments, and use them as proxies for the discount rate (r). Higher *BRate* measns the local government needs more LTF to make up for the inadequacy of the budget revenue, therefore there should be a positive correlation between *BRate* and *pLandS*. Higher *TIG* means the tertiary industry is more developed, and the local government will get more tax revenue (Tsui, 2005). The local government with more tax revenue should be less constrained, so *TIG* and *pLandS* should be negatively correlated. Higher *AIG* implies the local government has a larger scale of urban infrastructure investment, and there is evidence that the urban infrastructure investment is mainly supported by LTF in China (Tsui, 2011). The local government with higher *AIG* should need more LTF, so *pLandS* will have positive correlation with *AIG*.

We think the level of land price will also affect r . If local governments think the land price is high enough, they may transfer the land and take the money, which will raise their discount rate (r). Since the land price and housing price are cointegrated and have a long-run dynamic relationship (Liu et al.,

2013), the local governments may forecast the current land price based on the past housing price and land price. *HPI(-1)* and *LandP(-1)* may have positive correlations with *pLandS*.

We use the per capita disposable income (*INC*) as proxy for the local economic condition (α): higher *INC* implies higher α, so *INC* and *pLandS* should be positively correlated. We use the population density (*POPD*) as proxy for the scarcity of housing (β): higher population density means higher β, so *POPD* and *pLandS* should be negatively correlated. We use the lagged *HPI* minus fifth-order lagged *HPI* (*TrendHP*) as proxy for the trend of housing price growth (g): higher *TrendHP* means the housing price is growing, so *TrendHP* and *pLandS* should be negatively correlated.

4.2. Data Sources

Table 3 summarizes the definitions and data sources of all variables. Data about the land market (*LansS*, *LandTF* and *LandP*) come from the China Real Estate Index System (CREIS) Database. We use *INC* and *CPI* from China Monthly Economic Indicators, *POP* and *POPD* from China City Statistical Yearbook, and *LGBR*, *LGBE*, *TIRate*, *TInv*, *REInv* and *GDP* from China Macroeconomic Information Network Database.

Hang Lung Center for Real Estate at Tsinghua University provides the THU Housing Price Index (*HPI*) which is calculated with the hedonic model based on full sample transaction data in the newly-built housing market. According to the discussion of Wu et al. (2014), this index is superior to the existing official housing price indicators like the “Price Indices for Real Estate in 70 Large- and Medium-sized Cities” (70 Index), and can be expected to provide an accurate estimation of the price path in the major cities. After controlling for the

problems in the 70 Index as suggested by Wu et al. (2014), THU Housing Price Index provides an almost totally different picture of the housing price fluctuations, which is more consistent with the public observation in the market.

4.3. Data Processing and Summary

We calculate *BRate*, *TIRate* and *AIG* using the data from China Macroeconomic Information Network Database. It is plausible to assume that *pLandS* affects *BRate* and *AIG* by affecting the local government budget expenditure and the local government investment respectively. Local governments may gain more revenue due to sale more land, so that to make higher budget expenditure and more investment. To eliminate the influence of *pLandS* to *BRate* and *AIG*, we do the regressions of the local government budget expenditure on the lagged land transferring fees of each city, and the regressions of the local government investment on the lagged land transferring fees of each city. Then we have the residuals of the regressions (*LGBE#* and *Inv#*), and we calculate *BRate* and *AIG* using *LGBE#* and *Inv#* to control the influence of *pLandS* to *BRate* and *AIG*. Overall, the coefficients in our regressions more likely capture the effects of the exogenous component s of *BRate* and *AIG* to *pLandS*.

Since *POP* and *POPD* are annual data from China City Statistical Yearbook, we calculate the average growth rate of each quarter, and adjust them to quarterly data. We use *CPI* to adjust *INC*, *HPI* and *LandP*, and also use the X12-method to seasonally adjust *INC*. Then we can calculate *TrendHP*.

Table 4 summarizes the descriptive statistics and the correlations of the nine variables. The correlations between *pLandS* and *TIG*, *pLandS* and *POPD* are significantly negative, the correlation between *pLandS* and *TrendHP* is not significant, and the correlations between *pLandS* and other variables are

significantly positive.

