The Speculation Channel and Crowding Out Channel: Real Estate Shocks and Corporate Investment in China[*]

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Abstract

This paper uses detailed land transaction data of Chinese listed firms from 1998 to 2012 to analyze how real estate shocks affect corporate investment. In addition to the widely documented collateral channel, we also uncover two other channels: rising real estate prices induce more investment in commercial land unrelated to firms' core businesses but reduce non-land investment (*the speculation channel*); rising real estate prices reduce debt capacity and corporate investment of firms without land ownership relative to land holding firms (*the crowding out channel*). Through these channels, we also find that real estate shocks lead to substantial capital misallocation both within and between firms: a 1-percentage-point increase in land price leads to 5-8 percentage points of TFP losses due to misallocation of capital.

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I. Introduction

The boom and burst of real estate markets are closely related to macroeconomic fluctuations (Liu, Wang and Zha, 2012). It is widely recognized that the recent financial crisis in the U.S. was triggered by the collapse of the real estate market and the bursting of the real estate bubble was a primary culprit of the prolonged stagnation in Japan. Understanding the impacts of real estate price fluctuations on firm and household behavior is thus important for understanding long run economic growth and business cycles. It also has important policy implications on how government should restrain real estate bubbles and intervene during collapse of real estate markets.

Existing studies have documented an important collateral channel, through which rising real estate prices affect firm investment by mitigating financial constrains faced by firms. Gan (2007) shows that Japanese land-holding firms reduce their investment after the burst of the real estate bubble. Chaney, Sraer and Thesmar (2012) document that U.S. firms with land holding benefit from real estate price rises through the collateral channel by increasing investment with the rise of real estate value.

Real estate price fluctuations may also lead to misallocation of capital through two alternative channels.[1] First, an increase in real estate prices may induce firms to pursue more real estate investments unrelated to their core businesses, which we call a "speculation channel." Miao and Wang (2011) argue that a bubble in one sector attracts more capital to be allocated to the sector, and in turn crowds out investment in other sectors. Chen and Wen (2014) build a model to analyze how a self-fulfilling housing bubble can create severe resource misallocation to the housing sector. Second, in response to an increase in real estate prices, banks may grant more credit to land holding firms, crowding out credit to firms without land holdings. Consistent with this "crowding out channel," Bleck and Liu (2014) also emphasize that banks allocate more credit to firms in the bubble sector, crowding out credit for other sectors. A recent study by Chakraborty, Goldstein and MacKinlay (2014) documents that U.S. banks that extend more mortgage lending during the recent housing bubble period decrease commercial lending,

[1] There are plenty of studies on the stock market bubble and its real impacts (e.g. Morck, et. al, 1990, Barro, 1990, Chirinko and Schaller, 1996, Campello and Graham, 2010). The stock market bubble is fundamentally different from the real estate market bubble because in the former case firms can control the supply of overpriced securities through stock issuances, while no such effects exist in the real estate market.

providing evidence for a crowding out effect. Taken together, the aggregate welfare effect of real estate shocks depends on the interplay between the effects of relaxing financial constraints and misallocation of capital through these distinct channels.

In this paper, we use China's real estate market as a laboratory to systematically examine how real estate shocks affect firm investment. China provides a unique setting for this purpose due to two reasons. First, investment in the real estate sector investment has become an important part of the Chinese economy, accounting for 14% of China's GDP.[2] China's GDP has experienced fast growth over the past decade, and so have the real estate prices (Fang et al., 2015). There are ongoing debates among policy makers, academics, and investment practitioners regarding the potential risk of China following the footstep of Japan to enter a severe economic recession if the real estate market collapses. Movements in real estate prices also explain half of the variation in trade deficits in a sample of 18 OECD countries plus China (Laibson and Mollerstrom, 2010). Thus, understanding the consequences of China's real estate boom and its potential burst is important for studying not only the Chinese economy but also the global economy. Second, the "housing purchase restriction" policies in recent years in China provide a natural experiment in investigating the impacts of real estate shocks. Unlike the aggregate shocks such as the bursting of the Japanese real estate bubble, as analyzed by Gan (2007), the purchase restriction policy is only enforced in 46 Chinese cities, allowing us to construct a control group to examine the heterogeneous effects across cities.

By hand-collecting land transactions in 369 cities in China from 1998 to 2012 and by matching the land transaction data with Chinese listed companies, we are able to document three distinct channels for real estate shocks to affect firm investment. First, changes of land value are significantly correlated with increased investment of land-holding companies.[3] This result also holds true when we use land supply elasticity as an IV for real estate prices. This evidence is consistent with the collateral channel, as documented by Gan (2007) and Chaney, Sraer, and Thesmar (2012).

[2] The calculation is based on China Statistical Yearbook (CSY) of 2013.

[3] A contemporaneous study by Deng, Gyourko, and Wu (2014) finds no such results in a similar setting. We differ because our data cover 369 cities while they use only 35 large cities. Also, we show in the unreported table that the real estate price differs considerably by prices of residential, commercial, and industrial land. They use residential land prices while we use prices of commercial and industrial land and it will be shown later in the paper that the commercial land prices are an important driver of our results.

By decomposing firm investment into land investment and non-land investment, we show that an increase in land value leads to non-real estate firms to invest more in land and especially commercial land and take on less non-land investment. This finding lends support to the speculation channel, through which a real estate boom attracts firms to pursue more speculative investment in the real estate sector.

We further examine the crowding-out channel: due to the credit rationing policy in China, after granting more loans to land-holding firms after an increase in real estate prices, banks have to cut down loans to firms without land holdings. We test this crowding-out channel using loan level data. We find that as real estate prices rise, the bank branches located in cities with higher land prices granted more loans with collaterals, especially loans with real estate collaterals and much less credit loans. To further explore this channel, we focus on a subsample of non-land owners. We find that non-land owners tend to borrow less and invest less if they are located in cities experiencing higher real estate price increases. These findings suggest that while the real estate boom boosts the investment of land-holding firms through the collateral channel, it crowds out the investment of firms without land holdings.

Furthermore, we exploit housing purchase restrictions, which were implemented by the Chinese governments in 2010 as an effort to slow down the housing price booms in a list of cities, as a natural experiment to explore the effects of negative price shocks. It is shown that firms that hold lands in cities affected by the restrictive policies experience lower investment than those holding land in cities not affected by the policies, and that they cut back the share of commercial land investment and increase that of non-land investment. In the meantime, firms without land holdings have larger borrowing and investment in the treatment cities than those in the control group. These findings provide not only additional identification tests, but also evidence that the speculation and crowding out channels coexist.

Comparing land holding firms with no-land firms further reveals that land holding firms are less financially constrained and are more likely to be state-owned enterprises (SOEs). More importantly, land holding firms are more likely to be inefficient than no-land firms. The existing literature also documents consistent evidence that SOEs in China, although less financially constrained, are more inefficient than the financially-constrained non-SOEs (Hsieh and Klenow, 2009; Liu and Siu, 2011; Dollar and Wei, 2014). Combining these observations with our aforementioned empirical findings yields interesting implications for understanding the consequences of the speculation and crowd-out channels in China. First, rising real estate prices during the recent boom tend to enlarge the financial constraint gaps between land holding firms and no-land firms, especially between SOEs and non-SOEs. Since SOEs are more likely to hold lands and benefit more from the real estate boom, the real estate boom thus leads to greater misallocation of capital by worsening the credit constraint of those financially constrained firms, mostly non-SOEs which tend to be more efficient. Second, even for land holding firms, which are more likely inefficient SOEs, rising real estate prices induce more investment into the real estate sector, especially commercial land outside the firms' core businesses. This speculative behavior feeds back to the real estate boom and crowds out the firms' non-real estate investment. This effect injects an additional source of inefficiency into the real estate boom.

Motivated by the above argument, we explore the impact of a real estate boom on capital misallocation in China. Following Hsieh and Klenow (2009), we measure capital misallocation by TFP losses. We show that 1% increase in average land prices leads to 5-8% of aggregate TFP losses due to misallocation of capital, indicating that the overall distortion created by the real estate boom is substantial.

In sum, we find strong evidence on speculation and crowding-out channels of a real estate boom in China's context. While our empirical analysis confirms the collateral channel for real estate shocks to affect firm investment, our findings of the speculation and crowding out channels highlight an offsetting that a real estate boom may exacerbate inefficiency in the real economy and caution a common argument that a real estate boom can stimulate investment.

The remaining part of the paper is organized as follows. Section II introduces the background of China's real estate market and the purchase restriction policies. Section III describes the data and presents the summary statistics of the key variables; Section IV documents the three channels of real estate price shocks. Section V implements the empirical tests using a quasi-natural experiment. Section VI explores the effects of real estate price changes on resource misallocations. Section VII briefly concludes.

II. Institutional Background

The past decade has witnessed the boom of China's real estate market. The central government's stimulus package of 4 trillion RMB in 2009 against the backdrop of the Global Financial Crisis fueled the surge of property prices in 2010. Figure 1 reports the fluctuations of land prices over time. The red line represents average land price for commercial and residential (short for commercial hereafter) land from 1999 to 2013 and the blue line represents average land price for industrial land. The figure shows clearly that the commercial land price has risen dramatically since 2006, while industry land prices have remained flat over the same time period. We will describe the sources of the land price data in details in next section.

The rapid and persistent increases in housing prices across China, especially in first-tier and second tier cities, pushed the central government to issue tough measures to cool down the soaring housing market. One of these measures, the so-called "No.10 Order of the State Council" issued on April 17, 2010, requested local governments to take actions against excessive rises in housing and land prices and speculative purchases of properties. Under the pressure of the central government, Beijing issued a new policy on April 30, 2010, to prohibit any purchases of more than two apartments per household in the city, and became the first city to impose the housing purchase restrictions". It was soon followed by more and more first- and second-tier city governments. Up till the end of 2011, a total of 46 cities adopted the property purchase restriction policy. Appendix A shows a list of these cities and the announcement dates of the purchase restriction policies.

