



Holding the market under the stimulus plan: Local government financing vehicles' land purchasing behavior in China

Zhonghua Huang^a, Xuejun Du^{b,*}

^a College of Economics and Management, Zhejiang University of Technology, Hangzhou 310023, China

^b School of Economics and Management, Zhejiang University of Science and Technology, Hangzhou 310023, China

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ABSTRACT

China's stimulus plan in 2009–2010 brought local government financing vehicles (LGFVs) and new types of land finance into the spotlight. This paper uses national parcel-level land transaction data to examine the causes and consequences of LGFVs' land purchasing behavior in China. We found that LGFVs overbid significantly in terms of land prices. We explore channels through which LGFVs bid high prices for land. The stimulus plan induced local government to increase debt and rely more on land-based mortgages and land leasing revenue. Fiscal pressure led to an increase in LGFVs bidding for land. We found that the stimulus plan changed local governments' control over land leasing and land finance. Local governments hold more of the land market and inflate land prices following implementation of the stimulus plan.

1. Introduction

Consensus is slowly emerging that stimulus plans do not always benefit society, and can even have some unintended effects, such as worsening the efficiency of capital allocation and resource misallocation (Bai, Hsieh, & Song, 2016; Deng, Morck, Wu, & Yeung, 2011). China's stimulus plan in 2009–2010 brought local government financing vehicles (LGFVs) and local debt into the spotlight. To boost economic growth after the global financial crisis in 2007, Chinese central government put in place the ambitious plan to implement 4 trillion yuan worth of fiscal stimulus package at the end of 2008—roughly 12% of gross domestic product (GDP)—mainly including infrastructure projects. This stimulus plan spurred local governments to expand infrastructure investments for promoting economic growth. However, given the increasing fiscal pressure on local governments and the fact that they are forbidden from directly borrowing from banks by the Budget Law, they rely on LGFVs (also named local government financing platforms) to gain extra revenue and funding for infrastructure spending (Pan, Zhang, Zhu, & Wójcik, 2017). LGFVs aggressively purchase land from the primary land market at high prices and use it as collateral to borrow from banks (Lu & Sun, 2013).

Our paper aims to investigate LGFVs' land purchasing behavior and its effect on land prices in China based on national land transaction big data. We also identify the mechanisms through which LGFVs inflate land prices in the land market. Our paper provides new insights into local governments' behavior and intervention in the land market. Our paper also provides new evidence on LGFV-led land finance and its effect on land prices.

Our paper relates to three strands of literature. The first pertains to the effect of government intervention on land market, especially the role of local government intervention in the Chinese land market (Deng, 2003; Huang & Du, 2017a, 2017b; Tao, Su, Liu, & Cao, 2010). There is still confusion regarding the nature and effect of government intervention in land market among scholars and policy makers, especially in developing countries such as China. Compared to previous studies, our study attempts to identify a

* Corresponding author.

E-mail addresses: zhonghuahuang2006@aliyun.com (Z. Huang), duxuejun@aliyun.com (X. Du).

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new type of government intervention in the Chinese land market, whereby local governments participate in this market and inflate land prices through LGFVs' land purchasing.

The second strand of literature concerns local governments' land finance behavior. Most related literature has focused on local governments' land leasing and land financing behavior (Lin & Yi, 2011; Lin & Zhang, 2014; Yang, Ren, Liu, & Zhang, 2015) and the effects of these on the real estate market and urban development (Ding & Lichtenberg, 2011; Huang & Du, 2017a). Chinese local governments use land to gain land revenue, finance infrastructure investment and spur economic growth (Brueckner, 2007; Tao et al., 2010). In contrast to previous studies, however, we attempt to study a new phenomenon of LGFV-led land finance, whereby local governments gain land-based finance to fund infrastructure investment through LGFVs. This represents a new form of local government behavior regarding land finance in China.

Finally, our paper relates to literature on the effects of the stimulus package and the economic outcomes thereof. Some of this literature has examined the positive effect of the stimulus plan on industry development (Burdekin & Weidenmier, 2015) and economic growth (Diao, Zhang, & Chen, 2012; Fardoust, Lin, & Luo, 2012), while other studies have examined the negative or unintended effect of the stimulus plan on resource misallocation. For example, Bai et al. (2016) suggested that local governments set up local finance vehicles to distort financial resources to their favored private firms, which decreases capital allocation efficiency. Similar to studies by Deng et al. (2011), and Bai et al. (2016), our study focuses on the implications of "government intervention" via the stimulus plan in the land market, which local governments accelerate to inflate land prices by LGFVs after the stimulus plan.

Our study contributes to the literature on government intervention and land market by providing new empirical evidences on the effects of local government intervention on the land market in the Chinese context. Specifically, we explore a new type of land finance in China whereby local governments finance land through LGFVs to obtain revenue and mortgage loans. Our study also provides a new understanding of local governments' behavior, suggesting that the misaligned incentives of local governments distort land supply and inflate land prices.

The remainder of this paper is structured as follows. The next section reviews the background on China's LGFVs and local governments' behavior in the land market. Section 3 describes our empirical framework and data. Section 4 presents the empirical results and discussion. Section 5 explores the mechanism through which LGFVs overbid in the land market. Section 6 concludes.

2. Background on local government financing programs and local government behavior in the land market

2.1. Local government behavior in the Chinese land market

In China, land is heavily controlled by local governments. The institutional foundation for local governments exerting their control over the land market differs from those in Western countries. First, China's urban and rural land markets are segmented. Urban land is owned by the state, while rural land belongs to rural collectives (Ding, 2003). Rural land cannot be traded or converted to urban land for non-farm development without the permission of local government. Second, local governments monopolize the land supply. They have monopoly rights to convert rural land and lease it to potential developers.

Local governments can intervene in the land market by controlling the quota, price and leasing format of land (Yang et al., 2015). They can lease out land to potential developers via four transaction methods, including negotiation (*xieyi*), tender (*zhaobiao*), auction (*paimai*) and listing (*guapai*). The first method is a non-market transaction, while the other three are market transactions. In 2004, the Chinese Ministry of Land and Resources published Document No. [2004]71, which required that all land for business use be leased out via market transaction methods. Local governments prefer the listing method since it offers more room to control the land market (Cai, Henderson, & Zhang, 2013).

Land is an important finance tool for local governments to fund urban construction and infrastructure (Ding, 2003; Wang, Zhang, Zhang, & Zhao, 2011). Local governments lease out commercial and residential land to gain extra-budget revenue (Tao et al., 2010). They also use land as collateral to borrow from banks. Infrastructure investment is mainly financed by land leasing revenue and bank borrowing, especially following the stimulus plan of 2009–2010 (Bai et al., 2016; Ong, 2014).