5. Empirical Analysis

5.1. Baseline Models

Since we focuses on the effect of the financial constraints of local governments for the land supply, that is the effect of r for $Q_{L,1}^{S*}$, our baseline models are panel data regressions of local per capita land sales (in log) on proxies of r. The regressions also control the proxies of α, β and g. More precisely, we estimate:

$$pLandS_{i,t} = a_i + b' A_{i,t} + c' B_{i,t} + \varepsilon_{i,t}, i = 1, 2, \ldots, N; t = 1, 2, \ldots, \mathrm{T} \qquad (11)$$

where for city i, α_i is a city fixed effect, and $\varepsilon_{i,t}$ is the error term. $pLandS_{i,t}$ is the local per capita land sales (in log). $A_{i,t}$ is a vector of the proxies of r, including the indicators to measure financial constraints of local governments (*BRate*, *TIG* or *AIG*), the lagged housing price index (*HPI(-1)*) and the lagged average land price (*LandP(-1)*). $B_{i,t}$ is a vector of the proxies α, β and g, including the per capita disposable income (*INC*), the population density (*POPD*) and the trend of housing price growth (*TrendHP*).

Table 5 reports the estimators for the regressions of *pLandS* on the proxies of r, α, β or g respectively, and Table 6 reports the estimators of three baseline regressions. Since *TIG* and *AIG* are cross-section data, there is no city fixed effect in regression II and III in both Table 5 and 6. The observations of regressions are not consistent because of the availability of the sample data, but it does not affect our conclusions. For controlling the cross-section heteroskedasticity, we can use the pooled estimated generalized least squares (pooled EGLS) method to estimate the regressions.

We mainly focus on the estimators of *BRate*, *TIG* and *AIG*, which can show

us the effect of the financial constraint of the local governments to the land supply. In both Table 5 and 6, the estimators of *BRate* in regression I and *AIG* in regression III are significantly positive, and the estimator of *TIG* in regression II is significantly negative. The estimators of *BRate*, *TIG* and *AIG* collectively show the land supply will significantly affected by financial constraint. When local governments are more constrained, the budgetary revenue will not be able to support its expenditure. The most efficient way to get money is transferring land, and the current LTF will become more valuable. The estimators show that the per capita land sales will be larger in the cities whose governments are more constrained. The results are consistent with our analysis in Section 4.1 and the hypothesis (iii) in Section 3.2.

The signs of the estimators of *HPI (-1)*, *LandP(-1)*, *INC* and *POPD* in Table 5 and 6 are consistent with our expectation in Section 4.1. The estimators of *HPI (-1)* and *LandP(-1)* in both tables are significantly positive, which indicates the lagged housing price and land price will affect the discount rate. The estimators of *INC* in all regressions are all significantly positive, which indicates the local governments with better local economy will supply more land. The estimators of *POPD* in regression II and III in Table 6 are significantly negative, which find weak evidence that the local governments may supply less land in the cities that housing is scarcer in order to get more income in the future. These estimators support our analysis in Section 4.1 and the hypotheses (i), (ii) and (iii) in Section 3.2.

But we can't have a clear conclusion for the effect of *TrendHP* to *pLandS*. Only the estimator of *TrendHP* in regression I of Table 6 is significant, and the signs of estimators are different in Table 5 and 6. We guess maybe not all the local governments in China are going to hold the land for future gain when the housing price is rising.

5.2. Regressions Using Date of Cities in Different Regions

Further, we investigate the differences between the cities in different regions. According to the standard of National Bureau of Statistics of China, we divide the 35 major cities into three regions: eastern, central and western regions. Then we re-estimate the regressions in Table 6.

The signs of the estimators in Table 7 are almost the same as those in Table 5, but the sizes of the estimators are different. The estimator of *BRate* in regressions I using the data of the eastern cities is greater than those using the data of the central and western cities. In regressions II, the estimator of *TIG* using the data of the eastern cities is less than those using the data of the central and western cities. In regressions III, the estimator of *AIG* using the data of the western cities is far less than that using the data of the eastern cities, and it is not significant using the data of the central cities.