III. Data and Summary Statistics

A. Data

Our land holding data come from State Bureau of Real Estate Administration, which keeps records on land transactions between publicly-listed firms and local governments containing the information on land buyer, land area and transaction price. We hand-collected the data from 1998 to 2012, which covers 32,153 land transactions. The total area of land involved in these transactions is 1,871,781 hectare while the total size of payment is 1,660 billion RMB (equal to 301 billion dollars at current prices) accounting for 11.53% of the total land payments local governments received in the same period. We aggregate the transaction data to construct the land holding variable. The value of land held by each firm is measured as follows:

$$LandValue_{i,t} = \sum_{j}\sum_{k} LandArea_{j,k,i,t} * LandPrice_{j,k,t}$$

where $LandArea_{j,k,i,t}$ is the Area of k type of lands owned by firm i, in city j. at year t; $LandPrice_{j,t}$ is the average auction price of same type k of lands at year t, in city j. Based on the usage of the land, we classify two types of land: industrial land and commercial land. The different usages of the land are assigned by the government when the land is listed out for sale. It is very difficult to change the usage once assigned, if not at all possible.[4] We construct these variables at annual level to obtained firm-year observations. A firm's financial information is from the China Stock Market & Accounting Research Database (CSMAR), maintained by GTA Information Technology. Following the literature (Chaney et al., 2012 for example), we exclude financial firms, mining firms and real estate firms. We use annual data for the main results and quarterly data for the DID analysis. Given the fact that the house purchasing restriction policy was published after the September of 2010 and our firm data end in 2012, the quarterly data allow for more sensitivity tests on the policy effect. Our annual sample has 20,325 firm-year observations from 1998 to 2012, representing 2,346 unique firms. The variable definitions are summarized in Appendix B.

To quantify the effect of the asset price boom on firm investment, Chaney et al. (2012) use a novel proxy for the change of value of real estate asset holdings by using the price shock in the headquarter cities. The limitation of the approach, as acknowledged by Chaney et al. themselves is its reliance on the strong assumption that the real estate assets shown in the firm's book are mostly located in the cities where the headquarters are located. It may be true for the case of the US, but it is not necessarily true for China. Figure 2 shows firms' land holding across different provinces in China. We use two circular plots to link the public firms' original headquarter location and the destination where they bought lands. The segments around the circle represent the 31 provinces in China. The upper panel of the figure quantifies the size of land transaction by total amount of payment (in term of *yuan*). And the color-coded arcs linking two segments represent the size of land transaction firms made with local government. For example, the segment color-coded red represents all the land owners with their headquarters in Beijing. And

[4] Not only does the developer need the local government's permission for the change of usage, they also need the approval of the upper level Bureau of Real Estate Administration with legitimate reasons according to the Land Administration Law first published in 1998. The legitimate reasons must invoke public interests, such as city planning or public safety, etc.

each of the 31 red arcs represents the size of the land these "Beijing" firms bought in each of the 31 provinces. The figure shows that firms with their headquarters in Beijing also purchased lands in other provinces such as, Hebei, Tijan, Liaoning and Sichun, while firms with headquarters in Guangdong also own lands in Hubei, Jiangsu, and Zhejiang. The figure suggests that firms do hold a significant proportion of land in non-headquarter cities. Given that the land prices vary dramatically across cities, it is important to consider the land holding across country in order to correctly evaluate the value of firms' land holding.[5]

B. Summary Statistics

Panel A of Table 1 reports the summary statistics of the key variables used in the study. About 63% of firms who ever owned a land parcel in the sample period. The average land value divided by net PP&E, denoted by K, is around 0.44. Property is an important component of firms' asset. Over the sample period, the average land price for land holding firms is 1,146 yuan per squared meters with huge variations, with 90^{th} percentile being 2,045 and 10^{th} percentile being 404 yuan per squared meters. This reflects both the time series and cross-sectional changes of the land prices in the sample period. In the sample, firms' investment divided by net PP&E is around 33% with the median to be around 20% only. The Tobin's Q is around 2.6 and natural logarithm of total asset is around 21.

C. A Simple Comparison of Land Holding Firms and Non-owner Firms

Panel B of Table 1 provides a comparison of the land holding firms and non-owner firms at different years. For the whole sample, land holding firms are 1) relatively bigger in term of total assets or the number of employees, 2) more likely to be state-owned firms, 3) having higher leverage ratio, and 4) less productive than their non-owner counterparts. While the advantage of state-owned firms to own land persists from 2000 to 2010, the size gap between the owner and non-owner firms increases over time. Noticeably, the non-owner firms' debt ratio was larger than land holding firms at 2000 when the real estate boom cycle just began. However, their leverage ratios were caught up at 2005 and outpaced at 2010 by the land holding firms with the phenomenal increase in real estate price in China for the same period. In contrast, there is no

[5] This cross-county land holding may explain, at least in part, the difference between our results and those documented in Deng et. al (2014), who find no significant relationship between land value and firm's investment because they consider land holdings in 35 cities only while we have 369 cities in our sample.

productivity difference between two groups at 2000, but the disadvantage for land holding firms grew from 2005 to 2010.

IV. The Effect of Real Estate Value on Firm's Investment

How should a firm respond to an increase in real estate price, all else being equal? The "*collateral channel*" predicts a rise in gross investments for those asset-holding firms, as the increasing collateral value of real estate assets enhances owner firms' capacity to raise debt. Chaney et al. (2012) show that a $1 increase in collateral value leads the US public corporation to raise its investment by $0.06 in the house price boom from 1993 to 2007. Likewise, Gan (2007) finds that the burst of real estate bubble in Japan in the beginning of 1990s more adversely affects the land-holding firms' debt capacities and investments than firms without real estate.

Though the "collateral channel" predicts the financial constraint for asset-holding firms, it has no clear prediction on where the extra firm's investment will flow. If the asset-holding firms speculate on the continuing boom of asset prices, they may be inclined to invest more on those boom-related assets to arbitrage more from the bubble (we call it *speculation channel*). The bubble literatures typically emphasize on this speculation behavior during the process of real estate bubble formation. For example, Cheng, Raina and Xiong (2014) find that with the boom of US house price (2004-2006), the midlevel mangers in securitized finance aggressively increase their exposure to housing in their personal investment before the final bust of bubble in 2007.

Finally, one man's gain is another man's loss. The gain in land holding firms' collateral value may relatively reduce non-owner firms' ability to raise debt, and thereby adversely affect corporate investment (*crowding out channel*). In the following three sections, we test these three channels one by one.

A. Collateral Channel

In this subsection, we test whether real estate value change causes firms to change their investment. Firstly, we test this hypothesis using the standard investment-Q regression using firm-year observations in the whole sample. Following Chaney et. al (2012), we use the following regression setting:

$$\frac{I_{i,t}}{K_{i,t-1}} = \alpha + \beta * \frac{LandValue_{i,t-1}}{K_{i,t-1}} + \gamma * LandPrice_{i,t-1} + \theta X_{it} + \varepsilon_i + \delta_t + \epsilon_{it} \qquad (1)$$

Results are reported in Table 2, Panel A. The key dependent variable $\frac{I_{i,t}}{K_{i,t-1}}$ is the gross corporate investment at year t for firm i normalized by total fixed asset at year t-1. The key explanatory variable $\frac{LandValue_{i,t-1}}{K_{i,t-1}}$ is the total land value at year t-1 also normalized by total fixed asset at year t-1. To separate the effect of real estate asset value from the market price effect, we further add $LandPrice_{i,t-1}$, the average land price from cities where firm i holding land asset. All the regressions include a serial of control variables X_{it} including Tobin's Q, firm's end-of-year cash flow normalized by lagged fixed asset, total sale (logged), total firm asset (logged) and have firm fixed effects ε_i and year fixed effects δ_t, with standard errors clustered at firm level.

Regression (1) reports the OLS estimate using total land value as explanatory variable. Similar to Chaney et al. (2012), we find a significant positive effect of real estate asset value on gross investment at 1% level: each additional one Yuan of land value increases investment by 0.043 Yuan. This effect is economically substantial: the Yuan effect can be translated into that one standard deviation of land value increase leads to 8% (1.648*0.047) of investment increase, while the unconditional mean of the corporate investment is 33%. The average land price on the other hand has no significant effect on corporate investment.

One advantage of China's data is that it has detailed types of land. Based on Figure 1, different types of lands have dramatically different time trend. We thus separately estimate the effect of firms' commercial land value and industrial land value. Regression (2) and (3) report the results regressing total corporate investment on the values and average price for these two types of land. Only value for commercial land increases the total investment. The coefficient for commercial land value is even larger than that of total land value (0.111 vs. 0.043): so that each additional 1 Yuan of land collateral increases firm's investment by 0.111 Yuan, which can be translated into 18% of investment for one standard deviation of land value. Average price for commercial land also has significant effect on firm's total investment, although with much smaller magnitude (0.004) and marginal of significant level 10%. On contrast, neither value nor average price for industrial has effect on total investment (Regression (3)).

One issue related to this reduced form investment regression is the endogeneity problem. If the land price rises also imply increased investment opportunities for land-holding firms, the positive coefficient we documented may be due to omitted variable bias instead of a true causal effect. Followed Himmelberg, Mayer and Sinai (2005), Main and Sufi (2011) or Chaney, Sraer and Thesmar (2012), we address this endogeneity problem by instrumenting the land value and land price variables using the interaction of long-term interest rate with local land supply elasticity.

For $LandPrice_{i,j,t}$, we construct a IV_1 by interacting the average of supply elasticity $e_{i,j}$ for all the cities j where firm i holding land with national interest rate r_t at year t. The supply elasticity e_j for each city j is the proportions of land areas that are unsuitable for real estate development. We construct e_j measure for all the cities in our sample following similar approach as used by Saiz (2010). An area is defined as unsuitable for real estate development if it has a slope larger than 15%. The elevation data is obtained from the United States Geographic Service (USGS) SRTM 90m Digital Elevation Database v4.1 at the 90-meter resolution, which typically are spaced at the 90 square-meter cell grids across the entire surface of the earth on a geographically projected map.[6]

Figure 3 provides a scatter plot between this unsuitability index e_j and average land price. Consistent with Saiz (2010), we find that in China, this unsuitability index is also positively related to land price, suggesting it to be a valid instrumental variable. The IV_2 of $\frac{LandValue_{i,t}}{K_{i,t-1}}$ keeps the same functional form of the instrument for $LandPrice_{i,j,t}$, we simply weighted the $e_j * r_t$ by the area of land firm i holding in city j and divided by $K_{i,t-1}$. The function form for the pertinent IV is $\frac{e_{i,j}*r_t*area_{i,j}}{K_{i,t-1}}$.