Local governments' land finance behavior is related to fiscal pressure. The 1994 centralized fiscal reform radically changed local governments' revenue structure (Xu, 2011). Local governments' budgetary revenue decreased substantially, but their expenditure responsibilities did not decrease, and even increased due to rapid urbanization (Guo, 2009; Lu & Landry, 2014; Zhan, 2013). Under the increasing fiscal pressure, local governments began to favor land leasing as a new finance tool for funding expenditure and infrastructure construction (Cao, Feng, & Tao, 2008; Feng, 2013; Chen & Kung, 2016). During normal times, local governments' land leasing revenue dominates local extra-budgetary revenues (about half of local budget income), which could help to balance the local fiscal deficit (Lu & Sun, 2013; Su & Tao, 2017). Land leasing revenues even exceed the local budget revenue in some coastal areas of China (Tao et al., 2010).

2.2. Local government financing vehicles and the stimulus plan

LGFVs, which are established by local governments to finance municipal infrastructure investment, first emerged at the end of the twentieth century, but became popular after 2008 as a result of the stimulus plan. In March 2009, China's central bank and the Banking Regulation Commission jointly published a document that allowed local governments to use LGFVs to finance their

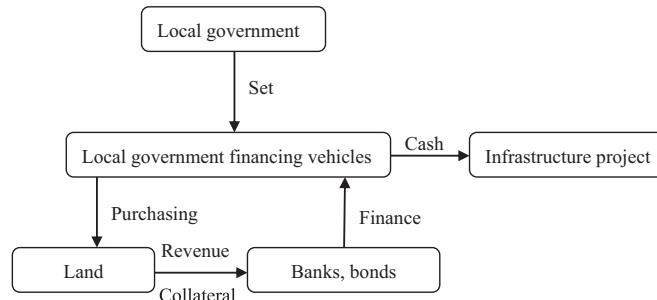


Fig. 1. Structure and function of local government financing vehicles.

investment projects to promote local governments' implementation of the stimulus plan. LGFVs are essentially state-owned enterprises (SOE) that are set up and controlled by local governments (provincial, prefectural or county-level cities).¹

LGFVs are the principal financial agency for local governments to fund infrastructure and promote economic growth. As they are restricted in terms of issuing bonds, local governments use their own financing vehicles—such as local government-controlled urban investment companies, infrastructure investment companies and land development agencies—to provide extra revenue or off-balance-sheet fiscal support for financing infrastructure and urban construction (Chen, He, & Liu, 2017). To spur economic growth following the financial crisis, the Chinese central government began to implement a 4 trillion yuan stimulus plan. However, the central government only contributed about 1.2 trillion yuan from four budget areas to finance investments under the plan, while the remaining 2.8 trillion yuan, which constituted 70% of the plan, was provided by local government, including via policy loans, local government bonds and bank loans (Lu & Sun, 2013).² A large part of the stimulus plan funds, 1.5 trillion yuan or 37.5% of total funds, was spent on infrastructure projects in 2009 and 2010.

The stimulus plan exacerbated the mismatch of local governments' revenue and expenditure, which increased their fiscal pressure. To circumvent the legal restrictions of the Budget Law that prohibited local governments from borrowing or running deficits, they resorted to creating off-balance-sheet companies, LGFVs or financing vehicles to fund the stimulus spending. In addition to financing infrastructure projects, LGFVs are engaged in commercial projects, such as commercial and residential projects development, which are essentially private projects (Bai et al., 2016).³ A typical arrangement is that LGFVs use land as collateral to borrow from banks, as well as to issue bonds. Following implementation of the stimulus plan, local governments relied more on LGFVs to finance infrastructure investment.

The typical function of LGFVs is presented in Fig. 1. City-level local government sets up several LGFVs and provides capital to them through the injection of land parcels, land leasing revenue, budget revenue and other assets, such as roads, bridges or funding (Lu & Sun, 2013; Tsui, 2011; World Bank, 2010). LGFVs provide funds for local governments through bank lending, issuing bonds and land-based mortgages. Local governments mainly use land leasing revenues or land mortgages to repay LGFVs' issued debt.

The relationship between LGFVs and local governments is intertwined. Local governments control these local financing vehicles and directly intervene in the running of the LGFVs, which are treated as municipal SOEs. LGFVs provide local governments with corporate vehicles to finance infrastructure projects, including road infrastructure, urban infrastructure and other public welfare projects (Pan et al., 2017). The growth of LGFVs is heavily dependent on local governments' investment, which represents a large part of Chinese local governments' role.

The rapid expansion of LGFVs was intensified by the stimulus plan. Before 2008, local government debt had already reached 5.57 trillion yuan, mainly from bank loans (NAO, 2011). The stimulus plan opened the floodgates in 2008 and 2009 to trigger a rapidly increasing number of LGFVs, leading to an explosion of local debt in 2009. The estimated number of LGFVs increased from 360 in 2007 (World Bank, 2010) to 8221 in 2009 (Zhang, 2013). According to our calculation regarding prefecture-level cities based on local debt data from WIND database (<http://www.wind.com.cn/>), LGFVs' debts (proxy for local government debt) rose from 10.85 billion yuan in 2007 to 1140.44 billion yuan in 2016 (Fig. 2).⁴ The size of LGFVs' debts expanded rapidly after 2009, exactly when the stimulus plan took effect.

2.3. LGFVs' land purchasing

Land plays an important role in LGFVs. As it is controlled by local governments, land is used as the main source of LGFVs' capital and collateral for LGFVs' borrowing. Land leasing revenue provides the main source for debt repayment. When the real estate market is booming, the increased value of land enables LGFVs to extract more loans. However, when the real estate market is bust, the fall in

¹ Most LGFVs are set and controlled by prefecture-level city governments.

² See also: <http://english.caijing.com.cn/2009-05-27/110172480.html>.

³ Bai et al. (2016) outlined Beijing's case regarding LGFVs for commercial and residential property development. LGFVs in other cities in China follow a similar pattern.

⁴ The WIND database collected and compiled local government financing vehicles' financial statements. An LGFV is defined as a company, owned by local government, whose main business covers infrastructure and municipal utilities. See www.wind.com.cn for more details.