Table 7 shows the results in Table 5 are robust: the local governments of different region cities in China all affect the land supply. Table 7 also finds evidence that the effects of the local governments in the eastern cities are much stronger than those in the central and western cities.

Table 7 also shows the effects of *TrendHP* to *pLandS* in different regions: the housing price growth has positive correlation with the land sales in the western cities, and negative correlation in the central cities, but not certain in the eastern cities. The local governments of the western cities will supply more land when housing price rises, while the local governments of the central cities will do the opposite thing.

6. Conclusions

We focus on the effects of the financial constraints of the local governments in China to the land supply, while the local governments are the monopoly suppliers on land markets of China. We first build a two-phase model of land supply under the precondition of benefit maximization for local governments,

and find the factors (including financial constraint) which can affect land supply. We empirically study the effects of the financial constraint and other factors on the land supply, using the panel data of 35 major cities in China from 2006Q1 to 2013Q3.

We have the following major findings. First, the financial constraints of local governments in China can significantly affect the land supply. When the local governments need more revenue to support the expenditure, they will transfer more land. Second, the effects of the financial constraint to the land supply are stronger in the eastern cities, and this means the governments in the eastern cities have stronger control over the land supply. Third, there is no evidence that significant differences exist between the central and western cities. Forth, we find that the land supply has positive correlation with the lagged land price and housing price and the per capita disposable income, and has negative correlation with the population density. Finally, there is no significant effect of the trend of housing price to the land supply, which means the governments supply land without considering the housing price is rising or falling.

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Table 1 The sources of the general budget revenue of local governments in China after the tax reform in 1994

	Source of revenue	Share proportion (%)		Notes
Shared between the central and local government	value-added tax (VAT)	central	75	VAT reform began in 2009, and the government allows companies to offset VAT by purchasing equipment.
		local	25	
	income tax (corporate and individual income tax)	central	60	Before 2003, the share proportion of the central was 50%, and it was changed to 60% in 2003.
		local	40	
	tax on the ocean petroleum resources	central	100	
		local	0	
	stamp tax on stock trading	central	97	Before 1997, the share proportion of the central is 50%, and it was changed to 80% in 1997, then it was changed to 97% in 2000.
		local	3	
All for local government	business tax	local	100	Excluding the part of the Ministry of Railways, head offices of banks, head offices of insurance company, which are handed over to the government in a centralized way
	city maintenance and construction tax	local	100	Excluding the part of the Ministry of Railways, head offices of banks, head offices of insurance company, which are handed over to the government in a centralized way
	profit handed in by the local enterprises	local	100	
	other tax revenues	local	100	Including house property tax, urban land use tax, land appreciation tax, tax on vehicles and boat operation, farm land occupation tax, deed tax, tobacco leaf tax, stamp tax and resource tax other than the tax on offshore petroleum resources, etc.
	local non-tax revenue	local	100	Including special program receipts, charge of administrative and institutional units, penalty receipts and others non-tax receipts.

This table shows the general budget revenue of local governments of China after the tax reform in 1994, and the information is collected from "The Finance Year Book of China 2012".