Regressions (4) to (6) replicates the estimation performed in regressions (1) to (3) using 2SLS. Table 2, Panel B reports the 1st stage results for regressions (4) to (6). Regressions (7) and (8) are the 1st stage for regression (4), (9) and (10) for regression (5) and (11) and (12) for regression (6). To construct the IV_2 for land value of commercial and industrial land, we replace the total land area with the pertinent amount for each types of land. Both IV_1 and IV_2 are significant with land value and land price for different types of land. The 2SLS estimates are

[6] Data source: http://www.cgiar-csi.org/data/srtm-90m-digital-elevation-database-v4-1

similar to those of OLS estimates: land value has significant positive effect on corporate investment (0.069 vs. 0.043). And the effect is mainly driven by commercial land.

B. Speculation Channel

In the follow section, we proceed to test the speculation channel. To find out to which sector the extra investment of firms would flow, we divide the total firm investment into three types: the first type is non-land investment, referring to those investment that are not for purchasing more land; the second type is commercial land investment measuring the firm investment in purchasing commercial land; and the third type is the industrial land investment measuring the firm investment in purchasing industrial land. If the land holding firms after relaxing their credit-constraint indeed continue to bet on price increase for land, we would expect the land investment in one type of land increases with the extra land value for the pertinent type. In contrast, a speculative land holding firms have relatively less incentive to invest in non-land investment than in land-related investment.

Table 3, Panel A reports the pertinent results replacing the dependent variable of total investment with non-land, commercial land, industrial land investments one by one. The model specifications are the same as those 2SLS models in regressions (4) to (6) of Table 2. Regression (2) confirm that increase in land value indeed leads to extra firm's investment in commercial land as speculation channel predicts. However, we do not find the same effect on non-land investment and industrial land investment. However, if we further break down the land value into commercial land value or industrial land value, the increase in commercial land value increases investment in commercial land (regression (5)). The same for industrial land value increase (regression (9)). In term of magnitude, one yuan increase in commercial/industrial land value leads to extra investment in pertinent type of land for 0.338 and 0.273 yuan. It is worth noticed that the increase in commercial land value even significant reduces the effect of non-land investment (regression (4)). This result indicates within the same firm, the increase in asset value also "crowding out" investment to the non real-estate sector.

The specifications using the absolute level of investment (Panel A) potentially capture both the level effect (due to collateral channel) and the proportional effect (from speculation channel). To further explore the effect of collateral value on the relative proportion of different types of investment, we replace the level variables with the proportion for each types of investment to total in Panel B, Table 3. The results are strikingly similar: the collateral value increase in one type of land leads to further investment in that type of land. While the boom of commercial land value negatively crowds out investment not related to land.

C. Crowding-out Channel

The previous section establishes that the real estate price boom leads to land holding firms increase total corporate investment and the new investment has been directed further into real estate sector. In this section, we explore the impact of real estate price boom on firms without real estate asset.

Firstly, we investigate how bank allocate their credits with real estate price changes. If banks tilts their lending more toward collateralized loan with real estate price boom, non-land owners will obtain less credits. To test whether the real estate price increase indeed leads bank to lend out more loan with real estate collateral, we collect a loan level data for our sample firms from the firm's public announcements. The data covers all the 48,429 loans made by the 2,345 Chinese listed firms from 1998 to 2012. For each bank loan, we collect information on collaterals and lender bank branch. We adopt the following specification for the test:

$$Collateral_{i,b,t} = \zeta + \lambda * LandPrice_{b,c,t} + X_{i,t}\mathrm{K} + \mu_{ib} + \iota_{bt} + \tau_{bc} + \pi_{i,b,c,t} \quad (2)$$

The dependent variable is the collateral characteristics for loan i lent by bank branch b at year t. The key explanatory variable is the average land price at year t for the city where the bank branch b was located. We use the same IV_1 in Table 2 as instrument for land price. All the regressions include a serial of firm level control variables X_{it} including Tobin's Q, firm's end-of-year cash flow normalized by lagged fixed asset, total sale (logged), total firm asset (logged) and have firm*bank branch fixed effects μ_{ib}, bank branch city fixed effects ι_{bt} and bank*year fixed effect τ_{bc}.

Table 4 reports the loan level results. Regression (1) use a dummy variable, which equals to one if loan i is with real estate collateral (otherwise=0) as dependent variable. The result indicates that the rising land price in the bank branch city does increase the probability of loan with real estate collateral. In regression (2), we further test whether the asset price also affects the collateral value of non real estate collateral. Likewise, we find the rising land price also increases the probability of loan with non real estate collateral. In contrast, the rising land price in bank branch city decreases probability for loan without (regression (3)). The result is consistent using ordinal measures of loan's collateral characteristics (regression (4)).

Panel B, C replace the average land price with average commercial or industrial land respectively. The average commercial land price yields similar results to those of average land price but with larger magnitude (regressions (5) to (8)). However, industrial land price has no effect on real estate collateral or no collateral but it increases the probability for loan with non real estate collateral (regressions (9) to (12)).

The loan level regressions provide evidences that the rising real estate price indeed leads bank to bias more toward collateral loan, especially loans with real estate collateral. To further confirm whether the crowding-out effect leads to absolute disadvantage in term of total investment and borrowing constrains for the non-owner firms, we conduct a within-group comparison on the non-owner firms. Specifically, we compare the total investment and size of new bank loan for non-owner firms located in the high land price and low land price cities. The specifications for the test is as the following:

$$\frac{I_{i,t}}{K_{i,t-1}} = \alpha + \beta * LandPrice_{i,c,t-1} + \theta X_{it} + \varepsilon_i + \delta_t + \epsilon_{it} \qquad (3)$$

The dependent variable is the same I/K for the non-owner firms. The key explanatory is the average land price for the city of the firm's location. Followed Chaney, Sraer and Thesmar, we define a firm's location by the city where the firm's head quarter is located. The control variables are the instrumental variable for land price are the same as Table 2.

Table 5 reports the results. The average commercial land price in headquarter city significant decrease both corporate investment and size of new bank loan for the non-owner firms (regression (1) to (4)), consistent with the crowding-out effect for the non-owner firms. But industrial land price has no significant effect for the pertinent variables (regression (5) to (8)) probably due to the relatively moderate rising for the industrial land price.

V. A Quasi-experiment on Negative Real Estate Price Shock

Throughout our sample period, Chinese real estate market was under the boom cycle of real estate price. Therefore, it is hard to tell whether the bust of real estate price has a symmetrical effect in reducing speculation for the land holding firms and the crowding out for the non-owner firms. However, a nationwide policy experiment after 2010 on the house purchase restriction provides us a unique to verify those effects in a negative price shock.

This restriction policy provides us a unique demand shock for identification. In order for the policy to have impacts on firm's behavior, this demand shock needs to have a significant impact on land price. There are couples of reasons why the policy may not have an impact on land prices. First, the policies may be expected by the firms and investors so that land market has ready reflected the expectation. Second, the market may expect the government to abolish the policy before long so the land transactions may not be affected by the housing market demand. In the end, whether the policy has any effects on land prices or not is an empirical question.

Figure 4 Panel A reports land prices variation for commercial land over event time, where event time 0 is the quarter when a city announces the purchase restrictions policy. This policy is enforced in 46 cities, so we have 46 treated samples. The event time varies city by city, covering about one and half year period. All the other cities are defined as control samples. The figure shows the coefficient β obtained from the following regressions,

$$LandPrice_{j,t} = \alpha + \sum_{\epsilon t} \beta_{\epsilon t} * Treated_j * EventTime_{j,t,\epsilon t} + \sum \lambda_j * t * City_j + \varepsilon_t + \gamma_j + \mu_{j,t} \quad (4)$$

The subscription ϵt represents event quarter, which takes value -9 till 9, with 0 represents the quarter when the policy is announced. $Treated_j$ is a dummy variable taking value of 1 if city j is one of the 46 cities affected by the policy. $EventTime_{j,t,et}$, takes value 1 if calendar quarter t is event quarter ϵt, and 0 otherwise. There are 19 event time dummy variables in total. The regression controls for city fixed effect, time fixed effects and city-time trend ($\sum \lambda_j \times t \times City_j$).

This regression uses city-quarter observations from 2008 till 2013. The bars in the figure show the estimated value of β and the dotted lines quantify the 95th confidence interval.
It is obvious from the figure that β is close to zero pre-event, suggesting that after controlling for time trend, there is no difference in land prices between treated cities and control cities. However, the difference becomes significantly negative in post-event time, suggesting that the policy has

negative impacts on land price in these 46 treated cities. The second panel shows land price variance for industrial land. Given the purchase restriction policy only applied to residential house, this demand shock only applied to commercial land used for real estate development but not to the industrial land which is used as factor for production. Panel B in Figure 4 shows exactly this pattern: unlike the price of commercial land, average price of industrial land in the treated cities does not change after the purchase restriction policy.

Given the restriction policy indeed immediately induces price decrease for commercial and residential land we then can adopt a Differences-in-Differences design in Table 3 to test whether the price decrease affects firm's investment. The regressions are as follows:

$$Y_{i,t} = \alpha + \beta * Treated_i * PostEvent_{i,t} + \sum_i \lambda_i * t + \varepsilon_i + \zeta_t + \varphi_{i,t} \quad (5)$$

where $Treated_i$ is a dummy variable taking value of 1 if firm i hold any land in at least one of the 46 treated cities and 0 otherwise. $PostEvent_{it}$, takes value of 1 if city i is a treated city and time t is post policy announcement, and 0 otherwise. The regression controls for firm fixed effect, time fixed effect and firm-time trend. β captures treatment effect of the restriction policy.

