Local Government Fiscal Deficit and Strategic Public Asset Management in Developing Countries: Evidence from China

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ABSTRACT

Local governments in developing countries often take a strategic approach for public asset management. In this paper, we examine the incentive and method that Chinese municipalities have when managing a special but important type of public assets: land, and its economic consequences for asset values. The evidence that residential land sales rose dramatically following the local governments experienced fiscal stress, supporting the hypothesis that local officials use land financing to stimulate economic development. Local governments tend to supply more land for sale when house prices are high; however, at the same time, demand drops more strongly in response to the rising price. To some extent, consumers help absorb price shocks of the housing market, or in other words, local residents provide indirect financing for economic development via the real estate market. Overall, the results of this paper suggest that in addition to the nature and consequences of local economic development policies and activities, attention should be paid to the incentive, approach and risk of strategic public asset management: the land sales.

Keywords, Economic development, Local government income, land sale, house price
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I. INTRODUCTION

Since the collapse of Bear Stearns and Lehman Brothers in 2008, the recent housing bubble and the subsequent financial crisis have severely hit the world economy. Many studies (Acemoglu 2009, Acharya and Richardson 2009, Gjerstad and Smith 2009, Stiglitz 2009, and Taylor 2009) have suggested various economic factors that directly and indirectly caused this crisis in the U.S. and other developed nations: credit conditions, international trade imbalances, fiscal policy, risk-taking in financial industries, and real-estate bubbles. Although local tax policy and economic development issues were not a major factor causing the crisis, some aspects of tax and development policies may have led banks, households and companies to take excessive risks. As suggested by Hemmelgarn, Nicodeme and Zangari (2012), tax incentives may have exacerbated the behavior of economic agents, leading them to wrong economic decisions. Homeownership-favoring tax policies could have increased housing demand and boosted real estate prices, which in turn could have caused a speculative bubble in the housing market. Similarly, the debt-financing-favoring tax policies could have led to leverage practices that added more risk to companies during economic downturns.

However, the tax incentives are absent or at least different in most developing countries, and this is a fundamental obstacle to take the same theory and apply it to the understanding of bubbles and crashes in these countries. For example, in the United States, local governments tend to have a good deal of flexibility in levying taxes and establish tax rates and tariff levels but comparatively little flexibility in creating or selling publicly owned assets (Peterson 2006a). In many developing countries, the reverse is true. The central government possesses all tax policy authority. Local governments do not have the power to introduce new taxes, abolish dysfunctional taxes, or change tax rates. Nor do they have the power to establish or modify service charges or tariff levels on their own. At the same time, they often own a much wider range of property assets, having a greater economic value relative to their annual budgetary revenues, and may have greater legal flexibility in deciding what to do with these assets than local governments in the United States. Central and local governments are expected to be the main player in urban development in the developing countries. In searching for financing options for economic development, local municipalities can look to the public assets of their balance sheets, ranging from infrastructure networks to publicly owned land (Peterson 2006b).

By far the most important of these public assets is land. Local government often own valuable land and have the legal authority to "create" more land or at least to gain property rights over new areas of land that they then can sell. For municipalities in such countries, acquiring, pricing, and selling land may be the most important aspect of property asset management and may be a more important source of discretionary revenue than anything the municipalities can do on the revenue side of their budget through tax policy or service fees.

Assets sales, more specifically, land sales, have the advantage of convenience and simplicity in terms of time and cost. Local officials often have more flexibility in managing their assets than they do in increasing tax rates, revising tax laws and policies, or issuing municipal bonds, all of which may require approval from central or provincial government. In addition, from the perspective of local officials, if land conversion is consistent with the core mission of urbanization, the strategic use of proceeds from land sales in local economic development without incurring debt is to be supported.

China is the largest developing country in the world and its economic expansion over the last decades has placed great demands of urbanization. One of the consequences of deepened reforms and increased penetration of market forces into the economy has been a massive development of land and real estate.‡ Land transactions have been at the heart of municipal finance in China's rapidly growing cities. Cities, in turn, have been expressly assigned the lead role in promoting China's economic development. Cities have devoted a lot of economic value of their property rights in land, then using the proceeds from land "sales" to finance an unprecedented expansion of urban infrastructure capacity. In fact, cities have succeeded so well in this effort that the national government has had to rein in their aggressive behavior, for fear that it will overheat the economy. Earlier official statistics indicate a net loss of 4.42 million hectares of cultivated land or 4.4 percentage between 1978 and 1996 (Lin and Ho 2005). With land sales contributing an important part of local revenue, local governments at various administrative levels have every motive to engage in land development, and land development has caused widespread land disputes, corruption and social discontent (Guo 2001).

Figure 1 shows the trend in government income, fiscal revenue, and the average quantity of land sales of 23 major Chinese metropolitan areas from 2003 to 2012. Local fiscal revenue has been rising from 12 billion RMB Yuan in 2003 to 723 billion RMB Yuan in 2012,

‡ For an overview of the development of China's real estate, see Fung, Huang, Liu and Shen (2006) and Fung, Jeng and Liu (2010).

whereas the net income has been falling from a deficit of 3.97 billion RMB Yuan in 2003 to a deficit of 17.1 billion RMB Yuan in 2012. The amount of land sales has been stable between 4.09 and 5.03 million square acres over the period before the global financial crisis, and declined to 3.68 million square acres in 2008 and 3.09 million square acres in 2009. Although the trend reversed and there was a sharp increase in land sales in 2010, the declining trend continued after 2010.