Table 2 Central and local budgetary revenue and proportion

Year	Revenue (Billion Yuan)			Proportion (%)	
	National	Central	Local	Central	Local
1980	115.99	28.45	87.55	24.52	75.48
1981	117.58	31.11	86.47	26.46	73.54
1982	121.23	34.68	86.55	28.61	71.39
1983	136.70	49.00	87.69	35.85	64.15
1984	164.29	66.55	97.74	40.51	59.49
1985	200.48	76.96	123.52	38.4	61.6
1986	212.20	77.84	134.36	36.7	63.3
1987	219.94	73.63	146.31	33.5	66.5
1988	235.72	77.48	158.24	32.9	67.1
1989	266.49	82.25	184.24	30.9	69.1
1990	293.71	99.24	194.47	33.8	66.2
1991	314.95	93.83	221.12	29.8	70.2
1992	348.34	97.95	250.39	28.1	71.9
1993	**434.90**	**95.75**	**339.14**	**22**	**78**
1994	**521.81**	**290.65**	**231.16**	**55.7**	**44.3**
1995	624.22	325.66	298.56	52.2	47.8
1996	740.80	366.11	374.69	49.4	50.6
1997	865.11	422.69	442.42	48.9	51.1
1998	987.60	489.20	498.40	49.5	50.5
1999	1144.41	584.92	559.49	51.1	48.9
2000	1339.52	698.92	640.61	52.2	47.8
2001	1638.60	858.27	780.33	52.4	47.6
2002	1890.36	1038.86	851.50	55	45
2003	2171.53	1186.53	985.00	54.6	45.4
2004	2639.65	1450.31	1189.34	54.9	45.1
2005	3164.93	1654.85	1510.08	52.3	47.7
2006	3876.02	2045.66	1830.36	52.8	47.2
2007	5132.18	2774.92	2357.26	54.1	45.9
2008	6133.04	3268.06	2864.98	53.29	46.71
2009	6851.83	3591.57	3260.26	52.4	47.6
2010	8310.15	4248.85	4061.30	51.1	48.9
2011	10387.44	5132.73	5254.71	49.4	50.6
2012	11725.35	5617.52	6107.83	47.91	52.09

Data Sources: China Macroeconomic Information Network Database

Table 3 Data sources

Variables	Definition	Data Sourses
LandS	Local Land Sales	China Real Estate Index System (CREIS) Database
LandTF	Local Land Transferring Fees	China Real Estate Index System (CREIS) Database
POP	Population	China City Statistical Yearbook
POPD	Population Density (in log)	China City Statistical Yearbook
pLandS	Local Per Capita Land Sales (in log)	Authors' Calculations
HPI	Housing Price Index (in log)	Hang Lung Center for Real Estate, Tsinghua University, China
HPI(-1)	Lagged THU Housing Price Index (in log)	Hang Lung Center for Real Estate, Tsinghua University, China
LandP(-1)	Lagged Average Land Price (in log)	China Real Estate Index System (CREIS) Database
CPI	Consumer Price Index (2006Q1=100)	China Monthly Economic Indicators
LGBR	Local Government Budget Revenue	China Macroeconomic Information Network Database
LGBE	Local Government Budget Expenditure	China Macroeconomic Information Network Database
LGBE#	The Residuals of the Regressions $LGBR_t^i = \alpha^i + \beta_t^i LandTF_t^i + \varepsilon_t^i$	Authors' Calculations
BRate	*BRate=LGBE# / LGBE*	Authors' Calculations
TIRate	The Average Proportion of the Tertiary Industry in the GDP from 2006 to 2012	China Macroeconomic Information Network Database; Authors' Calculations
TInv	Total Local Investment in Fixed Assets	China Macroeconomic Information Network Database
REInv	Local Investment in Real Estat	China Macroeconomic Information Network Database
Inv	*Inv= TInv- REInv*	Authors' Calculations
GDP	*Local Gross Domestic Product*	China Macroeconomic Information Network Database
Inv#	The Residuals of the Regressions $Inv_t^i = a^i + b_t^i LandTF_t^i + \varepsilon_t^i$	Authors' Calculations
ItG	*ItG =Inv#/GDP*	Authors' Calculations
AIG	Average ItG from 2006 to 2012	Authors' Calculations
INC	Per Capita Disposable Income (in log)	China Monthly Economic Indicators
TrendHP	lagged *HPI* minus fifth-order lagged HPI	Authors' Calculations