In implementing the DID estimation, we use three different control groups. In Panel A, Table 6, The control group is all other firms which own land but not in the treated cities or own no land at all. One concern for this large sample as control group is that the purchase restriction policy may change the investment opportunities in treated cities, thus affect firms operated in treated cities. If that is the case, the effects we observed may not be due to the policy, but rather due to the change of investment opportunities. To address this issue, we use a second control group in Panel B of Table 6: all non-land owner firms with headquarters in one of the 46 treated cities. This control group has similar investment opportunities as the treated firms but they do not experience the negative shocks on land value as the treated firms do. Another concern with this method is that firms' decision of owning a land is not random, thus the land owners may be fundamentally different from non-owners. Finally, to take care of this concern, we construct a third control sample: firms own land but not in the treated cities. The results for using these three control groups are reported in Panel A, B and C respectively.

Similar to Table 3, Regressions (1) to (3) use non-land investment, commercial land investment and industrial land investment as dependent variables respectively. To the levels of three types of investment, the restriction policy has significant negative effect only on commercial land investment. The effect for non-land investment and industrial land investment is insignificant across three different specifications in Panel A to Panel C. However, when we look at the effect on the share of three types of investment to total, not only does the negative policy shock significant reduce the share of commercial land investment, it also significant increases the share of non-land investment. For those land holding firms affect by the restriction policy compare to those unaffected land holding firms, the share of commercial land investment decreases for about 14%, while the share of non-land investment increases by 15%. Consistent to the no effect on industrial land price, the policy also has effect on neither the level nor the share of industrial land investment.

We then move to examine the effect of restriction policy on non-owner firms. In section IV D, we find that a positive change in real estate price has a negative crowding out effect on the non-owner firms. By the same token, a negative price shock on real estate should reverse the crowding out effect and positively affect the non-owner firms' corporate investment as well as size of new bank loan. The results in Table 7 confirm these conjectures. In sum, a negative price shock on real estate has symmetrical effects on reducing speculation and crowding out.

VI. The Real Estate Price Boom and Resource Misallocation

By direct more firms' investment into real estate sector (speculation channel) and squeeze out non-land investment and non-owner firms (crowding out channel), the real estate bubble potentially leads to resource misallocation and thereby adversely affect production. Though thorough estimation on the welfare effect for each specific channel is hard at this point, we would like to shed some light on the overall relation on real estate price boom and resource misallocation in production.

To conduct such test, we first need to construct a measure on resource misallocation. Hsieh and Klenow (2009) propose a method to measure of TFP loss due to resource misallocation:

$$\frac{TFP^{efficient}}{TFP} = \left(\sum \frac{R_i}{R}\left(\frac{TFPR_i}{\overline{TFPR}}\right)^{\frac{\eta}{1-\eta}}\right)^{\frac{1-\eta}{\eta}}$$

The counterfactual $TFP^{efficient}$ is the aggregate TFP after equalizing TFPR relative to those of the United State. The ratio of $TFP^{efficient}$ and TFP measures the potential TFP loss due to TFPR dispersion. The data needed to calculate this TFP loss is firm-level sales (revenues), capital and labor. We use the firm-level Chinese industrial census from 2000 to 2012 to calculate the aggregate TFP loss at prefecture-industrial level. To confirm whether there is indeed a correlation between real estate price boom and resource misallocation. We regress the city-year level average TFP loss on the average land price, the specification is as the following:

$$TFPLoss_{p,t} = \alpha + \beta * LandPrice_{p,t} + \sum_{i} \lambda_i * t + \varepsilon_i + \zeta_t + \varphi_{i,t} \quad (5)$$

Table 8 reports the results for the effect of average land price on aggregate TFP losses. Regressions (1) to (4) use simple average of aggregate distortion over 47 manufactural sectors in each city p at year t, while regressions (5) to (8) use the weighted average aggregate distortion (by industrial output). Regressions (1), (2) and (5) and (6) reports the OLS estimates, while regressions (3), (4) and (7) and (8) contain the 2SLS estimates. Columns (3) and (7) use the interaction of the city's average unsuitable land index and the national interest rate as instrument and columns (4) and (8) use the purchase restriction policy as instrument. All specifications show positive significant effects of average land price on the aggregate distortion. 1% increase in average land price leads to 5-8% of aggregate TFP losses due to misallocation, suggesting the overall distortion from real estate shock is substantial.

Figure 5 provides visual displays on the relation between aggregate TFP losses and average land price. Panel A fixes a linear prediction line, while Panel B uses a nonlinear fractional-polynomial plot. While both plots show a clear positive relation between average land price and aggregate efficiency losses, the nonlinear plot suggests the correlation between two variables is disproportionately larger in the high price regions.

VII. Conclusion

Financial crisis is commonly coupled with real estate market collapse and real estate market investment has become an important component of the whole economy. As a result, understanding the real consequence of real estate market fluctuation provides micro-foundations for understanding many macro-economic models.

In this study, we investigate the consequence of real estate market variations on firms' investment and financial behavior, using China's real estate market as a laboratory. We document that firms with land holdings and high land values can borrow more and investment more with real estate market boom, and they cut their borrowing and investment due to the "house purchase restrictions" policies.

However, when decomposing investment into commercial land investment, industrial land investment and non-land investment, we show that with real estate market boom, firms make more real estate investment, especially into the commercial land, and they cut back non-land investment at the same time. Further, the purchase restriction policy reduces affected firms' land investments. Next, using loan level data, we show that bank branches located in cities with high land price rises granted more collateralized loan, especially real-estate collateralized loans and less credit loans. Further, using a subsample of non-land owners, we show that the non-land owners who are affected more by real estate prices borrow less and invest less due to real estate price rise and the effects are reversed due to policy shocks. The evidence is consistent with the argument that real estate market boom causes firms speculation into commercial land sector, crowding out non-land investment. At the same time, the credit rationing also crowds out the investment of non-land owners.

Finally, to understand the aggregate effect, we implement investment efficiency tests. We show that the increased land prices relates to large total TFP losses, consistent with the argument that real estate market boom causes significant resource misallocations.

In short, the evidence is in general consistent with the existence of speculation channel and crowding out channel. The rising real estate market fosters more speculation investment into real estate sectors, crowding out investment in other sectors. Also, the rising real estate price directs more credits into land owners, which crowds out credits available for non-owners. Our study calls for caution in promoting a policy that intends for real estate boom to stimulate investment as the overall net effects of such a policy would be negative.

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Table 1 Descriptive statistics

Panel A of table 1 presents summary statistics of the listed firms sample excluding firms operating in the finance, insurance, real estate, construction, and mining industries. The firm's annual financial data is obtained from the CSMAR database. And the land holding data is obtained from the land transaction dataset author constructed. The upper panel of the table reports the summary statistics of the firm variables, land value and land price variable, policy shock variable for the whole sample. And the lower panel reports the corresponding variables for only the land owner firms (defined listed firm ever recorded purchased land from local government). Panel B presents simple comparison for the land owner and non-land owner firms at different years. We compare both the percentage of state-owned firms, the mean of total asset, the mean of number of employee, the mean of debt to asset ratio and the TFP by LP method between the two groups. The upper panel presents the comparison results using all samples. And the second, third and lower panel presents the comparison results at year 2000, 2005 and 2010 respectively. * p<0.10, ** p<0.05, *** p<0.01.

Panel A		Mean	Standard Deviation	Median	P10	P90
				All Sample		
Corporate Investment		0.33	0.39	0.20	0.03	0.78
Corporate Non Land Investment		0.29	0.34	0.19	0.02	0.67
Land Value	Ratio (Normalized by lagged Fixed Asset)	0.04	0.16	0.00	0.00	0.08
Commercial Land Value		0.04	0.17	0.00	0.00	0.08
Industrial Land Value		0.01	0.04	0.00	0.00	0.00
Average Land Price (City Where Firms Purchased Land)	Yuan/Square Meters, Logged	1.34	2.74	0.00	0.00	6.88
Tobin's Q		2.56	1.81	2.02	1.13	4.56
Cash Flow	Ratio (Normalized by lagged Fixed Asset)	1.62	6.73	0.15	-0.43	3.44
Sale		4.78	8.04	2.45	0.69	9.92
Total Asset	Yuan, Logged	21.24	1.22	21.11	19.93	22.74
Change in Total Debt	Change of Ratio	0.01	0.09	0.00	-0.09	0.11
Panel B				Land Owner Sample		
Land Owner (=1)		63.16%				
Corporate Investment		0.338	0.389	0.213	0.038	0.775
Corporate Non Land Investment		0.296	0.325	0.198	0.034	0.643
Land Value	Ratio (Normalized by lagged Fixed Asset)	0.067	0.199	0	0	0.178
Commercial Land Value		0.073	0.201	0	0	0.183
Industrial Land Value		0.009	0.055	0	0	0.011
Log of Average Land Price (City Where Firms Purchased Land)	Yuan/Square Meters, Logged	2.102	3.18	0	0	7.172
Tobin's Q		2.414	1.658	1.908	1.097	4.279
Cash Flow	Ratio (Normalized by lagged Fixed Asset)	1.236	5.13	0.166	-0.413	2.943

Sale		4.651	7.457	2.527	0.747	9.603
Total Asset	Yuan, Logged	21.448	1.259	21.321	20.073	22.999
Change in Total Debt	Change of Ratio	0.005	0.084	0	-0.092	0.104

Panel B	State-owned	Total Asset (log)	Number of Employee (log)	Debt/Asset Ratio	TFP (LP)
			All Sample		
Land-Owner Firms	0.327	21.445	7.655	0.215	0.046
Non-Land-Owner Firms	0.196	20.884	6.951	0.193	0.053
Difference	0.131***	0.561***	0.704***	0.022***	-0.007***
	(0.006)	(0.017)	(0.020)	(0.002)	(0.000)
			At Year 2000		
Land-Owner Firms	0.493	20.989	7.528	0.198	0.051
Non-Land-Owner Firms	0.307	20.823	7.171	0.231	0.052
Difference	0.187***	0.166**	0.357***	-0.033***	0.001
	(0.032)	(0.058)	(0.082)	(0.010)	(0.001)
			At Year 2005		
Land-Owner Firms	0.513	21.381	7.571	0.25	0.044
Non-Land-Owner Firms	0.341	20.929	6.982	0.249	0.048
Difference	0.171***	0.452***	0.589***	0.002	-0.004***
	(0.031)	(0.065)	(0.083)	(0.011)	(0.001)
			At Year 2010		
Land-Owner Firms	0.407	21.835	7.693	0.191	0.046
Non-Land-Owner Firms	0.243	20.965	6.822	0.135	0.058
Difference	0.164***	0.870***	0.871***	0.057***	-0.012***
	(0.022)	(0.064)	(0.065)	(0.008)	(0.001)

Table 2. Land Value and Firms Investment Behaviors, Fixed Effects & IV Estimation

This table investigates the effect of land value increase on firm's investment behavior using the land-owner sample. Panel A presents the results using total firm investment as dependent variable Columns (1) to (3) use OLS and columns (4) to (6) use IV estimation with the interaction between the unsuitable land measure and national interest rate as instrument. Panel B presents the 1st stage results for IV estimates in columns (4) to (6) in panel A. All specifications use year and firm fixed effects, control for Tobin's Q, firm's end-of-year cash flow and total sale and total firm asset and cluster observation at firm level. Robust Standard errors in parentheses; * p<0.10, ** p<0.05, *** p<0.01; Constant terms are not reported.