[Insert Figure 1 Here]

To better understand the changes in local real estate market, we plot the time series of house price index, worker wage, and total resident savings in Figure 2. The average house price peaked in 2007, right before the latest financial crisis. The continuous rising of income and savings,over the decade can be attributable to rapid growth of Chinese economy.

[Insert Figure 2 Here]

In this study we address two related questions. First, we examine the incentive and method that local governments use to manage their public assets (i.e., land sales in China). Second, we explore whether the municipalities' strategic public asset management practice has economic consequences for asset values, house prices in the context of this paper.

The remainder of the paper is organized as follows. Section II reviews the relevant prior research on the relationship between land finance and local economic development in China. Section III presents the sample data and measurement choice and illustrates the empirical strategy. Section IV evaluates the results. Section V discusses the findings and concludes.

II. LITERATURE AND HYPOTHESIS DEVELOPMENT

The economic and political dynamics underlying the linkage between local governments and asset markets (i.e., municipal autonomy, central intervention, land access, monopoly power, etc.) in developing countries are different to those in developed countries. For example, Malpezzi and Mayo (1987) suggest that governments in developing countries are more likely to intervene in housing markets. More often than not, the demand-side intervention takes the form of explicit rent control or implicit public finance and taxation. In this paper, we argue that in developing countries, municipalities take advantage of their administrative power of land allocation and real estate transaction taxation to relieve fiscal stress of local governments, obtain

financing for local economic development, and in turn benefit the promotion of local officials and politicians. However, the overall relationship between this strategic public asset management and real estate values can be ambiguous. On the supply side, the steady rise in real estate values and the bubble in the housing market increase the incentives of local officials to engage in land sales. On the demand side, a higher house price discourages consumers and investors from buying real estate properties. The net effect will depend on the relative elasticities of supply and demand.

This paper is related to three strands of literature. At a formal level it is related to the economic literature on the relationship between tax, housing market bubble, and economic crisis. In a survey of the empirical literature on the links between taxes and the 2008 financial crisis, Hemmelgarn et al. (2012) conclude that the evidence of whether tax systems may have created negative incentives favoring risk-taking, in terms of increased purchases of houses by households, is mixed. The authors suggested that lax monetary policy and increased risk-taking by lenders in the developed countries are the culprits to blame for the housing bubble. Goodman and Thibodeau (2008) suggest that one percentage point increase in the home ownership rate increases the housing demand by one million units in the United States, and on the supply side, land prices and housing construction costs increased substantially. With a specific focus on the Swiss market, Aregger, Brown and Rossi (2012) only find that capital gain taxes exacerbate hour price dynamics by examining the variation in taxation across Swiss cantons; however, they reported no effect of transaction taxes on house price growth.

This paper is also related to analyses of the driving factors of urban land and real estate values. In a theoretical study, Capozza and Helsley (1989) decompose the land price to four additive components: the rent value, the conversion cost, the value of accessibility, and a growth premium which is the value of expected future rent increases, and argue that the growth premium may easily account for half of the average price of land in rapidly growing cities. The evidence in Tse (1998) that there is no causal relationship between land supply and housing prices suggests that the impact of the local government's land supply is not an important driver of the volatile house prices in Hong Kong. Wang, Chan and Xu (2012) explicitly estimate the price elasticity of housing supply in 35 major cities in China and reveal that China's housing supply is moderately elastic: somewhat inline with postwar U.S. and prewar U.K., but less price elastic than countries with liberal regulatory environments.

Finally, and more importantly, the paper is closely related to a small but growing literature on the use of "land financing" in China's economic development since the opening of its economy in the late 1970s. In an analysis of land requisition and public leasing system in China, Cao, Feng and Tao (2008) argue that low-cost land acquisition is the fundamental cause of land-related distortions that have occurred during China's urbanization. The steadily increasing need for local development as the economic reforms progress requires continuous internal and external financing and a strategic use of public assets (i.e., land sales) is often unavoidable, especially when the fund available for discretionary allocation, usually from municipal fiscal surplus, are not sufficient and raising external capital is costly in time, information and regulation (Liu 2008). Lichtenberg and Ding (2009) investigate China's coastal provinces and report a positive relation among changes in urban area, values of urban land, and budgetary government revenues which serve as a proxy for fiscal surplus and deficit. In a follow-up study, Ding and Lichtenberg (2011) suggest that land has constrained economic growth in coastal areas but not elsewhere. Tao, Su, Liu and Cao (2010) examine the local fiscal incentives to use subsidized land and infrastructure as key instruments in regional competition for manufacturing investment. Using household survey data in eastern and central China, Fu (2014) find a negative association between local governments' land financing and individual home ownership. Zheng, Wang and Cao (2014) attribute the booming urban expansion in China to land sales by local governments to compensate for an unbalanced tax system that does not provide sufficient budgets.

On the basis of the above arguments, we hypothesize a negative relationship between local government income and the amount of land sales in the same area. In terms of the relationship between municipal fiscal health and local real estate values, the net effect can be ambiguous: either negative or positive, depending on the supply and demand elasticities of property prices. There is a positive relationship between the quantity of land sales and house price on the demand side and a negative relationship between land sales quantity and house price on the supply side. We summarize these primary hypotheses as follows:

Hypothesis 1 (Income Effect): Municipalities with more fiscal deficits (negative income or lower revenue) sell more land.