Table 4 Data summary

Variables	*pLandS*	*BRate*	*TIG*	*AIG*	*HPI(-1)*	*LandP(-1)*	*INC*	*POPD*	*TrendHP*
Panel A Summary									
Mean	-1.404	-0.063	0.489	0.016	4.998	7.525	8.405	7.153	0.092
Median	-1.224	-0.020	0.485	0.009	4.975	7.578	8.394	7.128	0.082
Max	1.725	0.800	0.745	0.066	6.029	13.625	9.116	9.346	0.543
Min	-7.824	-1.454	0.385	-0.001	4.473	0.329	7.716	5.409	-0.452
Std. Dev.	1.271	0.312	0.077	0.017	0.286	1.742	0.318	0.699	0.119
Observations	1041	1085	35	35	1050	984	1085	1085	910
Panel B Correlations									
pLandS	1								
BRate	0.214***	1							
TIG	-0.097***	-0.072	1						
AIG	0.025***	0.179***	0.401***	1					
HPI(-1)	0.337***	0.333***	-0.284***	0.081***	1				
LandP(-1)	0.239***	-0.004	-0.013	-0.162***	0.050	1			
INC	0.381***	0.291***	-0.195***	0.194***	0.620***	0.113***	1		
POPD	-0.138***	0.075	0.297***	0.066	-0.133***	0.027	0.088***	1	
TrendHP	-0.004	-0.131***	0.121***	0.056	0.214***	0.088***	-0.041	-0.046	1

Panel A summarizes the means, the medians, and the standard deviations of *pLandS* (in log), *BRate*, *TIRate*, *AIG*, *HPI(-1)* (in log), *LandP(-1)* (in log), *INC* (in log), *POPD* (in log) and *TrendHP* of 35 major cities in China. Panel B reports the correlations among the variables, and *** denotes significance at the 1% level.

Table 5 Determinants of local land supply

Regressions	I	II	III	IV	V	VI
C	-9.35***	-8.98***	-9.10***	-24.46***	-2.82**	-1.26***
	(-15.94)	(-16.71)	(-16.62)	(-23.60)	(-2.37)	(-40.16)
BRate	0.42***					
	(5.68)					
TIG		-0.75*				
		(-1.83)				
AIG			2.63*			
			(1.86)			
HPI(-1)	1.52***	1.44***	1.38***			
	(13.51)	(13.43)	(13.15)			
LandP(-1)	0.06***	0.12***	0.12***			
	(3.13)	(6.70)	(6.75)			
INC				2.74***		
				(22.26)		
POPD					0.20	
					(1.19)	
TrendHP						0.26
						(1.24)
City Fixed	Yes	No	No	Yes	Yes	Yes
Obs	903	970	970	1041	1041	892
Adj R-sq	0.60	0.19	0.18	0.53	0.32	0.48

This table summarizes the regressions of local per capita land sales (*pLandS*) on the proxies of r, which are the indicators to measure the financial constraints of local governments (*BRate*, *TIG* or *AIG*), the lagged housing price index (*HPI(-1)*) and the lagged average land price (*LandP(-1)*), α, which is the per capita disposable income (*INC*), β, which is the population density (*POPD*), and g, which is the trend of the housing price (*TrendHP*), respectively. Coefficients are estimated with pooled EGLS (Cross-section weights), and the heteroskedasticity-robust standard deviations are in parentheses. *** denotes significance at the 1% level, ** at the 5% level and * at the 10% level.

Table 6 Determinants of local land supply (2)

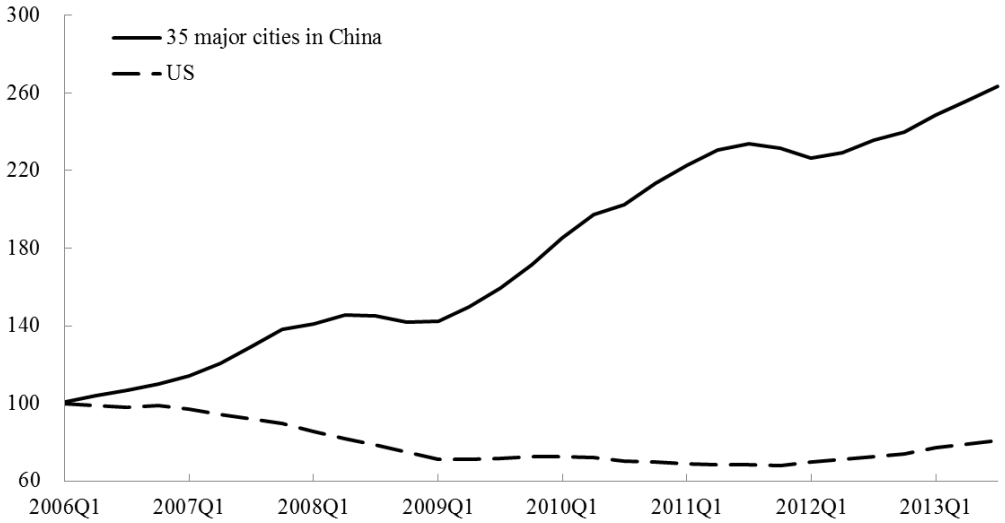
Regressions	I	II	III
C	-17.10***	-11.52***	-13.09***
	(-9.59)	(-13.48)	(-14.38)
BRate	0.34***		
	(4.14)		
TIG		-2.11***	
		(-5.38)	
AIG			10.52***
			(6.25)
HPI(-1)	0.60***	0.55***	0.33**
	(2.91)	(3.74)	(2.19)
LandP(-1)	0.05***	0.09***	0.08***
	(2.77)	(4.82)	(4.34)
INC	1.41***	1.14***	1.31***
	(5.18)	(8.84)	(9.48)
POPD	0.06	-0.24***	-0.23***
	(0.44)	(-5.04)	(-4.71)
TrendHP	0.55**	-0.14	0.05
	(2.48)	(-0.60)	(0.19)
City Fixed	Yes	No	No
Obs	876	878	878
Adj R-sq	0.60	0.23	0.24