Panel A	**Total Investment**					
	OLS			IV		
	(1)	(2)	(3)	(4)	(5)	(6)
Land Value	0.043***			0.069**		
	(0.016)			(0.028)		
Average Land Price	0.000			-0.002		
	(0.002)			(0.003)		
Commercial Land Value		0.111***			0.433***	
		(0.035)			(0.125)	
Average Commercial Land Price		0.004*			-0.008**	
		(0.002)			(0.004)	
Industrial Land Value			0.160			1.561
			(0.116)			(1.782)
Average Industrial Land Price			0.001			-0.002
			(0.004)			(0.013)
Number of Obs.	12192	12390	12394	12097	12294	12322
Adj. R-squared	0.334	0.33	0.328	0.1	0.078	0.056
Cragg-Donald Wald F-stat				1298.475	996.999	12.55

Panel B	1st Stage					
	Land Value	Average Land Price	Commercial Land Value	Average Commercial Land Price	Industrial Land Value	Average Industrial Land Price
	(7)	(8)	(9)	(10)	(11)	(12)
Unsuitability*Interest Rate Weighted by Land Area (IV_2)	475.637***	19.550*				
	(48.807)	(10.975)				
Unsuitability*Interest Rate Weighted by Commercial Land Area			0.017***	0.972***		
			(0.001)	(0.007)		
Unsuitability*Interest Rate Weighted by Industrial Land Area					701.192***	50.894***
					(227.608)	(46.932)
Average Suitability*Interest Rate (IV_1)	0.033***	0.972***	205.633***	44.106**	0.001	0.598***
	(0.005)	(0.007)	(15.101)	(21.423)	(0.002)	(0.083)
Number of Observations	13268	13475	13470	13474	13498	13498
Adj. R-squared	0.292	0.975	0.368	0.975	0.022	0.642

Table 3. The Effect of Land Value on Different Types of Firms' Investment, IV Estimation

This table investigates the effect of land value on different types of firms investment using the land-owner sample. Panel A presents the results using the size of investment while Panel B presents the results on percentage of different types of investment to total investment. All specifications use IV estimation with the interaction between the unsuitable land measure and national interest rate as instrument. All columns in Panel A and B use IV estimation with the interaction between the unsuitable land measure and national interest rate as instrument. All specifications use year and firm fixed effects, control for Tobin's Q, firm's end-of-year cash flow and total sale and total firm asset and cluster observation at firm level. Robust Standard errors in parentheses; * p<0.10, ** p<0.05, *** p<0.01; Constant terms are not reported.

Panel A	**Non-Land Investment**	**Commercial Land Investment**	**Industrial Land Investment**	**Non-Land Investment**	**Commercial Land Investment**	**Industrial Land Investment**	**Non-Land Investment**	**Commercial Land Investment**	**Industrial Land Investment**
					IV				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Land Value	-0.055	0.259***	-0.008						
	(0.075)	(0.058)	(0.010)						
Average Land Price	-0.003	0.005***	0.002***						
	(0.003)	(0.002)	(0.000)						
Commercial Land Value				-0.188***	0.338***	0.022			
				(0.072)	(0.075)	(0.018)			
Average Commercial Land Price				0.003	0.063***	0.024***			
				(0.033)	(0.024)	(0.006)			
Industrial Land Value							0.581	0.314	0.273***
							(0.553)	(0.342)	(0.084)
Average Industrial Land Price							-0.008**	0.014***	0.001***
							(0.004)	(0.002)	(0.000)
Number of Obs.	11455	10927	10927	11459	10931	10931	11459	10931	10931
Adj. R-squared	0.045	0.076	0.005	0.044	0.084	0.035	0.078	0.01	0.254
Cragg-Donald Wald F-stat	950.209	952.163	952.163	1009.442	1023.795	1023.795	13.001	12.509	12.509

Panel B	**%Non-Land Investment**	**%Commercial Land Investment**	**% Industrial Land Investment**	**%Non-Land Investment**	**%Commercial Land Investment**	**% Industrial Land Investment**	**%Non-Land Investment**	**%Commercial Land Investment**	**% Industrial Land Investment**
					IV				
	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Land Value	-0.219**	0.550***	-0.043						
	(0.086)	(0.125)	(0.028)						
Average Land Price	-0.012***	0.030***	0.008***						
	(0.003)	(0.004)	(0.001)						
Commercial Land Value				-0.503***	0.644**	0.051			
				(0.091)	(0.254)	(0.057)			
Average Commercial Land Price				-0.097***	0.430***	0.082***			
				(0.037)	(0.101)	(0.021)			
Industrial Land Value							-0.484	0.857	0.691***
							(0.553)	(0.894)	(0.248)
Average Industrial Land Price							-0.021***	0.052***	0.005***
							(0.004)	(0.006)	(0.001)
Number of Obs.	11589	10763	10510	11593	10767	10514	11593	10767	10514
Adj. R-squared	0.045	0.076	0.005	0.044	0.084	0.035	0.078	0.01	0.254
Cragg-Donald Wald F-stat	950.209	952.163	952.163	1009.442	1023.795	1023.795	13.001	12.509	12.509

Table 4. Land Price in Bank Branch City and the Accessibility of Bank Loan, Loan Level Results from 1998 to 2012

The table reports the effect of land price in the local bank branch city on accessibility of bank loan using the loan level data. The loan level data covers all the bank loan for all listed firm in China from 1998 to 2012. The dependent variable in Columns (1), (4), (7) is a dummy variable, which equals to 1 if the loan for the firm is made with collateral of any kind. And the dependent variable in Columns (2), (5) and (8) indicates whether the loan is made with real estate (land or building) as collateral. The dependent variable in Columns (3), (6) and (9) is also a dummy variable equals to 1 if the firm received the loan is a non-land owner firm. The key independent variable is the average land price in city where the lender bank branch located, where columns (1) to (3) use average land price for all types of land, columns (4) to (6) use average land price for commercial land and columns (7) to (9) for industrial land. All specifications include a serial high dimension fixed effects of: firm*bank branch, bank branch city, bank*year and control for other variables, and use the IV estimation with the interaction of the city's average unsuitable land index and the national interest rate as instrument. Robust Standard errors in parentheses; * p<0.10, ** p<0.05, *** p<0.01; Constant terms are not reported.

	Loan With Real Estate Collateral	Loan With Non Real Estate Collateral	Loan Without Collateral	Real Estate Collateral =2; Non Real Estate Collateral=1; No Collateral=0
		IV		
Panel A	(1)	(2)	(3)	(4)
Bank Branch City Land Price	0.098**	0.055*	-0.153***	0.252***
	(0.041)	(0.030)	(0.048)	(0.083)
Number of Observations	40372	40372	40372	40372
Adj. R-squared	0.253	0.299	0.260	0.249
Panel B	(5)	(6)	(7)	(8)
Bank Branch City Commercial Land Price	0.201**	0.118*	-0.319***	0.520***
	(0.090)	(0.060)	(0.104)	(0.185)
Number of Observations	40372	40372	40372	40372
Adj. R-squared	0.225	0.294	0.216	0.206
Panel C	(9)	(10)	(11)	(12)
Bank Branch City Industrial Land Price	-0.025	0.194**	-0.169	0.143
	(0.084)	(0.085)	(0.113)	(0.181)
Number of Observations	40372	40372	40372	40372
Adj. R-squared	0.337	0.215	0.332	0.355

Table 5. The Price Effect on Non-owner Firms.

This table investigates the effect of the land price increase on the non-owner firms. All specifications use only the non-owner firm sample. The upper panel (Columns (1) to (4)) uses the independent variable of average price for commercial land in cities where the firms' headquarter located, while the lower panel (Columns (5) to (8)) uses the average price for industrial land. Columns (1), (2) and (5), (6) use capital expenditure and Columns (3), (4) and (7), (8) use size of new bank loan as dependent variables, all variables are normalized by lagged fixed asset. All specifications use year and firm fixed effects and includes other control variables and cluster observation at firm level. Columns (2), (4), (6) and (8) use 2-stages least squared estimation with the interaction between the city-level unsuitability index and national interest rate as instrument. Robust standard errors in parentheses; * p<0.10, ** p<0.05, *** p<0.01; Constant terms are not reported.