Hypothesis 2 (Over-demand Effect): House price is higher when real estate developers (on behalf of consumers and investors) buy more land than the amount that municipalities can supply.

Hypothesis 3 (Over-supply Effect): House price is lower when municipalities sell more land than the quantity that real estate developers want to buy.

III. DATA AND METHOD

The primary data source of local government fiscal revenue and income, amount of land sales, real estate price index, income and residential wealth is the China Statistics from the China Data Online which is maintained by the All China Data Center at the University of Michigan. This database provides comprehensive information on China's economic and social development at national, provincial, county, city, and industrial levels. Numerous studies in development economics, health care, organization management, public finance, and urban planning have been published using this dataset (e.g., Fleisher, Li and Zhao 2010; Sun, Santoro, Meng, Liu and Eggleston 2008; Zhang 2012; Wang 2014; Ye and Wu 2014).

We construct two variables to measure the financial condition of municipalities. The first variable is $Fiscal\ Revenue_{i,t}$ which is the amount of local government i's fiscal revenue (in 100 million RMB Yuan) in year t. The second variable is $Government\ Income_{i,t}$ which is the difference in fiscal revenue and expenses in 100 million RMB Yuan. To some extent, fiscal revenue is a proxy for a municipality's size, whereas the government income reflect its need for seeking external financing for economic development projects. Often, local officials are evaluated by the central and provincial governments based on a series of economic indicators such as GDP growth, revenue and income contributions to the upper level governments. During periods of fiscal stress, land sales are often used to substitute for a tax rate hike or raising capital from external sources (e.g., in the form of municipal bonds). The potential for local revenue mobilization through land sales has been heightened by China's urban real estate boom. We collect data on the amount of municipality i's land sold to private real estate developers in year t and create a new variable called $Land\ Sale_{i,t}$.

Officially, the legalization of land sales started 1992 and over a long time, it was mainly for industrial use by private and foreign enterprises. Recently more and more land is sold for commercial and residential development in the urban-rural fringe regions. Understanding the trend and pattern of land use and value will provide more insights on how local officials maximize their extra-budgetary income over time and across regions. We construct two variables to measure the mix of land use: $Commercial\ to\ Residential\ Price_{i,t}$ and *Commercial to*

Residential Sale$_{i,t}$. They are calculated as the ratios of price and quantity of land sold for commercial use and those for residential housing. In addition, we create variables to account for real estate value, resident income and population wealth: *House Price*$_{i,t}$ (index), *Worker Salary*$_{i,t}$ (annual salary in RMB Yuan), *Resident Savings*$_{i,t}$ (total savings in 100 million RMB Yuan). The detailed definition of all variables used in the study and their corresponding summary statistics are presented in Table 1.

[Insert Table 1 Here]

The specification of the baseline regression model to examine the relationship between local land sales, house price, and government income is given by:

$$LandSale_{i,t} = \alpha_0 + \beta_1 GovernmentIncome_{i,t} + \beta_2 HousePrice_{i,t} + \beta_3 Controls_{i,t} + \varepsilon_{i,t}$$

where $LandSale_{i,t}$ is the total quantity of land sales in city i at time t; $GovernmentIncome_i$ is the fiscal income (revenues net of expenses) of city i in year t; $HousePrice_{i,t}$ is the house price index of city i in year t. Control variables include the commercial to residential house price ratio, commercial to residential land sales ratio, worker salary, and total resident savings. It should be noted that from the perspective of governmental accounting, proceeds from land sales are not part of the municipal revenue. Rather, they are treated "Special Item" and added to the ending fund balance (possibly for discretionary use) on the Statement of Revenues, Expenditures, and Changes in Fund Balances.

The second set of regressions tests whether the level of fiscal revenue also plays a role in incentivizing land sales and whether the fiscal surplus or deficit in year t is related to more or less land sale activities in subsequent years: $t+1$, $t+2$, and $t+3$. The basic specification is as follows:

$$LandSale_{i,t} = \alpha_0 + \beta_1 FiscalRevenue_{i,t} + \beta_2 GovernmentIncome_{i,t} + \beta_3 HousePrice_{i,t} + \beta_4 Controls_{i,t} + \varepsilon_{i,t}$$

$$LandSale_{i,t} = \alpha_0 + \beta_1 FiscalRevenue_{i,t-1} + \beta_2 GovernmentIncome_{i,t-1} + \beta_3 HousePrice_{i,t} + \beta_4 Controls_{i,t} + \varepsilon_{i,t}$$

$$LandSale_{i,t} = \alpha_0 + \beta_1 FiscalRevenue_{i,t-2} + \beta_2 GovernmentIncome_{i,t-2} + \beta_3 HousePrice_{i,t} + \beta_4 Controls_{i,t} + \varepsilon_{i,t}$$

$$LandSale_{i,t} = \alpha_0 + \beta_1 FiscalRevenue_{i,t-3} + \beta_2 GovernmentIncome_{i,t-3} + \beta_3 HousePrice_{i,t} + \beta_4 Controls_{i,t} + \varepsilon_{i,t}$$

Here, we need to emphasize that house price is treated as a determining variable in the above regression equation, enabling rent-seeking bureaucrats to maximize rewards (performance evaluation according to economic development and revenue contributions) by selling optimal amount of land based on the current price. However, the price itself is also likely to be determined endogenously by the quantity (amount of land sales). This requires simultaneous estimation of a supply and demand function for price and quantity. In this system, price is assumed to be determined simultaneously with demand. The important statistical implications are that price is not a predetermined variable and that it is correlated with the disturbances of both equations ($\xi_{i,t}$, $\varepsilon_{i,t}$).