This table summarizes the regressions of local per capita land sales (*pLandS*) on the indicators to measure the financial constraints of local governments (*BRate*, *TIG* or *AIG*), the lagged housing price index (*HPI(-1)*), the lagged average land price (*LandP(-1)*), the per capita disposable income (*INC*), the population density (*POPD*) and the trend of the housing price (*TrendHP*). The estimators of *BRate*, *TIG* and *AIG* prove the same hypothesis: the local government, which is more constrained, will supply more land for short-term gains. Coefficients are estimated with pooled EGLS (Cross-section weights), and the heteroskedasticity-robust standard deviations are in parentheses. *** denotes significance at the 1% level, ** at the 5% level and * at the 10% level.

Table 7 Estimation results of models using data of different regions

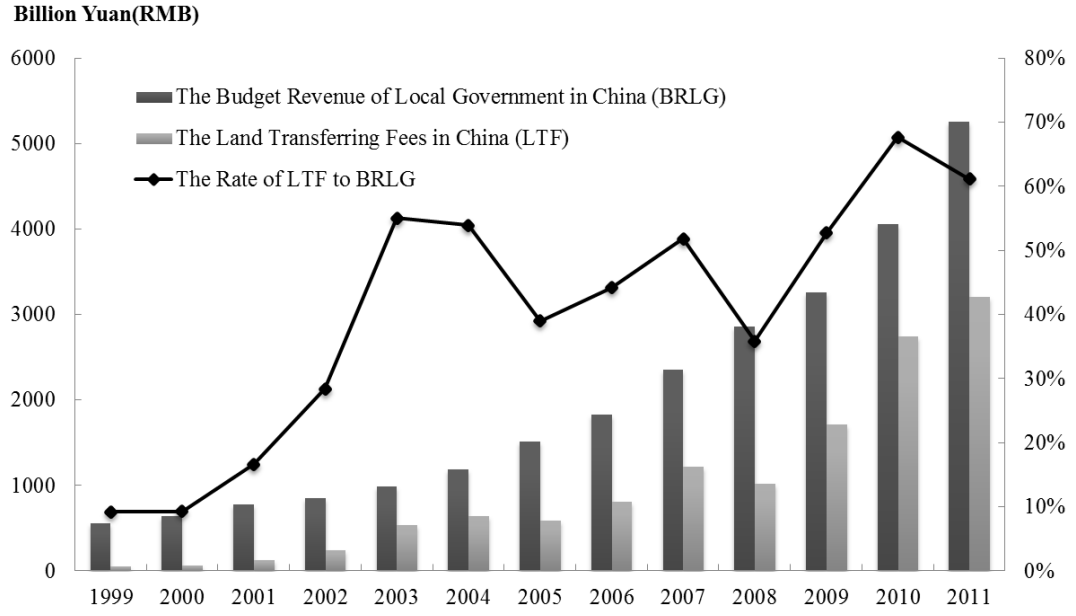
Regressions	I			II			III		
	Eastern	Central	Western	Eastern	Central	Western	Eastern	Central	Western
C	-14.11***	-23.06***	3.99	-3.39*	-28.69***	-19.05***	-7.00***	-25.88***	-17.46***
	(-4.43)	(-8.03)	(0.36)	(-1.80)	(-11.69)	(-8.54)	(-3.75)	(-12.01)	(-7.80)
BRate	0.38***	0.23**	0.32**						
	(3.00)	(2.36)	(2.37)						
TIG				-2.80***	-2.36***	-2.04***			
				(-5.40)	(-2.52)	(-2.25)			
AIG							15.13***	2.48	1.37**
							(9.24)	(0.98)	(2.45)
HPI(-1)	0.58**	-0.01	2.19***	0.76***	-0.94**	2.56***	0.29	-1.06**	2.39***
	(2.11)	(-0.02)	(4.61)	(3.38)	(-2.36)	(8.34)	(1.52)	(-2.67)	(7.51)
LandP(-1)	0.06*	0.05	-0.01	0.25***	0.10***	-0.07**	0.21***	0.09***	-0.11***
	(1.94)	(1.56)	(-0.03)	(8.30)	(3.45)	(-2.08)	(7.14)	(2.84)	(-3.48)
INC	0.93**	2.55***	0.56**	0.39***	3.76***	0.41	0.96***	3.68***	0.48
	(2.13)	(4.52)	(1.05)	(1.56)	(8.48)	(1.17)	(4.07)	(8.18)	(1.37)
POPD	0.22	-0.01	-3.15*	-0.73***	-0.17***	-0.13*	-0.77***	-0.24***	0.12
	(0.87)	(-0.03)	(-1.77)	(-6.66)	(-1.92)	(-1.68)	(-6.66)	(-2.84)	(1.57)
TrendHP	2.04**	1.50**	-1.55***	-0.40	1.73***	-1.69***	0.04	1.67***	-1.69***