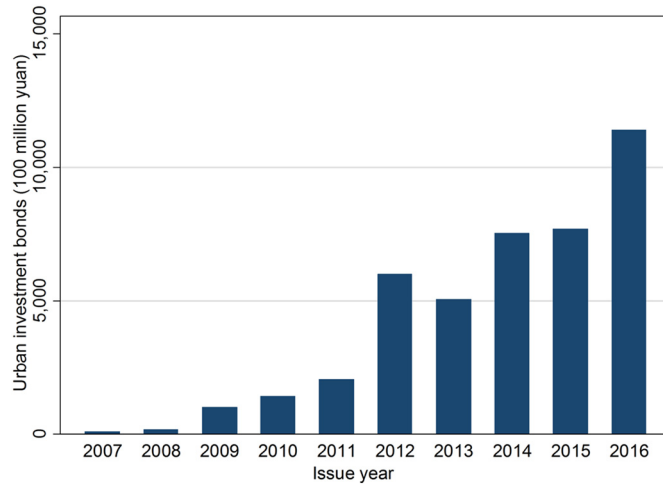


Fig. 2. Urban investment bonds issued by prefecture-level cities' governments (2007–2016).

(Note: Data sourced from WIND database (<http://www.wind.com.cn/>))

the value of land demands that LGFVs provide more collateral land, which also exacerbates their fiscal pressure. In addition, a drop in land prices will hurt the debt repayment ability of LGFVs and local governments. As a result, LGFVs have a strong incentive to bid up land prices and prop the real estate market (Ambrose, Deng, & Wu, 2015; Pan, Huang, & Chiang, 2015; Wu, Feng, & Li, 2014). In fact, LGFVs purchased more land after 2008 (Fig. 3).

The stimulus plan led local governments to rely more heavily on land collateral-based finance. After the 2008 global financial crisis, local governments' land leasing revenue dropped sharply as the real estate market was in recession. It was difficult for local governments to obtain sufficient revenues to balance the local fiscal gap, shocked by the crisis. The stimulus plan (4 trillion yuan) in 2009–2010 exacerbated this fiscal gap, as 70% of stimulus packages were to be provided by local governments. Faced by increasing fiscal pressure and competitive pressure arising from Chinese local leaders' tenure promotion, local governments resorted to additional financing vehicles (Chen & Kung, 2016; Lu & Sun, 2013). As they are prohibited from direct market borrowing and issuing bonds, local governments circumvented the Budget Law by setting up LGFVs and transferring land as collateral to help LGFVs secure loans. Local governments have incentives to raise land prices through LGFVs' outbidding in the primary land market. In addition, they often provide explicit guarantees, thereby also facilitating LGFVs' borrowing. LGFVs have become the main tool for local governments to finance infrastructure investment and promote local economic growth since implementation of the stimulus plan.

Several moral hazard issues exacerbate LGFVs' aggressive land purchasing behavior. Local governments expect the central government to bail them out if they cannot pay back debt. Banks are also driven by the same expectation and ignore the risk of debt. However, the central government was not expecting this when it allowed LGFVs to be created due to pressure to meet the GDP target after the global recession in 2008.

Fig. 3 portrays the land purchasing patterns of LGFVs' from 2007 to 2016. As can be seen, there were only small fees and a low number of LGFVs purchasing land prior to the stimulus plan. The value and number of LGFVs purchasing land increased substantially

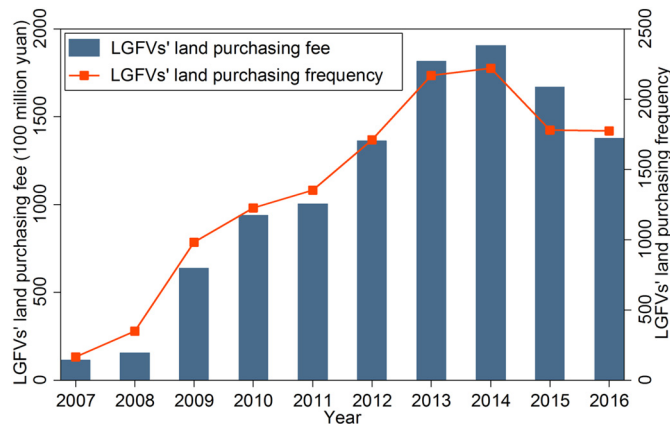


Fig. 3. Land purchasing fees of local government financing vehicles over time (2007–2016).

(Note: Data sourced from WIND database and China land transaction database (<http://www.landchina.com/>))

after the economic downturn in 2008–2009. Compared with Fig. 2, LGFVs' land purchasing fees account for a sizable share of the local government debt (> 10%).

3. Empirical framework

3.1. Econometric specification

To investigate the effects of LGFVs on land prices, we employ a hedonic model for baseline empirical specification, as follows:

$$LP_{ijt} = \alpha + \beta_1 LGFV + \lambda X_{jt} + \delta City_j + \gamma Year_t + \varepsilon_{ijt} \quad (1)$$

Where LP_{ijt} is the leasing price of land parcel i in area (county) j and in year t ; and $LGFV$ is a dummy equal to 1 if the land is bought by an LGFV. X_{jt} is a series of control variables at the parcel and at the city level. $City_j$ and $Year_t$ are city (county) and year fixed effects, respectively, which help mitigate issues from omitted variable bias that plague traditional hedonic models. Our identifying assumption is that, conditional on city and year fixed effects and on the controls X_{jt} , the dummy of LGFV is orthogonal to the error term.

We also test the robustness of our results using an alternative measure of land price (floor price of land), examining alternative hypotheses and addressing the endogeneity problem. Further, we run several sets of regressions to explore the mechanisms through which LGFVs inflate land prices.

3.2. Data description

We collected national parcel-level land transaction data from <http://www.landchina.com/>. The dataset includes all 356,822 commercial and residential land parcels leased out in the Chinese primary land market from 2007 to 2016. All detailed information includes the land parcel's selling price, area, location grade (16 categories of land location grade; grade 1 land has best location condition and is near a city center), land usage (8 types of land usage), transaction method, date, buyer's name and so on. For each land parcel, we identify the winning bidder's information, including LGFV or non-LGFV, by merging the LGFV database published by the China Banking Regulatory Commission in 2016 and the national land transaction database.⁵ Finally, we identify 12,414 parcels purchased by LGFVs, accounting for 3% of total land parcels.

We focus on the residential and commercial use of land parcels on which LGFVs' land purchasing is concentrated.⁶ We also restrict our regression sample to parcels transacted through competitive market methods. These parcels were leased out either through tender, listing or auction. Most land (77%) was sold by listing, and 21% of land was sold by auction. The description and summary statistics of the main variables are shown in Table 1.

Table 2 reports the summary statistics of land parcels by LGFV and non-LGFV buyers. Interestingly, LGFV-purchased parcels had a lower-quality location than did non-LGFV parcels, suggesting that LGFVs' buying parcels were in less expensive locations. In addition, LGFVs' parcels were generally larger but more expensive than those of non-LGFV parcels. These results imply that LGFVs prefer to buy land at higher prices and with larger areas in order to obtain a high land asset value, which confirms our suggestion that LGFVs purchase land at high price to gain more funds by which to finance infrastructure investment.