Demand function:

$$LandSale_{i,t} = \alpha_0 + \beta_1 HousePrice_{i,t} + \beta_2 Controls_{i,t} + \xi_{i,t}$$

Supply function:

$$LandSale_{i,t} = \alpha_1 + \beta_3 HousePrice_{i,t} + \beta_4 FiscalRevenue_{i,t} + \beta_5 GovernmentIncome_{i,t} + \beta_6 Controls_{i,t} + \varepsilon_{i,t}$$

The equilibrium condition is that demand ($LandSale_{i,t}$ the demand function) equals supply ($LandSale_{i,t}$ the supply function). The fact that $LandSale_{i,t}$ is associated with two disturbances ($\xi_{i,t}$, $\varepsilon_{i,t}$) really poses no problem in estimation because the disturbances are specified on the separate equations of the demand and supply functions. One of the two equations can be rewritten to place $HousePrice_{i,t}$ on the left-hand side, making this endogeneity explicit in the specification.

Demand function:

$$HousePrice_{i,t} = -\frac{\alpha_0}{\beta_1} + \frac{1}{\beta_1} LandSale_{i,t} - \frac{\beta_2}{\beta_1} Controls_{i,t} + \xi_{i,t}$$

Supply function:

$$HousePrice_{i,t} = -\frac{\alpha_1}{\beta_3} + LandSale_{i,t} - \frac{\beta_4}{\beta_3} FiscalRevenue_{i,t} - \frac{\beta_5}{\beta_3} GovernmentIncome_{i,t} - \frac{\beta_6}{\beta_3} Controls_{i,t} + \varepsilon_{i,t}$$

Often, two-stage least squares (2SLS) can be applied to address the correlation between regressors and disturbances because ordinary least squares (OLS) generate biased estimates of the parameters (a_0, a_1, β_1, β_2, β_3, β_4, β_5, β_6) due to the violation of OLS assumptions. Using

instruments for the endogenous variable, $HousePrice_{i,t}$, 2SLS will produce consistent estimates. Here, we use three-stage least squares (3SLS) to estimate the coefficients of our equation system. The use of 3SLS over 2SLS is essentially an issue of accuracy and efficiency.

IV. RESULTS

The summary statistics of all variables that will be included in the regressions are shown in Table 2. The average municipal revenue is 35.7 billion RMB Yuan and they have fiscal deficits of 8.9 billion RMB Yuan on average. Over the ten-year period from 2003 to 2012, the average house price index is 105.4 and the average quantity of land sales is about 4 million square meters in a year. As the price and sale ratios of commercial to resident land suggest, cities are more likely to sell land to private developers for commercial use than residential real estate development. In terms of the measures of resident income and wealth, a typical worker in our same earns 31.8 thousand RMB Yuan in a year, and the average savings of all residents living in a city is about 265 billion RMB Yuan.

The Pearson's correlations are reported in the lower-left triangle of Table 2. An examination of the correlation matrix indicates that correlations between independent variables are generally small. This low correlation among the covariates helps prevent the problem of multicollinearity that causes high standard errors and low significance levels when both variables are included in the same regression. However, there is one pair of variables having correlations above or close to 1.0: *Fiscal Revenue* and *Resident Savings* (0.93). The Spearman's correlation matrix in the upper-right triangle of Table 2 confirms this strong correlation. To be cautious, we will exclude *Resident Savings* in some of the regression specifications to avoid potential multicollinearity problems. In addition, we will calculate and report the variance inflation factor (VIF) to assess the severity of multicollinearity in each specification.

[Insert Table 2 Here]

Table 3 provides the results of the coefficient estimates for the statistical relationship between local government income, house price, and land sales. The dependent variable in all specifications is the quantity of land sold to residential real estate developers. Across all specifications, the negative and statistically significant coefficient estimate of local government income suggests that municipalities experiencing fiscal stress (deficit) are the ones who sold more land for real estate development. In addition, the positive coefficient of house price index

and the negative coefficient of worker salary further indicate that this practice is more prevalent during the housing market boom period and among cities with lower income, presumably causing loss of income tax revenue.

[Insert Table 3 Here]

The Variance Inflation Factor (VIF) is calculated for each independent variable to determine if these variables display collinearity amongst themselves. The mean VIFs (ranging from 1.08 to 1.94) reported at the bottom of table are below the cut-off point of ten (Myers 2000), suggesting no problem with multicollinearity in our regressions.

In additional sensitivity tests of whether the level of fiscal revenue also plays a role in incentivizing land sales and whether the fiscal surplus or deficit will drive up or down land sale activities in subsequent years, we include local government revenue in the regression specifications and use the lagged values of both fiscal revenue and income. The results in Table 4 show that the quantity of land sales rose following the fiscal crisis over both short-term (one year) and long-term (three years) horizons.