Sample:	Non-Land-Owner Firms			
Dependent Variables:	Corporate Investment		New Bank Loan	
	OLS	IV	OLS	IV
Panel A	(1)	(2)	(3)	(4)
Commercial Land Price	-0.034***	-0.150***	-0.007***	-0.046***
	(0.005)	(0.056)	(0.001)	(0.010)
Tobin's Q	0.016***	0.015***	0.001	0.001
	(0.004)	(0.004)	(0.001)	(0.001)
Cash Flows	-0.002	-0.002	-0.001***	-0.001***
	(0.001)	(0.001)	(0.000)	(0.000)
Sale	0.017***	0.016***	0.000	-0.000
	(0.002)	(0.002)	(0.000)	(0.000)
Total Asset	0.073***	0.073***	0.020***	0.020***
	(0.015)	(0.014)	(0.004)	(0.004)
Number of Observations	10400	10053	9775	9449
Adj. R-squared	0.442	0.279	-0.039	-0.452
Panel B	(5)	(6)	(7)	(8)
Industrial Land Price	-0.004*	0.002	-0.000	-0.017
	(0.003)	(0.070)	(0.001)	(0.022)
Tobin's Q	0.020***	0.015***	-0.001	-0.000
	(0.004)	(0.004)	(0.001)	(0.001)
Cash Flows	-0.001	-0.001	-0.001***	-0.001**
	(0.001)	(0.001)	(0.000)	(0.000)
Sale	0.017***	0.017***	0.000	0.000
	(0.002)	(0.002)	(0.000)	(0.000)
Total Asset	0.056***	0.056***	0.014***	0.015***
	(0.012)	(0.014)	(0.003)	(0.003)
Number of Observations	14777	12655	14073	11715
Adj. R-squared	0.368	0.055	-0.016	-0.212

Table 6. Land Value and Firms Investment Behaviors, DID Estimation

This table investigates the effect of the restricted purchasing policy on firm's investment behaviors. The key independent variable is the interaction of treated firms and post event dummies variable. The treated firms refer to firms holding land parcels in the 46 limited purchasing cities. And the post event dummy variable indicates the period after the limited purchasing policy is announced in the pertinent cities. The dependent variables in Columns (1) to (3) are firm's not-land investment, commercial land investment and industrial land investment. Both variables are normalized by lagged fixed asset. And Columns (4) to (6) reports the corresponding results for the share of these three types of investment to that total. The upper panel reports the results using the full firm sample after 2008, while the middle panels uses only the firms held land in the 46 limited purchasing cities. And the lower panel used only the land owner sample. Control variables include Tobin's Q, cash flows, total sale revenue and total asset of the firms. All specifications use year and firm fixed effects and cluster observation at firm level. Robust Standard errors in parentheses; * p<0.10, ** p<0.05, *** p<0.01; Constant terms are not reported.

	Non-Land Investment	Commercial Land Investment	Industrial Land Investment	% Non-Land Investment	% Commercial Land Investment	% Industrial Land Investment
Panel A: Firms Holding No Land in Limited Purchasing City (46) as Control Group						
	(1)	(2)	(3)	(4)	(5)	(6)
Treated Firms*Post event	0.008	-0.026*	-0.001	0.150***	-0.135***	-0.005
	(0.024)	(0.014)	(0.003)	(0.035)	(0.033)	(0.009)
Number of Observations	7631	6950	6950	7760	7122	6869
R-squared	0.770	0.417	0.359	0.911	0.297	0.310
Panel B: Non-Land-Owner Firms in Limited Purchasing City (46) as Control Group						
	(7)	(8)	(9)	(10)	(11)	(12)
Treated Firms*Post event	0.009	-0.028*	-0.000	0.153***	-0.139***	-0.003
	(0.025)	(0.014)	(0.003)	(0.036)	(0.034)	(0.009)
Number of Observations	5863	5364	5364	5961	5553	5300
R-squared	0.761	0.451	0.369	0.901	0.304	0.321
Panel C: Land-Owner Firms Holding No Land in Limited Purchasing City (46) as Control Group						
	(13)	(14)	(15)	(16)	(17)	(18)
Treated Firms*Post event	0.007	-0.028*	-0.000	0.151***	-0.141***	-0.004
	(0.025)	(0.015)	(0.003)	(0.036)	(0.035)	(0.009)
Number of Observations	5133	4785	4785	5262	5015	4762
R-squared	0.740	0.427	0.369	0.873	0.299	0.322
Firm-Specific Time Trends	Yes	Yes	Yes	Yes	Yes	Yes

Table 7. The Policy Shock on Non-owner Firms in the Treated Cities, 2000-2012.
This table investigates the effect of the limited purchasing policy on the non-landowner firms. All specifications use only the non-land-owner firm sample. The key independent variable is the interaction of treated firms and post event dummies variable. The treated firms refer to non-land-owner firms located in the 46 limited purchasing cities. And the post event dummy variable indicates the period after the limited purchasing policy is announced in the pertinent cities. The dependent variable is the capital expenditure for Columns (1) and change of debt for Columns (2). All variables are normalized by lagged fixed asset. All specifications use year, firm fixed effects and the firm specific time trend and cluster observation at firm level. Robust standard errors in parentheses; * p<0.10, ** p<0.05, *** p<0.01; Constant terms are not reported.

Sample:	DID on Non-Land-Owner Firms	
Dependent Variables:	Investment	New Bank Loan
	(1)	(2)
Treated Firms*Post event	0.095***	0.017***
	(0.011)	(0.002)
Tobin's Q	0.012***	0.001***
	(0.002)	(0.000)
Cash Flows	-0.004**	0.000
	(0.002)	(0.000)
Sale	0.019***	0.000
	(0.002)	(0.000)
Total Asset	0.092***	0.005***
	(0.013)	(0.001)
Firm Specific Time Trend	Yes	Yes
Number of Observations	13984	15684
Adj. R-squared	0.701	0.265

Table 8. The Average Land Price and TFP Losses from Misallocation, 2000-2012

This table investigates the effect of average land price on the aggregated level manufactural firms' TFP loss at city level. The data used in this regression is a city-year panel. The TFP loss is calculated using the Hsieh and Klenow (2009), which is the percentage of output gain from hypothetical reallocation to the real output. The data used for calculation is China's industrial census from 2000 to 2012. The average land price data is the land transaction dataset collected by authors from www.landchina.com. Columns (1) to (4) use the simple average of TFP loss over 47 manufactural sectors, while columns (5) to (8) use the weighted average of TFP loss using the sector-wide output to total output as weight. Columns (1), (2) and (5) and (6) use OLS regression, while regressions (3), (4) and (7) and (8) contain the 2SLS estimates. Columns (3) and (7) use the interaction of the city's average unsuitable land index and the national interest rate as instrument and columns (4) and (8) use the purchase restriction policy as instrument. All specifications control for city fixed effects and year fixed effects. Robust standard errors in parentheses; * p<0.05, ** p<0.01, *** p<0.001; Constant terms are not reported.

	Average TFP Loss				Weighted Average TFP Loss			
	OLS	OLS	IV	IV	OLS	OLS	IV	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Average Land Price	0.023***	0.013***	0.079***	0.050***	0.051***	0.038***	0.077***	0.049***
	(0.003)	(0.003)	(0.021)	(0.009)	(0.007)	(0.006)	(0.020)	(0.009)
City Specific Time Trend	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Number of Observations	4754	4754	4754	4754	4754	4754	4754	4754
Adj. R-squared	0.621	0.738	0.308	0.629	0.565	0.711	0.962	0.561

Figure 1. Average Land Price for Commercial (& Residential) Land versus Industrial Land, 2000-2015
This figure plots the average land price for two types of land from 2000 to 2015. We separate the land transactions into two types based on the usage of land: the commercial & residential land versus the industrial land. The 1.6 million full land transitions dataset is used for graphing this figure.

Figure 2. The Geographic Distribution of the Location Where China's Firm brought Land
Following Abel and Sander (2014)'s visualization on global bilateral migration flows, we use two circular plots to link the public firm's original location and the destination where they bought land.
The segments around the circle represent the 31 provinces in China. And color-coded arcs linking two segments represent the size of land transaction firms made with local government. For example, the segment color-coded red represents all the land buyer public firms from Beijing. And each of the 31 red arcs represents the size of land these "Beijing" firms bought in each of the 31 provinces. The upper panel of the figure quantifies the size of land transaction by total amount of payment (in term of *yuan*).
Our sample covers all 32,153 the land transactions between public firms and local governments in China from 1998 to 2012. The total areas of land involves in these transaction is 1,871,781 hectare while total size of payment is 1,660 billion RMB (equal to 301 billion dollars at current price) accounting for 11.53% of the total land payment local governments received in the same period.

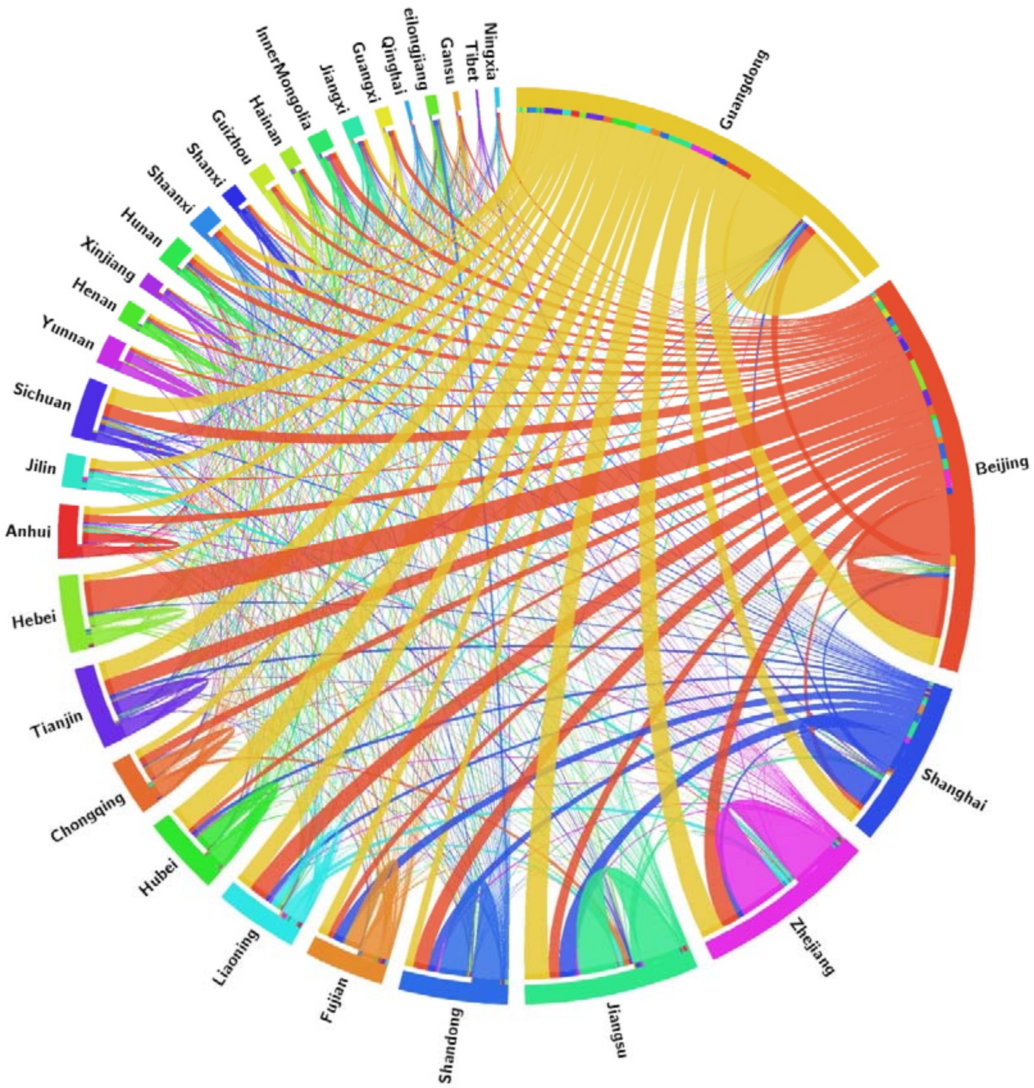


Figure 3. City Land Development Unsuitability Index and Average Land Price in 2008
This figure plots the city unsuitability index and the average land price in the primary land market in 2008. Followed Saiz (2010), we construct a unsuitability index for land development for each municipal city in China. The elevation data used to calculate the unsuitability index is obtained from the United States Geographic Service (USGS) Digital Elevation Model (DEM) at the 90-meter resolution.