4. Empirical results

4.1. Baseline results

Table 3 presents the baseline estimation results. In column (1), we regress log land price on LGFV and on a set of year and city dummies, without including any other control variable. The coefficient on LGFV variable is 0.09, which means that LGFVs outbid other developers in the land market by 9%. Of course, this coefficient should be interpreted with caution, due to the fact that the land purchasing price of LGFVs may be correlated with other characteristics associated with higher land prices. In columns (2)–(4), we thus add a series of controls: land area, land location grade, year limit, floor area ratio, and dummies for land transaction method, land usage and land source type. The coefficient for the LGFVs increases to 0.114 in column (4), and is significantly positive. This indicates that LGFVs outbid other developers in the land market by 11%. These results suggest that LGFVs significantly inflate land prices compared to other private developers.

We further explore the heterogeneous effect of LGFVs on land prices according to type of city. The effects of LGFVs on land prices may vary with the fiscal status of cities, because LGFVs' land purchasing is closely related to local governments' debt issuance and repayment. We group the sample into not issuing and issuing local government debt (proxied by urban investment bonds), and examine the effect of LGFVs on land prices for each group. Table 4 reports the estimated results. Interestingly, the coefficient for LGFVs in the issuing local debt group is positive and statistically significant, while it is not significant in the not issuing local debt group. This result suggests that LGFVs significantly inflate land prices in cities that issue local government debt. This is because LGFVs purchase land to facilitate the issuance and repayment of local government debt.

⁵ We merged 2008 economic census database with the national land parcels database to identify whether the winning bidders were SOEs.

⁶ Local governments have incentives to raise commercial and residential land leasing prices, which will increase their land leasing revenues. The industrial land leasing price in China is largely depressed because local governments compete each other to offer lower prices so as to attract outside investment (Huang & Du, 2017b).

Table 1
Description of main variables.

Variables	Definition	Obs.	Mean	Std. dev.
Land price	Land price per lot area (yuan/m ²)	356,822	2171.82	4864.18
Land parcel variables				
LGFV	Equal to 1 if the winning bidder was an LGFV	356,822	0.03	0.18
Area	Total lot area (hectares)	356,822	2.87	99.25
Floor area ratio	Planning floor ratio for the parcel	312,336	2.48	1.39
Year limit	Land usage year limit	280,808	58.85	14.51
Land location grade	Grade of land location (location quality decreasing from grade 1 to grade 18)	356,822	5.18	4.45
Land transaction methods				
Tender	Dummy, equal to 1 if the land was sold through tendering and 0 otherwise	356,822	0.02	0.12
Auction	Dummy, equal to 1 if the land was sold through auction and 0 otherwise	356,822	0.21	0.41
Listing	Dummy, equal to 1 if the land was sold through listing and 0 otherwise	356,822	0.77	0.42
SOE	Dummy, equal to 1 if the land was bought by an SOE and 0 otherwise	356,822	0.04	0.19

Table 2
Summary statistics for LGFV and non-LGFV purchases.

Variables	LGFVs	Non-LGFVs	Diff.
Land price	2292.65	2167.47	125.18**
Land location grade	5.34	5.17	0.17**
Area	4.85	2.80	2.05*
Year limit	54.74	55.89	−1.15**
Floor area ratio	2.50	2.48	0.02

* $p < 0.05$.

** $p < 0.01$.

Table 3
Estimation results for the effect of LGFVs on land prices.

Variables	(1)	(2)	(3)	(4)
LGFV	0.093* (0.031)	0.146* (0.031)	0.124* (0.032)	0.114* (0.031)
Log area		−0.069* (0.005)	−0.052* (0.005)	−0.040* (0.005)
Land location grade		−0.052* (0.003)	−0.039* (0.003)	−0.037* (0.003)
Year limit			0.002* (0.000)	0.000 (0.001)
Floor area ratio			0.220* (0.006)	0.213* (0.006)
Constant	6.150* (0.025)	6.328* (0.029)	5.671* (0.039)	5.905* (0.140)
Land transaction method dummies	No	No	Yes	Yes
Other controls	No	No	No	Yes
County fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
N	356,819	356,819	242,679	242,679
R ²	0.547	0.564	0.625	0.631

Notes: Standard errors clustered at county level are reported in parentheses. Other controls include land usage and land source dummy variables.

* $p < 0.01$.

4.2. Placebo test

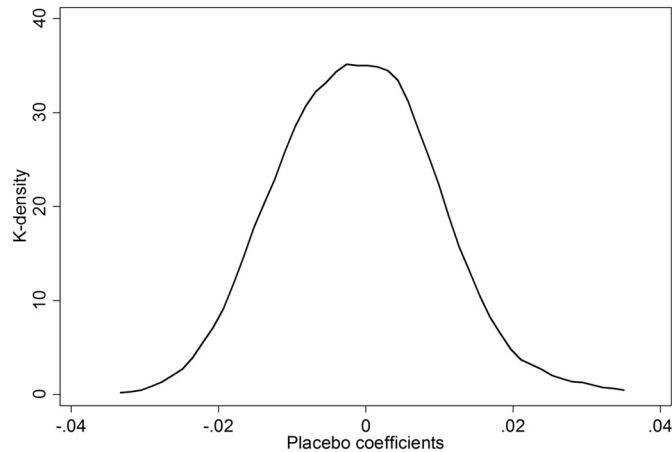
The key identification assumption of our estimation is that LGFVs' land purchasing was uncorrelated with several unobserved factors after controlling for the above control variables, city and year fixed effects. To assess the plausibility of this assumption, we perform a placebo test. We randomly choose a land parcel and then falsely assign it to be bought by an LGFV. We then reestimate our baseline model using the false LGFV variable. We repeat the estimation exercise 500 times and store the estimation coefficients for LGFV. The empirical cumulative distribution of coefficients on LGFV is presented in Fig. 4. The distribution of the coefficient of LGFV is significantly centered around zero, suggesting that our benchmark estimate is significantly outside the range of coefficients estimated in the placebo test. The results of the placebo test confirm that our regression results are not spurious.

Table 4

Estimation results for the heterogeneous effect of LGFVs on land prices for not-issuing and issuing local government debt groups.

Variables	Not issuing local government debt	Issuing local government debt
	(1)	(2)
LGFV	0.081 (0.059)	0.127* (0.034)
Log area	−0.058* (0.006)	−0.026* (0.007)
Land location grade	−0.038* (0.004)	−0.043* (0.004)
Year limit	−0.002 (0.001)	0.002 (0.001)
Floor area ratio	0.211* (0.007)	0.211* (0.008)
Constant	6.187* (0.227)	5.802* (0.240)
Land transaction method dummies	Yes	Yes
Other controls	No	No
County fixed effect	Yes	Yes
Year fixed effect	Yes	Yes
N	105,963	99,806
R ²	0.604	0.625

Notes: Standard errors clustered at county level are reported in parentheses. Other controls include land usage and land source dummy variables.