[Insert Table 4 Here]

Overall, this empirical evidence suggests the hypothesis of income effect that local governments may have used land sales to fund stimulus projects because these regions were finding it difficult to secure money amid the economic slowdown.§ This result is in sharp contrast to Lutz, Molloy and Shan (2011) in which local government tax revenues in the U.S. dropped steeply following the housing market contraction.

The above regression specifications treat house price as an independent variable; however, house price is also likely to be determined endogenously by the amount of land sales. To address this endogeneity issue, we construct a system of two interdependent equations: land demand function and land supply function. In this system, house price is assumed to be determined simultaneously with demand (land sale quantity). The equilibrium condition is that land demand equals land supply. We estimate the coefficients of our equation system using three-stage least squares (3SLS) and report the results in Table 5.

[Insert Table 5 Here]

§ The Ministry of Finance confirmed that in 2009 that it will allow this practice in the future (Bloomberg News 2009).

Based on the significance of coefficient loadings in specifications (1) and (2) we can identify three factors affecting the demand of land for residential development: house price (negative effect), income (negative) and wealth (positive) and two factors explaining the substantial heterogeneity in the degree to which local governments chose to sell land to property developers: house price (positive) and local government income (negative). A useful way to look at the economic significance of the ability of fiscal surplus or deficit to affect land sales and real estate values is to examine the percentage change in the quantity of land sales and house price when local government income is increased by one standard deviation. We estimate the magnitude of the income effects on house price for three specifications where house price is a statistically significant factor in either the land supply or demand function. The results are reported in Table 6.

[Insert Table 6 Here]

In the supply function of the contemporaneous model (1), the quantity change in the predicted land sales is 66% in response to one standard deviation change in house price, whereas the quantity change is -156.6% in the demand function. The net effect of municipal income on house price is actually negative: the percent changes in the predicted change in house price is 1.6% in response to one standard deviation change in municipal income. The economic significance is substantial (5.6%) in the extended model (2) which includes the level of local government revenue as a control variable; For the model (5) that uses three year lagged values of fiscal income to predict house price changes, the response is moderate: one standard deviation increase in municipal fiscal income can increase local house price by 2.5 percentage, according to the model prediction. This evidence clearly supports the hypothesis of over-supply effect that municipalities sell more land than the amount that real estate developers want to buy (on behalf of consumers and investors) and, in turn, drive down real estate values.

V. DISCUSSION AND CONCLUSION

The economic role of metropolitan areas has gained more importance in the current era of economic globalization (Sassen 2001). In this new economy, cities are not only monocentric locations of production and consumption but the junctions of flows that facilitate economic activities in a multinucleated pattern. This suggest that economic development requires local governments to provide the necessary physical infrastructure, human resources, and

institutional framework, which has major implications for municipal governance, resource allocation and utilization. Following the recent financial crisis, concerns often arise about whether local governments take advantage of their administrative power of public asset allocation and taxation to relieve fiscal stress of local governments and obtain financing for local economic development. Given the fact that housing markets, tax incentives, growth opportunities, budgetary concerns, and economic development needs in developing countries are different from those in the Western countries, the emergence of cites, suburbs, and multinucleated centers serving as centers for economic activity in these countries has raised interesting questions as to whether the municipalities' strategic public asset management has economic consequences for asset values.

In this study, we focus on public management of land in China, specifically, the sales of land-use rights for real estate development over the ten-year period from 2003 to 2012. We obtain the data on the fiscal condition of local governments, the amount of land sales, house price, worker income, and residential wealth of 35 major Chinese cities and metropolitan areas to answer the question whether the rise of residential real estate value is partially attributable to the supply of land by regional and local authorities whose explicit aim is to encourage economic development. We provide evidence that that residential land sales rose dramatically following the local governments experienced fiscal difficulties over both short- and long-term horizons. This suggests that local officials may have used land financing as a strategic method of public asset management to stimulate local economic development when they find it difficult to secure capital from external sources during the period of deficits.

With respect to the real estate values, the results of this paper suggest caution: local governments' deficits and their financing needs do not necessarily drive up house prices in the same municipality. We actually observe that house prices fall following an increase in the quantity of land sales. However, there is also a dark side. While local governments tend to supply more land for sale when house prices are high, demand drops more strongly in response to the rising price. Overall, the evidence of this over-supply effect reported in this paper suggests that in addition to the nature and consequences of local economic development policies and activities, attention should be paid to the incentive, method and risk of strategic public asset management–land sales in this case.

This finding has profound policy implications in terms of policy response to the boom-bust housing cycle. Neglecting real estate booms can have disastrous consequences (Crowe,

Dell'Ariccia, Igan and Rabanal 2013). However, both the real estate market and the political system in China are different to those of their Western counterparts. Therefore, we have to understand the underlying mechanism behind the real estate bubble in China from 2000 to 2008. If it was indeed attributable to the noncompetitive market (Liu 2009) and local governments' speculative land hoarding (Du and Peiser 2014), the deficit-driven land sales investigated in the current research may have offset the effect of the low elastic housing supply, which made house price less sensitive to land supply (Glaeser, Gyourko, and Saiz 2008), at least in these municipalities in the short run. The high demand elasticity for housing implies that local residents help absorb the price shocks of the housing market, or in other words, Chinese consumers may have provided indirect financing for local economic development via the real estate market.