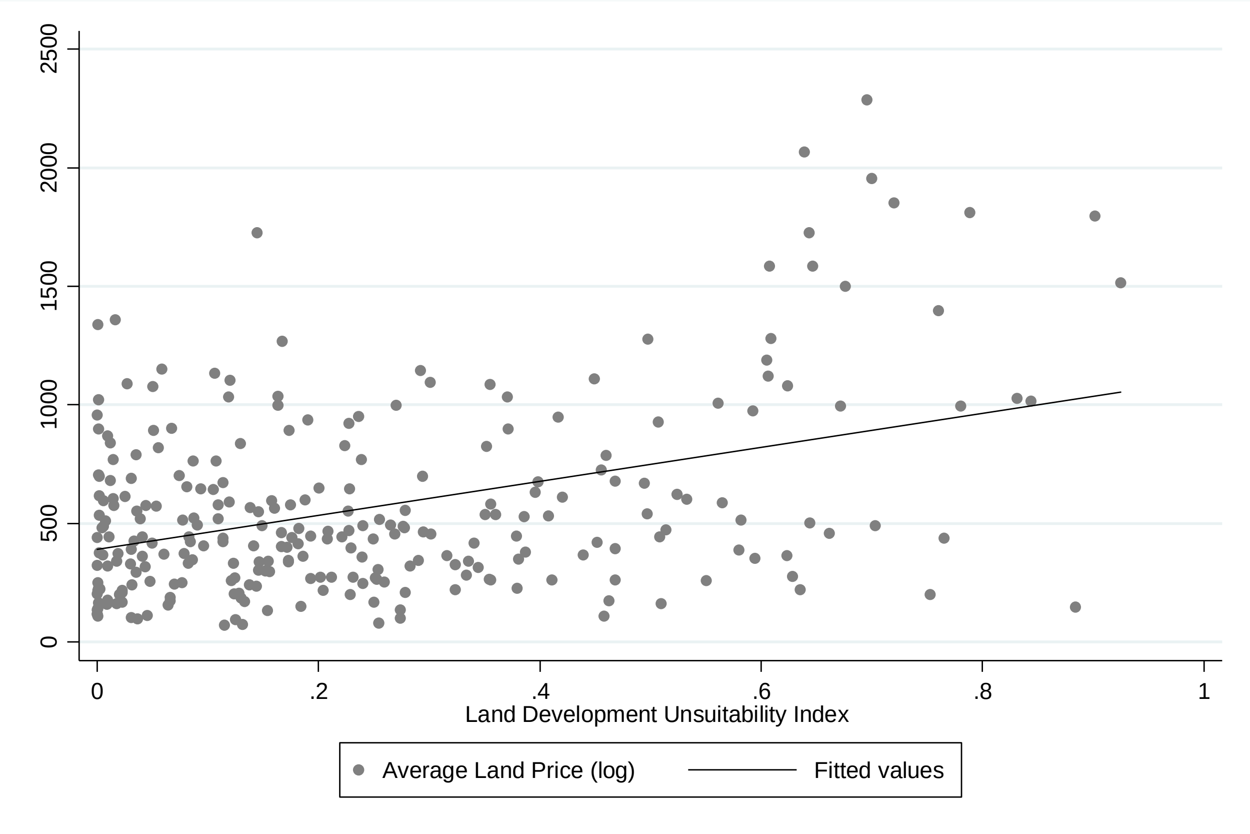


Figure 4. The DID Estimation on the Effect of Restricted Purchasing Policy on Land Price and Transaction Volume
This figure plots the Diffs-in-diffs estimators by the pre- and post-policy treatment quarters. The upper panel uses the city average land price for commercial land as dependent variable (y-axis) and the lower panel uses the average land price for industrial land as dependent variable (y-axis). The x-axis is the number of quarters since housing restriction policy.