* $p < 0.01$.**Fig. 4.** Placebo test for the distribution of estimated coefficients of LGFV.

4.3. Further analysis and robustness checks

To further check the robustness of our results, we use an alternative measure of land price, examine an alternative hypothesis, address the endogeneity problem and add more controls.

First, we use an alternative measure of land price, floor price of land (land price per floor area). Table 5 presents the estimated results. In column (1), we only include city and year fixed effects. In columns (2)–(4), we add the same set of control variables as in previous regressions to account for varying individual differences across land parcels. The coefficients of LGFV are significantly positive in columns (3)–(4) when we add more controls. The size of the coefficient on the LGFV variable decreases, but is also significant as we use the floor land price. Overall, we get a similar pattern of results with the alternative dependent variables.

Second, to address the concern that the positive effect of LGFV on land prices may have resulted from the fact that LGFVs purchased parcels in more expensive locations, we regress land location grade on LGFV and a set of control variables. Table 6 reports the results. The coefficient for LGFV is not significant, indicating that the parcels' location grade is not associated with LGFVs.

Third, we address the concern that the effect of LGFVs on land prices may have resulted from SOEs' outbidding in land prices. Some scholars have suggested that SOE real estate developers overbid on prices in the land market, as they can access capital at very low cost (Ambrose et al., 2015; Deng et al., 2011). To test whether the observed high bids of LGFVs resulted from SOEs' outbidding (omitted variable problem), Table 7 reports the estimation results. In column (1), we regress land price on SOE, and found that the coefficient for SOE is positive and statistically significant, which is consistent with Deng et al.'s (2011) result. However, when we include both SOE and LGFV variables, the coefficient for SOE becomes smaller, and the coefficient for LGFV is significantly positive and larger than that of SOE (see column (2)). This result indicates that the effect of LGFVs outbidding is larger and more significant

Table 5

Estimation results for alternative measure of land price: land price per floor area.

Variables	(1)	(2)	(3)	(4)
LGFV	0.005 (0.030)	0.046 (0.030)	0.083* (0.033)	0.077* (0.032)
Log area		−0.056** (0.005)	−0.069** (0.005)	−0.057** (0.005)
Land location grade		−0.031** (0.003)	−0.037** (0.003)	−0.035** (0.003)
Year limit			−0.003** (0.000)	−0.001 (0.001)
Floor area ratio			−0.177** (0.006)	−0.179** (0.006)
Constant	5.558** (0.028)	5.671** (0.030)	6.165** (0.041)	6.247** (0.135)
Land transaction method dummies	No	No	Yes	Yes
Other controls	No	No	No	Yes
County fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
N	313,489	313,489	242,679	242,679
R ²	0.482	0.492	0.538	0.544

Notes: Standard errors clustered at county level are reported in parentheses. Other controls include land usage and land source dummy variables.

* $p < 0.05$.** $p < 0.01$.**Table 6**

Estimation results for the land location grade.

Variables	(1)	(2)	(3)	(4)
LGFV	0.056 (0.054)	0.036 (0.054)	0.003 (0.058)	0.010 (0.057)
Log land price	−0.357** (0.020)	−0.351** (0.021)	−0.321** (0.024)	−0.305** (0.024)
Log area		0.026** (0.009)	0.022* (0.009)	0.010 (0.010)
Year limit			−0.008** (0.001)	−0.004 (0.005)
Floor area ratio			−0.067** (0.011)	−0.060** (0.011)
Constant	6.891** (0.151)	6.875** (0.152)	7.498** (0.199)	7.120** (0.421)
Land transaction method dummies	No	No	Yes	Yes
Other controls	No	No	No	Yes
County fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
N	356,828	356,828	242,679	242,679
R ²	0.765	0.765	0.778	0.778

Notes: Standard errors clustered at county level are reported in parentheses. Other controls include land usage and land source dummy variables.

* $p < 0.05$.** $p < 0.01$.

than that of SOEs, and our results cannot be attributed to SOEs outbidding.

Fourth, we further address the endogeneity problem. LGFV may be endogenous to land price due to problems arising from simultaneous and omitted variables. First, to address potential selection bias pertaining to the fact that local governments' inflation of prices of specific parcels purchased by LGFVs is related to parcel characteristics, we use the propensity score-matching (PSM) method to reduce selection bias and estimate the average treatment effect of LGFVs on land prices. The idea of PSM is to compare the outcomes of the treated (LGFV-purchased parcels) with those of the control (non-LGFV) parcels that are as similar as possible given observed characteristics. We assume that the probability of LGFVs purchasing a land parcel is related to parcel characteristics including area, land location grade, year limit, floor area ratio, land transaction methods, land usage and source. Table 8 provides the results for the logit propensity score estimation. All the coefficients in column (1) are statistically significant, which confirms our assumption and fits the data well.

We present the propensity score-matching estimation results in Table 9. The average treatment effect on land prices is about 30% higher for LGFVs. That is, the price of parcels purchased by LGFVs is 30 percent higher than those of non-LGFVs.

However, PSM is only valid if the selection depends on observed characteristics. To deal with the possible selection on unobservable variables, we exploit the variation in the ratio of land suitable for urban development (land suitability) as an instrument

Table 7
Estimation results for LGFVs and SOEs.

Variables	(1)	(2)
SOE	0.102* (0.020)	0.076* (0.020)
LGFV		0.088* (0.032)
Log area	−0.039* (0.005)	−0.040* (0.005)
Land location grade	−0.037* (0.003)	−0.037* (0.003)
Year limit	0.000 (0.001)	0.000 (0.001)
Floor area ratio	0.214* (0.006)	0.214* (0.006)
Constant	5.900* (0.140)	5.902* (0.140)
Land transaction method dummies	Yes	Yes
Other controls	Yes	Yes
County fixed effect	Yes	Yes
Year fixed effect	Yes	Yes
N	242,679	242,679
R ²	0.631	0.631

Notes: Standard errors clustered at county level are reported in parentheses. Other controls include land usage and land source dummy variables.

* $p < 0.01$.

Table 8
Estimated coefficients for logit propensity score model.

Variables	(1)
Log area	0.484* (0.008)
Land location grade	−0.004* (0.003)
Year limit	−0.003* (0.002)
Floor area ratio	0.071* (0.008)
Constant	−5.658* (0.486)
Land transaction method dummies	Yes
Other controls	Yes
County fixed effect	No
Year fixed effect	Yes
N	242,680
Log likelihood	−33,999.655

Notes: Standard errors clustered at county level are reported in parentheses.