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Figure 1. Land sale and local government fiscal condition

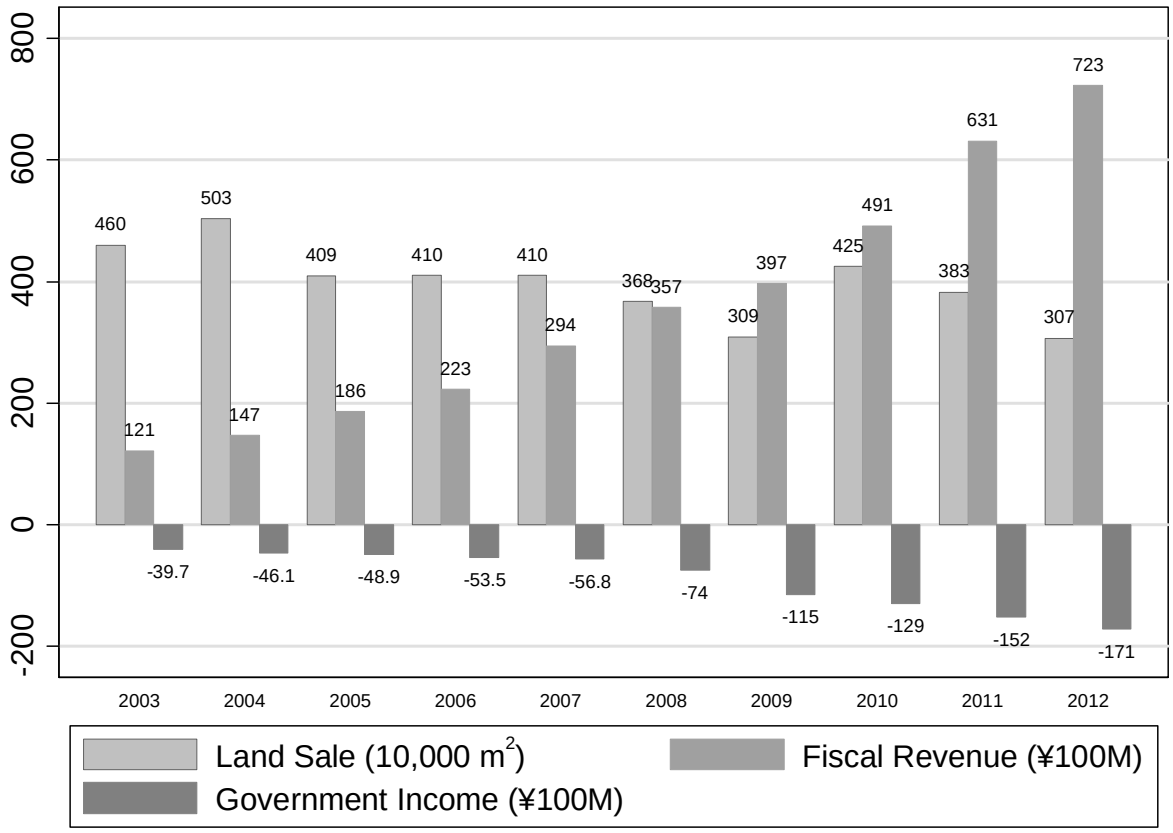

Figure 2. Land sale and local government fiscal condition

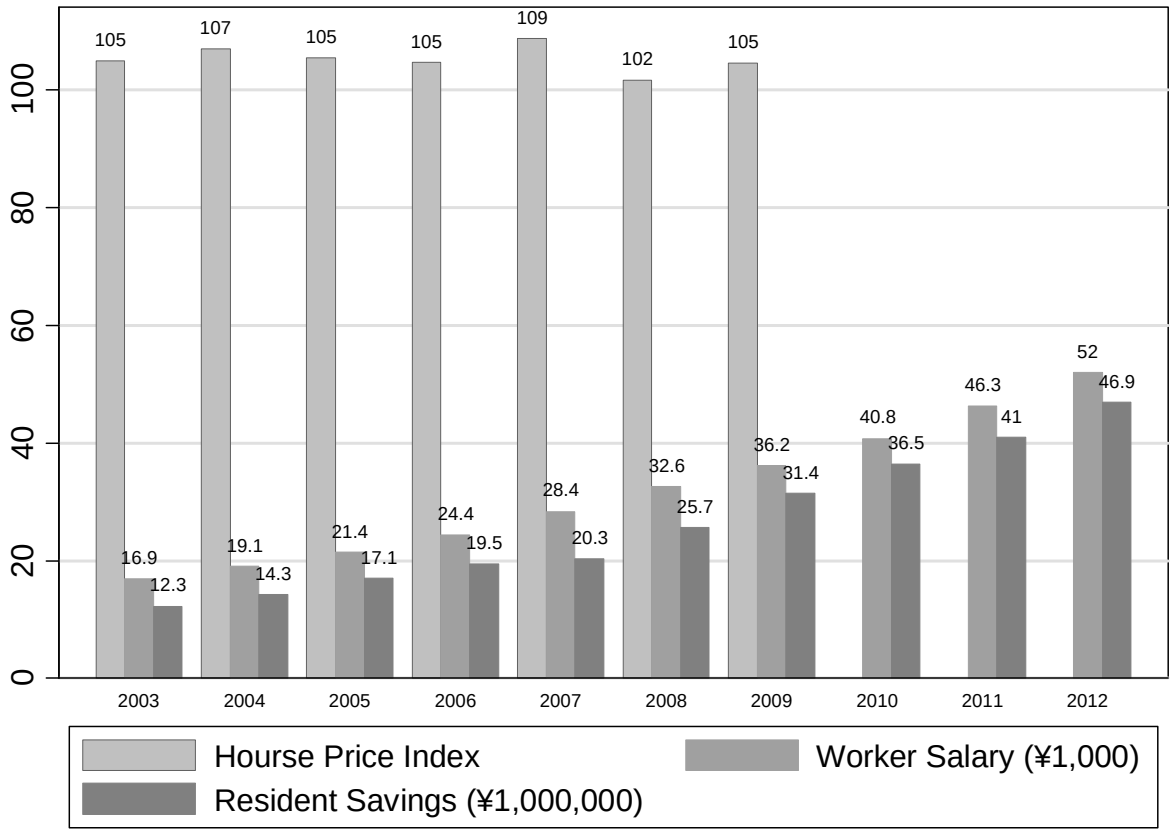

Table 1. Variable definitions and summary statistics

Variable	Definition	N	Mean	Standard Deviation
Fiscal Revenue	Local government fiscal revenue amount in 100 million RMB Yuan	210	357.1	531.9
Government Income	Difference in local government fiscal revenue and expense (100 million RMB Yuan)	210	-88.64	131.2
Land Sale	Areas of land sold to residential real estate developers in 10 thousands square meters	210	398.4	351.9
House Price	House sales price index	210	105.4	4.2
Commercial to Residential Price	Price of commercial housing sales divided by price of residential housing sales	210	1.061	0.063
Commercial to Residential Sale	Areas of commercial housing sales divided by areas of residential housing sales	210	1.128	0.114
Worker Salary	Annual worker salary in RMB Yuan	210	31,802	13,679
Resident Savings	Total residential savings amount in 100 million RMB Yuan	210	2,649	3,079

Table 2. Correlation matrix

The upper-right triangle is the Spearman's correlations matrix and the lower-left triangle is the Pearson's correlation matrix.

	Fiscal Revenue	Government Income	Land Sale	House Price	Commercial to Residential Price	Commercial to Residential Sale	Worker Salary	Resident Savings
Fiscal Revenue		-0.54	0.43	0.04	-0.32	0.15	0.70	0.90
Government Income	-0.54		-0.33	-0.01	0.21	0.01	-0.37	-0.65
Land Sale	0.21	-0.48		0.11	0.01	0.02	0.01	0.42
House Price	0.02	0.04	0.11		0.03	0.03	-0.05	0.03
Commercial to Residential Price	-0.17	0.09	0.02	0.12		0.38	-0.38	-0.29
Commercial to Residential Sale	0.12	0.03	-0.08	-0.08	-0.40		0.08	0.05
Worker Salary	0.73	-0.32	0.03	-0.04	-0.31	0.13		0.58
Resident Savings	0.93	-0.58	0.25	0.01	-0.15	0.08	0.72	

Table 3. Local government income and land sale for residential real estate development