	(2.36)	(2.50)	(-3.03)	(-1.37)	(3.23)	(-3.18)	(0.12)	(3.07)	(-2.96)
City Fixed	Yes	Yes	Yes	No	No	No	No	No	No
Obs	409	204	263	409	204	265	409	204	265
Adj R-sq	0.62	0.46	0.51	0.32	0.43	0.37	0.41	0.41	0.33

This table summarizes the regressions of local per capita land sales (*pLandS*) on the indicators to measure the financial constraints of local governments (*BRate*, *TIG* or *AIG*), the lagged housing price index (*HPI(-1)*), the lagged average land price (*LandP(-1)*), the per capita disposable income (*INC*), the population density (*POPD*) and the trend of the housing price (*TrendHP*). Using data of different regions, we have three groups of regressions. The National Bureau of Statistics of China divides the main land of China into three regions, and the eastern region includes 16 cities (Beijing, Dalian, Fuzhou, Guangzhou, Haikou, Hangzhou, Jinan, Nanning, Ningbo, Qingdao, Shanghai, Shenyang, Shenzhen, Tianjin and Xiamen), the central region includes 8 cities (Taiyuan, Changchun, Harbin, Hefei, Nanchang, Zhengzhou, Wuhan and Changsha), the western region includes 11cities (Hohhot, Nanning, Chongqing, Chengdu, Guiyang, Kunming, Xi'an, Lanzhou, Xining, Yinchuan and Urumqi). The Eastern, Central and Western regressions use the data of the cities in the east, central and west regions, respectively. Coefficients are estimated with pooled EGLS (Cross-section weights), and the heteroskedasticity-robust standard deviations are in parentheses. *** denotes significance at the 1% level, ** at the 5% level and * at the 10% level.



Data Sources: Bank for International Settlements (BIS); Hang Lung Center for Real Estate, Tsinghua University

Figure 1 The housing price index of the US and 35 major cities in China (2006Q1-2013Q3)



Data Sources: Finance Year Book of China and China Land and Resources Almanac 2000 to 2012

Figure 2 The budget revenue of local government and the land transferring fees in China (from 1999 to 2011)