* $p < 0.01$.

Table 9
Propensity score-matching estimation results for LGFVs bidding on land prices.

Matching method	Log land price		
	LGFV	Non-LGFV	ATT
Nearest neighbor	7.26	7.01	0.25*
Radius matching	7.27	6.91	0.36*
Kernel matching	7.27	6.97	0.30*

Notes: ATT, average treatment effect on the treated.

* $p < 0.01$.

Table 10
IV estimation results for the endogeneity problem.

Variables	Using land suitability as the IV	
	First stage (Logit regression)	Second stage
	(1)	(2)
LGFV		0.682*** (0.022)
Land suitability	0.589*** (0.051)	
Log area	0.477*** (0.009)	−0.366*** (0.011)
Land location grade	−0.008** (0.003)	−0.033*** (0.003)
Year limit	0.005* (0.003)	−0.003** (0.001)
Floor area ratio	0.070*** (0.009)	0.167*** (0.007)
Constant	−6.149*** (0.505)	9.916*** (0.203)
Land transaction method dummies	Yes	Yes
Other controls	Yes	Yes
County fixed effect	No	Yes
Year fixed effect	Yes	Yes
N	196,261	196,261
LR chi-square (15)	5594.14***	
R ²		0.600

Notes: Standard errors clustered at county level are reported in parentheses. Other controls include land usage and land source dummy variables.

* $p < 0.1$.

** $p < 0.05$.

*** $p < 0.01$.

for LGFVs' participation in land purchase. The idea of this instrumental variable is that the more developable land a city has, the higher the likelihood that local government will inflate land prices via LGFVs and use land mortgaged financing for urban construction and infrastructure investment. This is because LGFVs are set up by local governments to gain land-based finance to fund infrastructure investment, and LGFVs are more likely to purchase land in cities with higher land suitability. Our exclusion criterion is plausible for land suitability, as natural geographical conditions have limited direct effects on land prices. In addition, an IV (instrumental variables) estimation would be valid for plausibly exogenous instrumental variables (Conley, Hansen, & Rossi, 2012). Following Saiz (2010), we calculate the ratio of land suitable for development (land with a slope below 15 degrees and other than water bodies) for each prefecture city using China's digital elevation model data from the United States Geographic Service at a 90 m resolution (for more details, see Huang & Du, 2017a).

Table 10 presents the estimated results. The results of the first-stage regression in column (1) show that the likelihood of LGFVs' participation in land purchasing is positively associated with cities' land suitability. Parcels are more likely to be bought by LGFVs in cities with more developable land. The results of the second-stage regression in column (2) show that the coefficient on LGFV is positive and statistically significant. These results indicates that local governments would intervene in land markets and inflate land prices through LGFVs. Our IV estimation results confirm that LGFVs have a positive effect on land prices.

Finally, to address the omitted variable bias, we further control for district factors (prefecture cities' socio-economic variables). Cities' fundamental factors, including GDP per capita, the second industrial output ratio, the third industrial output ratio, foreign direct investment per capita and fiscal pressure (measured as the ratio of local expenditure to revenue) may also influence land price. We also include controls for housing price. To mitigate the simultaneity problems, we use (one year) lagged housing price in the set of district factors. All the district factor variables are sourced from China City Statistical Yearbook (2008–2016). Table 11 provides the results for adding district factors. The coefficients on LGFV are similar to the results shown in Table 3, confirming the positive effect of LGFV on land prices.

5. Understanding the mechanisms

Having used several methods to establish a link between LGFV and land prices, we now turn to understanding the mechanism through which LGFVs have driven up land prices. Based on the incentives behind local governments' land finance, we lay out four channels. The first channel is the role of the stimulus plan: implementation of the stimulus plan exacerbates local governments' reliance on LGFVs' land-based finance. The second channel is "local debt". LGFVs bid up land prices for facilitating local governments to issue more debt using land as collateral and to repay debt coming mainly from land leasing revenue. The third channel is "fiscal pressure". LGFVs outbid for land prices much more in cities with higher fiscal pressure, which pushed local governments to outbid for

Table 11

Estimation results when controlling for district factors.

Variables	(1)	(2)	(3)	(4)
LGFV	0.097** (0.035)	0.150** (0.035)	0.129** (0.037)	0.120** (0.037)
Log area		−0.064** (0.006)	−0.053** (0.005)	−0.042** (0.005)
Land location grade		−0.059** (0.004)	−0.043** (0.004)	−0.041** (0.003)
Year limit			0.003** (0.000)	−0.001 (0.001)
Floor area ratio			0.223** (0.007)	0.216** (0.007)
Constant	2.360* (1.331)	1.852 (1.382)	0.962 (1.412)	1.571 (1.361)
Land transaction methods dummies	No	No	Yes	Yes
Other controls	No	No	No	Yes
County fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
District factors	Yes	Yes	Yes	Yes
N	248,046	248,046	169,213	169,213
R ²	0.515	0.533	0.602	0.607

Notes: Standard errors clustered at county level are reported in parentheses. Other controls include land usage and land source dummy variables. District factors include prefecture level cities' domestic product per capita, the second industrial output ratio, the third industrial output ratio, foreign direct investment per capita, fiscal pressure and lagged housing price.

* $p < 0.1$.

** $p < 0.01$.

land prices in order to balance the fiscal gap. The fourth channel is “political cycle”. LGFVs more aggressively outbid on land prices over political cycles when provincial leaders focused more on local government officials' performance (such as promoting investment through land-based debt).

5.1. Stimulus plan

The first channel is related to the stimulus plan. Implementation of the stimulus plan exacerbated local governments' reliance on land mortgage-based finance, which led to LGFVs more aggressively purchasing land at higher prices (Lu & Sun, 2013). One consequence of China's 2009–2010 stimulus plan was the expansion of local expenditure. To implement the stimulus plan, local governments relied more on land financing to fund infrastructure investment and local expenditure (Ambrose et al., 2015). They set up LGFVs and allowed these to inflate land prices in order to use land as collateral to gain more loans from banks (Bai et al., 2016). To examine the stimulus plan's impact on LGFVs' land purchasing behavior, we use the following estimation equation.

$$LP_{ijt} = \alpha + \beta LGFV * Stimulus\ plan + \lambda X_{jt} + \delta City_j + \gamma Year_t + \varepsilon_{ijt} \quad (2)$$

Where *Stimulus plan* is a dummy equal to 1 when the stimulus plan was carried out after 2009. We include the same set of control variables (X_{jt}) as previous regressions. The coefficient on the interaction term, *LGFV*Stimulus plan*, represents the impact of the stimulus plan on land prices through LGFVs.