The dependent variable is the area of land sale to local residential real estate developers. The independent variables include local government income, house price index, commercial to residential house price ratio, commercial to residential land sale ratio, worker salary, and local resident savings. z-statistics are shown in the parentheses with ***, ** and * indicating its statistical significant level of 1%, 5% and 10% respectively.

Dependent Variable: Land Sale to Residential Real Estate Developers	(1)	(2)	(3)	(4)	(5)	(6)
Local Government Income	-2.415*** (-8.811)	-2.250*** (-6.869)	-2.012*** (-6.245)	-2.004*** (-6.199)	-1.999*** (-6.171)	-1.977*** (-6.073)
Hour Price Index	10.12** (2.043)	10.74** (2.116)	9.063* (1.842)	9.324* (1.881)	8.874* (1.794)	9.166* (1.845)
Commercial to Residential House Price Ratio				-183.1 (-0.505)		-291.2 (-0.741)
Commercial to Residential Land Sale Ratio					-84.48 (-0.475)	-138.9 (-0.721)
Worker Salary	-0.00803*** (-3.233)		-0.0136*** (-3.953)	-0.0142*** (-3.919)	-0.0135*** (-3.889)	-0.0143*** (-3.935)
Resident Savings		-0.00743 (-0.618)	0.0378** (2.316)	0.0388** (2.356)	0.0380** (2.324)	0.0397** (2.401)
Constant	-598.8 (-1.133)	-852.6 (-1.591)	-390.9 (-0.737)	-211.4 (-0.330)	-280.3 (-0.483)	76.48 (0.101)
N	210	210	210	210	210	210
Adj. R-squared	0.272	0.236	0.287	0.284	0.284	0.283
F-test	27.01***	22.56***	22.02***	17.61***	17.60***	14.72***
Mean VIF	1.08	1.35	1.94	1.83	1.77	1.77

Table 4. Lagged government revenue, income and land sale

The dependent variable is the area of land sale to local residential real estate developers. The independent variables include local government income, fiscal revenue, house price index, commercial to residential house price ratio, commercial to residential land sale ratio, worker salary, and local resident savings. z-statistics are shown in the parentheses with ***, ** and * indicating its statistical significant level of 1%, 5% and 10% respectively.