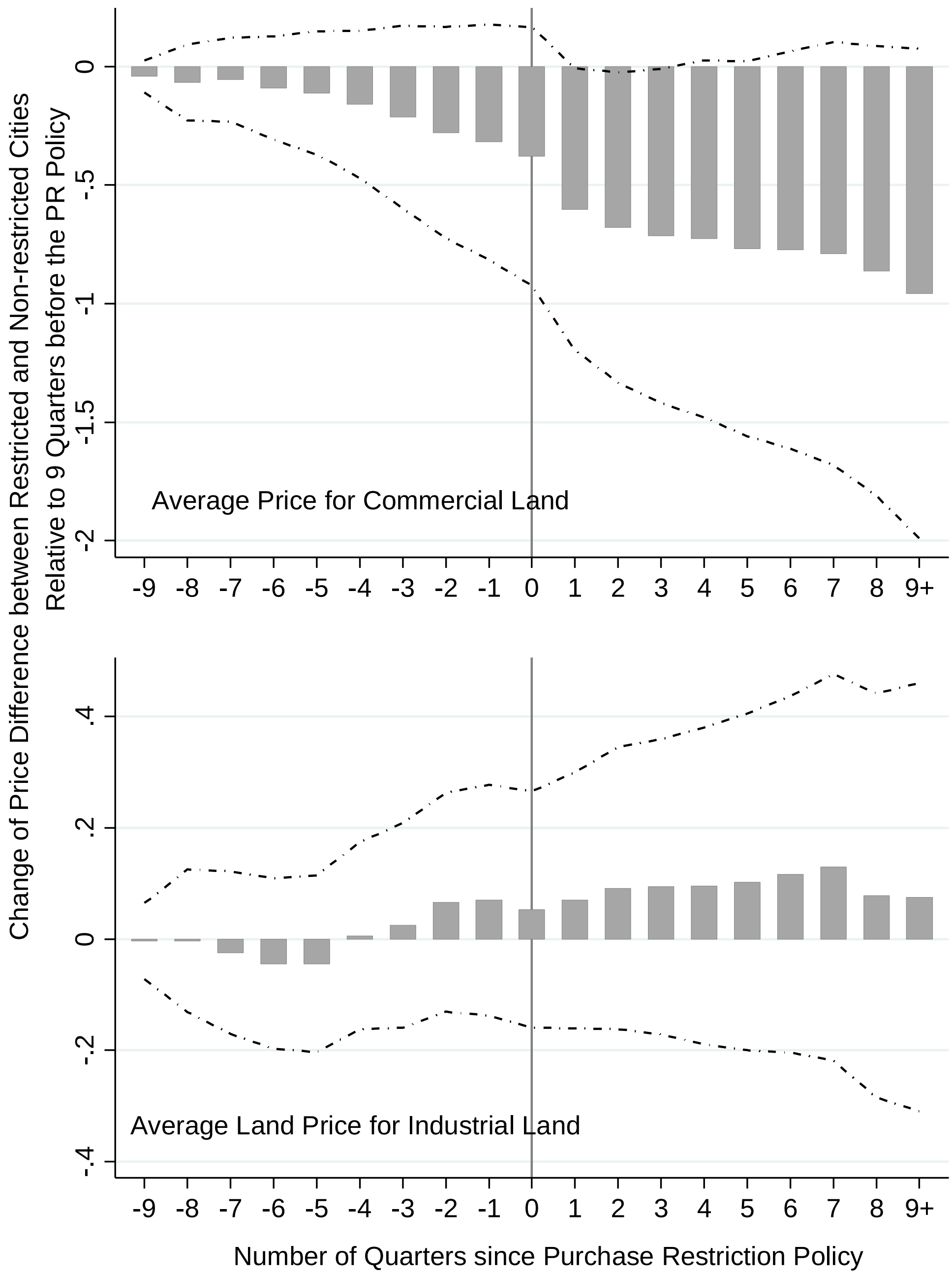
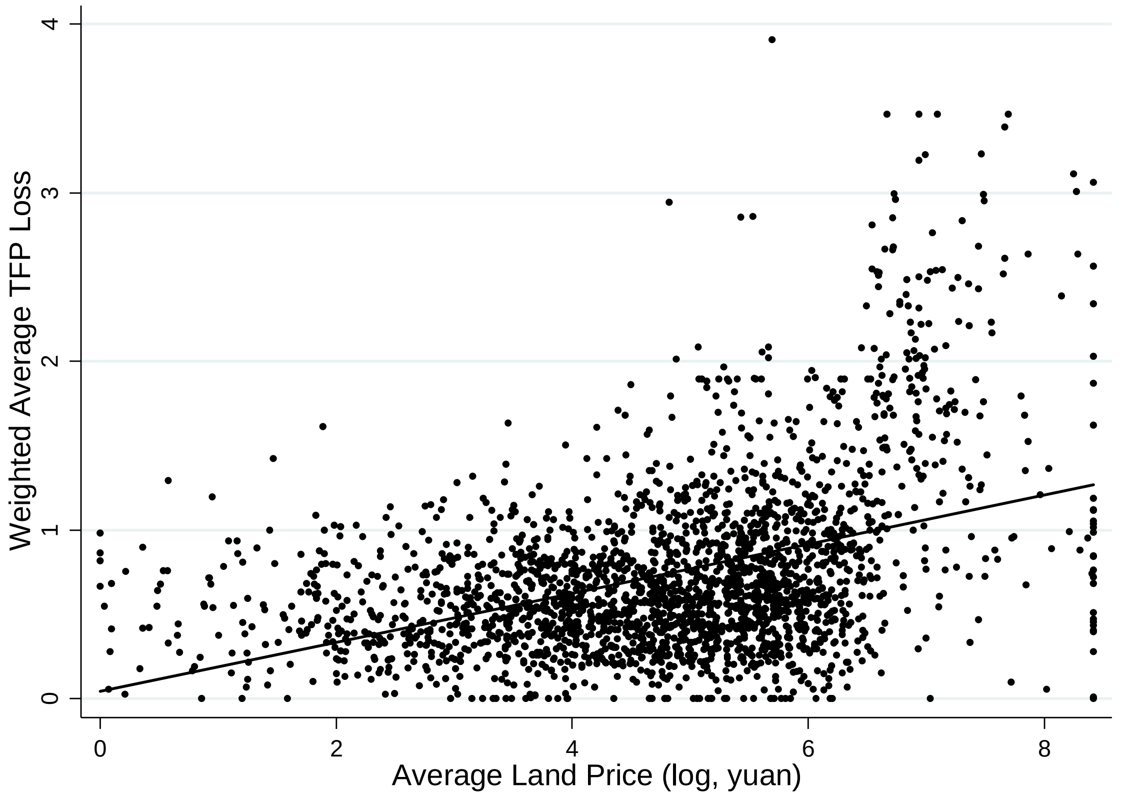
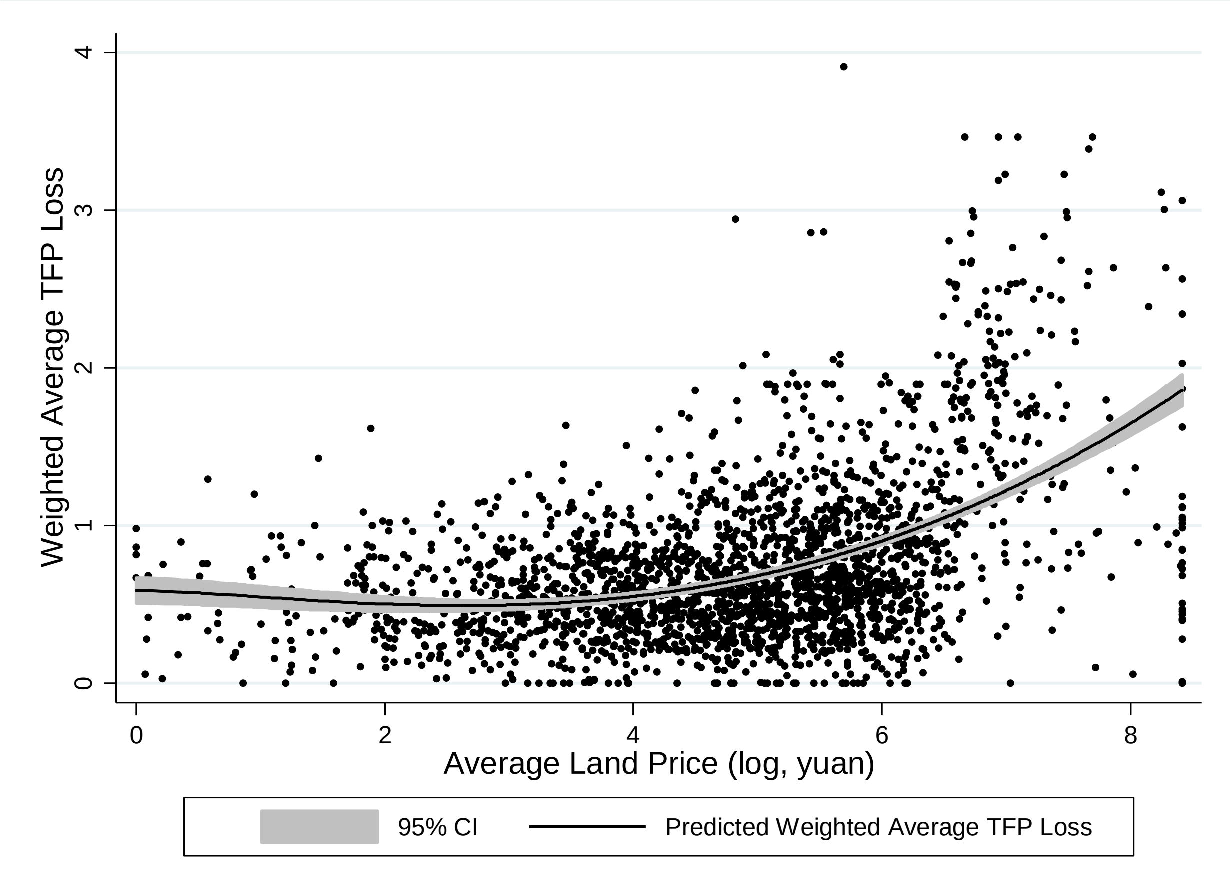


Figure 5. Average Citywide TFP Loss and Land Price, 2000-2012

This figure plots the scatter plot and linear fitted line for citywide average TFP Loss and Land Price from 2000 to 2012. The TFP loss is calculated using the Hsieh and Klenow (2009), which is the percentage of output gain from hypothetical reallocation to the real output. The data used for calculation is China's industrial census from 2000 to 2012. The average land price data is the land transaction dataset collected by authors from www.landchina.com.



Panel A: Linear Prediction Plot



Panel B: Fractional-polynomial Prediction Plot

Appendix A. 46 Housing Policy Cities Lists and Policy Announcement Date

City		Code	Year	Month	Day
北京市	Beijing	110000	2010	4	30
天津市	Tianjin	120000	2010	10	13
石家庄市	Shijiazhuang	130100	2011	2	20
太原市	Taiyuan	140100	2011	1	14
呼和浩特市	Huhehaote	150100	2011	4	14
沈阳市	Shenyang	210100	2011	3	1
大连市	Dalian	210200	2011	3	2
长春市	Changchun	220100	2011	5	20
哈尔滨市	Haerbin	230100	2011	2	28
上海市	Shanghai	310000	2010	10	7
南京市	Nanjing	320100	2010	10	13
无锡市	Wuxi	320200	2011	2	24
徐州市	Xuzhou	320300	2011	5	1
苏州市	Suzhou	320500	2011	3	3
杭州市	Hangzhou	330100	2010	10	11
宁波市	Ningbo	330200	2010	10	9
温州市	Wenzhou	330300	2010	10	14
绍兴市	Shaoxing	330600	2011	8	25
金华市	Jinhua	330700	2011	3	23
衢州市	Quzhou	330800	2011	9	9
舟山市	Zhoushan	330900	2011	8	2
台州市	Taizhou	331000	2011	8	25
合肥市	HeOLSi	340100	2011	1	25
福州市	Fuzhou	350100	2010	10	11
厦门市	Xiamen	350200	2010	10	1
南昌市	Nanchang	360100	2011	2	20
济南市	Jinan	370100	2011	1	21
青岛市	Qinghai	370200	2011	1	30
郑州市	Zhengzhou	410100	2011	1	6
武汉市	Wuhan	420100	2011	1	15
长沙市	Changsha	430100	2011	3	4
广州市	Guangzhou	440100	2010	10	15
深圳市	Shenzhen	440300	2010	9	30
珠海市	Zhuhai	440400	2011	11	1
佛山市	Foshan	440600	2011	3	18
南宁市	Nanning	450100	2011	3	1
海口市	Haikou	460100	2010	10	15
三亚市	Sanya	460200	2010	10	12
成都市	Chengdu	510100	2011	2	16
贵阳市	Guiyang	520100	2011	2	18

昆明市	Kunming	530100	2011	1	19
西安市	Xi'an	610100	2011	3	1
兰州市	Lanzhou	620100	2011	3	7
西宁市	Xining	630100	2011	8	1
银川市	Yinchuan	640100	2011	2	24
乌鲁木齐市	Wulumuqi	650100	2011	3	9

Appendix B. Variables Definition

Variable Name	Definition
Land Owner Firm	A dummy variable indicates a firm has holding land in our sample period from 1998 to 2012.
Corporate Investment	Corporate investment is measured as capital expenditures divided by the lagged book value of PPE and capital expenditures are calculated as the sum of cash paid for the acquisition of fixed assets, intangible assets and other long-term assets in the quarterly statement of cash flows.
Land Value	Land value is the market value of land assets holding by company normalized by lagged PPE.
Average Land Price (City Where Firms Purchased Land)	The average land price for the cities where firms purchased land measured the annual average land price for the cities where firms owned land parcels which equals to 0 if a firm does not own any land according to transaction records.
Tobin's Q	Tobin’s Q is measured as the market value plus total debt normalized by the book value of the firm.
Cash Flow	Cash flow is computed as the net operating cash flow divided by lagged PPE. Sales revenue is measured as cash received from sales of goods and services divided by lagged PPE.
Sale	Sale is defined as the natural logarithm of annual sale revenue.
Total Asset	Size is expressed as the natural logarithm of current total assets.
New Bank Loan	New bank loan is defined as the new loans a firm got within a given year from different banks, which is normalized by lagged book value of PPE.
Change in Total Debt	Change in total debt measure the change of book value of (long term debt + short term debt) at year t, which is normalized also by lagged PPE.
Firm-specific Policy Shock	Firm-specific policy shock is the diffs-in-diff dummy estimator indicates a firm holds lands in the cities with "housing purchase restriction" policies at year after the policy is in Effect.
Treatment Group Firm	Treatment group firm is a dummy variable indicates that a firm holds lands in the cities with "housing purchase restriction” policies.
TFP (Olley-Pakes Estimation)	Total Factor Productivity estimated using the Olley-Pakes estimation.
TFP (Levinsohn-Petrin Estimation)	Total Factor Productivity estimated using the Levinsohn-Petrin estimation.