Table 12 presents the estimation results from this analysis. Column (1) shows that LGFVs bid higher land prices following the stimulus plan. Columns (2)–(4) add more controls to the regressions, whereby the coefficients of *LGFV*Stimulus plan* stay statistically significant and positive. These results suggest that the stimulus plan had a positive effect on LGFVs' bidding for land prices.

5.2. Local government debt

The second channel is related to local government debt. LGFVs bid up land prices to gain more land leasing revenue and mortgages by which to repay local government debt (Lu & Sun, 2013; Pan et al., 2017). To investigate the effect of local government debt on LGFVs' land price bids, we regress the interaction term, *LGFV*Log debt*, on the price of land leasing, with the same controls as those employed in the previous regressions.

Table 13 presents the estimation results from this analysis. Column (1) shows that LGFVs bid higher land prices in cities with more local government debt. Further, columns (2)–(4) add more controls, as per the previous regression, whereby the coefficients of *LGFV*Log debt* stay statistically significant and positive. These results confirm that the local government debt had a positive effect on LGFVs' land price bids.

Table 12
Estimation results for the effect of the stimulus package on LGFVs' land prices.

Variables	(1)	(2)	(3)	(4)
LGFV*Stimulus plan	0.096** (0.036)	0.148** (0.035)	0.126** (0.038)	0.117** (0.037)
Stimulus plan	0.599** (0.106)	0.609** (0.113)	0.471** (0.113)	0.520** (0.109)
Log area		−0.064** (0.006)	−0.053** (0.005)	−0.042** (0.005)
Land location grade		−0.059** (0.004)	−0.043** (0.004)	−0.041** (0.003)
Year limit			0.003** (0.000)	−0.001 (0.001)
Floor area ratio			0.223** (0.007)	0.216** (0.007)
Constant	2.365* (1.332)	1.860 (1.383)	0.972 (1.413)	1.581 (1.362)
Land transaction method dummies	No	No	Yes	Yes
Other controls	No	No	No	Yes
County fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
District factors	Yes	Yes	Yes	Yes
N	248,046	248,046	169,213	169,213
R ²	0.515	0.533	0.602	0.607

Notes: Standard errors clustered at county level are reported in parentheses. Other controls include land usage and land source dummy variables. District factors include prefecture level cities' domestic product per capita, the second industrial output ratio, the third industrial output ratio, foreign direct investment per capita, fiscal pressure and lagged housing price.

* $p < 0.1$.

** $p < 0.01$.

Table 13
Estimation results for the effect of local government debt on LGFVs' land prices.

Variables	(1)	(2)	(3)	(4)
LGFV*Log debt	0.043* (0.011)	0.053* (0.011)	0.035* (0.011)	0.032* (0.011)
Log debt	0.006 (0.011)	0.003 (0.011)	0.007 (0.012)	0.007 (0.012)
Log area		−0.048* (0.008)	−0.037* (0.007)	−0.027* (0.007)
Land location grade		−0.068* (0.006)	−0.048* (0.005)	−0.045* (0.005)
Year limit			0.003* (0.001)	0.001 (0.001)
Floor area ratio			0.222* (0.008)	0.215* (0.008)
Constant	2.385 (2.033)	1.699 (1.994)	1.169 (2.093)	1.595 (2.092)
Land transaction method dummies	No	No	Yes	Yes
Other controls	No	No	No	Yes
County fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
District factors	Yes	Yes	Yes	Yes
N	120,231	120,231	83,605	83,605
R ²	0.523	0.540	0.628	0.633

Notes: Standard errors clustered at county level are reported in parentheses. Other controls include land usage and land source dummy variables. District factors include prefecture level cities' domestic product per capita, the second industrial output ratio, the third industrial output ratio, foreign direct investment per capita, fiscal pressure and lagged housing price.

* $p < 0.01$.

5.3. Fiscal pressure

The exacerbated gap between expenditure and revenue following the stimulus plan made local governments keen to pursue various extra-budgetary revenue sources and finance vehicles. Land leasing revenue and land-based debt finance soon became crucial tools for local governments to obtain extra-budgetary revenue and to finance infrastructure investment (Cai, 2011; Cao et al., 2008; Chen & Kung, 2016). The budget deficit facing Chinese cities has intensified since the economic crisis in 2008. As the real estate

Table 14
Testing the channel of fiscal pressure.

Variables	(1)	(2)	(3)	(4)	(5)
LGFV*Fiscal pressure	0.029** (0.013)	0.053*** (0.013)	0.052*** (0.014)	0.050*** (0.014)	
LGFV*Fiscal pressure*Stimulus plan					0.049*** (0.014)
Stimulus plan					0.536*** (0.111)
Fiscal pressure*Stimulus plan					−0.006 (0.016)
Log area		−0.064*** (0.006)	−0.053*** (0.005)	−0.042*** (0.005)	−0.042*** (0.005)
Land location grade		−0.059*** (0.004)	−0.043*** (0.004)	−0.041*** (0.003)	−0.041*** (0.003)
Year limit			0.003*** (0.000)	−0.001 (0.001)	−0.001 (0.001)
Floor area ratio			0.223*** (0.007)	0.216*** (0.007)	0.216*** (0.007)
Constant	2.363* (1.334)	1.873 (1.384)	0.990 (1.413)	1.600 (1.363)	1.588 (1.374)
Land transaction method dummies	No	No	Yes	Yes	Yes
Other controls	No	No	No	Yes	Yes
County fixed effect	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes
District factors	Yes	Yes	Yes	Yes	Yes
N	248,046	248,046	169,213	169,213	169,213
R ²	0.515	0.533	0.602	0.607	0.607

Notes: Standard errors clustered at county level are reported in parentheses. Other controls include land usage and land source dummy variables. District factors include prefecture level cities' domestic product per capita, the second industrial output ratio, the third industrial output ratio, foreign direct investment per capita, fiscal pressure and lagged housing price.

* $p < 0.1$.

** $p < 0.05$.

*** $p < 0.01$.

market became depressed and land leasing revenue dropped significantly after the economic crisis in 2008, local governments resorted to setting up LGFVs and financing land through them. LGFVs, controlled by local governments, purchase land at high prices from the land market. They also mortgage their land to banks to repay local government debt and finance infrastructure investments.

To test whether fiscal pressure increased LGFVs' land price bids, we regress the interaction term, LGFV*Fiscal pressure, on the price of land leasing, with the same controls of the variables as in the previous regressions.