Dependent Variable: Land Sale to Residential Real Estate Developers	(1)	(2)	(3)	(4)
Local Government Income	-1.984*** (-6.079)			
Local Fiscal Revenue	-0.0961 (-0.556)			
Local Government Income $_{t-1}$		-2.734*** (-6.652)		
Local Fiscal Revenue $_{t-1}$		-0.348* (-1.659)		
Local Government Income $_{t-2}$			-3.492*** (-6.753)	
Local Fiscal Revenue $_{t-2}$			-0.757*** (-2.867)	
Local Government Income $_{t-3}$				-4.025*** (-5.939)
Local Fiscal Revenue $_{t-3}$				-1.089*** (-3.130)
Hour Price Index	9.345* (1.874)	8.359* (1.733)	5.303 (1.019)	8.207 (1.427)
Commercial to Residential Hour Price Ratio	-289.3 (-0.735)	-251.5 (-0.658)	-201.7 (-0.495)	718.8 (1.096)
Commercial to Residential Land Sale Ratio	-126.1 (-0.649)	-96.18 (-0.509)	-101.9 (-0.530)	155.0 (0.630)
Worker Salary	-0.0139*** (-3.763)	-0.0113*** (-3.055)	-0.00746* (-1.801)	-0.00670 (-1.323)
Resident Savings	0.0533* (1.803)	0.0672** (2.263)	0.0687** (2.349)	0.0677** (2.181)
Constant	27.37 (0.0360)	-10.76 (-0.0146)	181.7 (0.225)	-1,376 (-1.234)
N	210	208	173	138
Adj. R-squared	0.280	0.298	0.301	0.278
F-test	12.62***	13.54***	11.57***	8.54***
Mean VIF	3.77	3.99	4.14	4.29

Table 5. System of simultaneous equation for the land demand and supply model

In this simultaneous system, price (house price index) is assumed to be determined simultaneously with demand and correlated with the disturbances of both demand and supply equations. In the demand function, quantity (area of land sale to local residential real estate developers) is associated with house price index, worker salary, and resident savings. In the supply function, land sale is determined by house price index, local government income, fiscal revenue, commercial to residential house price ratio, and commercial to residential land sale ratio. The equilibrium condition is that supply equals demand and this system is estimated using three-stage least square(3SLS) regression analysis. z-statistics are shown in the parentheses with ***, ** and * indicating its statistical significant level of 1%, 5% and 10% respectively.

Dependent Variable: Land Sale to Residential Real Estate Developers	(1)	(2)	(3)	(4)	(5)
	Land Demand Function				
House Price Index	-148.5** (-1.987)	-104.9* (-1.702)	-100.6 (-1.463)	-30.86 (-0.643)	-94.88** (-2.182)
Worker Salary	-0.0305*** (-4.203)	-0.0229*** (-3.437)	-0.0234*** (-3.412)	0.000502 (0.177)	-8.75e-05 (-0.0134)
Resident Savings	0.125*** (3.988)	0.110*** (4.334)	0.110*** (4.273)	0.0245* (1.675)	0.0191 (0.825)
Constant	16,612** (2.093)	11,852* (1.808)	11,403 (1.558)	3,556 (0.706)	10,295** (2.256)
Chi-squared	18.84***	19.01***	18.50***	3.19	5.37
	Land Supply Function				
House Price Index	62.78* (1.653)	222.2 (0.945)	72.54 (0.295)	-83.94 (-1.242)	-67.40 (-1.124)
Local Government Income	-2.678*** (-4.799)	-4.699*** (-3.235)			
Local Fiscal Revenue		-0.432 (-1.173)			
Local Government Income $_{t-1}$			-5.535*** (-4.420)		
Local Fiscal Revenue $_{t-1}$			-0.495 (-1.429)		
Local Government Income $_{t-2}$				-0.704** (-1.977)	
Local Fiscal Revenue $_{t-2}$				0.199 (0.996)	
Local Government Income $_{t-3}$					-1.908 (-1.501)
Local Fiscal Revenue $_{t-3}$					-0.132 (-0.358)
Commercial to Residential Hour Price Ratio	-266.1 (-0.707)	-118.6 (-0.176)	-291.4 (-0.471)	-218.2 (-1.141)	-32.52 (-0.111)
Commercial to Residential Land Sale Ratio	-2.867 (-0.00277)	-1,126 (-0.572)	-163.4 (-0.0774)	284.2 (0.929)	593.5 (1.348)
Constant	-6,082 (-0.516)	-21,874 (-0.929)	-6,928 (-0.283)	9,074 (1.288)	6,802 (1.041)
N	210	210	208	173	138
Chi-squared	31.47***	24.39***	32.10***	15.83***	37.28***

Table 6. Economic significance

To better quantify the results of the simultaneous system model, we estimate the percent change in the predicted percentage change in house price that our models generate in response to one standard deviation shocks to the explanatory variables of interest: local government income and house price.

Regression Model of simultaneous system		(1)	(2)	(5)
Year(s) of lagged local government income		0	1	3
Significant Factors in Land Demand Function		House Price Index Worker Salary Resident Savings	House Price Index Resident Savings	House Price Index
Significant Factors in Land Supply Function		House Price Index Government Income	Government Income $_{t-1}$	Government Income $_{t-3}$
Percentage change in house price		1.6%	5.6%	2.5%
Percentage change in quantity of land sales	Supply Function	66.2%		
	Demand Function	-156.6%		