Table 14 provides the estimation results for the channel of fiscal pressure on LGFVs' land price bids. Columns (1)–(4) indicate that the coefficient of LGFV*Fiscal pressure is significantly positive. In column (4), a one-unit increase in local governments' fiscal pressure (ratio of expenditure to revenue) leads to a 5% increase in LGFVs' bid price in the land market. Column 5 further shows that the stimulus plan reinforced the impact of fiscal pressure on LGFVs' land price bids. Previous empirical work has also found a positive effect of fiscal pressure on land prices (Wu, Li, & Yan, 2015). However, our study further examined a specific channel in which local fiscal pressure has a positive effect on land prices—that is, through LGFVs' outbidding in the purchase of land parcels.

5.4. Political cycle

Previous studies have suggested that political cycles affect local governments' land supply behavior (Huang & Du, 2017a; Chen & Kung, 2016). Local government officials, incentivized by their career concerns, may try to maximize their chances of promotion by raising investment through land-based debt and finance (Cai, 2011; Chen & Kung, 2016). LGFVs more aggressively outbid for land during political cycles when provincial leaders focus more on local city leaders' performance (such as promoting investment through land-based debt and land finance). To test this channel, we set a series of dummy variables for political cycles.⁷ First, we set two dummy variables for local city leaders' tenure,⁸ including the first and second year of tenure (Tenure1, Tenure2). Second, we set several dummy variables for the provincial Communist Party Congress (CPC), including the first and second year before the CPC (BCPC1, BCPC2), the year of the CPC (CPC) and the first year after the CPC (ACPC1). These political cycle variables are then interacted with LGFV. Table 15 reports the estimated results. In columns (1) and (2), the coefficients of LGFV*Tenure1 are significantly positive, implying that LGFVs outbid more aggressively in the early years of local city leaders' tenure. In Columns (3) and

⁷ The provincial Communist Party Congress and local city leaders' turnover are local political cycle events in China. We manually collect China provincial Communist Party Congress time and local city leaders' tenure data from websites (<http://www.people.com.cn/>; <http://baike.baidu.com/>).

⁸ We use tenure data from 2006 to 2013 for local city secretaries, as they generally have more political power than mayors in China. Our results are robust to mayors' tenure data.

Table 15
Testing the channel of political cycles.

Variables	(1)	(2)	(3)	(4)
LGFV*Tenure1	0.115** (0.046)	0.116** (0.046)		
Tenure1	−0.019 (0.016)	−0.033* (0.020)		
LGFV*Tenure2		0.079 (0.089)		
Tenure2		−0.039** (0.020)		
LGFV*ACPC1			0.150*** (0.057)	0.153*** (0.057)
ACPC1			−0.021 (0.022)	−0.029 (0.023)
LGFV*CPC			0.005 (0.152)	0.009 (0.152)
CPC			−0.018 (0.029)	−0.040 (0.034)
LGFV*BCPC1			−0.009 (0.066)	−0.005 (0.066)
BCPC1			−0.002 (0.022)	−0.036 (0.031)
LGFV*BCPC2				0.157*** (0.043)
BCPC2				−0.051* (0.027)
Log area	−0.041*** (0.005)	−0.041*** (0.005)	−0.041*** (0.005)	−0.041*** (0.005)
Land location grade	−0.041*** (0.003)	−0.041*** (0.003)	−0.041*** (0.003)	−0.041*** (0.003)
Year limit	−0.001 (0.001)	−0.001 (0.001)	−0.001 (0.001)	−0.001 (0.001)
Floor area ratio	0.216*** (0.007)	0.216*** (0.007)	0.216*** (0.007)	0.216*** (0.007)
Constant	1.507 (1.365)	1.439 (1.365)	1.538 (1.368)	1.565 (1.371)
Land transaction method dummies	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes
County fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
District factors	Yes	Yes	Yes	Yes
N	169,213	169,213	169,213	169,213
R ²	0.607	0.607	0.607	0.607

Notes: Standard errors clustered at county level are reported in parentheses. Other controls include land usage and land source dummy variables. District factors include prefecture level cities' domestic product per capita, the second industrial output ratio, the third industrial output ratio, foreign direct investment per capita, fiscal pressure and lagged housing price.

* $p < 0.1$.

** $p < 0.05$.

*** $p < 0.01$.

(4), the coefficients for LGFV*ACPC1 and LGFV*BCPC2 are significantly positive, implying that LGFVs raise land prices much more in the second year before and the first year after the CPC. These results suggest that political cycle factors exacerbate LGFVs' outbidding behavior. This is because local government officials try to signal their performances by promoting investment through land-based finance during political cycles in order to increase their chances of promotion.

6. Conclusions

The link between China's local government finance and land market is not well understood by scholars and policy makers. Due to fiscal pressure, Chinese local governments are relying more on a new type of land-based finance to fund infrastructure investment under the stimulus plan. Based on China's national land parcel transaction data from 2007 to 2016, we examined the effect of LGFVs' land purchasing behavior on the land market, and investigated the channels through which the stimulus plan affected LGFVs' outbids for land. We found that local governments significantly inflated prices of land parcels purchased by LGFVs—compared to non-LGFVs, LGFVs overbid for the land by over 10%. The stimulus plan aggravated their outbidding behavior in the land market. LGFVs overbid more for land in cities with more local government debt and high fiscal pressure. Political cycle factors fostered LGFVs' outbidding behavior. This reflected local governments' increased direct control over the land market and induced a new type of land mortgage-based finance. Previous studies have suggested that land revenue is a major incentive for local governments' intervention in the land

market (Huang & Du, 2017a; Tao et al., 2010). However, our study suggests that local governments' land revenue and land finance incentives are intertwined. Local governments not only intervene in the land market, but also directly participate in the land market and raise land prices, which is part of the strategic framework used by local governments to finance infrastructure investments and spur economic growth.

Our study suggests that LGFV-led land finance and outbidding behavior does exist in China. LGFV firms outbid more for land prices compared to other non-LGFV buyers in the primary land market. As incentivized by the central government's stimulus plan, local governments tried to increase debt from the bank using land-based mortgages and also to raise land-related revenue. Our study also suggests that China's stimulus plan had some unintended effects. It increased local governments' direct control over the land market. LGFVs' overbidding for land reflects local governments' behavior of holding market.

The policy implication of our study is that central government should pay attention to the unintended effects of local governments' control over the land market under the stimulus plan, and regulate local governments' land-based finance behavior. LGFVs, controlled by local governments, inflated land prices to expand local debt to fund infrastructure investments. However, rapid credit expansion of LGFVs distorted the economic structure. Credit expansion to LGFVs unnecessarily raises land prices, crowds out private-sector lending and increases the economy's reliance on local government-led land finance and investment. The multiple objectives of local governments' intervention in land supply leads to land market inefficiency and misallocation. Although the stimulus plan has stabilized growth in the short term, it may be at the cost of distorting factor market and damaging economic efficiency in the long term.

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